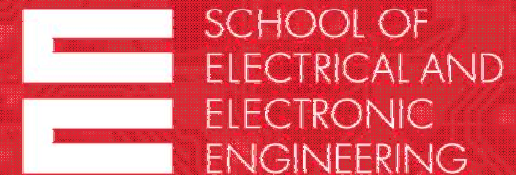


An overview of FP7 funded PV-Crops

Prof Michael Conlon
Head, SEEE
5 December 2014



- **PhotoVoltaic Cost r€duction, Reliability, Operational performance, Prediction and Simulation: PV-Crops**
- **3 Key Objectives of the FP-7 call topic**
 - Improvement of performance, reliability and lifetime
 - Cost reduction of PV Systems
 - Better integration of PV into grid
- **Lead to lower Levelized Cost of Energy (LCoE)**
 - Reduction of 30% of the LCoE of PV to achieve 0.2-0.09 /kWh by 2015 and 0.14-0.07€/kWh by 2020 and an increase of 9% in the performance ratio of PV systems
 - Enhancement of grid integration of PV by mitigating PV power fluctuations and integrating energy management and storage to allow 30% of PV penetration by 2020

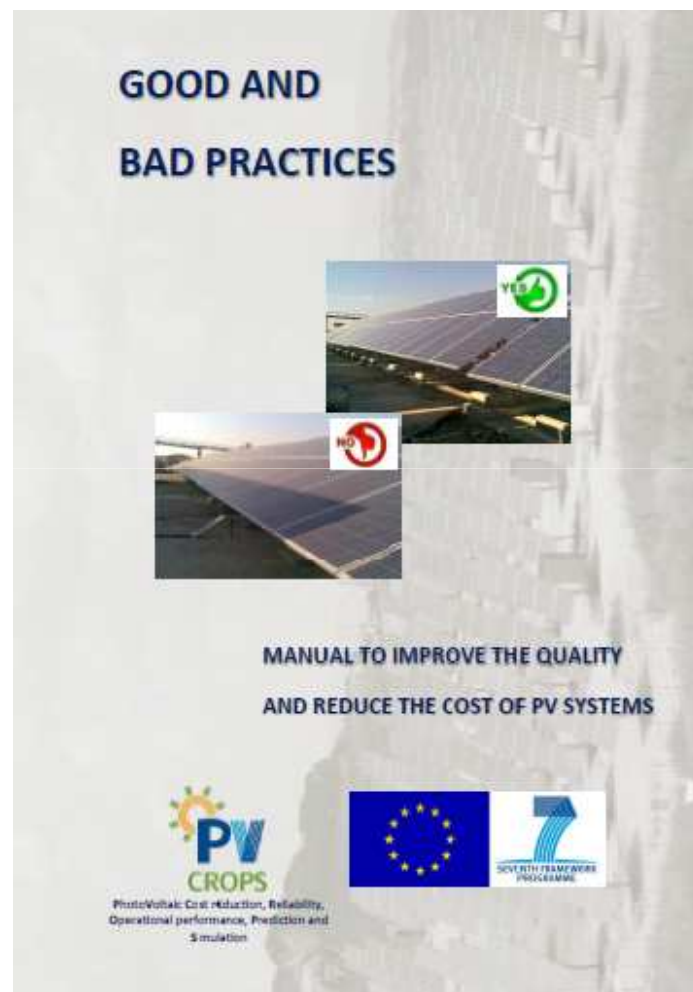
- **Objectives to be attained by 5 fields of work**
 - Robust modelling, advanced simulation and design optimization, through an open source, simulation and design toolbox incorporating built-in learning tools
 - Prediction of system output with respect to solar resource, local weather and system behaviour, including prediction and mitigation of PV power fluctuations
 - Integration of energy management and storage strategies, using innovative batteries and allowing PV to participate in the secondary regulation of the grid
 - Monitoring real time follow-up and advanced diagnoses of performance, providing performance analyses including the detection of hidden problems reducing operational costs
 - Hardware, software and contractual solutions for field and laboratory testing, developing kit solutions for the commissioning of PV plants and BIPV

- **PV-Crops includes 19 results**
 - Technical documents
 - Toolbox solutions
 - Technology development
 - Databases
 - Training
 - Spin-offs
- **Validated on a wide set of EU PV systems and on one of the biggest in the world proposed for Morocco**
- **November 2012 to November 2015**

- **Universidad Politecnica de Madrid, Spain**
- **Universidad Publica de Navarra, Spain**
- **Universidade de Evora, Portugal**
- **CL Senes, Bulgaria**
- **DIT, Ireland**
- **Office National de l'Electricité, Morocco**
- **Acciona Energia SA, Spain**
- **Ingeteam Power Technology SA, Spain**
- **RTONE SARL, France**
- **Sunswitch SA, Belgium**
- **Renewable Energy Dynamics Technology Ltd, Ireland**
- **APERRE ASBL, Belgium**

WP	Title
1	Coordination and management of the consortium
2	Technical specifications to increase performance and reliability and reduce LCoE
3	Simulation tool for robust modelling, design and performance optimization
4	Toolbox for the prediction of energy production on an hourly basis
5	Prediction and mitigation of power fluctuations introduced by PV plants to improve their grid integration
6	Incorporation of energy management and storage systems to ground-based PV plants
7	Integration of energy management and storage systems to improve BIPV functionalities
8	Diagnosis tool to uncover the performance failures
9	Hardware, software and contractual solutions for the testing of PV plants and BIPV
10	Dissemination and exploitation of the results and their impact

WP 2 - Manual on Good and Bad PV Practices



http://www.pvcrops.eu/sites/default/files/u10/Good_and_Bad_Practices.pdf

- **Potential for using second-hand Li-Ion batteries from electrical vehicles for BIPV is significant**
- **Projection of availability of batteries over next 5 – 10 years**
- **Viability of re-use**
- **Refurbishment requirements**
- **Contrast effect of differing charge/discharge cycles (EV and BIPV) with life-time**

5kVA, 6 hours; Vanadium Redox Flow Battery

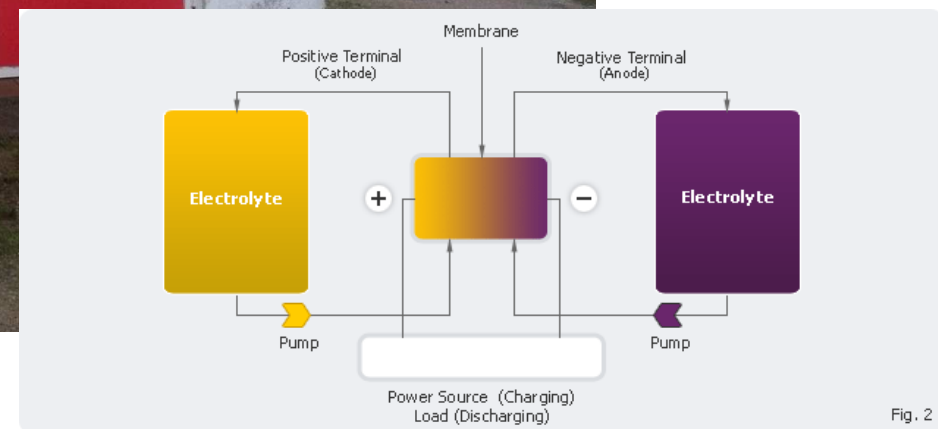


Fig. 2

Control and Monitoring



Vanadium Tank, One each side, Defines energy capacity



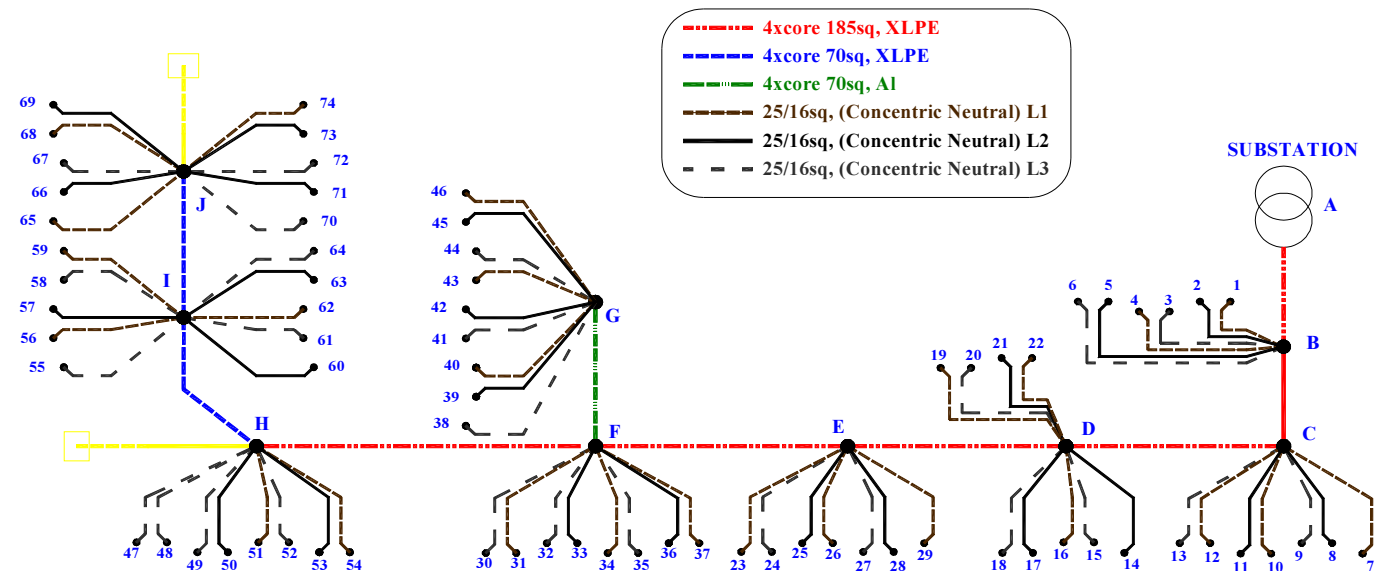
Power Stack



300V/6kW PV Panel; 48V dc bus; 3, 1 ϕ inverters



- 74 Bus system, mixed single-phase and 3-phase

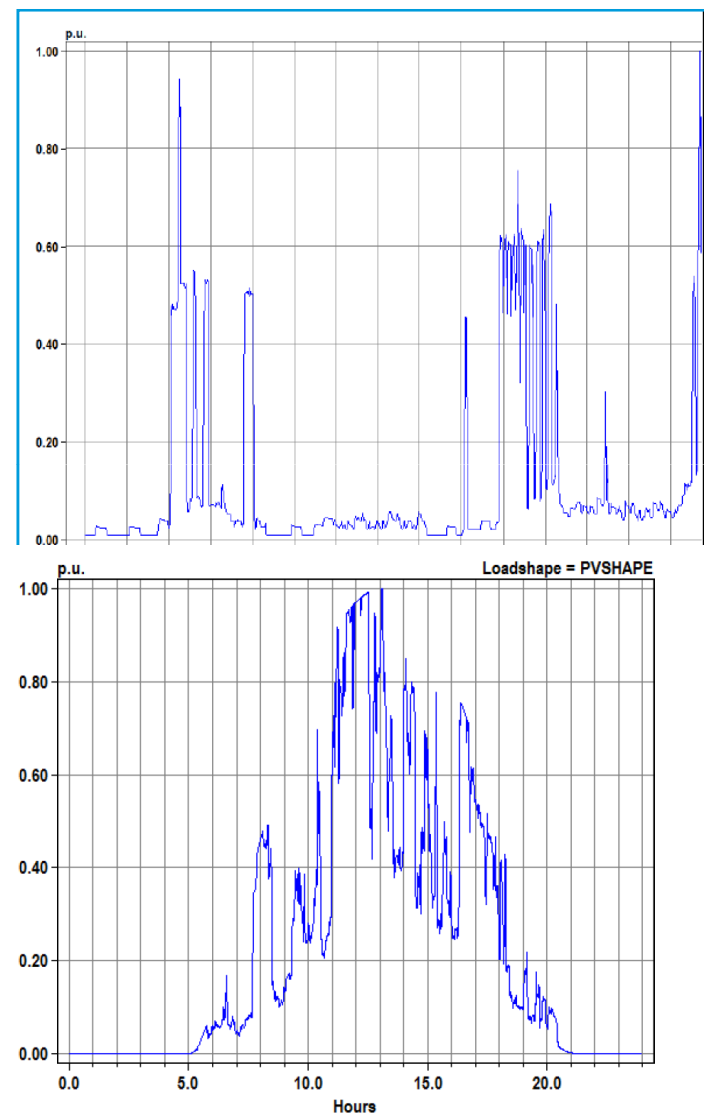


4-Wire Bus Connections			
From Bus	To Bus	Line Config	Length
A	B	2	24
B	C	2	36.2
C	D	2	45.7
D	E	2	45.5
E	F	2	58.9
F	G	3	48.8
F	H	2	58.2
H	I	1	58.9
I	J	1	48.3

Line Config	Cable	Line-Con.
1	70-XLPE	L1-L3
2	185-XLPE	L1-L3
3	70-NAKBA	L1-L3
4	25/16 AYCY	L1
5	25/16 AYCY	L2
6	25/16 AYCY	L3

2-Wire Bus Connections				Load (kW)
From Bus	To Bus	Line Config	Length	
B	1	5	12.7	6.329
B	2	6	58.1	7.198
B	3	6	39.4	0
B	4	5	55.6	0.294
B	5	4	44.5	0.361
B	6	4	9.1	2.882
C	7	6	20	4.459
C	8	4	25.9	0.336
C	9	5	39.7	7.214
C	10	6	20.3	0.28
C	11	5	24.8	0.467
C	12	4	34.4	0.32
C	13	4	39.9	0
D	14	5	22.5	0.48
D	15	4	22.1	0
D	16	6	21.2	5.387
D	17	6	34.8	0.355
D	18	5	25.2	4.339
D	19	6	37.1	1.72
D	20	4	40.6	5.32
D	21	5	34.3	1.532
D	22	4	37.6	3.18
E	23	5	36.2	6.925
E	24	6	23.1	0.314

- **Actual domestic load**
 - Not aggregated or deemed profile
- **PV Output**
 - 5kW per phase
- **Analysis**
 - Originally developed in Matlab
 - Current version on OpenDSS



Analysis of 4-Wire Distribution Network

