The Imperative of Establishing the Mediterranean-Dead Sea Channel: Meeting the Demands of Escalating PV Electricity Production

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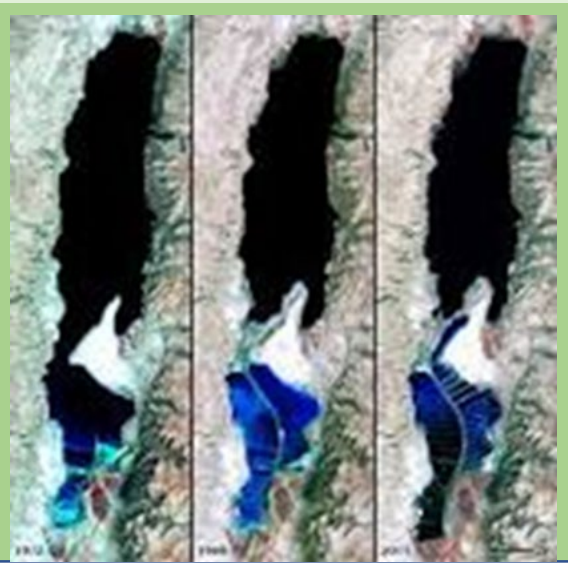
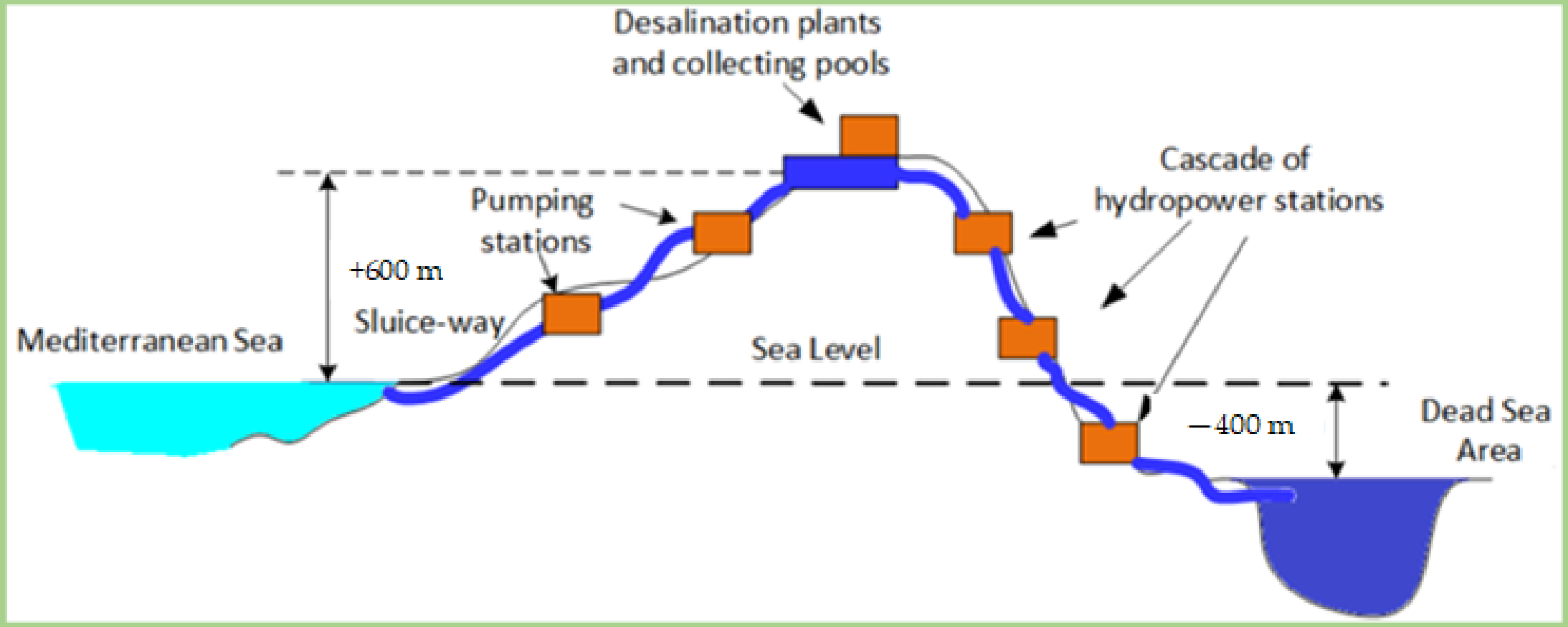
Outlines:

- The substantial increase of PV electricity production and desalinated water
- Counteracting the steady decline of the Dead Sea level
- Development of hydro-storage power facilities to the leveling electricity generation from conventional power plants
- Additional Advantages: Green Zones and Desert Resorts



Principle structure of the Mediterranean-Dead-Sea channel project



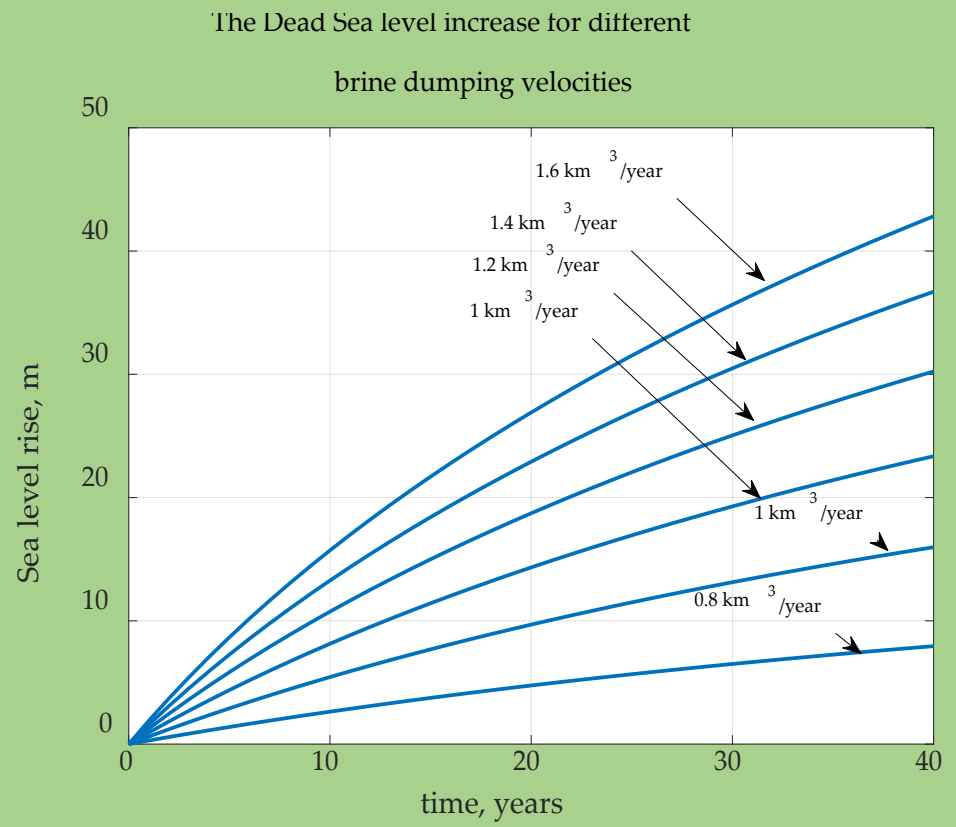
The estimation of the possible discharge brine volume to the Dead-Sea

The feasible discharge of brine into the Dead Sea is determined by the evaporation rate, increasing surface area and allowable rising of a sea level

$$E_{salt} = f(W)[\beta(S_s)e_{sat}(\theta_s) - \psi e_{sat}(\theta_a)]$$

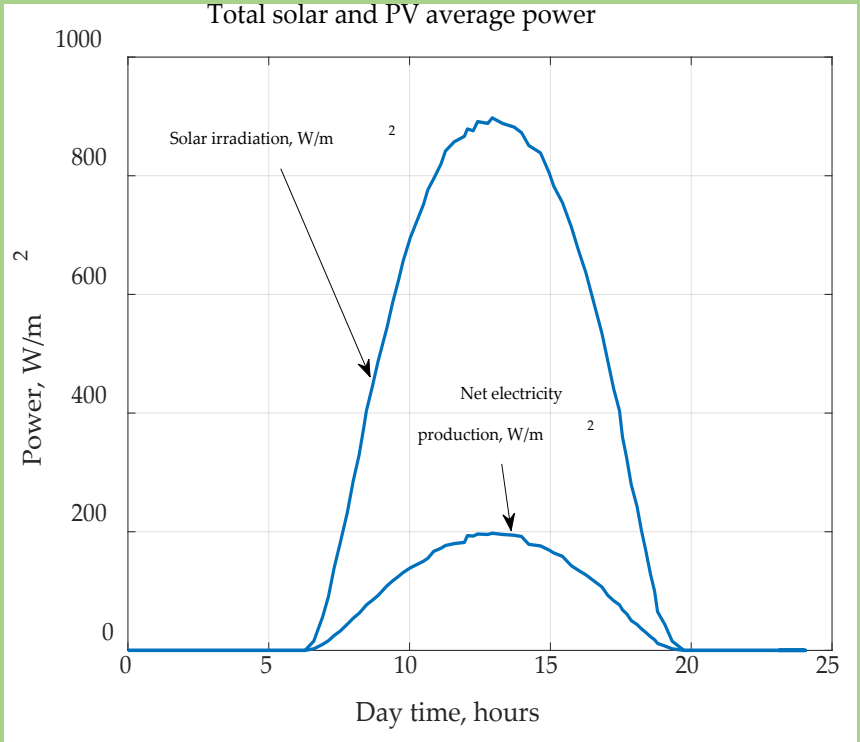
$$A = A_0 + \frac{A_{beg} - A_0}{H_{tot}}\Delta h = A_0 + \alpha \cdot \Delta h = 620 + 11 \cdot \Delta h, km^2$$

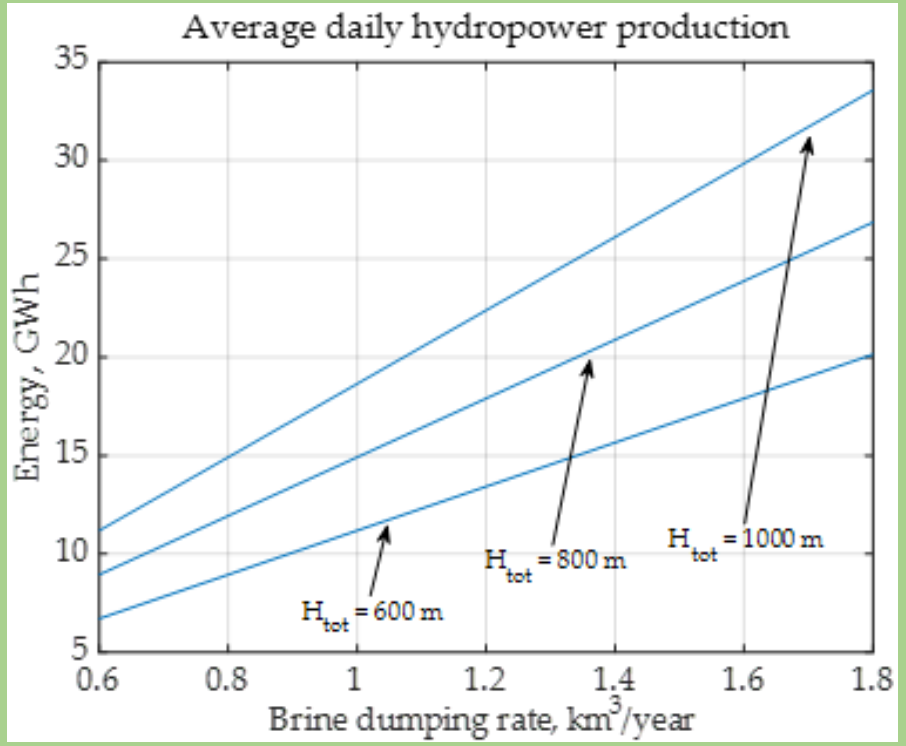
$$\frac{dh}{dt} \approx \frac{\Delta h}{\Delta t} = \frac{V_{brine} - V_{evap}}{A} = \frac{V_{brine} - Av_{evap}}{A}$$
$$= \frac{V_{brine}}{A} - v_{evap}$$



Energy Production from PV Facilities and Hydro-storage

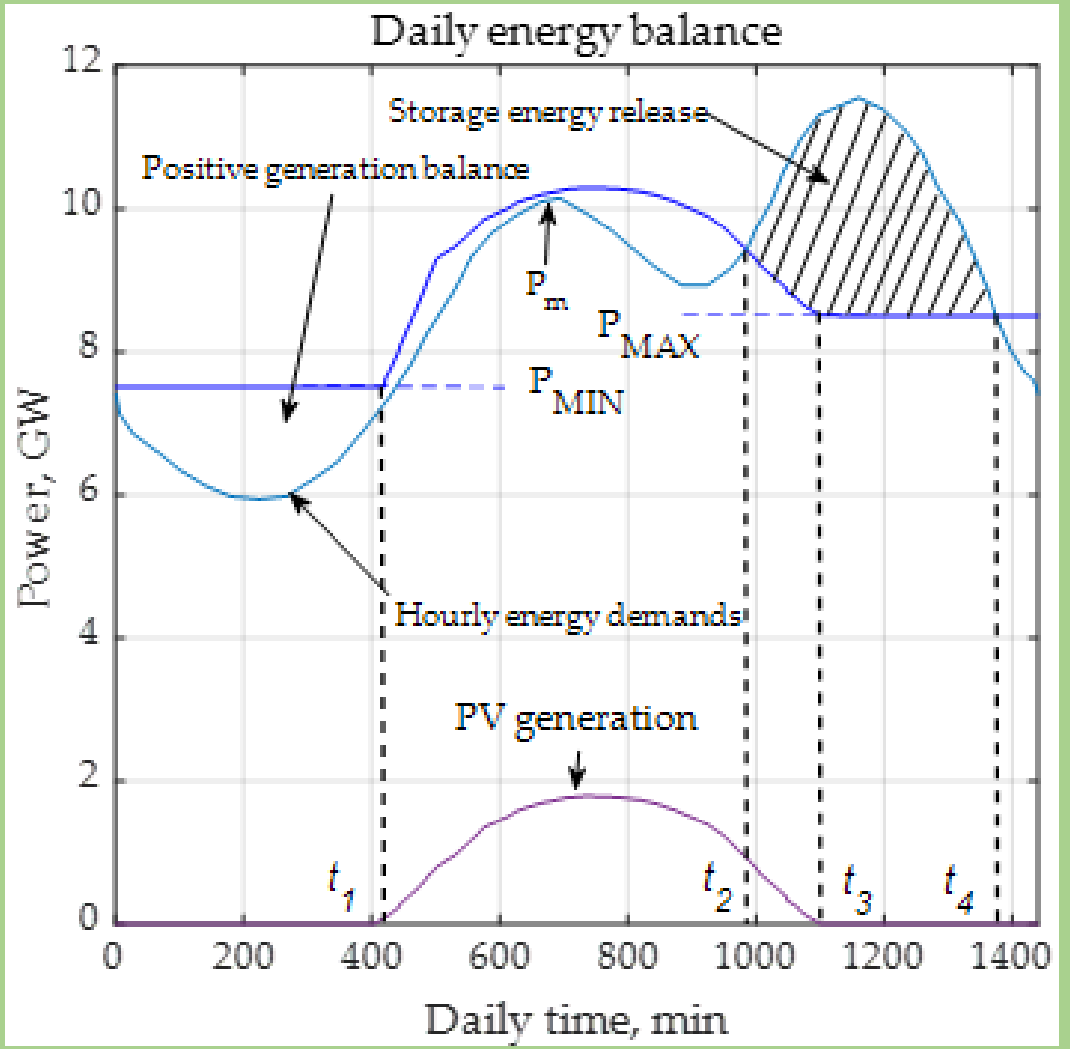
Daily balance is summarized from the power from conventional stations, PV plants and hydro-storage facilities





Summarized Daily Balance of the Total Energy Production

t1 - The beginning of the PV electricity generation;
t2 – The beginning of a common functionality of conventional stations, PV evening decay and hydro-storage release;
t3 –The phase-out of PV generation and the continuation of common conventional and hydro-storage facilities;
t4 – Discontinuation of Hydro-Storage Functionality;
t4-t1 – Night-Time Operation When Conventional Power Plants Supply Electricity Only;



Efficiency of Hydro-pumped Storage at Varying Altitudes for Brine Disposal

The efficiency is summarized from energy for Mediterranean water lifting and hydro-dynamic losses:

$$W_{lift} = \frac{V_{sw}}{\eta_{pump}} \cdot \left[(H_{tot} - \Delta H)\rho_{sw} g + \frac{V_{sw} \frac{128\mu L}{\pi D^4}}{(T_d + t_2 - t_4)} \right]$$

$$K_{PS} = \frac{W_{HP}}{W_{lift}} = \frac{\eta_{HP}\eta_{pump} H_{tot} \rho_{brine} g (1 - K_{rec})}{\left[(H_{tot} - \Delta H)\rho_{sw} g + \frac{128\mu L V_{sw}}{\pi D^4 (T_d + t_2 - t_4)} \right]}$$

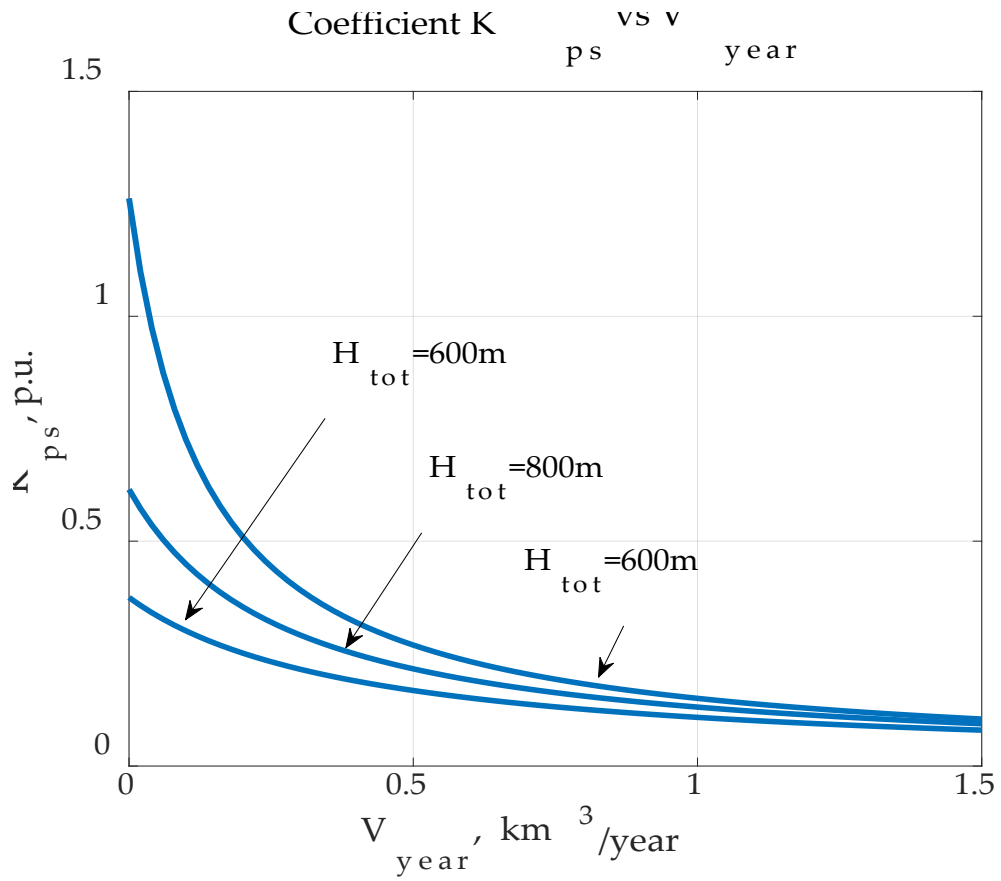
$$= \frac{\rho_{brine}}{\rho_{sw}} \frac{\eta_{HP}\eta_{pump}(1 - K_{rec})}{1 - \frac{\Delta H}{H_{tot}} + \frac{128\mu L V_{sw}}{\pi D^4 H_{tot}(T_d + t_2 - t_4)}}$$

For a specific project:

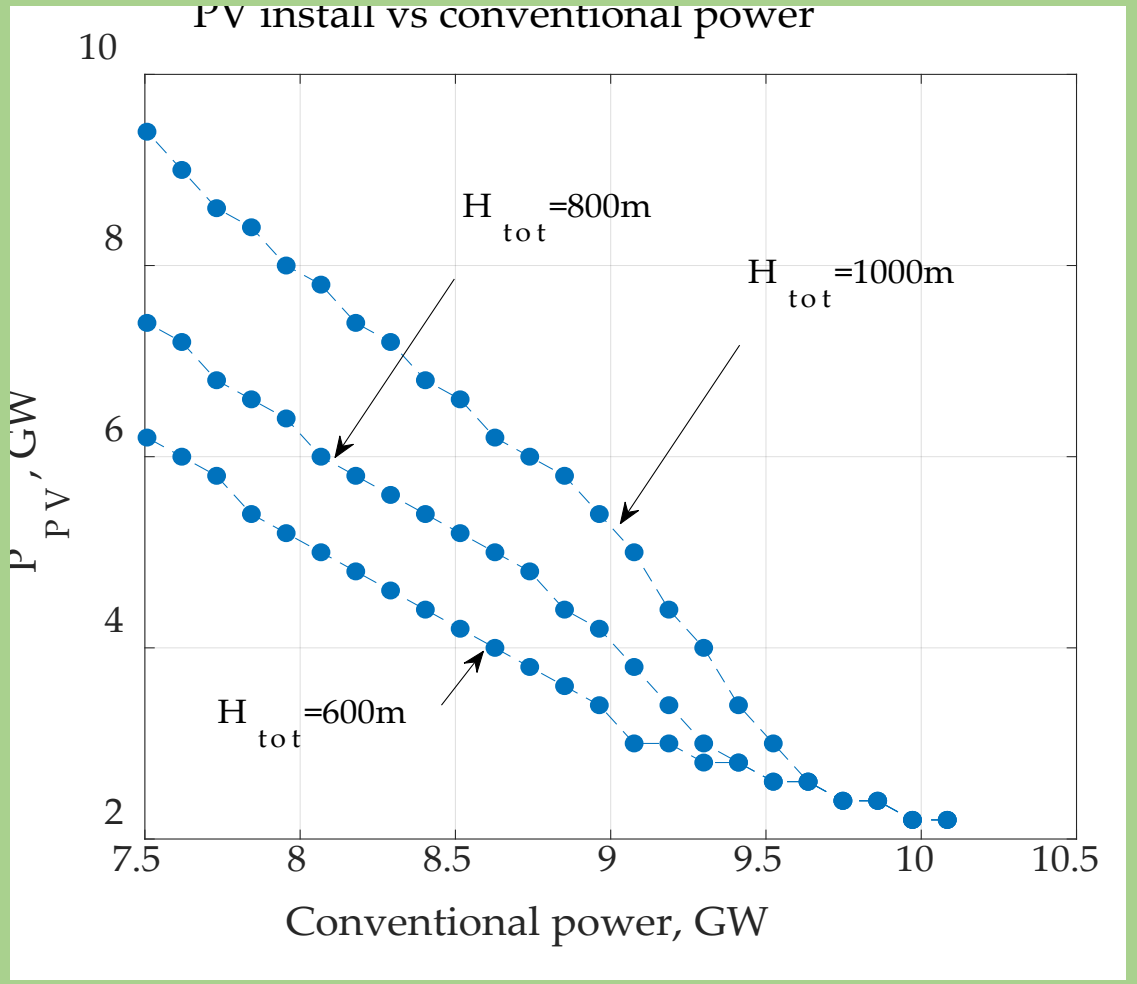
$$K_{PS} = \frac{0.7065 \cdot \left(0.9^{\frac{H_{tot} - \Delta H}{100}}\right)\left(0.95^{\frac{H_{tot}}{100}}\right)}{1 + \frac{\Delta H}{H_{tot}}\left(3.692 \cdot V_{year} - 1\right)}$$

Pumping Storage Efficiency

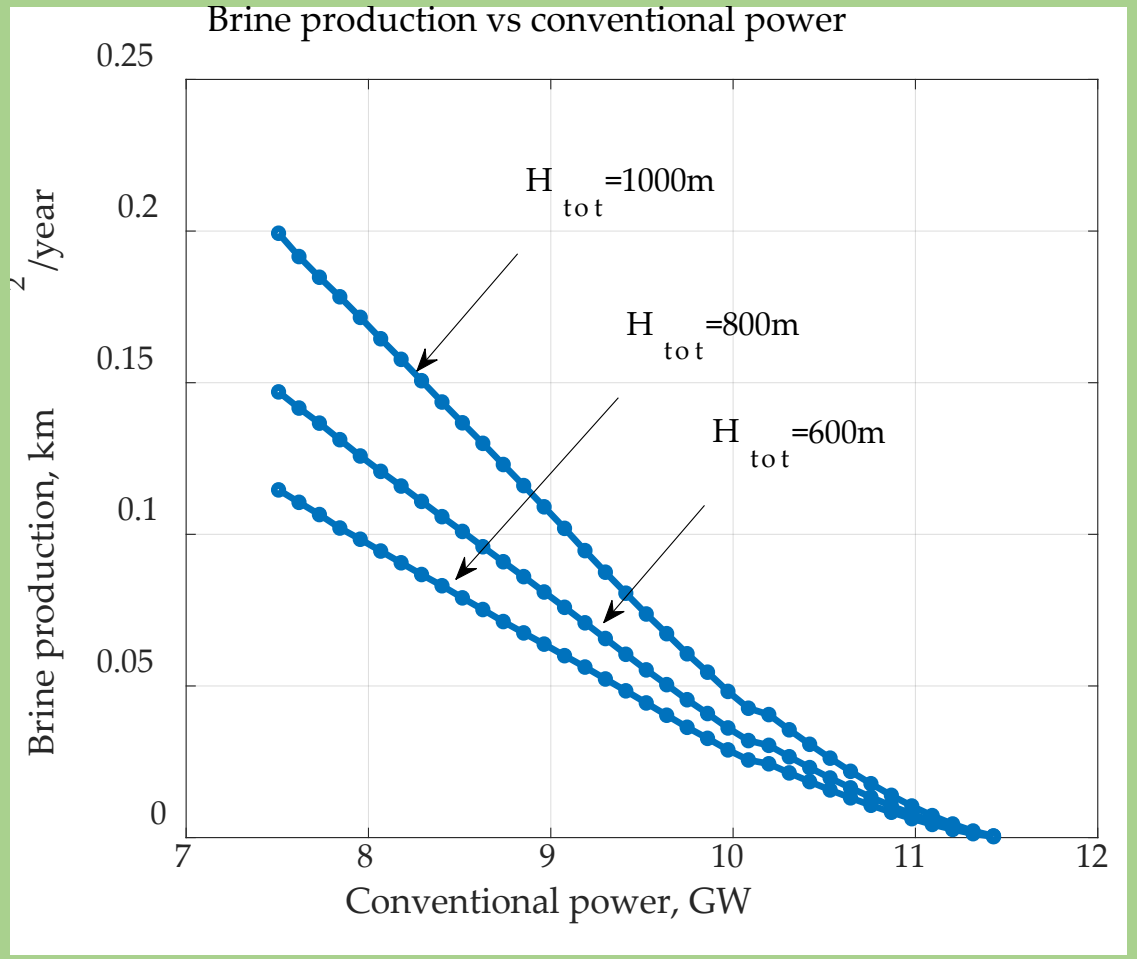
The coefficient of a pumping storage efficiency K_{PS} which reflects the productivity of the hydro-pumping storage, can be represented as follows:

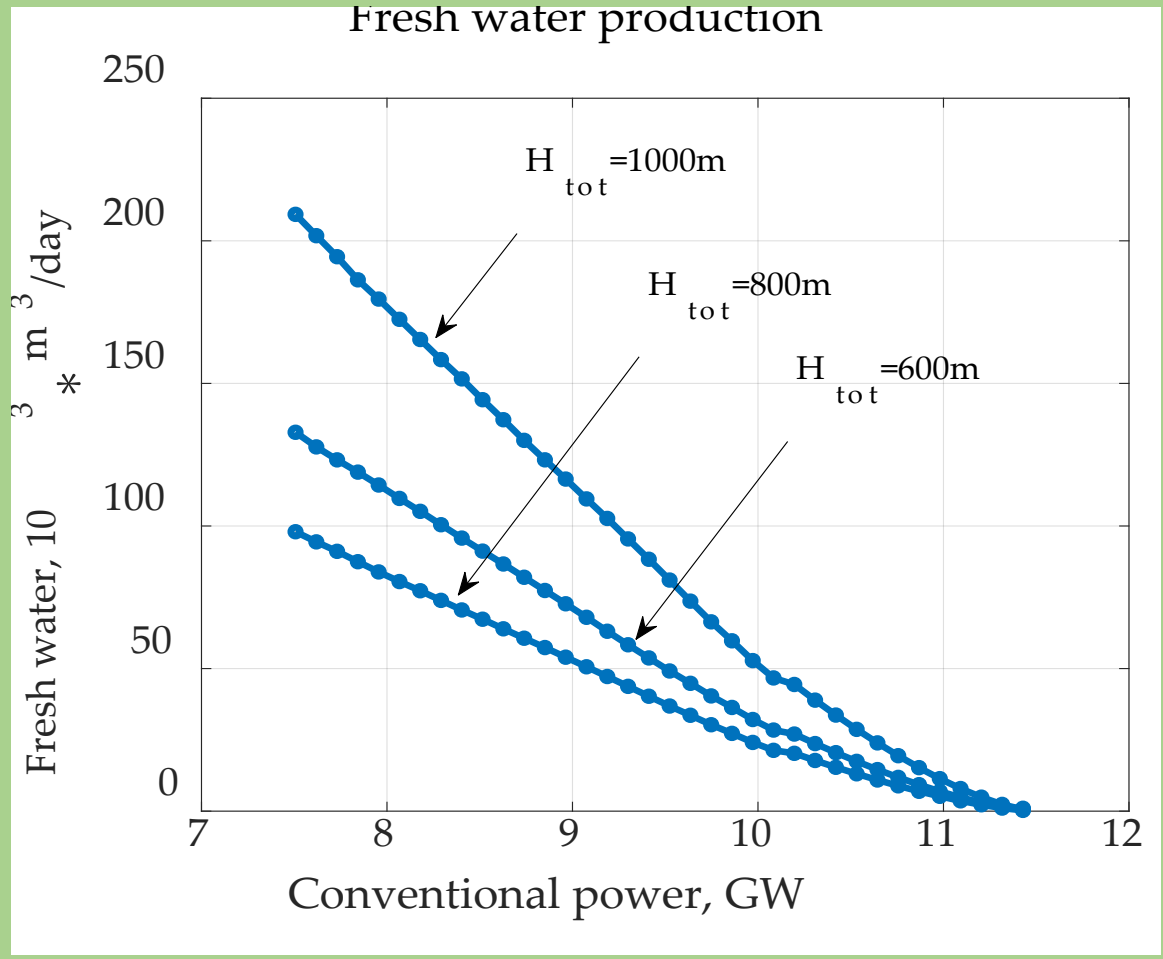


Estimation of Optimal Photovoltaic Electricity Production

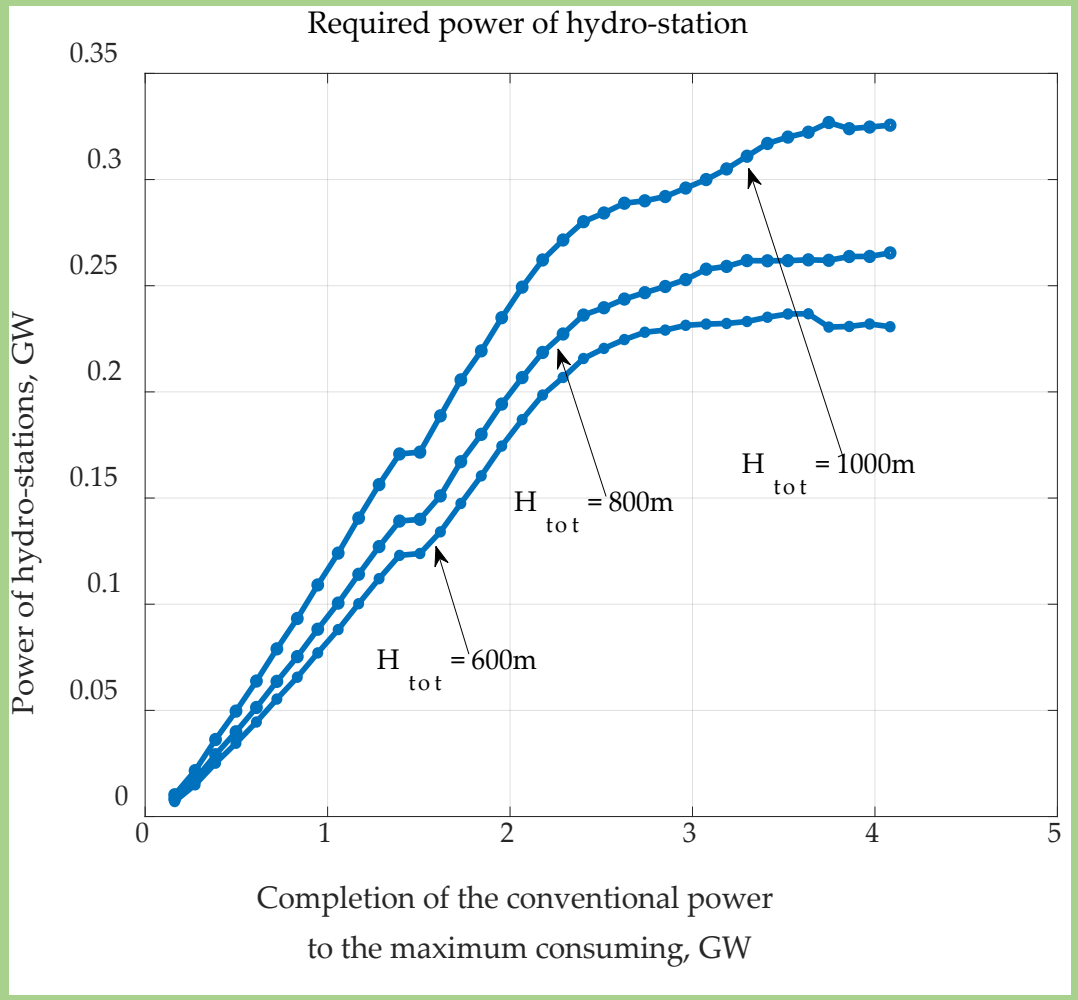


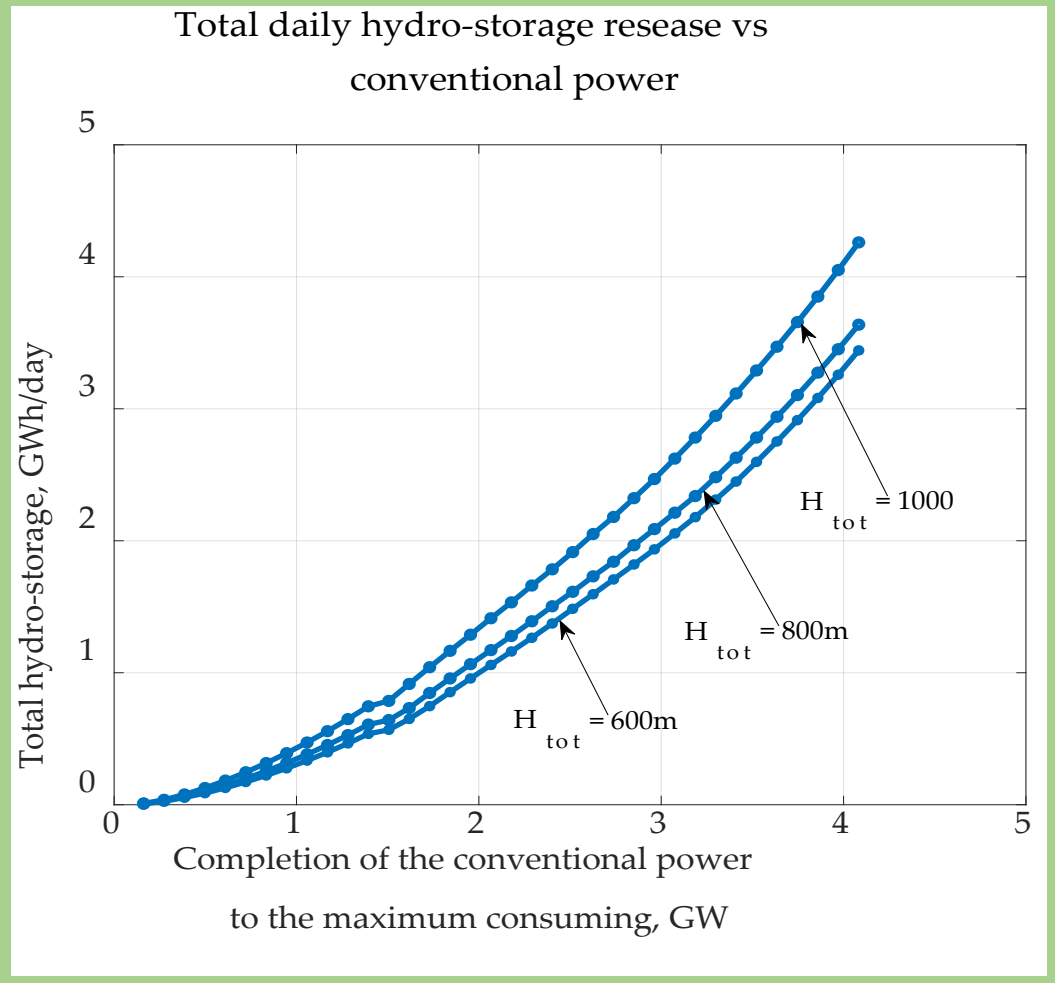
Fresh water and brine production





Results of the project functionality





Conclusions

The creation of a project for the Mediterranean-Dead Sea Canal will ensure:

- A **significant increase in photovoltaic (PV) solar energy production**, potentially contributing up to **25-30%** or more of the total electricity consumption.
- **Prevention of further depletion of the Dead Sea** by addressing the ongoing reduction in its surface area, helping to stabilize its water levels.
- The establishment of **hydro-pumped storage facilities**, which will enhance the efficiency of conventional power stations by balancing energy supply and demand.
- An increase in **fresh (desalinated) water production**, contributing to water security in the region.
- Additional benefits, including the **recreation of green zones** and the development of **desert resorts**, promoting environmental sustainability and economic growth.

Publications:

1. Averbukh, Moshe. "The Imperative of Establishing the Mediterranean–Dead Sea Channel: Meeting the Demands of Escalating PV Electricity Production." *Journal of Clean Energy and Energy Storage* 1 (2024): 2450005.
2. Lineykin, Simon, Abhishek Sharma, and Moshe Averbukh. "Eventual Increase in Solar Electricity Production and Desalinated Water through the Formation of a Channel between the Mediterranean and the Dead Sea." *Energies* 16.11 (2023): 4272.

THANK YOU FOR ATTENTION!