

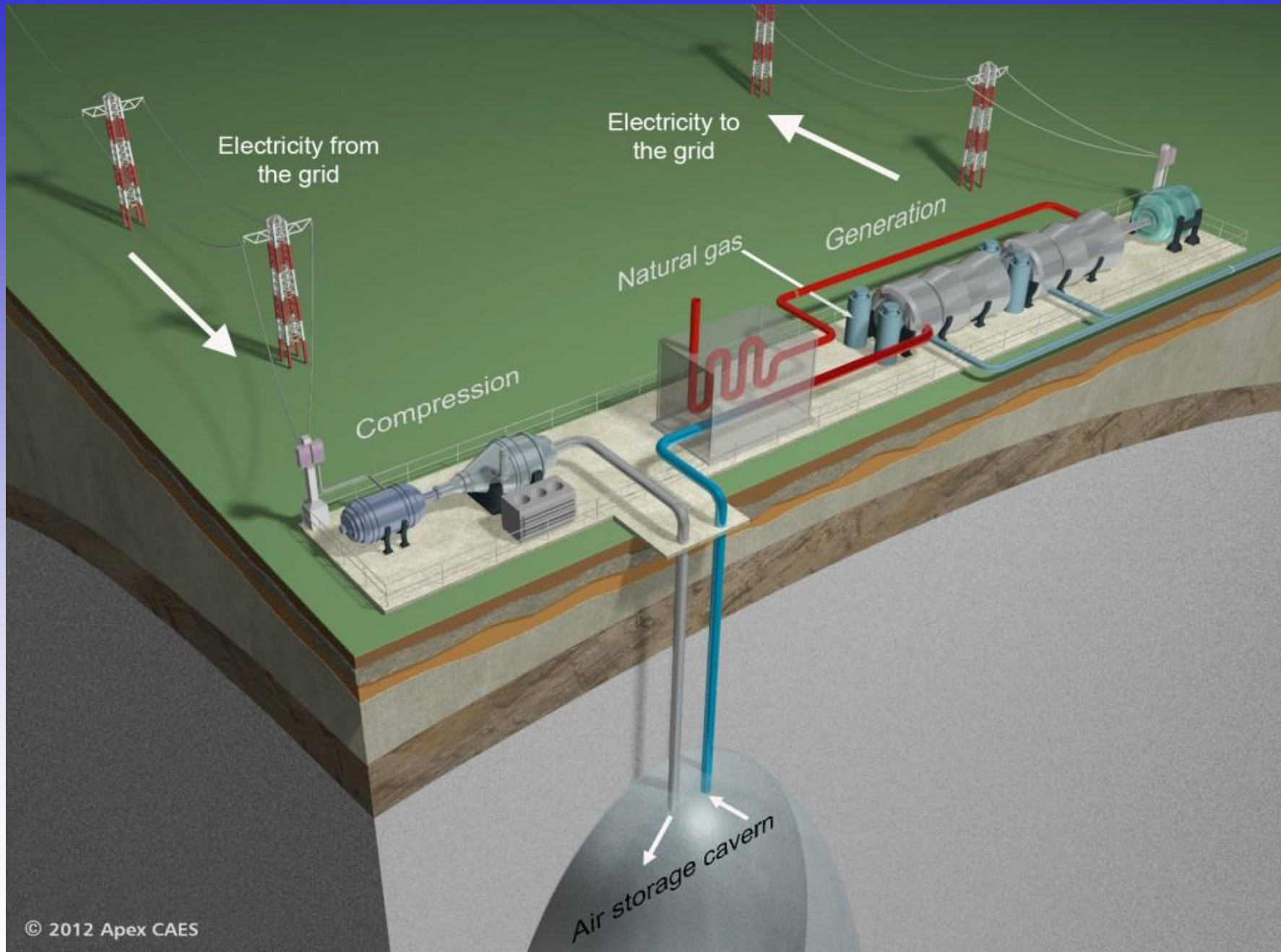
Compressed Air Energy Storage CAES

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6/23/21

WI PSC/DOE ENERGY
STORAGE WEBINAR



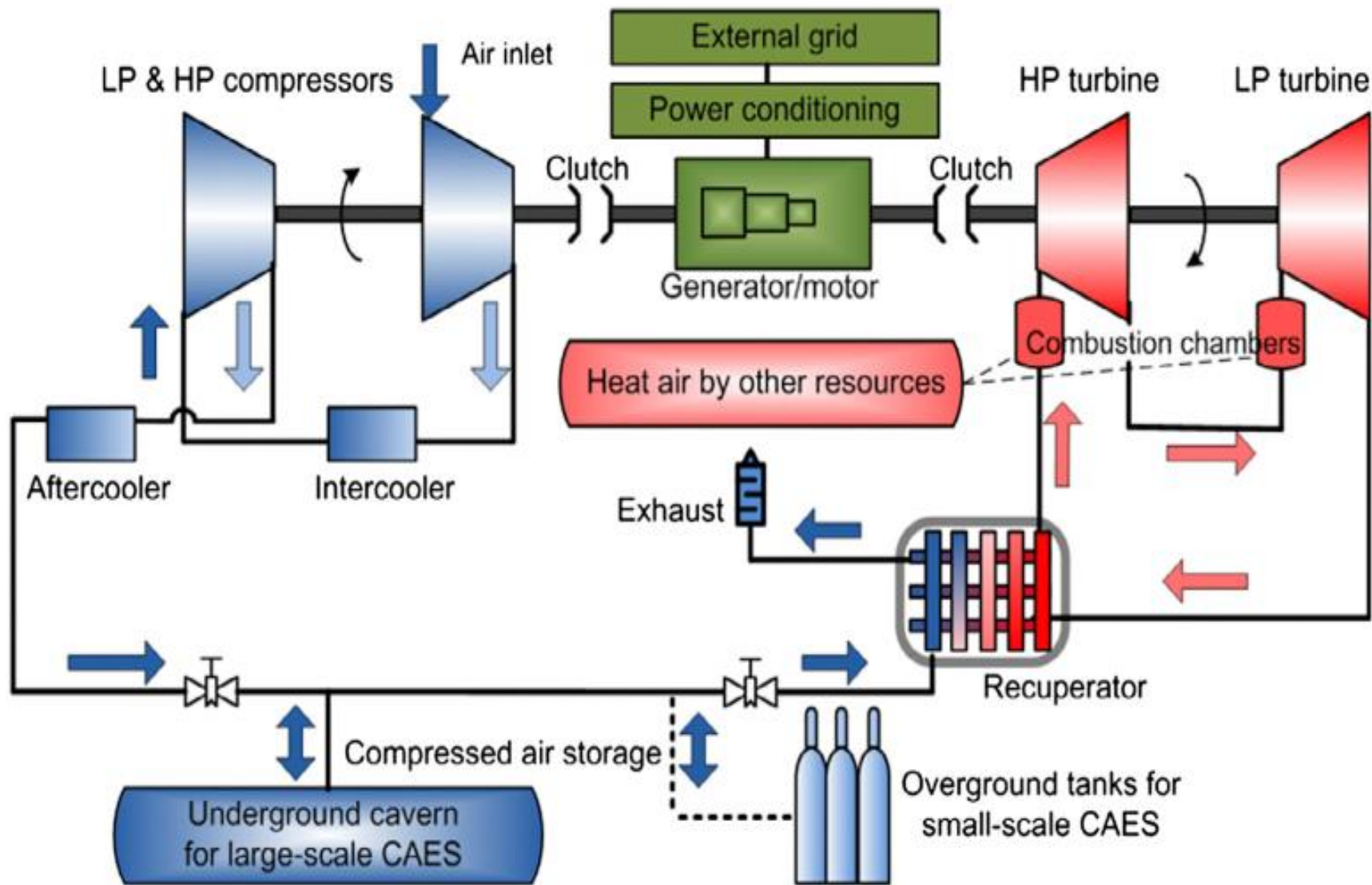
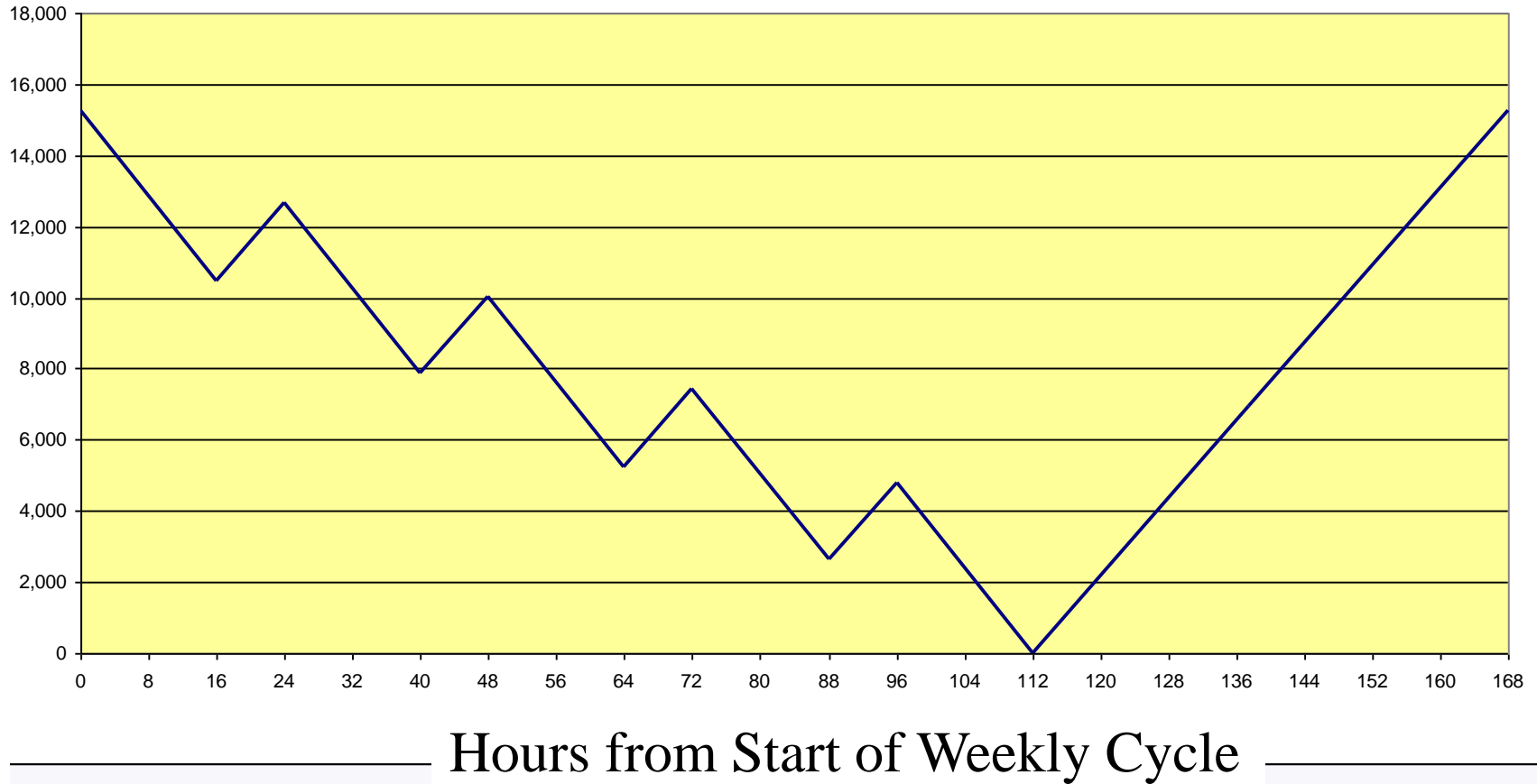


Fig. 1. CAES system configurations [8].

COMPRESSION CYCLES

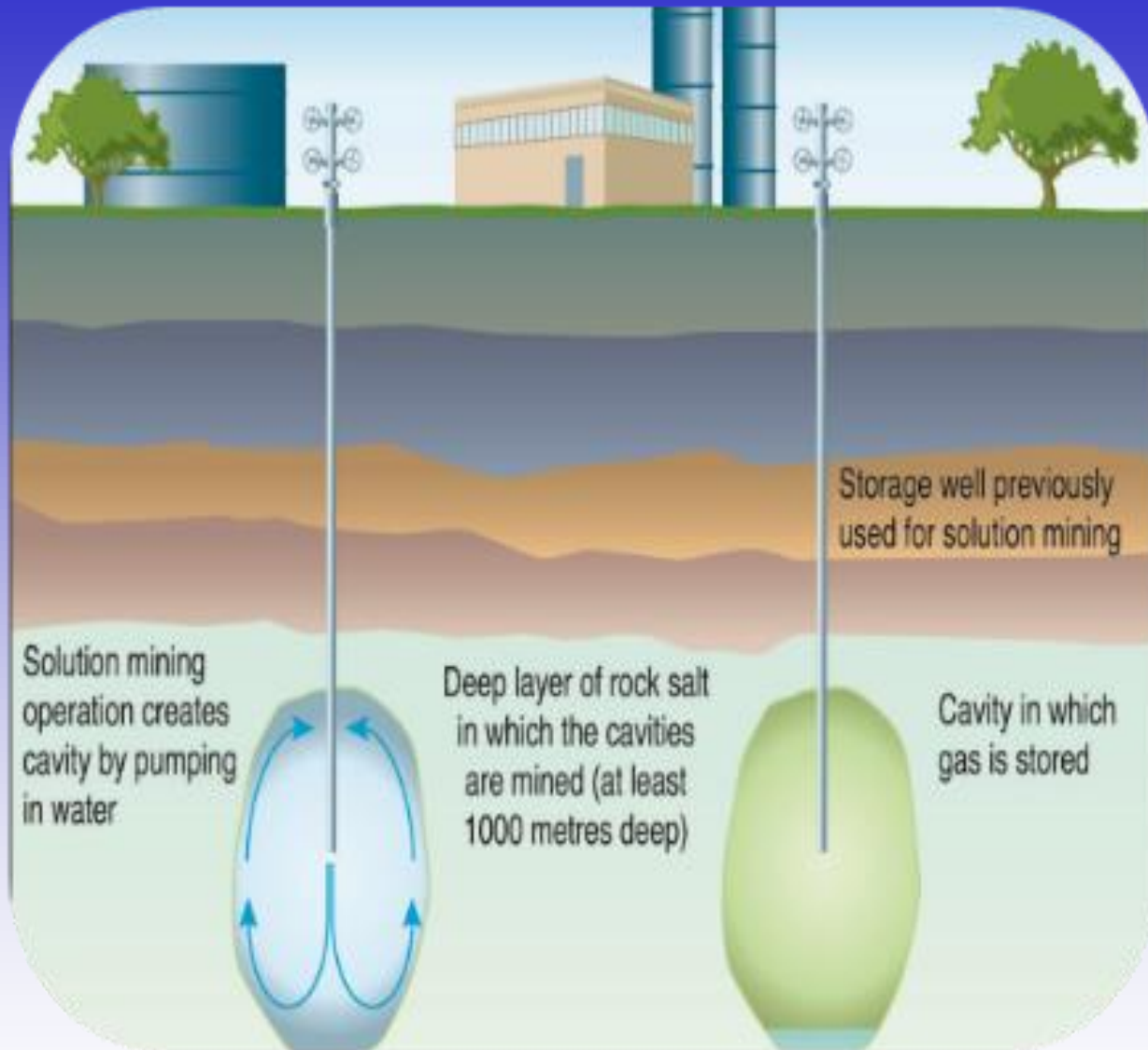
Inventory, MWh; One 300 MW Unit, 5x16 Peak Period cycle

Inventory, MWh as pre-compressed air

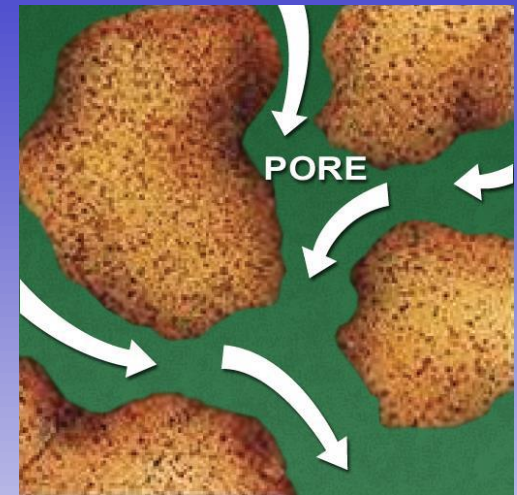
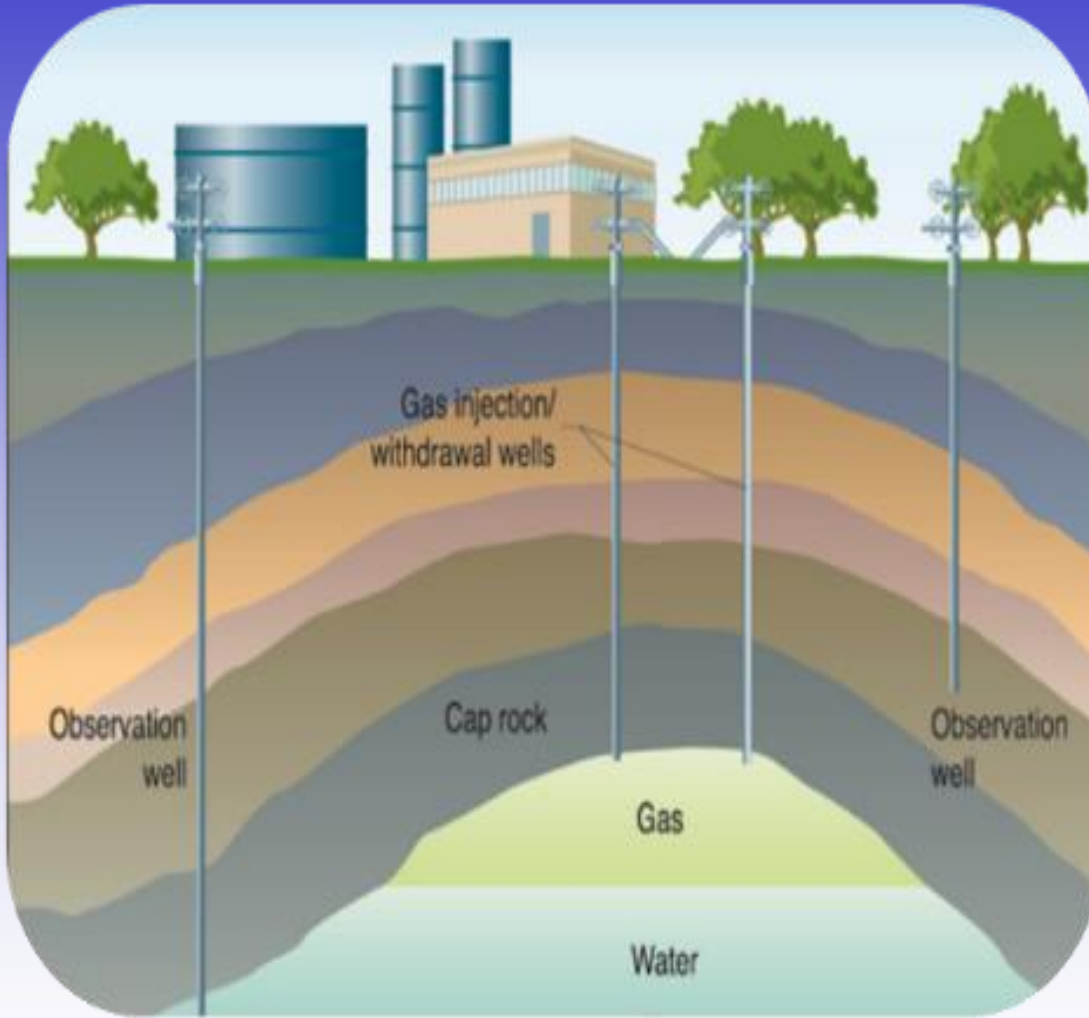


Container Options

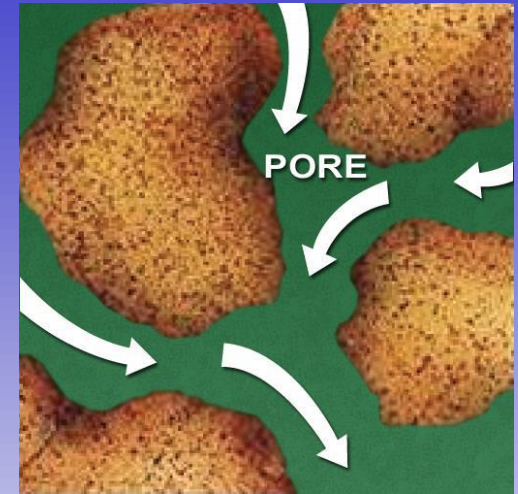
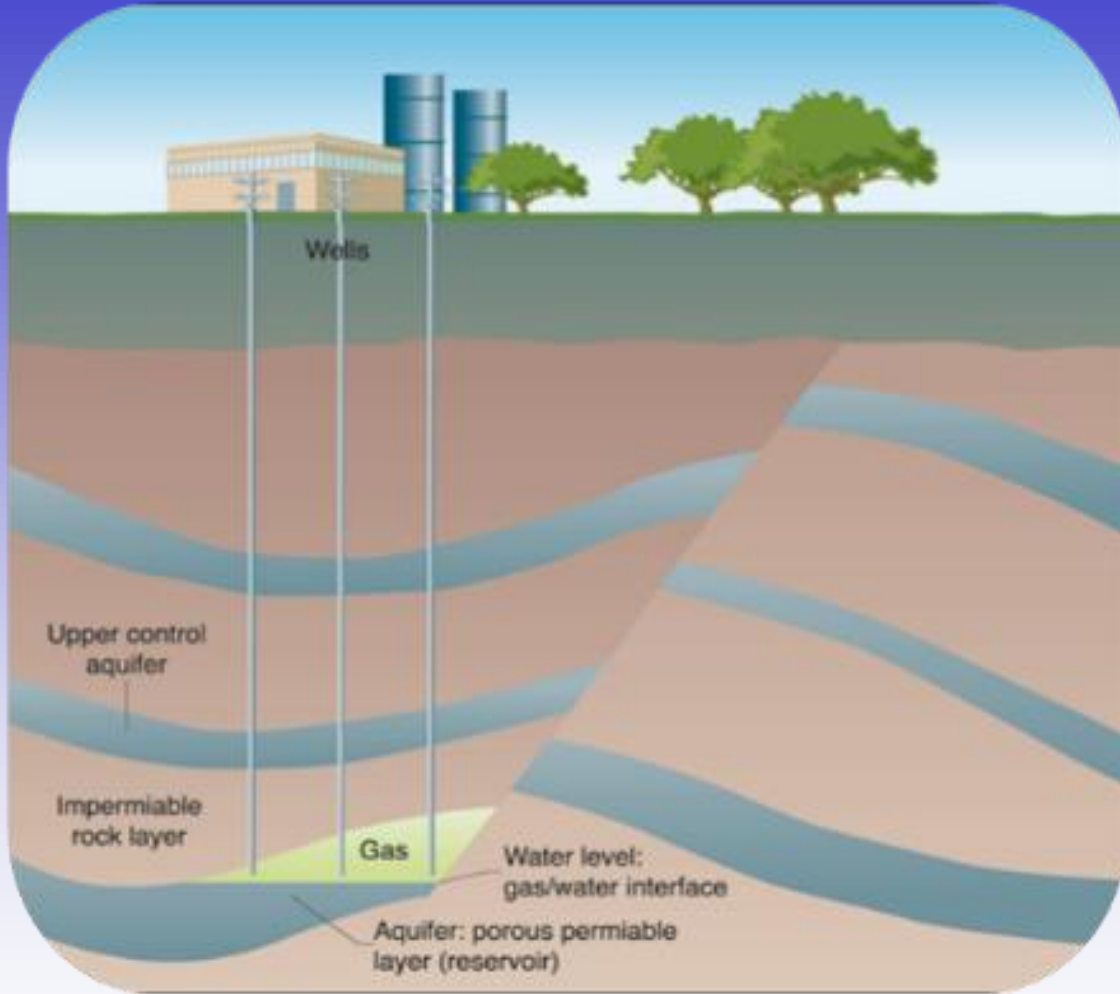
- Salt caverns
- Mined openings
 - Existing/abandoned
 - Lined
 - Water curtains
- Reservoirs
 - Natural Gas
 - Aquifers
- Man made containers



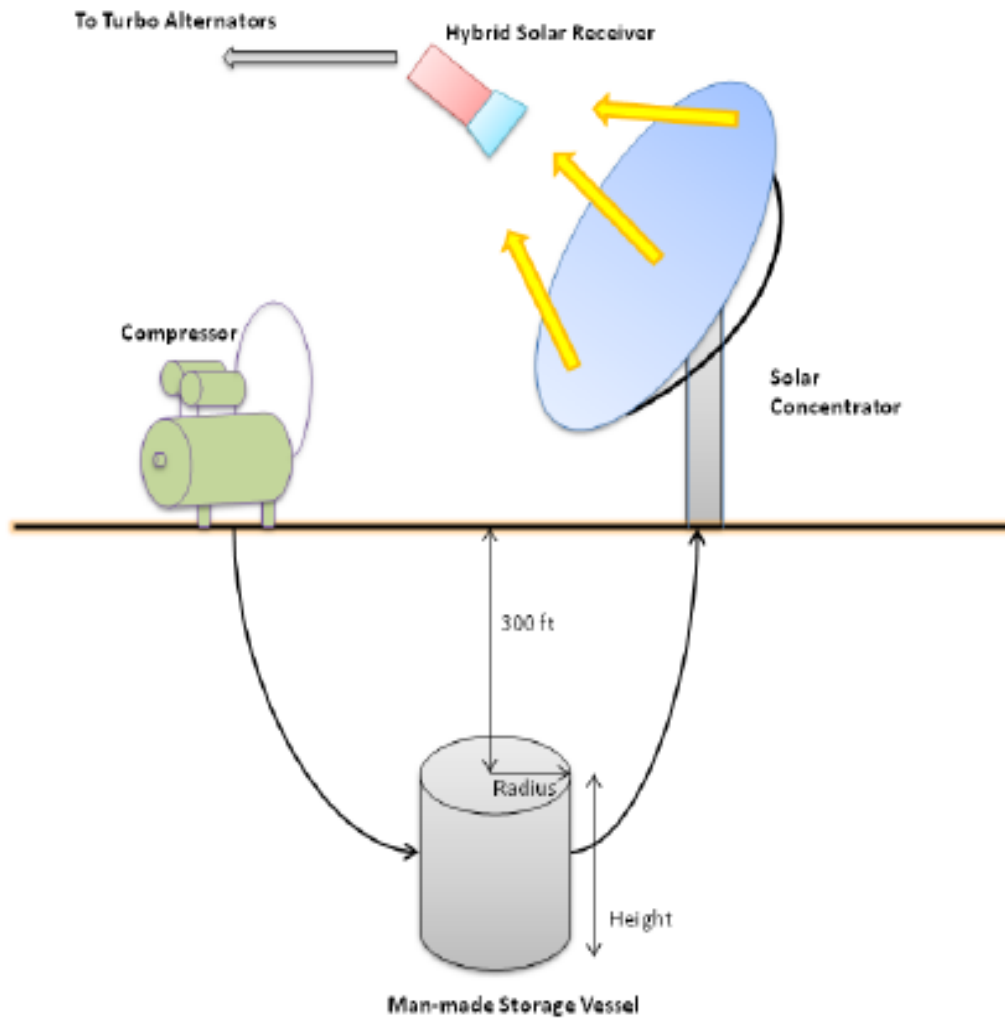
Huntorf, Germany, 290 MW 1978
McIntosh, Alabama 110 MW 1991



Depleted reservoirs are proven gas reservoirs that are easy to develop and operate due to existing infrastructure



Aquifers are similar in geology to depleted reservoirs, but must be proven to trap gas



Designed/engineered buried reinforced concrete vessels in association with solar generation

Munoz-Ramos, et al,
SAND2012-5912

EXISTING

Table 1

Key technical characteristics of current conventional CAES facilities.

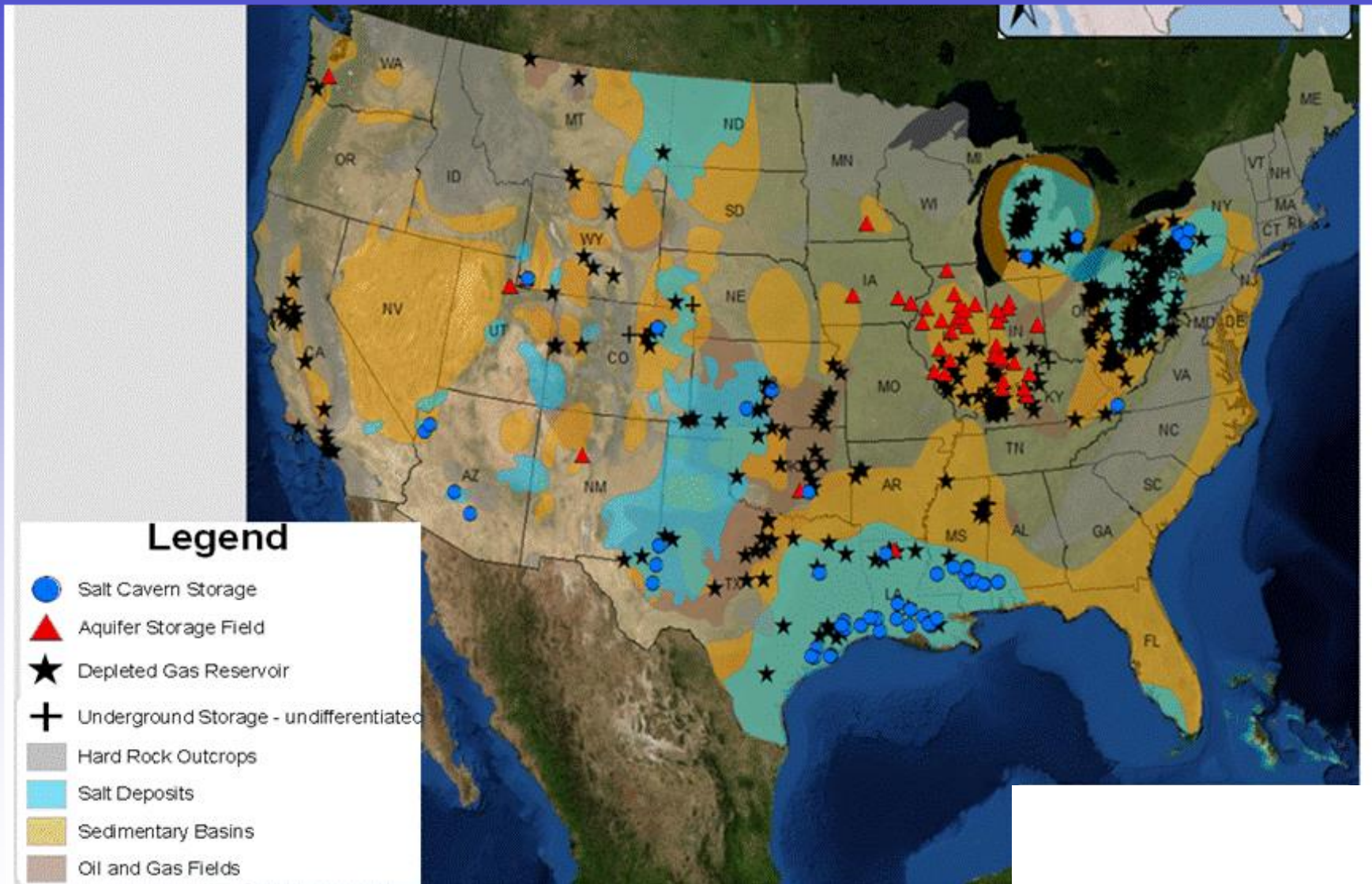
CAES Facility	Operator	Year Operational	Deliverable Power [MW]	Discharge Time [hr]	Efficiency [%]	Pressure [bar]	Cavern Type
Huntorf, Germany	Uniper Kraftweke GmbH	1978	290	2	29	48–66	Two solution-mined salt caverns
McIntosh, AL, USA	Power South Energy Cooperative	1991	110	26	36	<76	Single solution-mined salt cavern

PLANNED

Table 2 Major recent CAES projects.

Project Name	Location	CAES Technology	Project Purpose	Status	Years Active	Power [MW]	Capacity [MWh]	Efficiency [%]	Air Storage
TICC-500	Tsinghua University, China	Adiabatic, sensible heat store	Demonstration	Active	2014 – present	0.5	0.5	33	30–110
Chinese Academy of Sciences, CAES demonstration plant	Bijie City, Guizhou, China	Adiabatic, sensible heat store	Demonstration	Active	2017 – present	2.8 (charge) 10 (discharge)	40	62.3	70
Pilot scale demonstration of AA-CAES	Gotthard base tunnel, Biasca, Switzerland	Adiabatic, sensible heat/combined sensible-latent heat store	Demonstration	Active	2017 – present	0.7	–	63–74	8
Zhongyan Jintan CAES	Jintan, Jiangsu, China	Adiabatic, sensible heat store	Commercial	Commissioned	2017 – present	50–60	200–300	–	–
Goderich A-CAES facility	Goderich, Ontario, Canada	Adiabatic, cavern flooded and hydrostatic pressure used for isobaric storage	Commercial	Active	2019 – present	2.2 (charge) 1.75 (discharge)	7	>60	–
Apex CAES Bethel Energy Centre	Tennessee Colony, Texas, USA	Conventional diabatic, gas fuelled	Commercial	Commissioned	2019 – present	324–487	16,000	–	–
Feicheng A-CAES	Feicheng, Shandong, China	Adiabatic, sensible heat store	Commercial	Active	2019 – present	1250 (expected)	7500	67	–
PG&E Advanced Underground CAES	San Joaquin County, California, USA	Conventional diabatic, gas fuelled	Commercial	Commissioned	2020 – present	300 (expected)	–	–	–
Angas A-CAES facility	Strathalbyn, South Australia, Australia	Adiabatic, cavern flooded and hydrostatic pressure used for isobaric storage	Commercial	Commissioned	2022 (expected)	5	10	>60	–

CAES Geologic Potential in the US



Thanks!

● *Questions?*