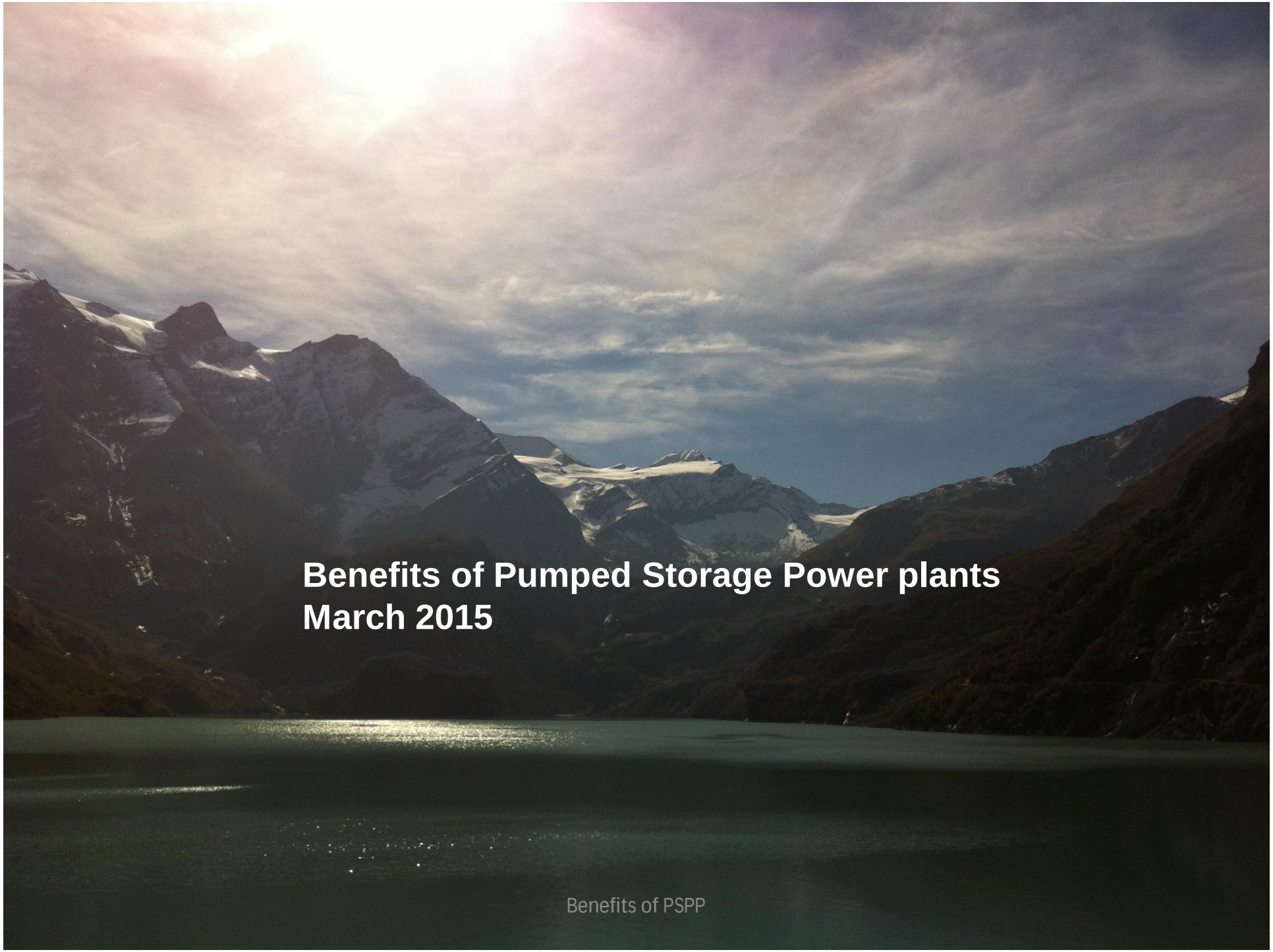
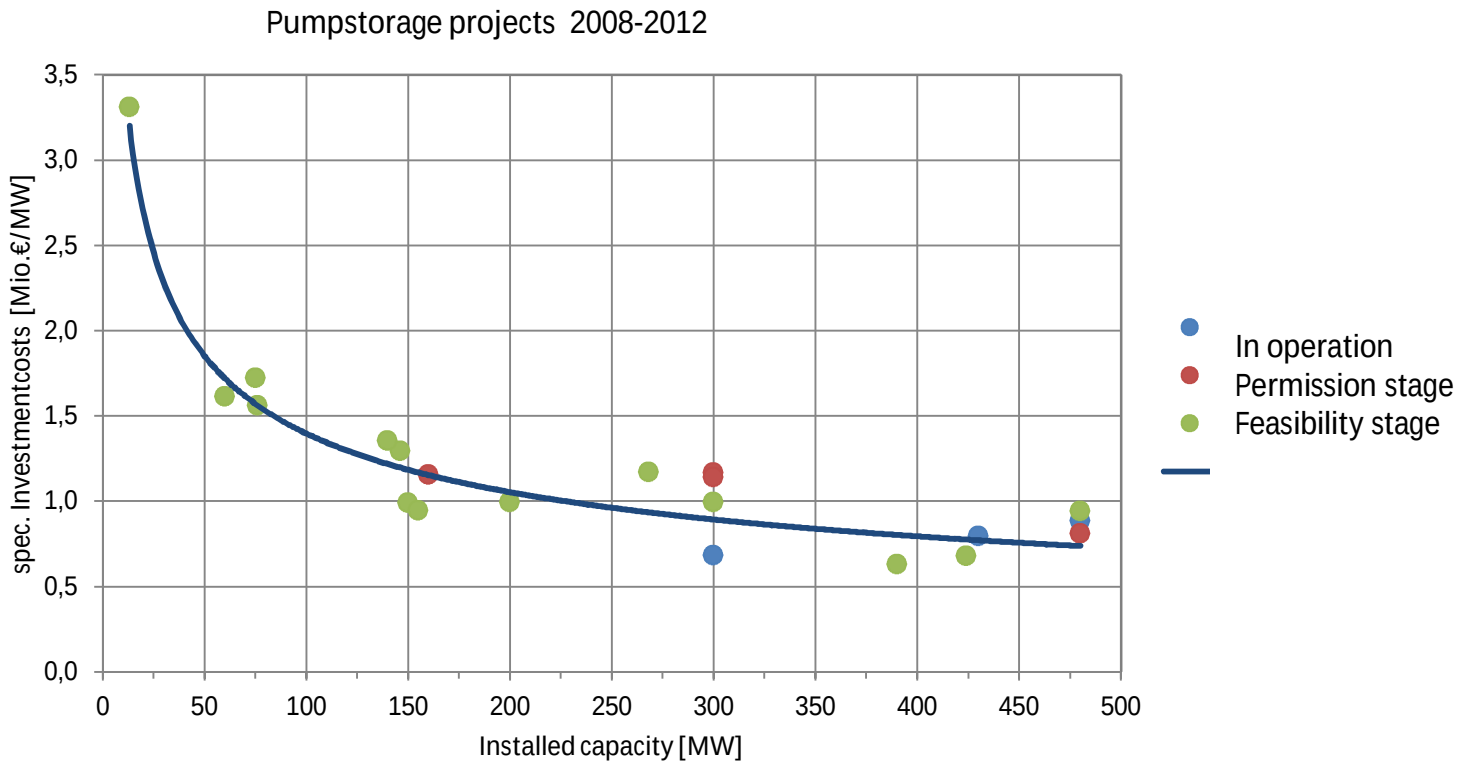


Benefits of Pumped Storage Power plants
March 2015

Specific Costs of Pumpstorage power plants (indication only)

Specific Investmentcosts



Technologies for storage of over-capacity

Comparison of Technologies: Costs

- PSPP are the most economic large scale storage technology
- Batteries are cost effective at low capacity, costs increasing linear with capacity

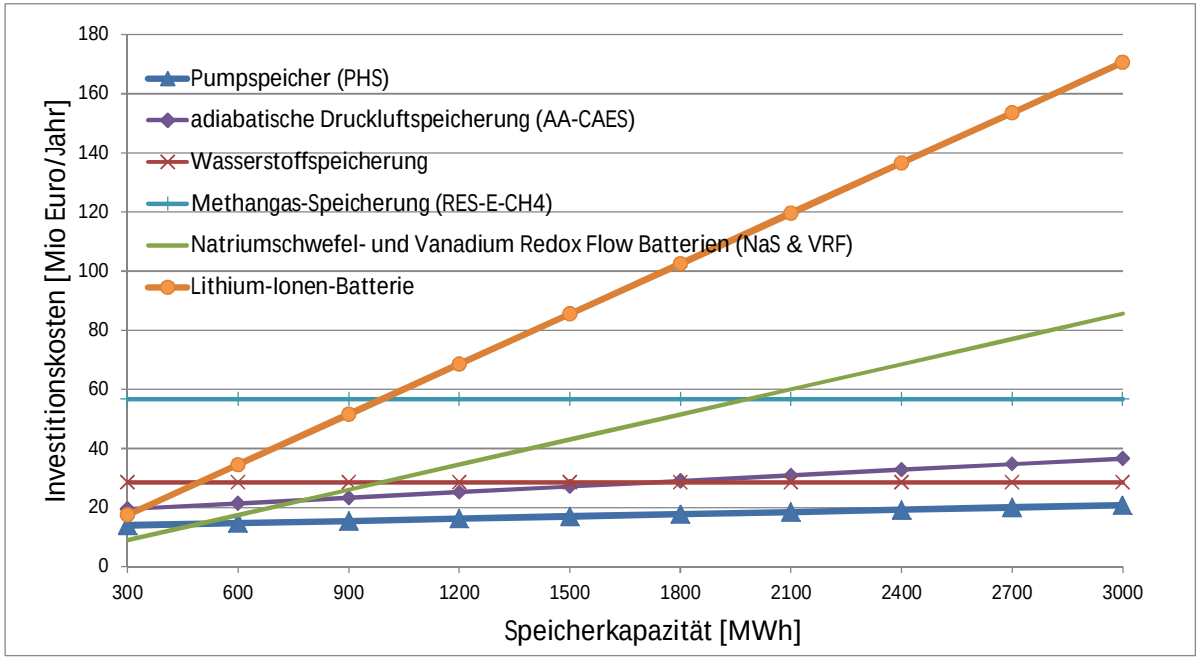
Example:

 Invest costs to guarantee 1h 300 MW **(=300 MWh)**

Pumpspeicher	Li-Ion Batterien
14 Mio €/Jahr	18 Mio €/Jahr

 Investcosts to guarantee 10h 300 MW **(=3000 MWh)**

Pumpspeicher	Li-Ion Batterien
20 Mio €/Jahr	170 Mio €/Jahr



Yearly Investcosts of a 300 MW Storage in relation to the Storage capacity [MWh]

Quelle: Kloess 2012, mod.

Specific costs of storage – daily and weekly

- Daily - Storage costs with different technologies
- Assumption: 0.- costs for pumping

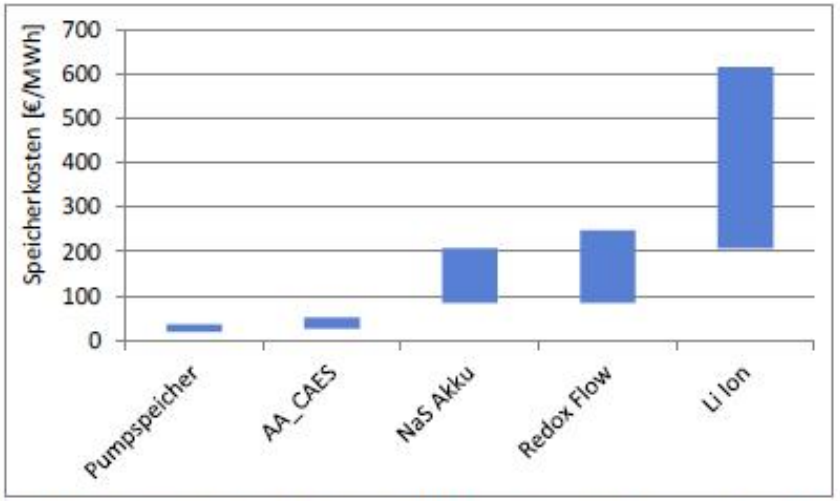


Abbildung 40: Spezifische Kosten der Speicherung – Tagessspeicher (Strompreis Laden: p_{in} = 0 €/MWh)

- Daily - Storage costs with different technologies
- In relation to the costs for pumping (0.- to 200 €/kWh

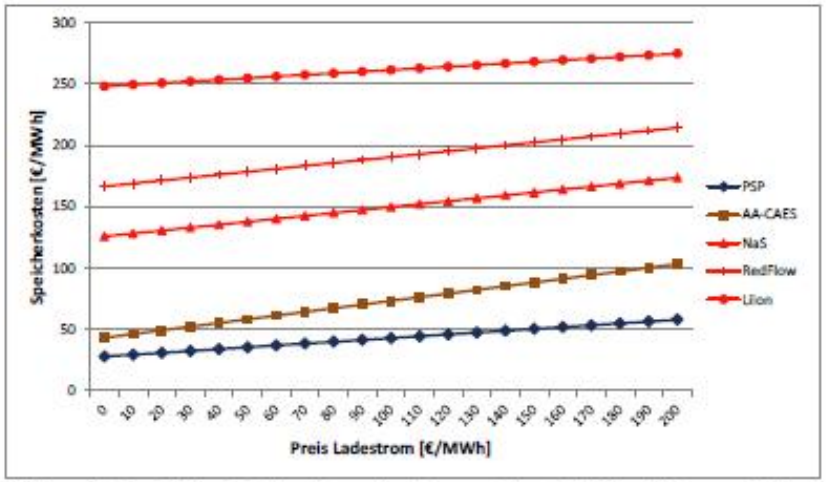


Abbildung 41: Spezifische Speicherkosten der Tagessspeicher in Abhängigkeit vom Preis des Ladestroms

Specific costs of storage – daily and weekly

- Weekly - Storage costs with different technologies
- Assumption: 0.- costs for pumping

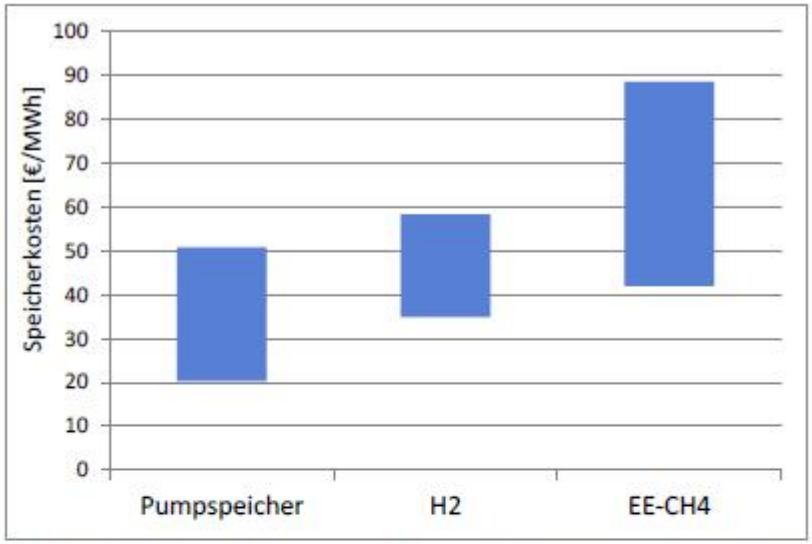


Abbildung 42: Spezifische Kosten der Speicherung – Wochenspeicher (Strompreis Laden: p_{in} = 0 €/MWh)

- Weekly - Storage costs with different technologies
- In relation to the costs for pumping (0.- to 200 €/kWh

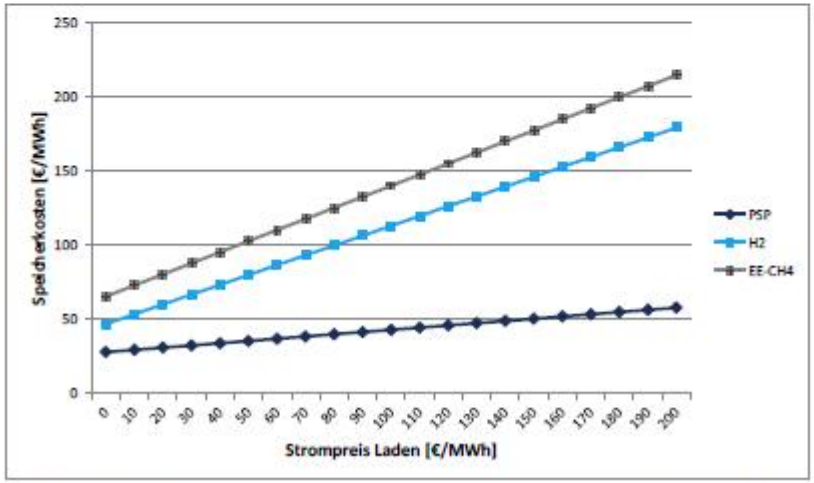


Abbildung 43: Spezifische Speicherkosten der Wochenspeicher in Abhängigkeit vom Preis des Ladestroms

Capabilities and advantages of pumped storage power plants

Flexibility for and Responsive

- Advantages of Dual Capability – Pumping and Turbine operation
  - Capability to absorb surplus energy from the grid to pump and re-fill upper reservoir, and the capability to release pumped water stored in the upper reservoir to contribute to demand requirements
  - Offer grid frequency stabilisation function
  - Primary and secondary control market contribution in generation
  - Tertiary market possible in generation and pumping mode
- The growing development of renewable energy requires provision of:
  - Complementary capacity in combination with renewables
  - Potential for storage of excess energy from wind and solar
  - Potential to balance wind and solar power which tend to deliver erratic and fluctuating daily production
- Schemes possible in the range 150 – 1800 MW, with intention of 2 to 10 hours daily generating operations

Benefits of Pumped Storage Power Plants

- Economic
  - Employment
  - Improvement of effectiveness of energy system
  - Reduced network costs
- Storing Energy
  - Provide a substantial contribution towards a balance between electricity generation and consumption
  - Absorb excess power in the grid particularly when balancing energy produced by wind and solar plants
    - wind and solar erratic through 24 hour period
    - planned increase of wind and PV capacity in nearly all countries
- Balancing Services
  - Provide required regulatory functions contributing to grid stabilization and frequency regulation at primary and secondary levels in generating mode
  - Black Start services ability

Benefits of Pumped Storage Power Plants

- Increasing Effectiveness of Renewables
  - Diversify the energy mix
  - Absorb base load production particularly from nuclear and coal plants at night and release during peak hours in morning and evening

- Reducing Transmission costs
  - Installing PSPP close to demand and generation of wind power and other renewables

- With the rapidly increasing portion of energy production coming from renewables pump storage has a part to play in complimenting and balancing production and managing the grid.

Selection of Pumped Storage Sites

- Main Criteria's for the selection of proposed PSPP sites:
  - Location near the consumers and renewable energy sources
  - Suitable location for cavern and reservoirs
  - Good accessibility
  - Expected technical conditions (head / flow)
  - Size of reservoir in relation to the installed power and the required operation mode
  - Grid connection possibility in the vicinity of the site
  - Similar concepts as successfully in operation in other countries