Assessment of Solar Heating and Cooling
Comparison of Thermal and PV Driven Systems

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Content

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- Results from studies
  - Task 53 (Eurosun)
  - SolarHybrid (UIBK)
  - Yazaki – UIBK cooperation
- Summary

Introduction

- Assessment Tool was developed for
  - Technical & Economic key figures
  - Bivalent heating & cooling systems
  - Solar thermal and PV driven
  - Based on IEA SHC Tasks 38/44/48

- Collection of basic information for components
  - T53 Standard & specific calculation
  - Standardized conversion factors
  - Economics / investment costs

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Technical key figures

- Assessment based on (monthly) energy balances

- Non-renewable primary energy ratio **(PER_{NRE})**
  - Space heating, cooling, domestic hot water, etc.
  - E.g. ε_{el} = 0.4 kWh/kWh_{PE} / ε_{EC} = 0.9 kWh/kWh_{PE}

- Fractional savings (**$fsav_{PRE-NRE}$**)
  - Compared with REF System
  - T53 standard: natural Gas / air cooled VCC

$$PER_i = \frac{\sum Q_{i,out}}{\sum \left(\frac{Q_{el,i,in}}{\varepsilon_{el}} + \frac{Q_{i,in}}{\varepsilon_{in}} \right)} \qquad f_{sav.PER} = 1 - \frac{PER_{NRE.ref}}{PER_{NRE.SHC}}$$

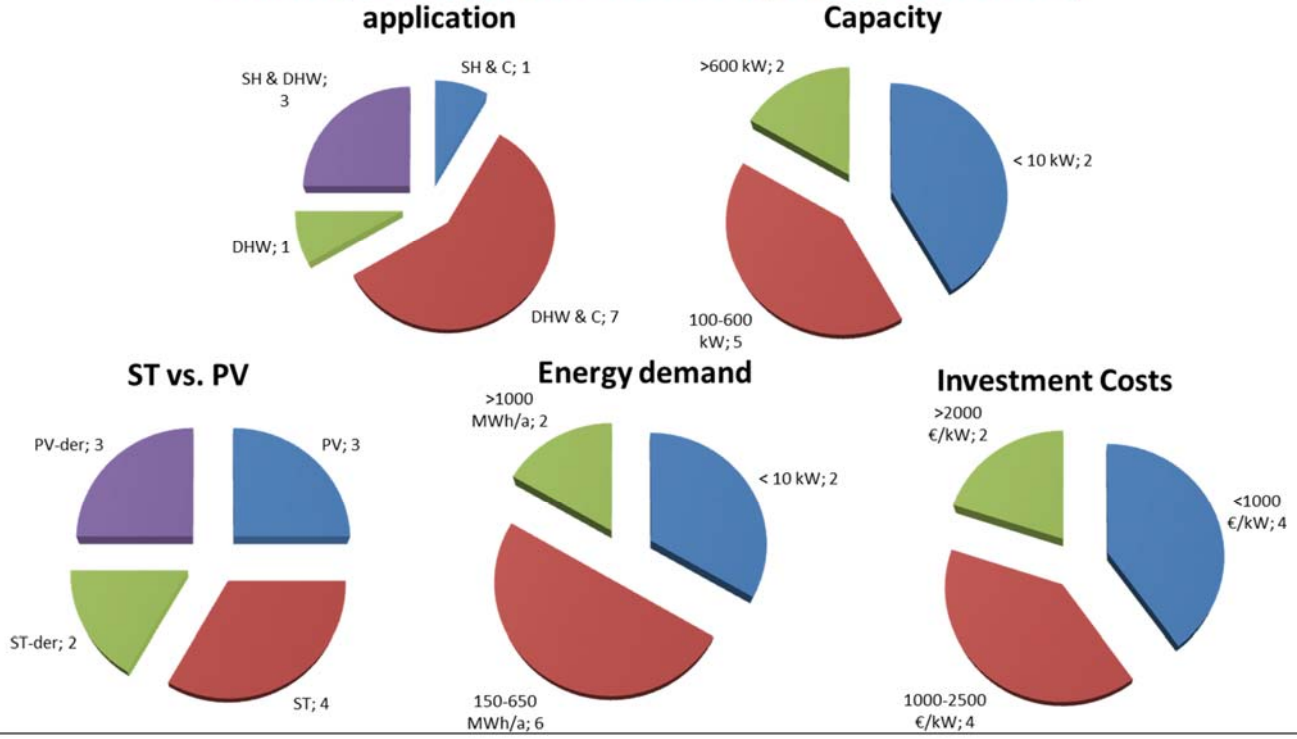
Indicative Economic Analysis

- Based on averaged cut-off costs
- Method & input values base on VDI- and EN-standards
- Under consideration of
  - Investment, Replacement & residual value, Maintenance & service and operational costs (energy, water)

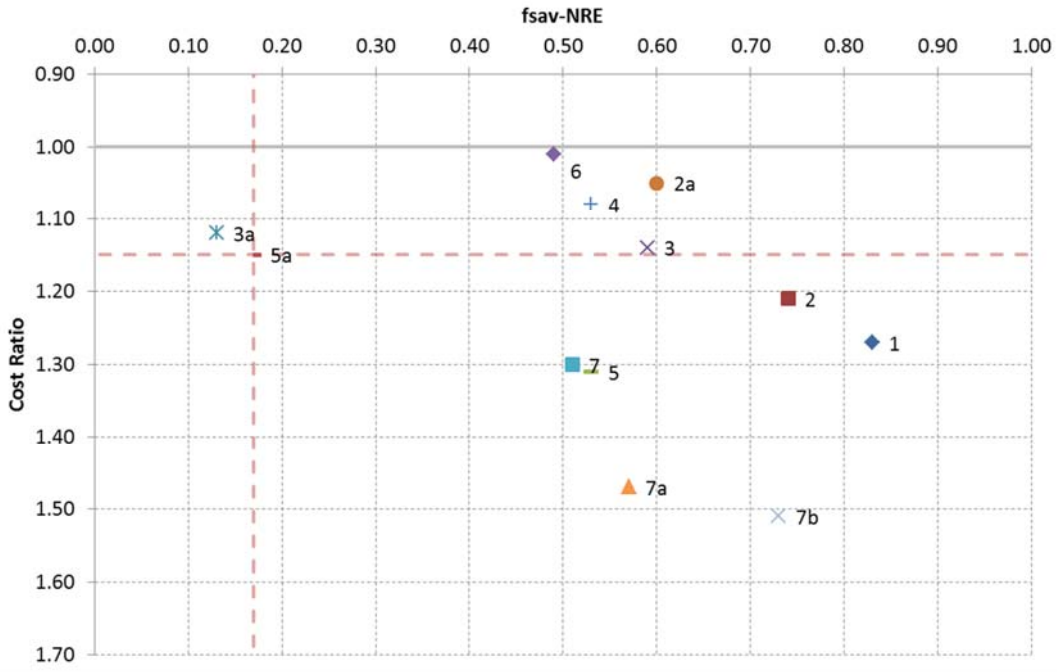
- Levelized costs of energy
  - SHC and Reference system

- Cost Ratio (**CR**) $$\text{cost ratio} = \frac{levelized\ costs\ SHC}{levelized\ cost\ REF}$$

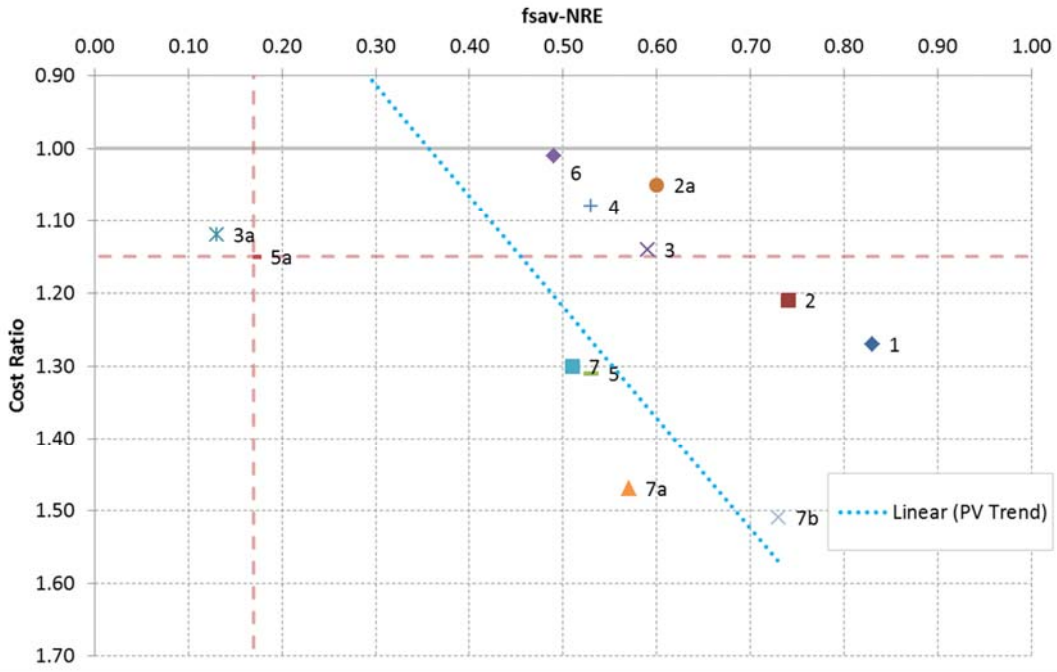
Survey of 7 plants in T53 (status 09/2016)



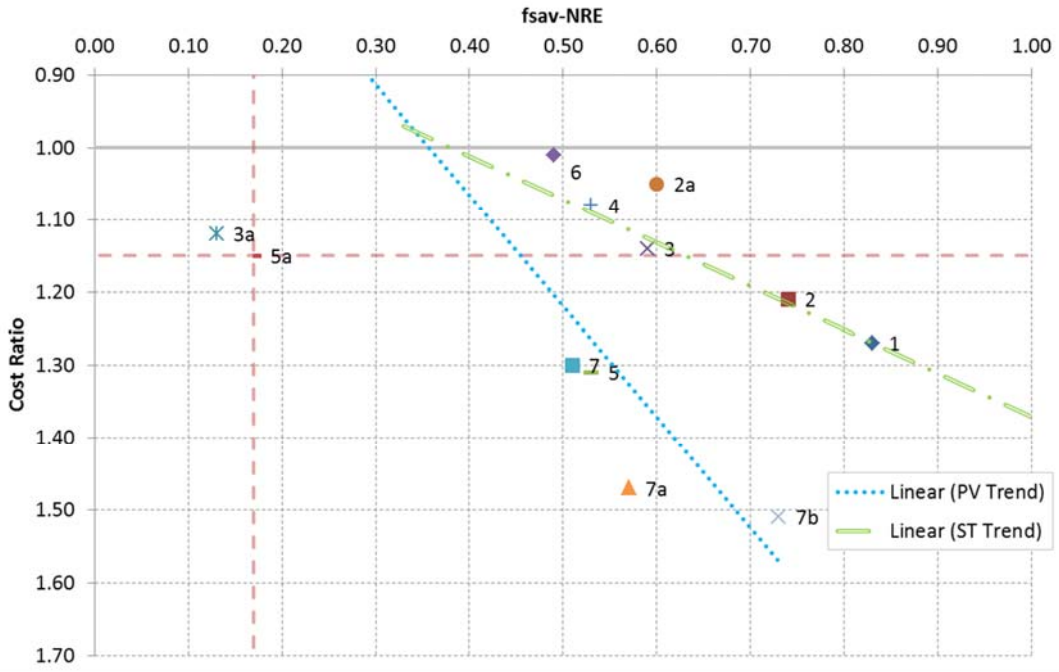
Costs vs. non-renewable primary energy savings



By trend PV vs. ST



By trend PV vs. ST

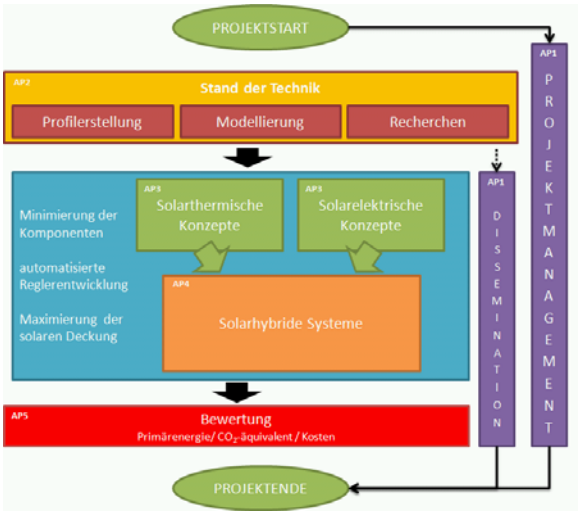


SolarHybrid

- Austrian research project by
  - University of Innsbruck
  - University of applied sciences Upper Austria (ASIC)
  - Engie Kältetechnik GmbH (former Cofely)
  - Pink GmbH

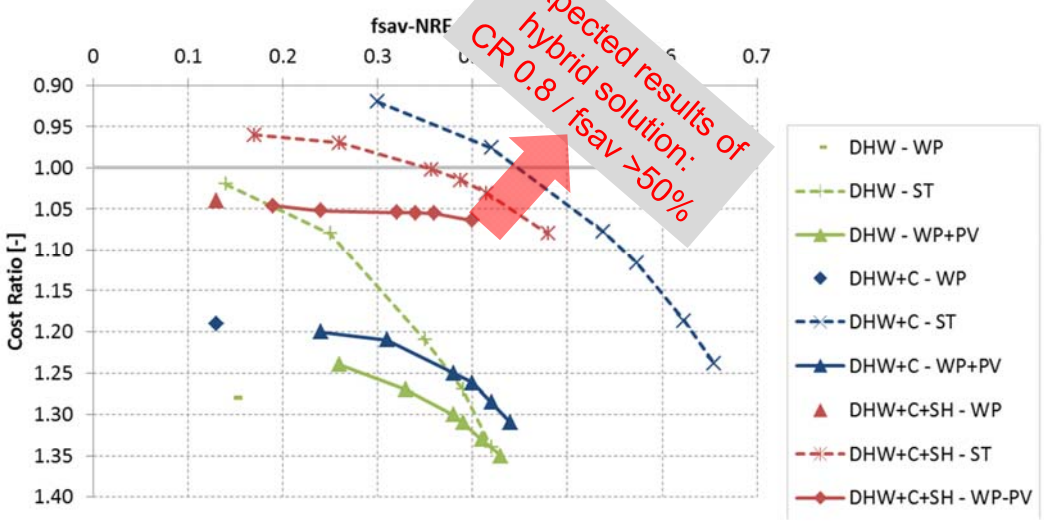
SolarHybrid

- Main objective is the development and evaluation of economics and efficiency of solar hybrid systems
  - Development of adapted **components**, measurement of these by means of **hardware-in-the-loop tests**
  - Preforming of **Simulations** to optimize the hybrid system
  - Achievement of a max. efficiency through **innovative control** concepts
  - Cost savings by **reduction of components**
  - Holistic assessment of thermally and electrically driven systems



SolarHybrid – selected results

- TRNSYS simulation results for ST system vs. PV driven heat pump system for HOTE[illegible] profile in Innsbruck



Conclusions (i)

- Task53 Tool allows
  - Comprehensive assessment of SHC plants
  - Benchmark under standardized factors
  - Benchmark against other renewable technologies
  - Simplified comparison of different applications and technologies

- 7 plants up to now in T53 comparison!
- New results from
  - TheBat, SolPol-4/5, SolarHybrid, Yazaki,…

Conclusions (ii)

- PV and ST driven systems equal in trends of
  - > 50% non-renewable primary energy savings
  - Cost Ratio > 1
  - Higher solar fractions (savings) → higher costs
- Cost
  - Priority on reduction of investment cost
  - (electrical) efficiency less important

  → SHC systems can get cost competitive!

We NEED YOUR INPUTS and more benchmarks

…join activity C3 and provide data…

Show up together in SWC/SHC/SAC

Thank you for your attention!

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