



Nexus Solar Energy-Water-Industry

IEA SHC Task 62 – Solar Energy in Industrial Water & Wastewater Management

Solar Academy

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Worldwide problems



- **Industry and agriculture largest water AND energy consuming sector** (OECD, IEA, 2016) (Eurostat, 2018)
- Change to a **sustainable, resource- and energy-efficient** industry will be the **major challenge**



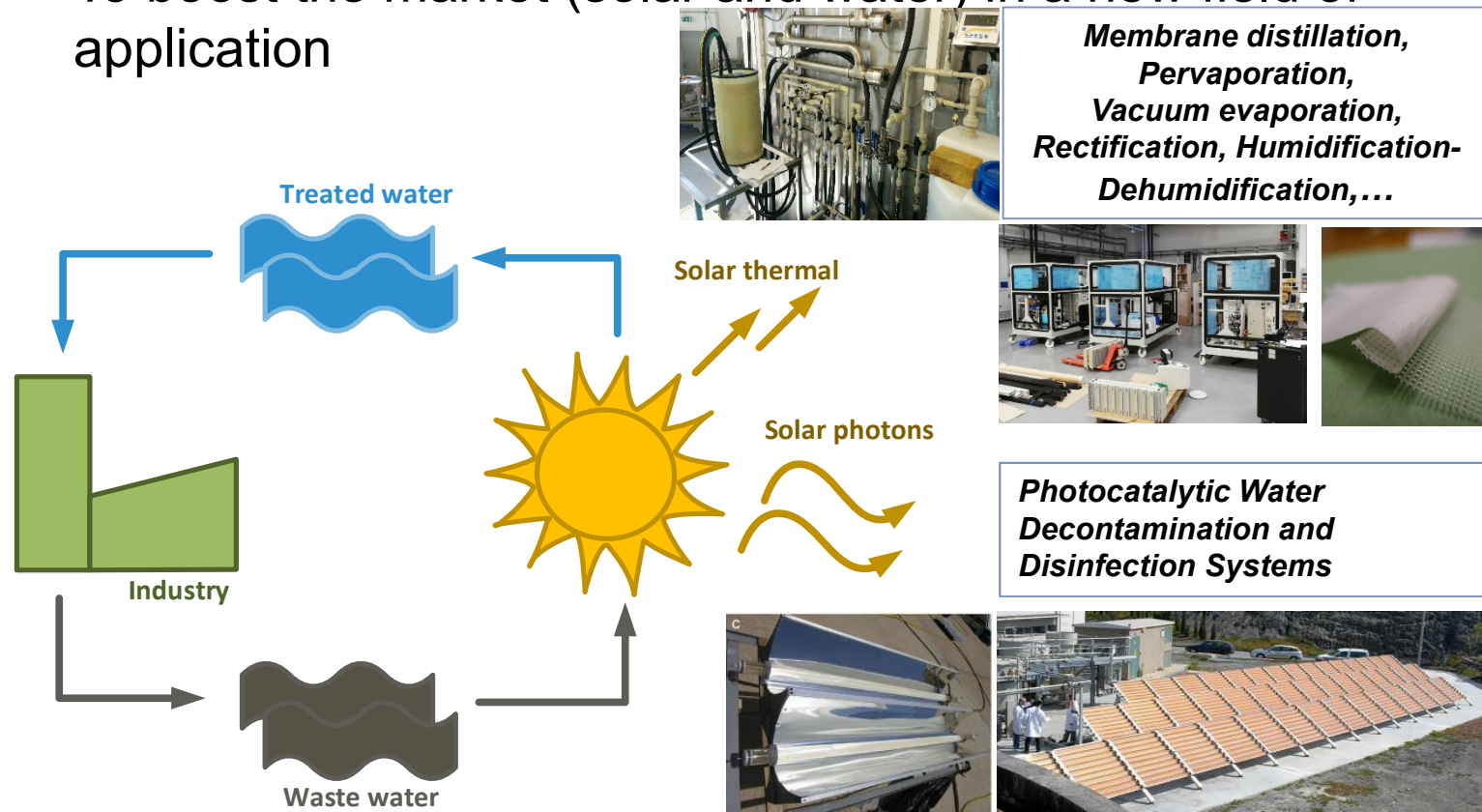
- **10% of global water withdrawals** in 2014 were from industry (OECD, IEA, 2016)
- High **disposal costs** and **resource losses** for industry



- **20% of energy demand** of municipalities for WWTPs
- **Energy demand appr. 40 kWh per inhabitant** and year

Two approaches

- Solar energy as reliable source for CO₂ reduction
- To boost the market (solar and water) in a new field of application



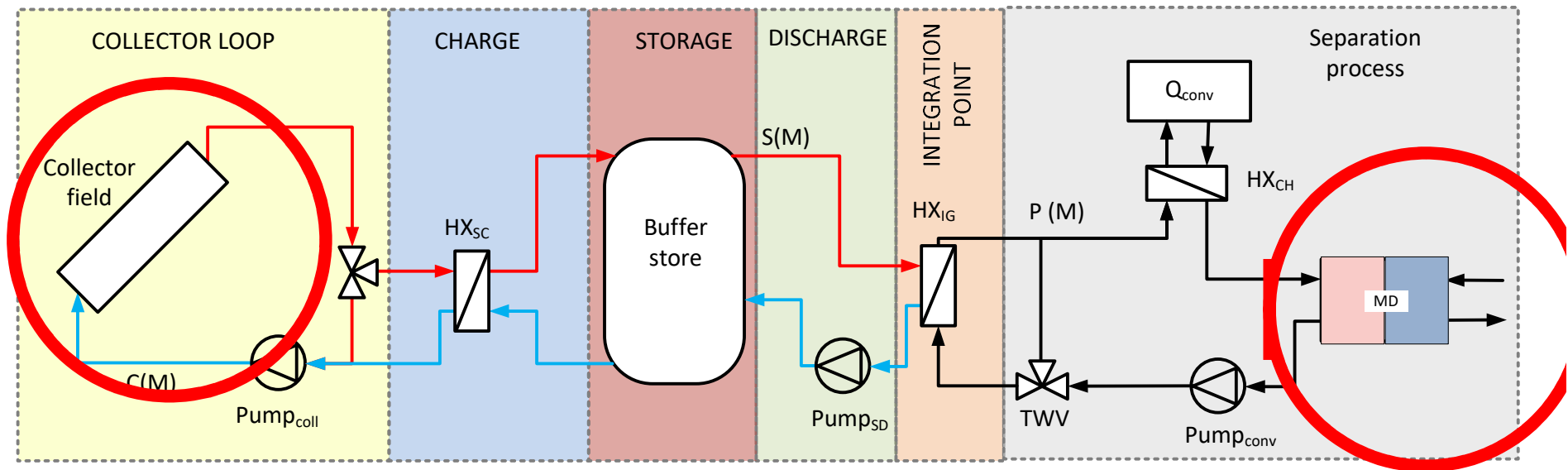
Targeted results



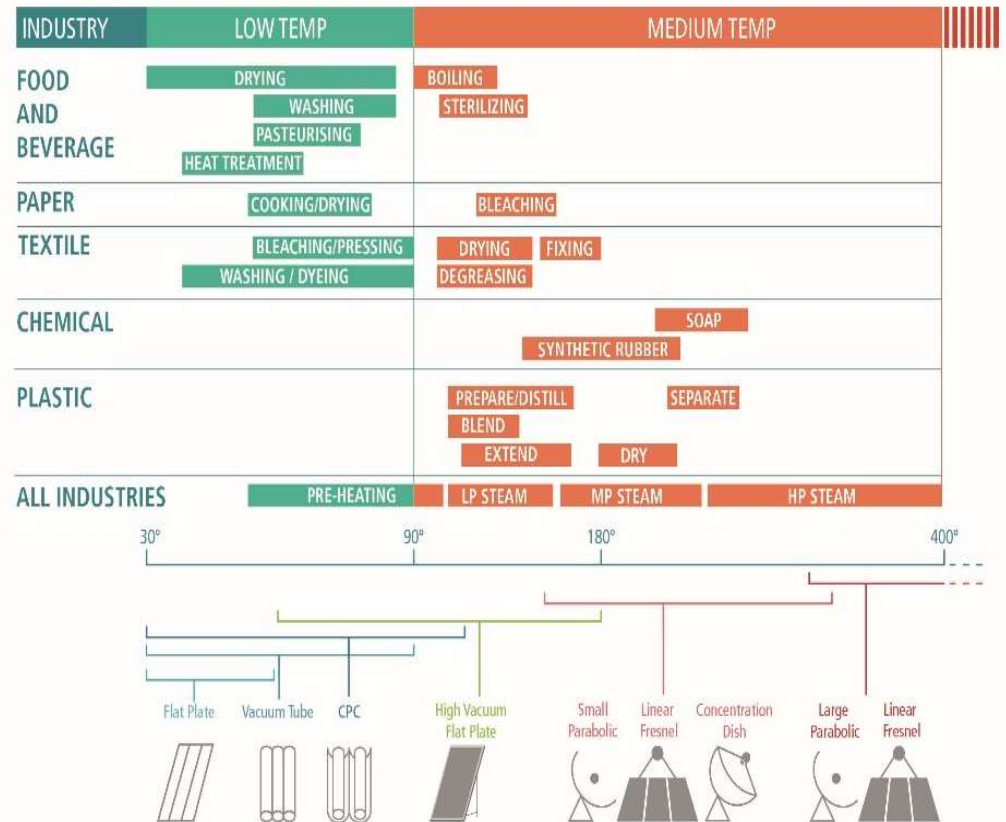
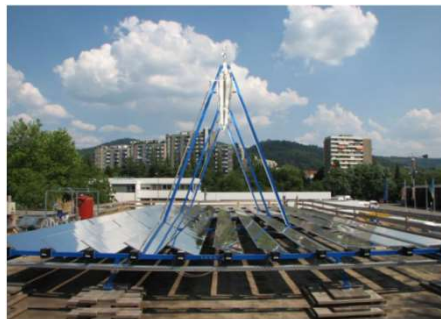
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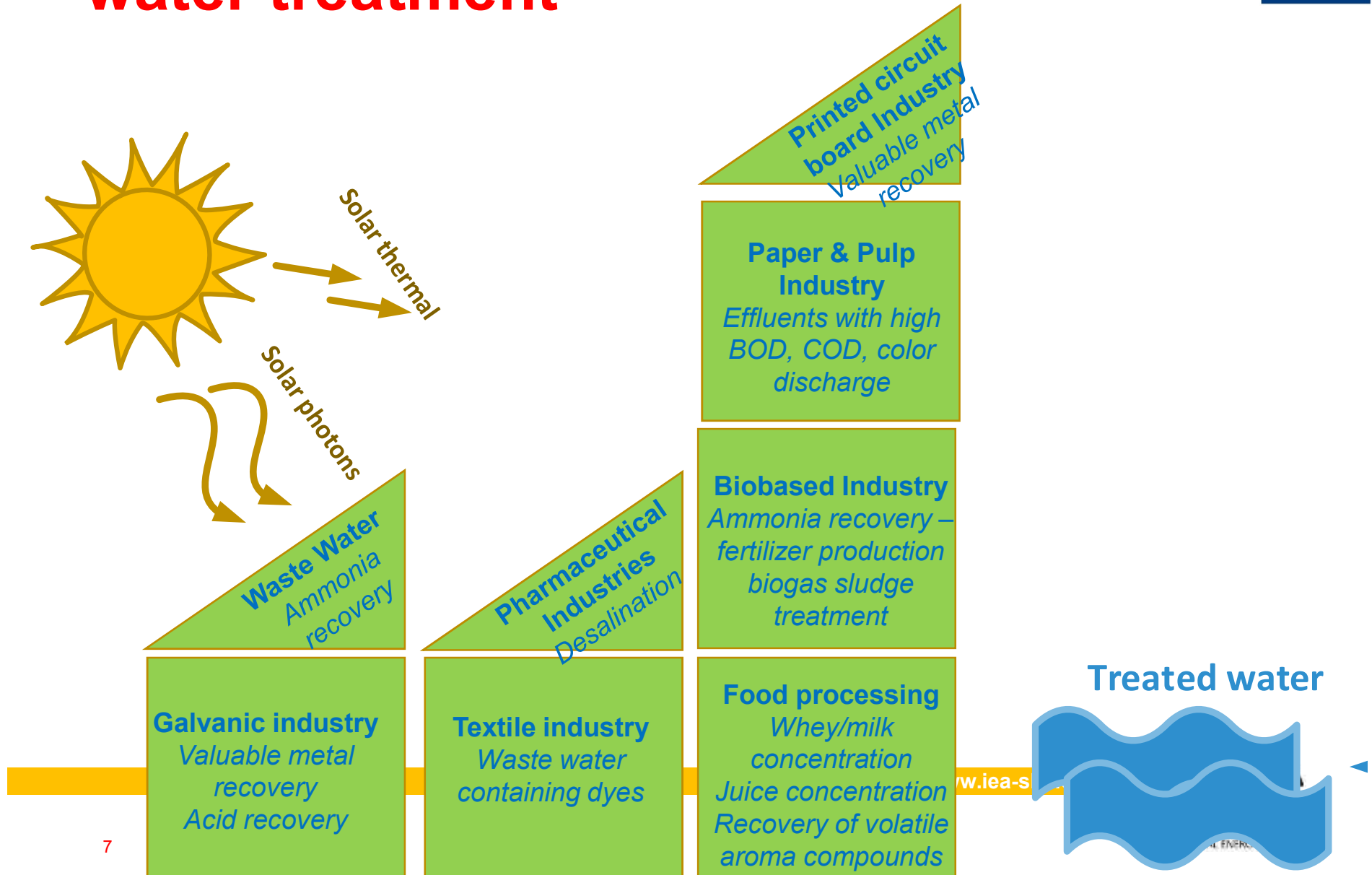
Integration concepts – potential applications & examples



Solarthermal collectors

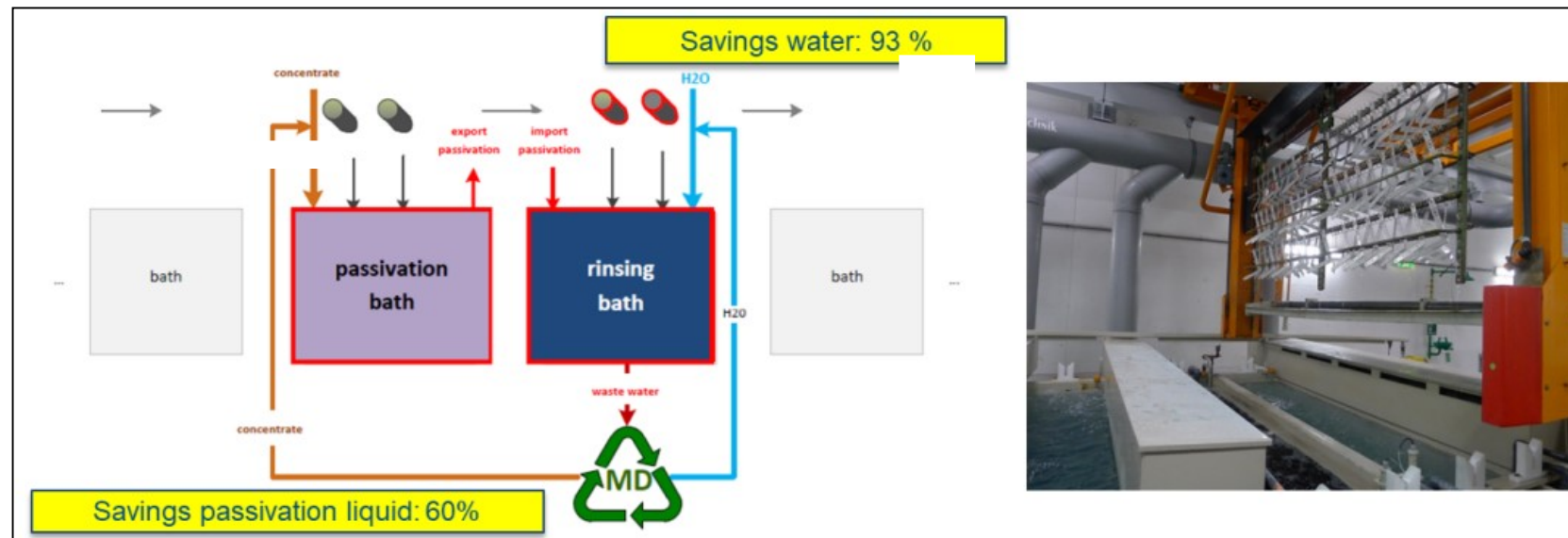
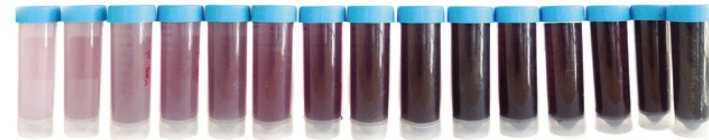


Possible industrial applications for water treatment



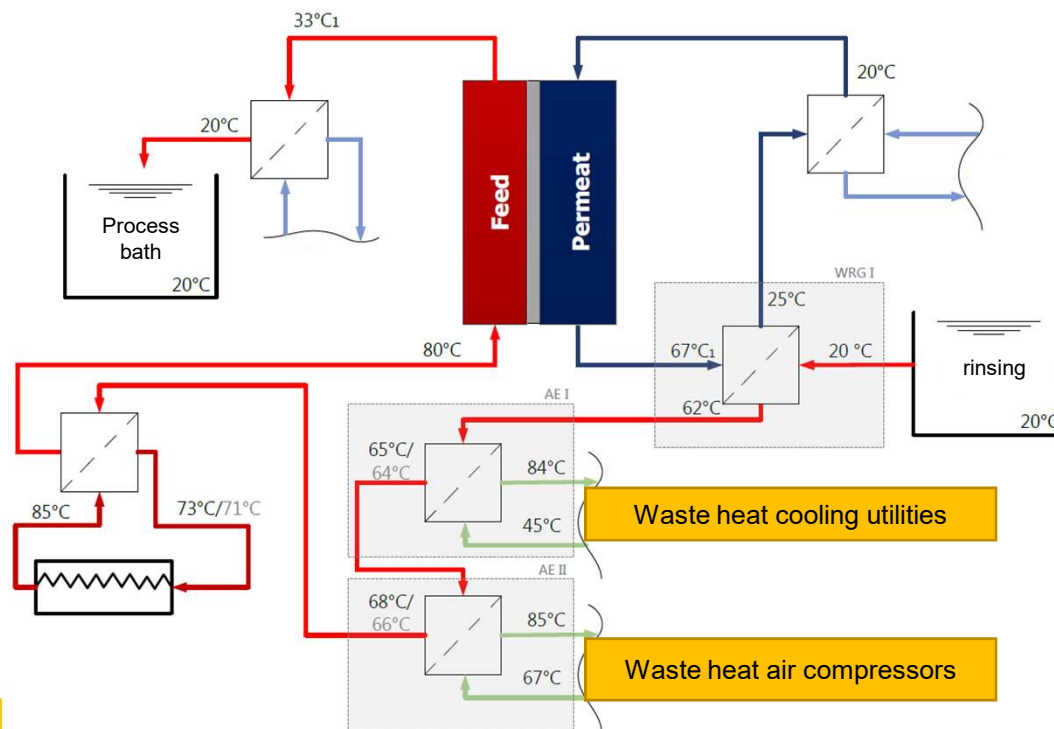
MD for resource recovery in galvanizing industry

- Target – concentrating contaminated rinsing water from electroplating substances for reuse of passivation liquids and water into the production process

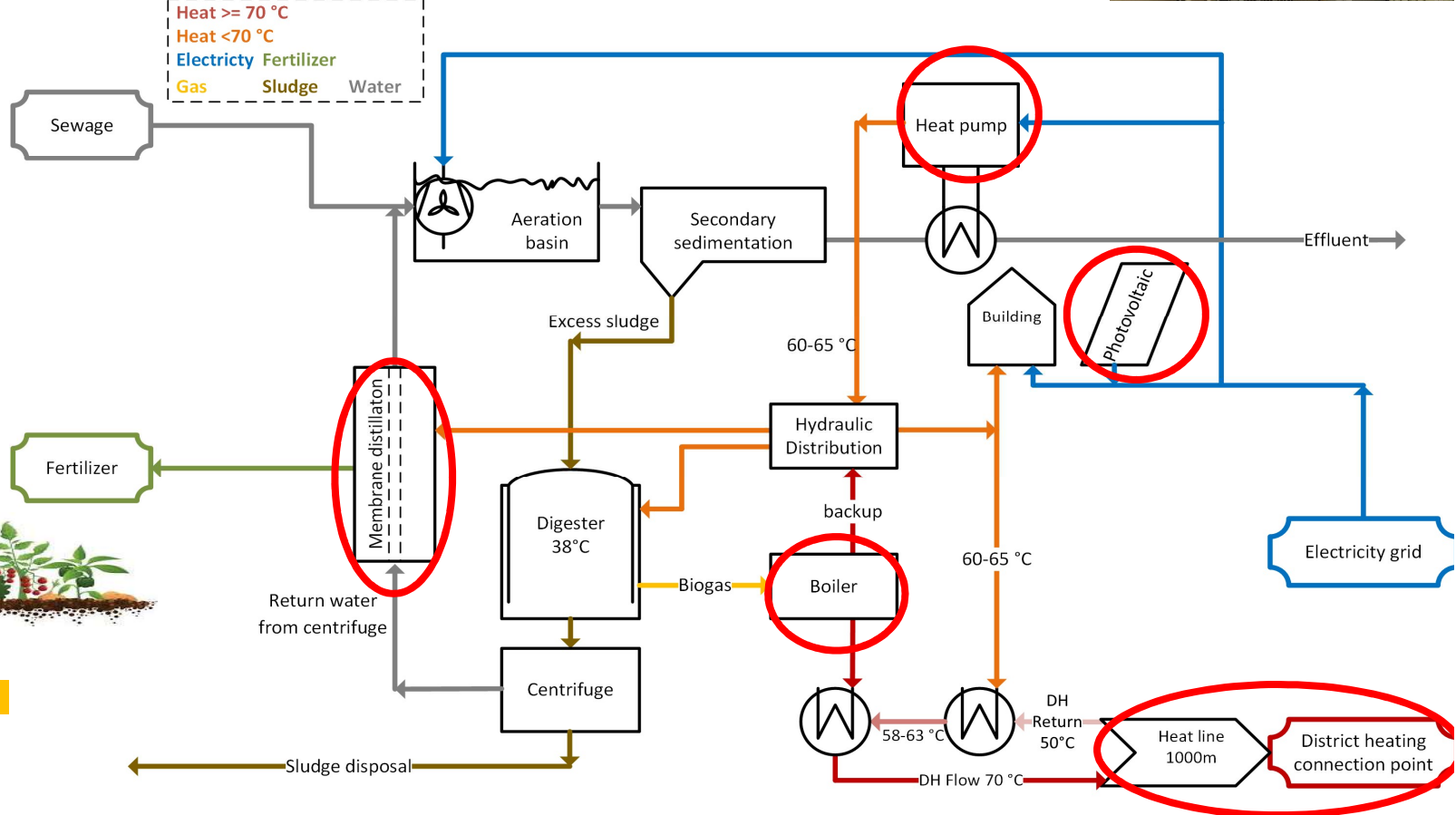


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Waste water treatment plants as a hub for combined resource- and energy efficiency



Waste water treatment plants as a hub for combined resource- and energy efficiency



Pilot scale tests have proved:

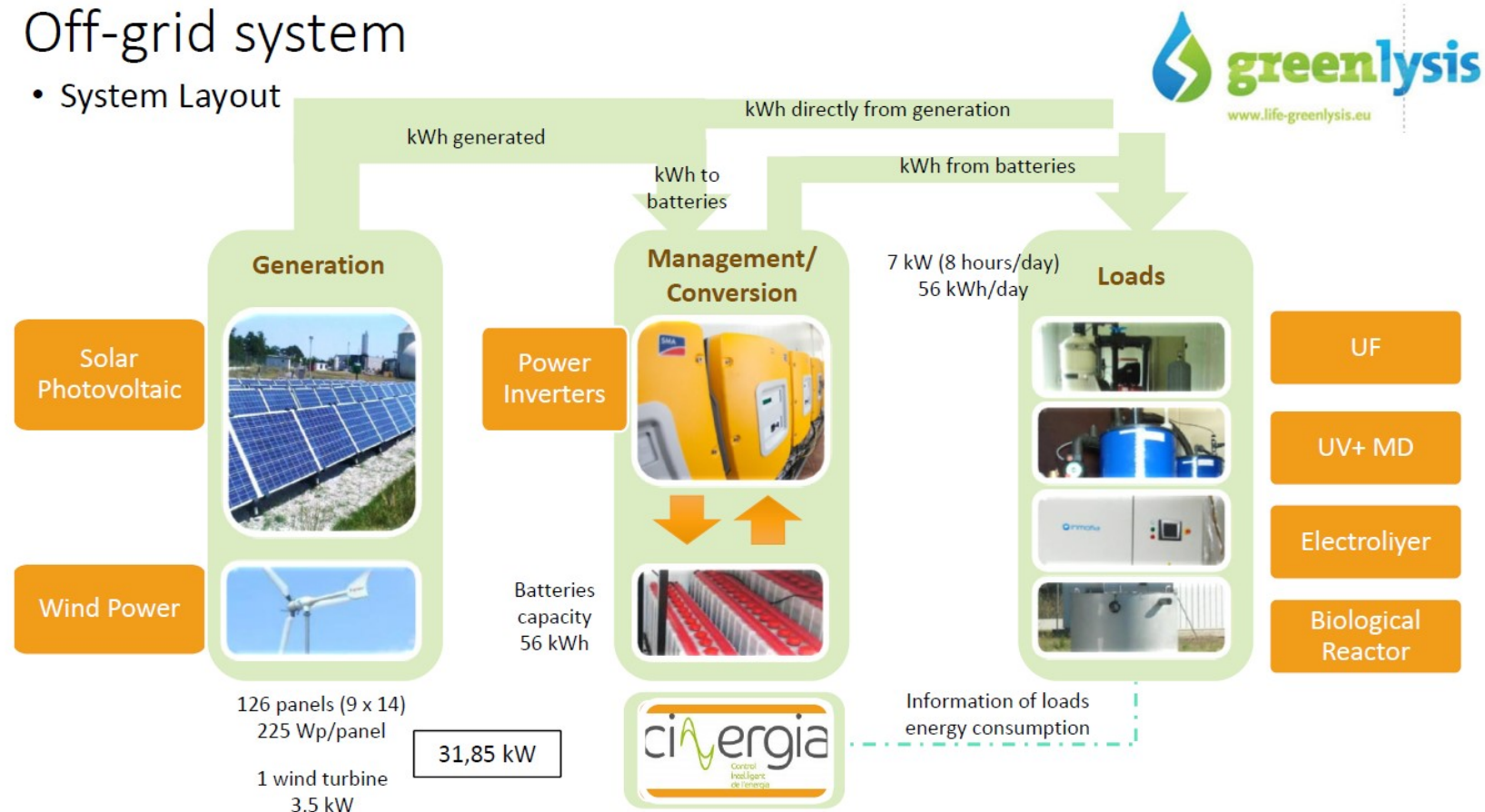


- 10-20% electricity savings
- 20-30% more biogas yield
- 51 kg/d fertilizer $(\text{NH}_4)_2\text{SO}_4$
- Large scale realization is ongoing in Austria with:
 - Solar sludge dryer
 - Heat pump in cleaned effluent
 - CHP running on biogas for electricity and heat production for district heating network
 - *Potential: NH_3 Fuel Cell*

Technology integration for water and resource recovery schemes

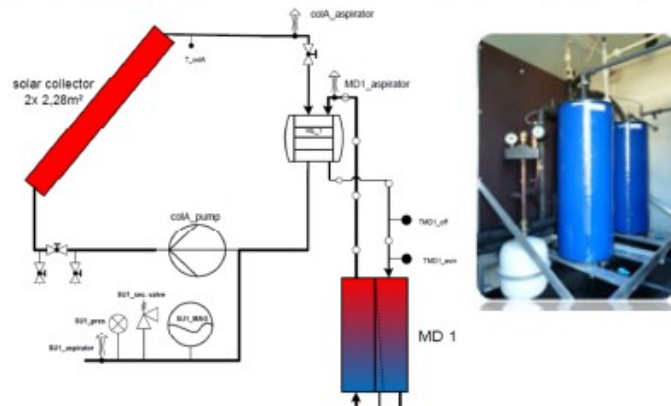
Off-grid system

- System Layout



Technology integration for water and resource recovery schemes

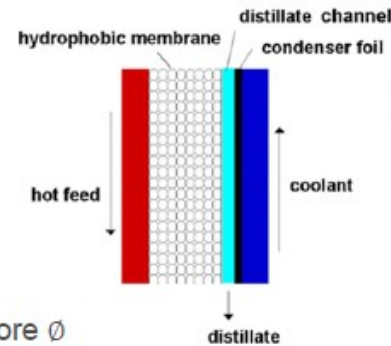
Membrane Distillation (MD)



Design conditions

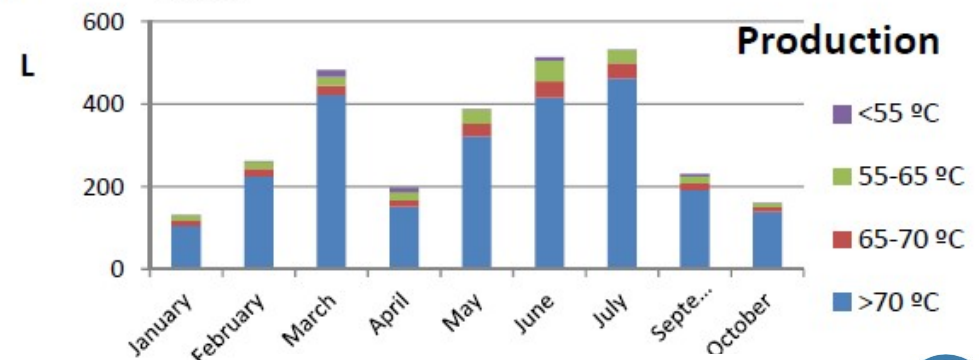
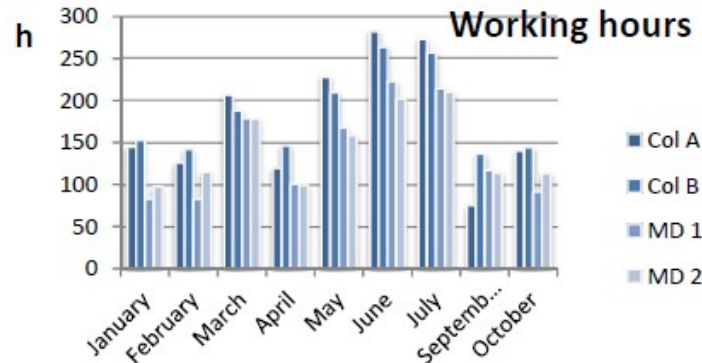
Working temperature: 60-80°C

Production rate: ~ 5-10 L/d



1 or 2 solar thermal collectors for each step

2 modules of 10 m² area PTFE membrane (0,2 and 0,1 μm pore Ø)



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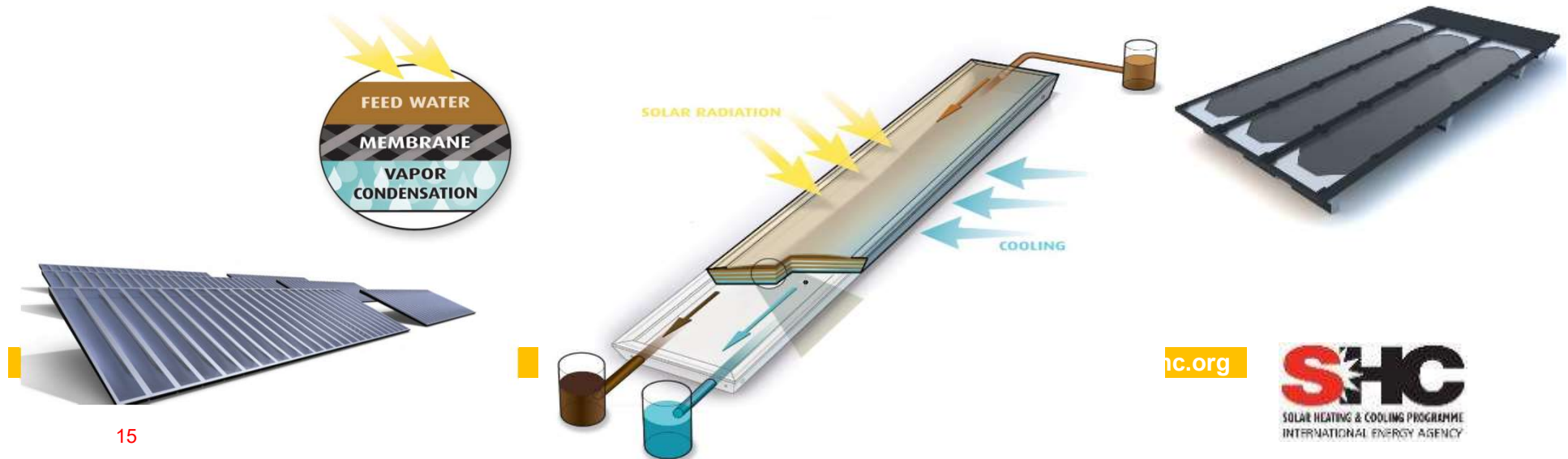


Novel solar collector with integrated membrane distillation



SOLARDEW
CLEAN WATER SOLUTIONS

- Small scale membrane distillation
- producing drinking water from virtually any source of polluted, contaminated or saline water by
- utilizing solar radiation and the use of a MD process
- Main markets include developing countries, emergency relief (e.g. in case of natural disasters), military, etc.

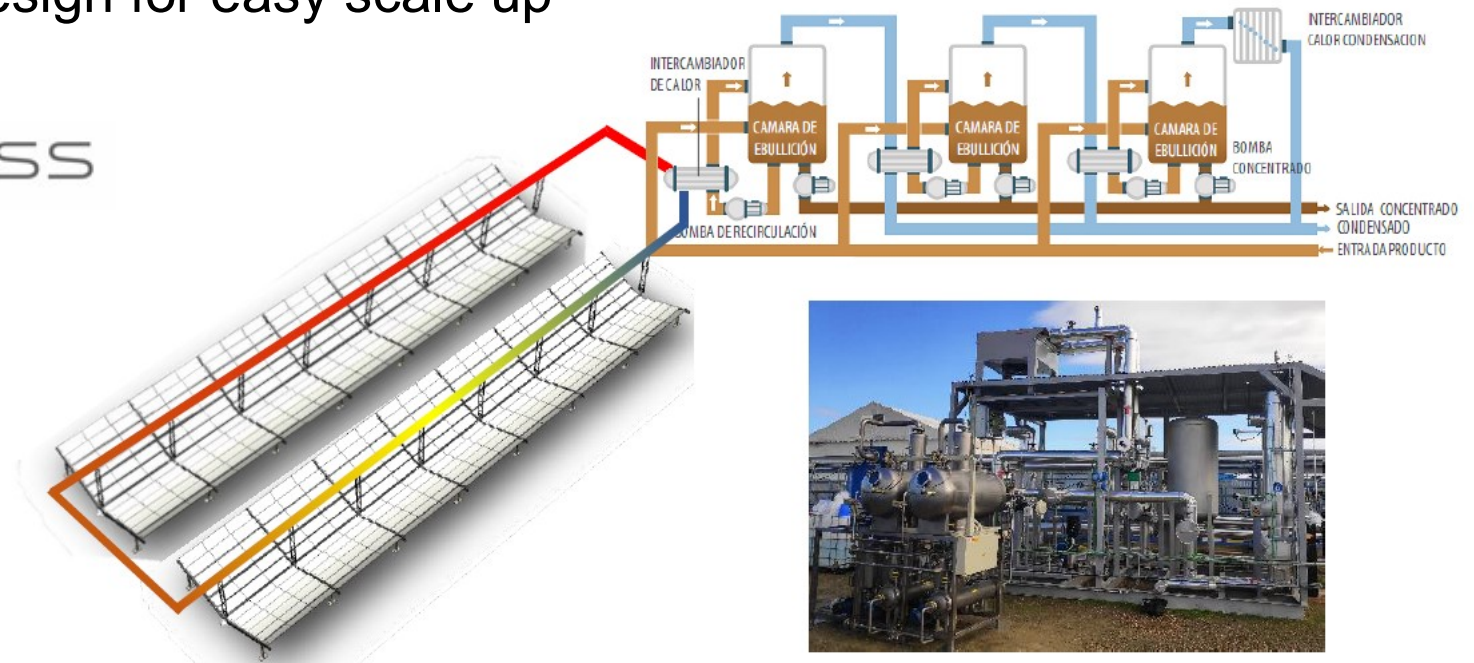


Solar multi-stage evaporators



- Solar thermal Fresnel - collectors from RIOGLASS supplying multi stage evaporator
- Application for **waste water, sludge from biogas plant etc.**
- Pilot plant running in Spain for waste water from copper mine (concentration factor 4)
- Modular design for easy scale up

RIOGLASS



Most important findings



- NEXUS Solar Energy-Water-Industry very important role in future strategies for fossil CO₂ reduction
- Waste water treatment plants as promising energy and resource source
- Membrane separation technologies for recovery of nutrients and products/wastes with added value
- New solar thermal collector concepts for industrial and municipal water treatment.
- Decision making framework/guidelines for stakeholders needed
- Overview on “best practice examples” and boost new realizations



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