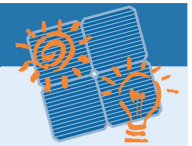


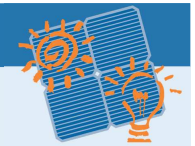
Status and Development of Software Tools for PV Hybrid and Mini-grid Systems

Georg Bopp, Matthias Vetter
Fraunhofer ISE
Germany

Anja Lippkau
Conergy AG
Germany

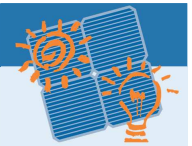
Luis Arribas
Ciemat
Spain

PVPS



Presentation Plan

1. Workshop Agenda
2. Task 11 Overview
3. Task 11 Scope
4. Overview of Design Tools



Workshop Agenda

- INTRODUCTION (15 minutes):
  - 0) Introduction and welcome (Workshop Chair)
  - 1) Overview of design tools based on Task 11 work (Georg Bopp)

- DEVELOPERS POINT OF VIEW (90 minutes):

  A) Free, generally available tools
  - 2) NREL tools (Homer, Vipor, Hybrid 2) (Benjamin Kroposki, NREL)
  - 3) RETscreen (Yves Poissant, NRCan)

  B) Commercial or limited availability tools
  - 4) PVSOL (Thomas Hawlitzki, Valentin Software)
  - 5) IPSYS (15 minutes) (Oliver Gehrke, RISO)

  C. Standard commercial system simulators
  - 6) Modelica/Dymola based tools (Matthias Vetter, Fraunhofer ISE)
  - 7) Matlab/Simulink based tools (A. Costa, CIEMAT)

- BREAK (15 minutes)

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Workshop Agenda

- USERS POINT OF VIEW (30 minutes)
  - 8) Commercial users – system designers (Xavier Vallve, TTA)
  - 9) Research institutions (Luis Arribas, CIEMAT)
  - 10) Special issues from a hardware and software developer Schwunk, Fraunhofer ISE)

- FORUM (30 minutes): Panel discussion with presenters and audience on
- presentations
- Needs of next generation software for
  - System design and optimization
  - Development of control strategies
  - Feasibility, financial, environmental analysis
  - Research and simulation
- Trends: open source software, interoperability (data exchange) between tools, web-based tools, other topics.
- CLOSING

Goal of workshop

- Present a selection of different software tools
- Discuss the advantages and disadvantages
- Suitability of software tools for different tasks
- Needs for the next generation of software tools
  - recommendations for software developers

Task 11 Overview

- **Main Goal**:to promote the role of PV technology as a technically relevant and competitive source in hybrid power systems and associated mini-grids.

- **Definitions and delineation:**

  A PV hybrid power system is a PV-based generation source combined with other electrical generating source(s).

  A mini-grid is a "small" (rated power and area) electrical grid that can operate in "island mode" separately from the main distribution grid.

  Mini-grids may be considered for more than just the stand-alone point of view. Some projects are under development to implement minigrids in the view that, in the future, they could be interconnected or connected to a main grid.

- Involved countries: Austria, Australia, Canada, France, Germany, Japan, Korea, Norway, Spain, and Switzerland

- Operating Agent: Konrad Mauch from Canada

Konrad.mauch@ieee.org

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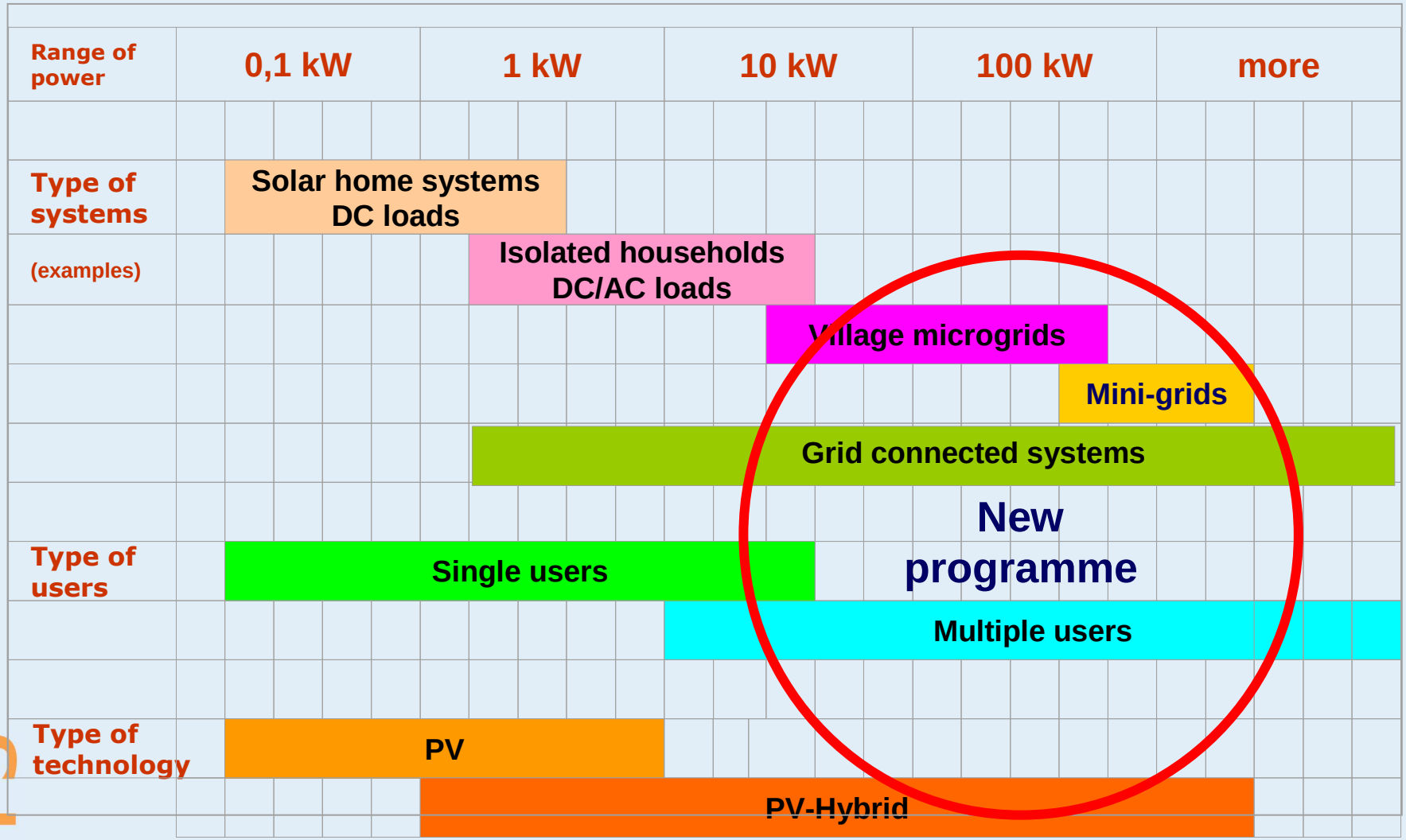
Task 11 Scope



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Subtask 12: Design tools

- **Evaluation and comparison of system design methodologies and tools and development of guidelines for design tools**
- **Distribution of a survey questionnaire dealing with**
  - -Tool availability (generally available or proprietary) and cost
  - -Tool features and application area (e.g. used models and software code, feasibility analysis, system sizing and design, simulation)
  - - Characteristics and quality of user interface and documentation
- **22 different software tools are used**
- **Classification of all and test/comparison of 7 tools**
  - - dimensioning (system sizing) and/or simulation
  - - free
  - - commercial
  - - standard commercial system simulators

Detailed Overview

free tools

Retscreen	Dim
HOMER	Dim/Sim
Hybrid2	Sim
Vipor *	Dim/Sim
Jpélec *	Dim/Sim

PowerSim	Sim
Matlab Simulink	Sim
Dymola	Sim
PowerFactory	Sim

* design of distribution netwok

commercial tools

Off Grid Pro	Dim
PVSYST	Dim/Sim
PVSOL	Dim/Sim
Solar Pro	Sim

standard commercial system simulators

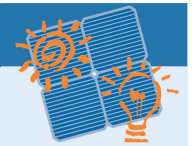
Simplorer (APL)	Dim/Sim

internal tools

Off Grid Sizer	Dim	Conergy
sunny island design	Dim	SMA
PVS	Dim/Sim	ISE
TALCO	Dim/Sim	ISE
Dymola PV Hybrid	Sim	ISE
Matlab Simulink Hysis	Sim	CIEMAT
Matlab Simulink PVToolbox Matlab Simulink N.N.	Sim Sim	Canmet SET
PowerFactory Tool box	Sim	ISET

PVPS

Programm	PV-SPS	RETScreen	PV-SOL	PVSYST	Hybrid2	PV-DesignPro	HOMER
Version	2.0	Version 3.2	2.6 R5	v3.41	1,3c R3	v6,0	2.2 beta
Date of recent version	2001	2005	2006	2006	2004	2004	2005
Date of 1.version	2001	1997	1998	1994	1998	1998	1993
Costs (single license)	58 Euro	free	498 Euro	465 Euro	free	130 Euro	free
Language versions	Engl.	Engl., French	Ger., French, Engl., Spain	French, Engl.	Engl.	Engl.	Engl.
Instruction manual quality	(1)	+	+	F1 man.	-	o	+
User knowledge	Normal	normal	normal	normal	high skilled	normal	skilled
User friendless	O	+	o	o	-	o	+
Component dimensioning)	PV-D-B	PV-D-B	PV-B	PV-B	no Dim.	no Dim.	(3)
Simulation	no Sim.	no Sim.	PV-D-B	PV-D-B	PV-D-B-W	PV-D-B-W	PV-D-B-W-
Plausibility check	Yes	no	yes	yes	no	no	yes
Irradiation data base	4 locations	yes + S	yes + S	yes + S	yes	yes + S	yes
Wind data base	No	yes	no	no	no	no	no
Emission balance	No	yes	yes	no	yes	no	yes
Economic analysis	No	yes	yes	yes	yes	yes	yes
Clearness of data input for users	O	+	-	o	-	-	+
Clearness of data input for system components	+ (4)	+ (5)	+	o	-	+	+
Result output clarity	+	+	o	o	-	o	+
Time resolution of the output	month, year	month, year	hour, day, week, month, year	hour, day, month, year	User-defined	hour, day, week, month, year	hour, day, week, month, year
Project report/ printout	O	+	+	+	-	o	+



Results

- A lot of software tools available
- Only some tools can integrate wind power
- No tool (of the 7) can integrate another power source, like micro hydro
- Only some tools include financial and/or environmental analysis
- Data exchange between different tools very difficult
- No tool with open source software available, except some internal toools