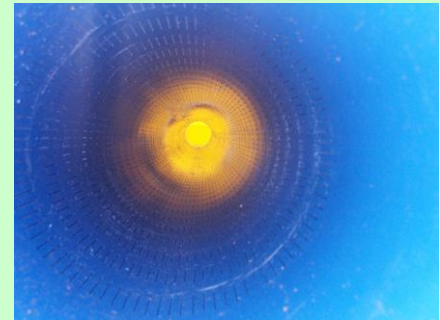


International Energy Agency



What kind of storage  
do you need?



# Energy Storage – Properties



- **General Properties of an energy Storage System:**
  - Storage capacity (kWh/kg, kWh/m<sup>3</sup>)
  - Charging/discharging power (W/kg, W/m<sup>3</sup>)
  - Storage Efficiency
  - Storage period (time)
  - Price (€/kWh, €/kW)
  - Storage Cycles (per year, day...)
  - Competing Technology

# Mechanical, Electrical and Thermal Energy Storage Technologies



Storage Technologies	Capacity kWh/t	Power MW	Efficiency	Storage Time	Cost €/kWh
Pumped Hydro	1	1-500	80%	day - month	50
Flywheel	5-100	1-100	90%	hour	3000-5000
CAES	2 kWh/m <sup>3</sup>	300	40-70%	day	400-800
Lead-Acid	40		85%	day - month	200
Li-ion bat.	130	0.02 - ??	90%	day - month	1000
NaS bat.	110	0.05 - 50	85%	day	300
Redox-Flow bat.	25	0.01-10	75%	day - month	500
SMES	3	10	95%	hour - day	100000
Supercaps	5	0.001 - 1	95%	hour - day	100000
Hot Water	10-50	0.001 - 10	50-90%	day - year	0.1
PCM	50-150	0.001 - 1	75-90%	hour - week	10-50
Chemical Reactions	120-250	0.01 - 1	100%	hour - day	8-40
Hydrogen	30000	0.001 - 1	25-50%	day - year	1000 €/kW

**Has to be validated and updated!**

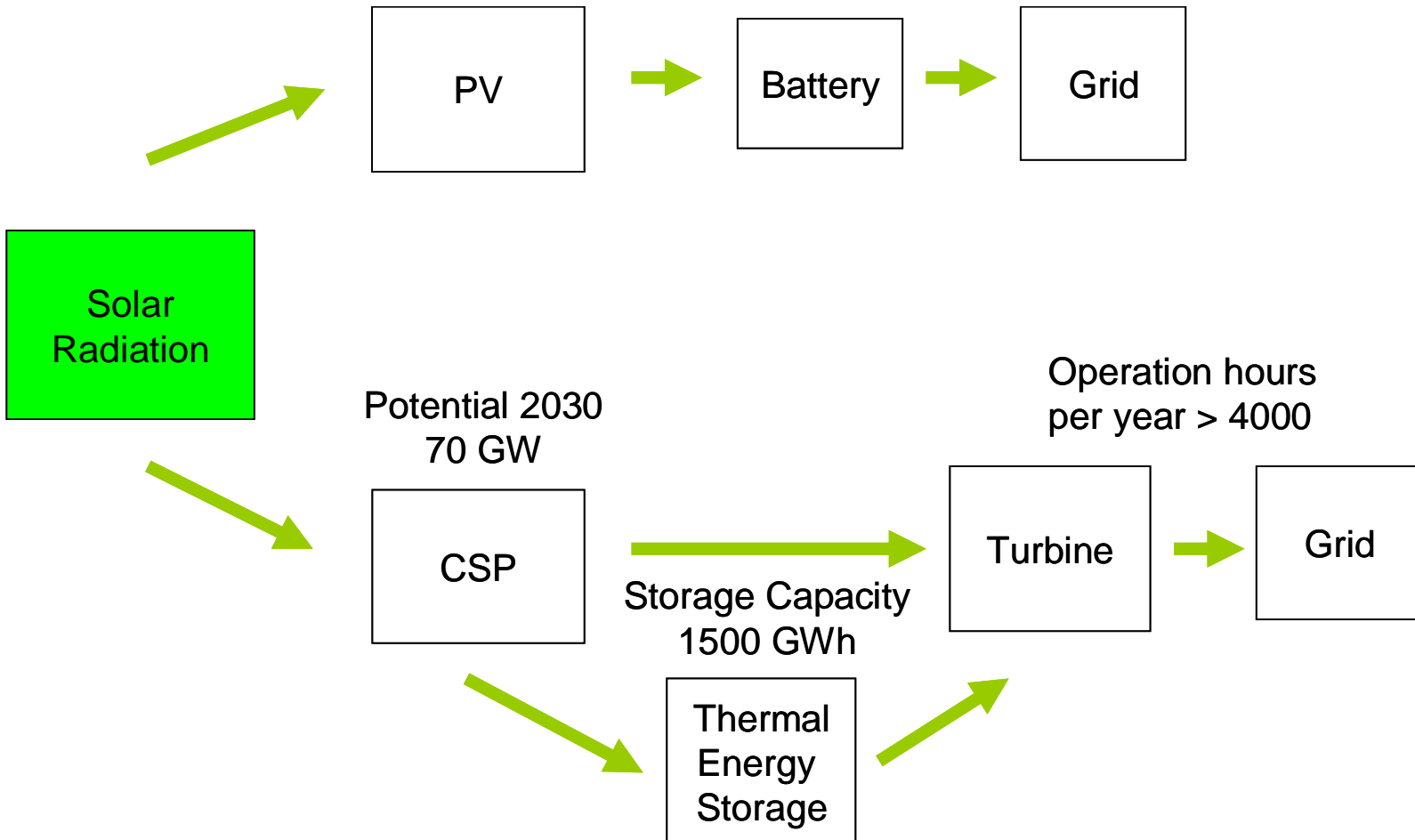


# Application Side

# „Between“ the Technologies: Existing Examples



- Solar Power



# Energy Storage – Properties



- General Properties of an energy Storage System:
  - Storage capacity (kWh/kg, kWh/m<sup>3</sup>)  
**Not that important**
  - Charging/discharging power (W/kg, W/m<sup>3</sup>)  
**Absolute: 100 MW, specific: not that important**
  - Storage Efficiency  
**Should be high, solar field is expensive**
  - Storage period (time)  
**6-8 hours**
  - Price (€/kWh, €/kW)  
**Should be inexpensive...**
  - Storage Cycles (per year, day...)  
**1 per day**
  - Competing Technology  
**Storage: EES (?), General: PV, CCS power plants**

## Next Steps



- This meetings question: „Do you need storage?
- Next meetings question: „What kind of storage do you need?“
- Templates will be send around before the meeting
- Discussion on the suitable storage technology for the application at the meeting



# Potentials

## From the big scenario to the actual storage



- General storage demand can be calculated
- General storage demand should be classified
  - Electrical / Thermal
  - Central / Distributed
  - High / low power output
  - Long / short term
  - Others (?)
- Suitable Storage Technology can be identified
- Potentials for each technology can be identified
- R&D activities can be focussed