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PV (as a main source) for Rural Electrification

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ECREEE Regional Forum
on the ECOWAS Solar Energy Initiative

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PV (as a main source) for Rural Electrification

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ARE promotes renewable energy in developing countries

Alliance for Rural Electrification

ARE is an international non-profit business association. It advocates for sustainable rural electrification with renewable energy.

Our objectives are:

- The Alliance attracts and unites all relevant private sector actors in order to speak with one voice
- The Alliance generates technical and financial solutions about rural electrification
- ARE communicates and advocates for rural electrification using RES

Our Partners and Interlocutors

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RE Industry

The donors and policy trendsetters

UNDP

European Investment Bank

OECD

Governments of Developing Countries

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Shining a Light for Progress

Other actors

- **NGOs**
- **Think Tanks**
- **Rural authorities**
- **Consumers**
- **Media**

The Alliance for Rural Electrification Members

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Acciona
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Enel Green Power
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ISE FRAUHOFER
IT Power
KACO
Kaito
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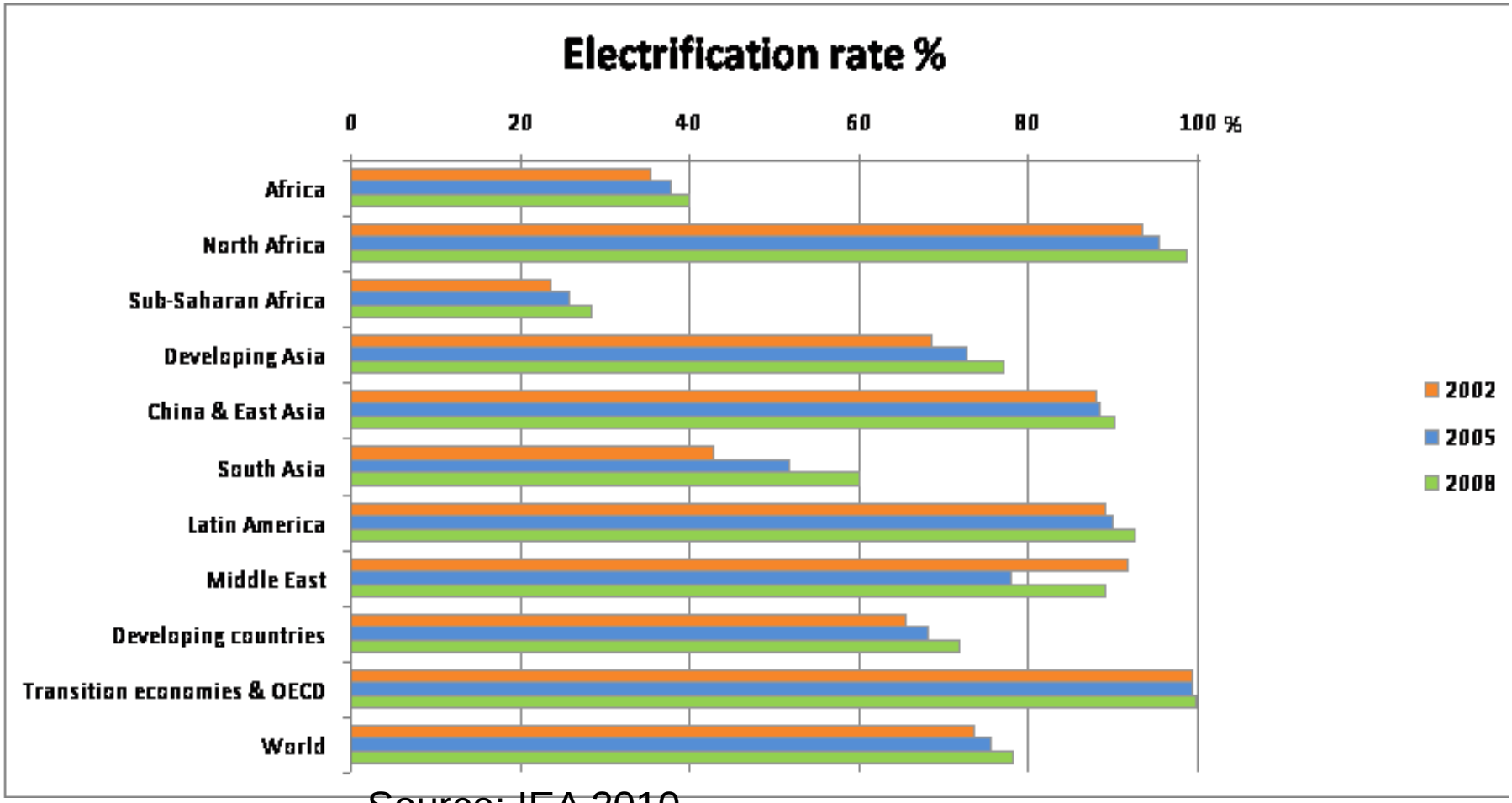
Trojan Battery
University of Southampton
University of Twente
The Wind Factory
Wonderenergy

Globally electrification rates rise...



Source: IEA 2010

In Sub-Saharan Africa (SSA) even more people without electricity

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	Population without electricity (millions)				
	2002	2005	2008	Trend 02-05	Trend 05-08
Africa	**535**	**554**	**589**	**19**	**35**
North Africa	9	7	2	-2	-5
Sub-Saharan Africa	526	547	587	21	40
Developing Asia	**1019**	**930**	**809**	**-89**	**-121**
China & East Asia	221	224	195	3	-29
South Asia	798	706	614	-92	-92
Latin America	**46**	**45**	**34**	**-1**	**-11**
Middle East	**14**	**41**	**21**	**27**	**-20**
Developing countries	1615	1569	1.453	-46	-116
Transition economies & OECD	7	8	3	1	-5
World	1623	1577	1.456	-46	-121

Source: IEA 2010

If current trends do not change, the energy outlook for the poor in SSA remains dull

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Table 3: **Number of people without access to electricity and electrification rates by region in the New Policies Scenario** (million)

	2009			2015	2030	2009	2015	2030
	Rural	Urban	Total	Total	Total	%	%	%
Africa	466	121	587	636	654	42	45	57
Sub-Saharan Africa	*465*	*120*	*585*	*635*	*652*	*31*	*35*	*50*
Developing Asia	716	82	799	725	545	78	81	88
China	*8*	*0*	*8*	*5*	*0*	*99*	*100*	*100*
India	*380*	*23*	*404*	*389*	*293*	*66*	*70*	*80*
Other Asia	*328*	*59*	*387*	*331*	*252*	*65*	*72*	*82*
Latin America	27	4	31	25	10	93	95	98
Developing countries*	1229	210	1438	1404	1213	73	75	81
World**	**1232**	**210**	**1441**	**1406**	**1213**	**79**	**81**	**85**

*Includes Middle East countries; **includes OECD and transition economies.

Source: IEA 2010

Rural electrification is the key challenge

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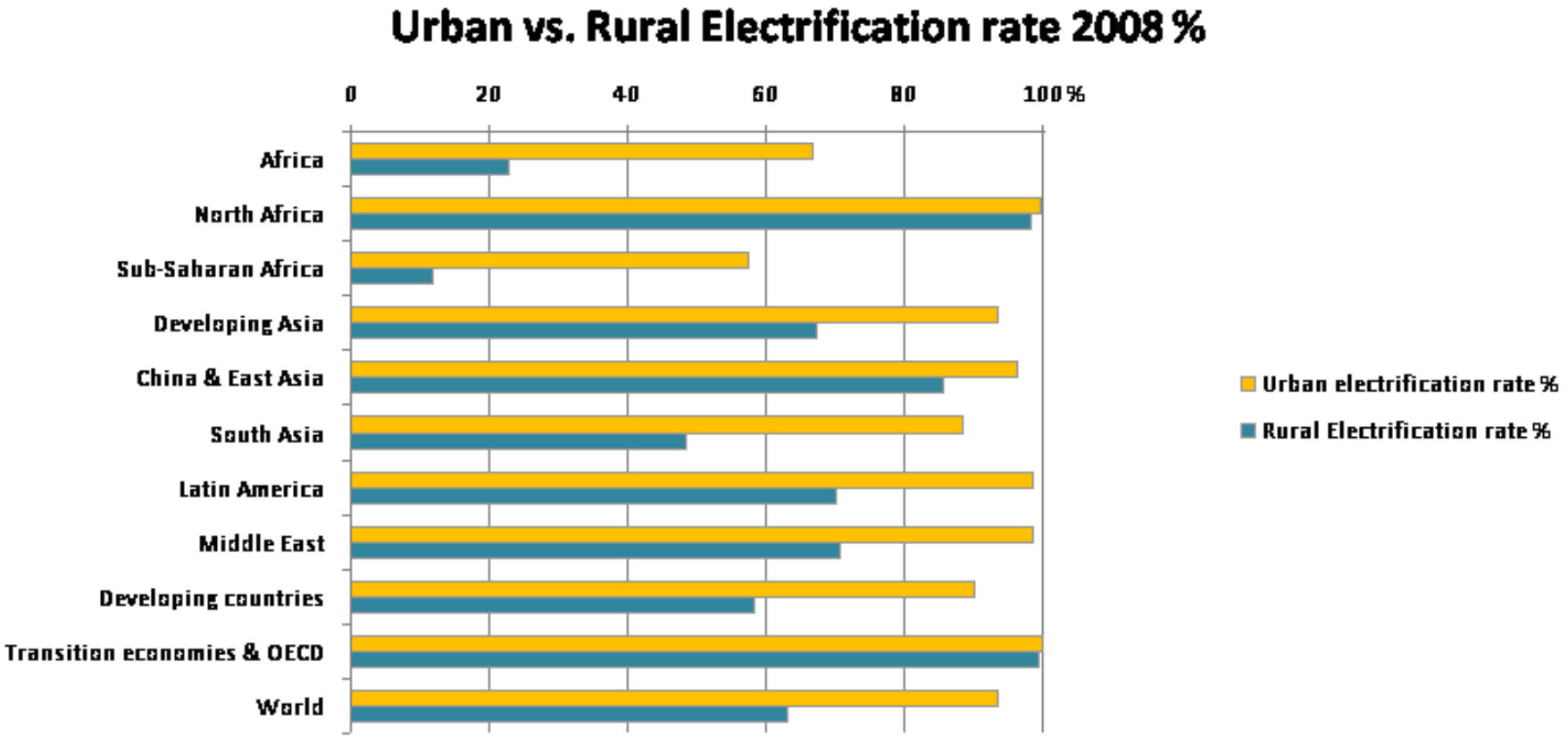

Source: IEA 2010

Solar irradiation is more abundant exactly where energy is more needed

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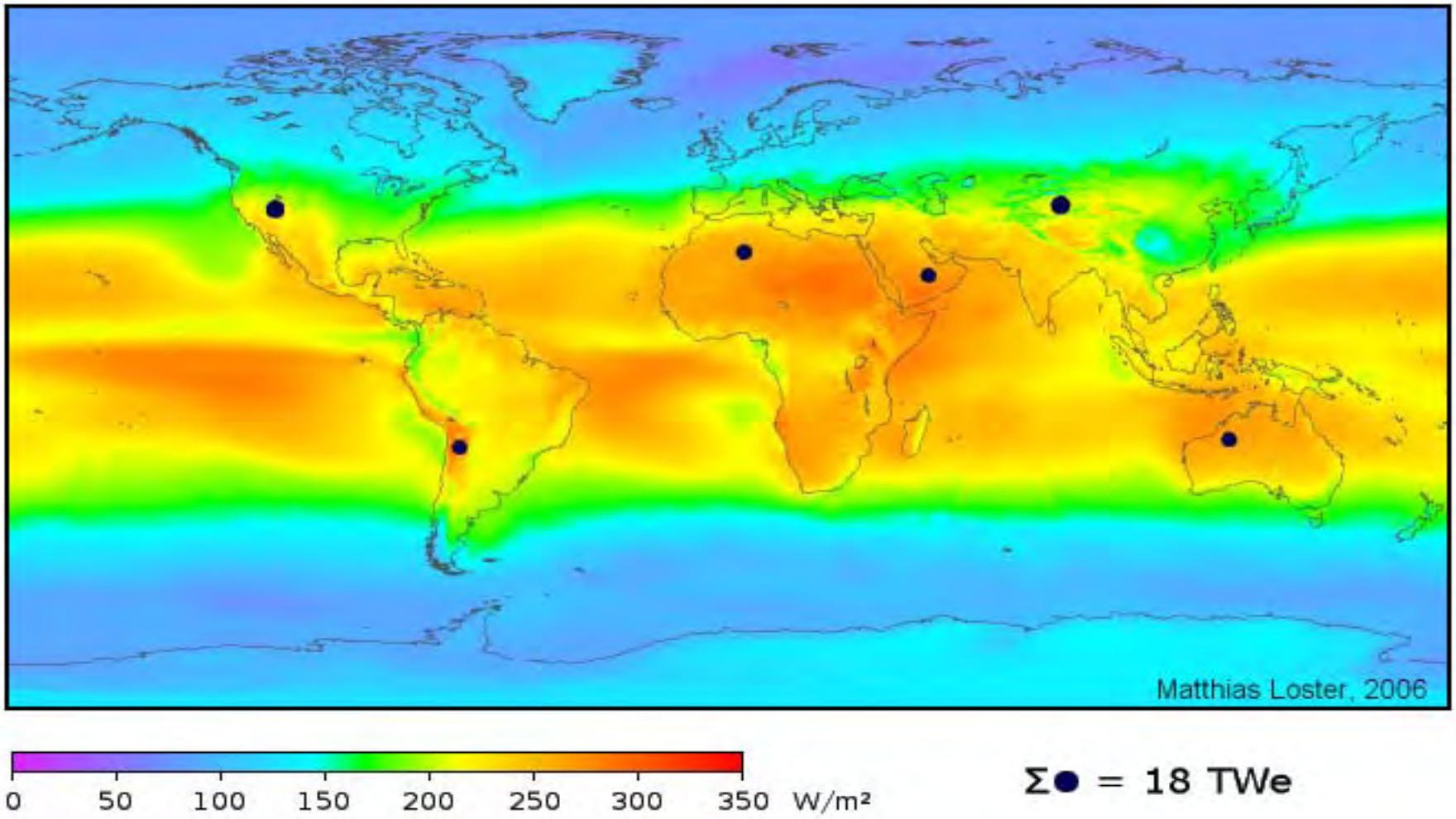
See sunbelt study in www.epia.org also sponsored by ASIF and ARE



PV Industry has become in a few years a competitive energy source, even without subsidies

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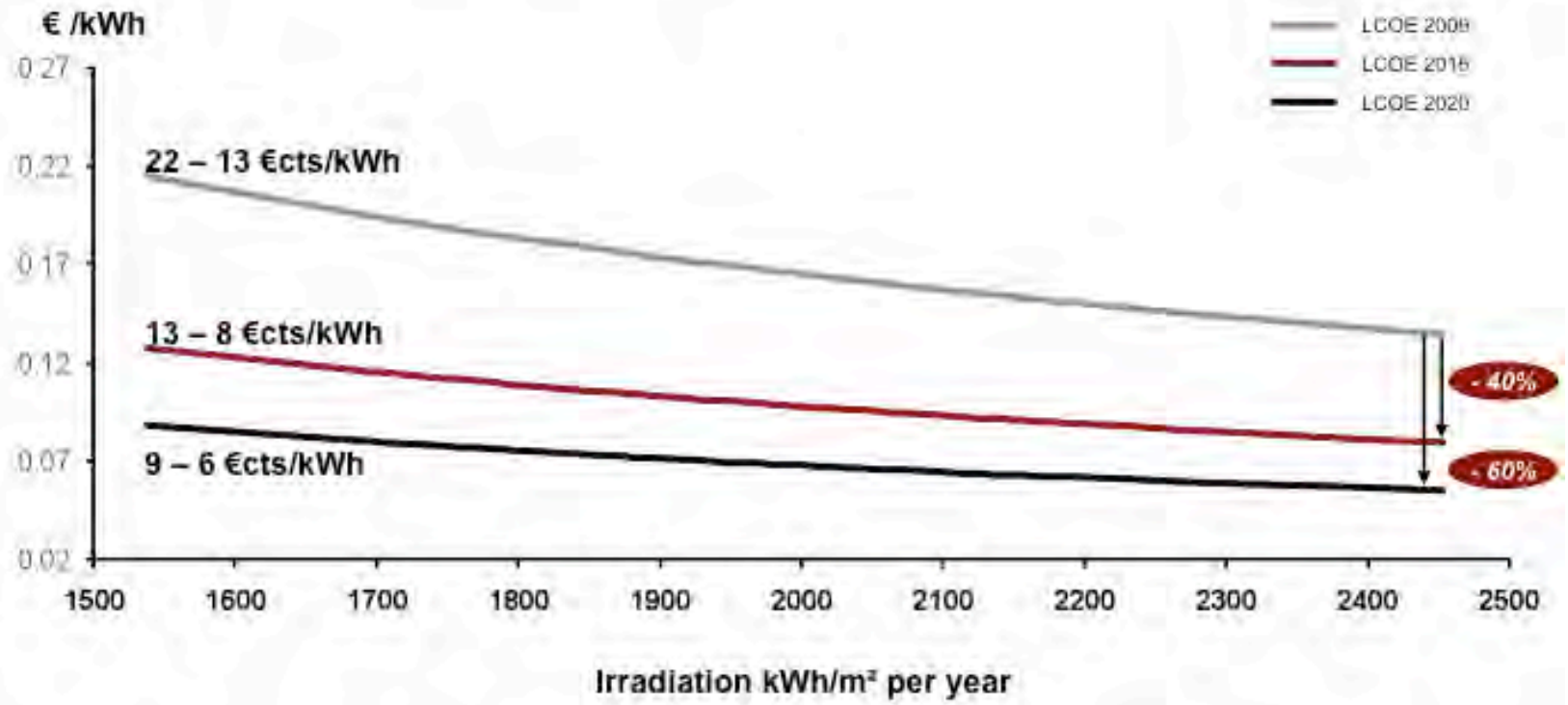
The forecasted industry learning curve will reduce PV LCOE by 40% in 2015 and almost 60% in 2020 if the full growth potential was captured

PV LCOE



(1) Field system >1 MW_p ; 85% performance ratio; 25 years system lifetime; O&M costs 1.5% of Capex; Debt financing with WACC: 6.4 %; System Price 2009: 3000 €/kWp

Sources: National Renewable Energy Laboratory; Set for 2020; A.T. Kearney analysis

Competitive in front of traditional technologies

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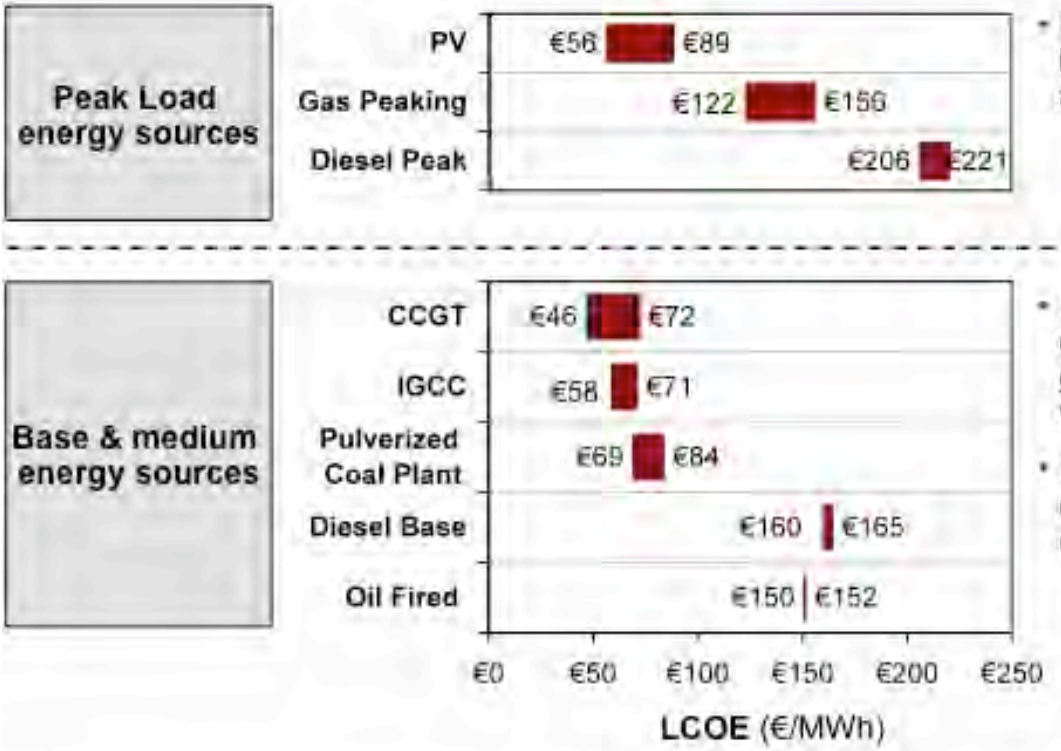
By 2020 PV will even be competitive with some medium to base load technologies in many countries

Comparison of LCOE by 2020



- PV will be competitive with all peak load technologies, both gas peaking and diesel engines
- In 6 countries out of the 22 that are currently using coal for power generation, PV will be competitive with IGCC
- In few countries (5 out of 37) PV will even be competitive with combined cycle gas turbine (CCGT)

(1) LCOE conventional sources includes CO2 cost of 38 €/tonne
(2) LCOE of Gas Peaking and CCGT in countries with very low gas prices (< $3/MBTU) in 2009 are not displayed
Sources: National Renewable Energy Laboratory; National Energy Technology Laboratory ; Set for 2020; World Bank; A.T.Kearney analysis

With a high potential for many countries and billions of people

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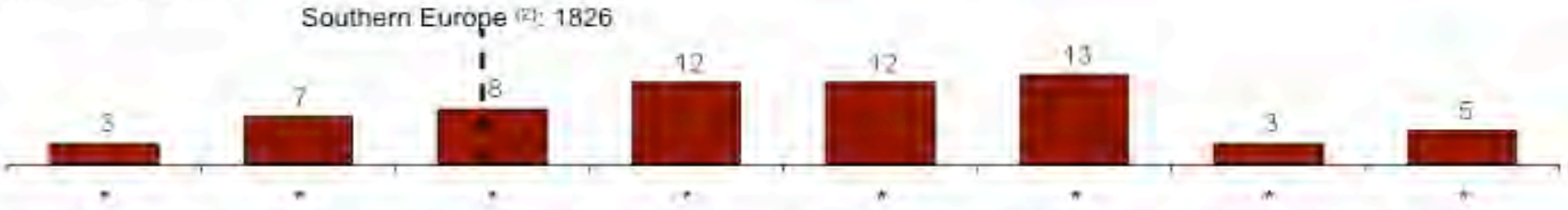
51 developing countries have a higher irradiation than Southern Europe, largely explaining their strong PV attractiveness

Irradiation distribution(1)

(kWh/m² per year)



- Ecuador
- Congo
- Philippines

- Cameroon
- Colombia
- Cote d'Ivoire
- Indonesia
- Malaysia
- Myanmar
- Tunisia

- Algeria
- Argentina
- Bangladesh
- Cambodia
- China
- Ghana
- Uganda
- Vietnam

- Angola
- Dominican Republic
- Guatemala
- Iran
- Iraq
- Jordan
- Libya
- Mozambique
- Qatar
- Syria
- Tanzania
- Thailand

- Brazil
- Chad
- Costa Rica
- Egypt
- Lebanon
- Mexico
- Nepal
- Nigeria
- Peru
- Somalia
- Sri Lanka
- Venezuela

- Afghanistan
- Chile
- Cuba
- Jamaica
- Kenya
- Kuwait
- Madagascar
- Mali
- Morocco
- Pakistan
- Saudi Arabia
- United Arab Emirates
- Zambia

- Botswana
- Ethiopia
- South Africa

- India
- Namibia
- Senegal
- Sudan
- Yemen

(1) Irradiation is the average yearly irradiation from the capital of the country , except for India, Mumbai instead of New Delhi; Vietnam, HCMC instead of Hanoi

(2) Average Southern Europe: consists out of Malta, Cyprus, Greece, Italy, Spain and Portugal

Sources: NASA

And this trend is expected to continue

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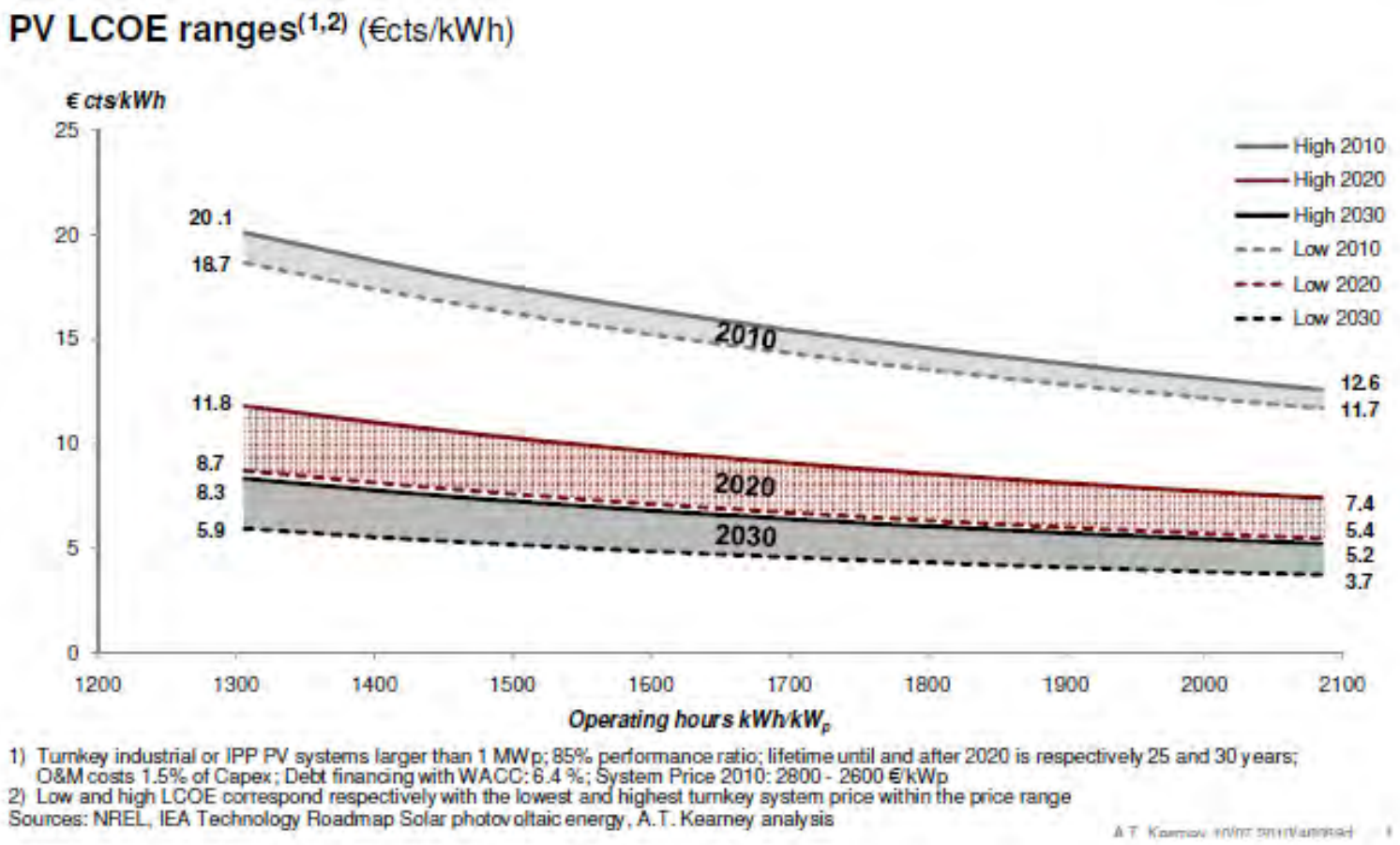

Figure 9: PV Levelized Cost of Energy in Sunbelt irradiation conditions 2010, 2020 and 2030

Source: ARE, EPIA, AT Kearney

Strong technological progress can be expected for all system components

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Table 1. PV technology state-of-the-art and major objectives/milestones for the next 10 years (numbers and ranges are indicative because of the spread in technologies, system types and policy frameworks)

PV Technology state-of-the-art and major objectives/milestones for the next 10 years		2007	2010	2015	2020
Turn-key price large systems (€/Wp)*		5	2,5-3,5	2	1,5
PV electricity generation cost in Southern EU (€/kWh)**		0,30-0,60	0,13-0,25	0,10-0,20	0,07-0,14
Typical PV module efficiency range (%)	Crystalline silicon	13-18%	15-20%	16-21%	18-23%
	Thin films	5-11%	6-12%	8-14%	10-16%
	Concentrators	20%	20-25%	25-30%	30-35%
Inverter lifetime (years)		10	15	20	>25
Module lifetime (years)		20-25	20-25	25-30	35-40
Energy pay-back time (years)		2-3	1-2	1	0.5
Cost of PV + small-scale storage (€/kWh) in Southern EU (grid-connected)=***		--	0,35	0,22	<0,15

Source: EPIA

Technologies: From the SHS to Off-Grid Mini Hybryd Energy Systems

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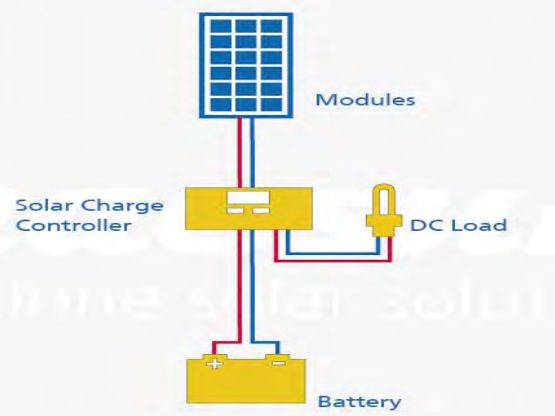
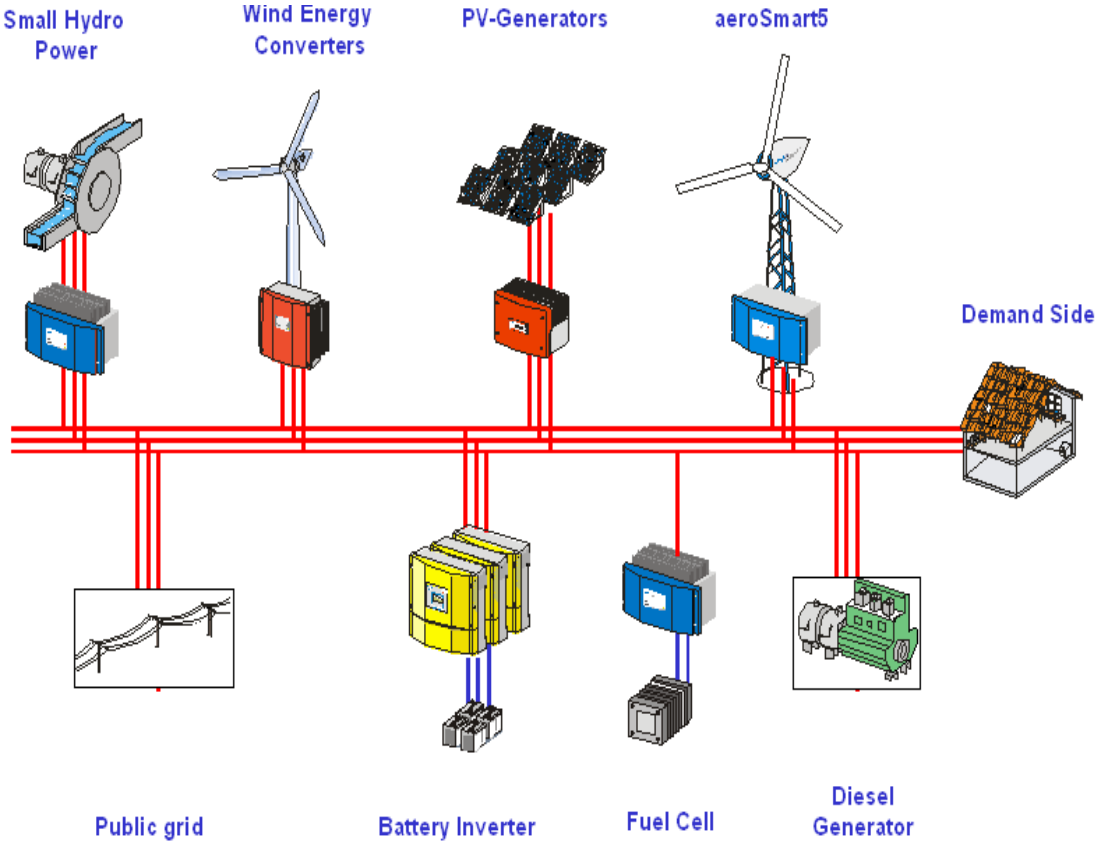
Solar Home System



Hybrid Mini-Grid



Decentralised renewables and existing grid

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The trend: A new energy model in Developed Countries:

Decentralized & Connected

Objectives: Security Supply
CO2 Emissions reduction
To develop RES industries

Decentralised renewables and existing grid

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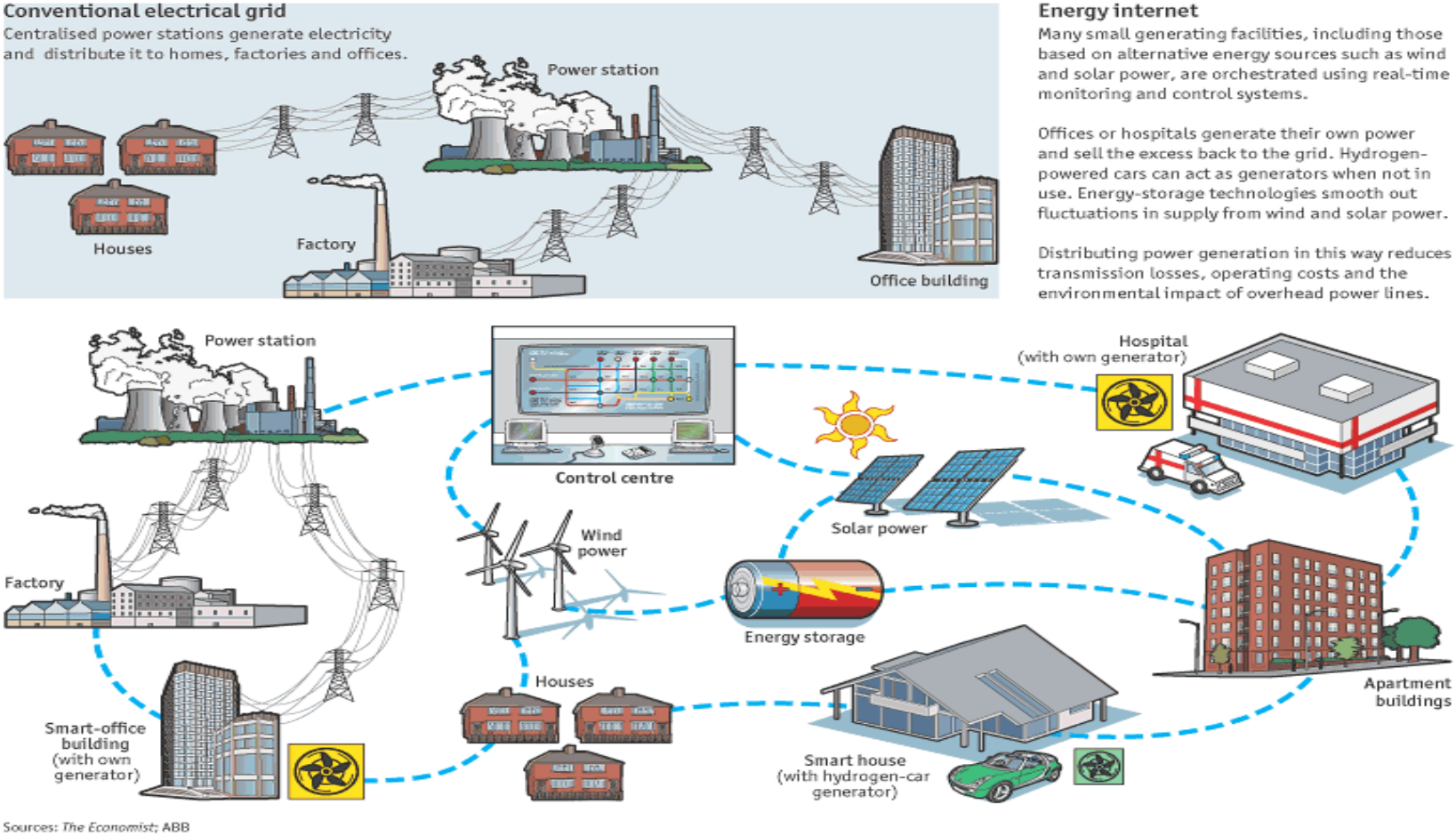
The challenges in developed countries in order to apply this model are bigger than in developing countries

The shape of grids to come?



Decentralised renewables, existing grid and new rural electrification: The sustainable solution

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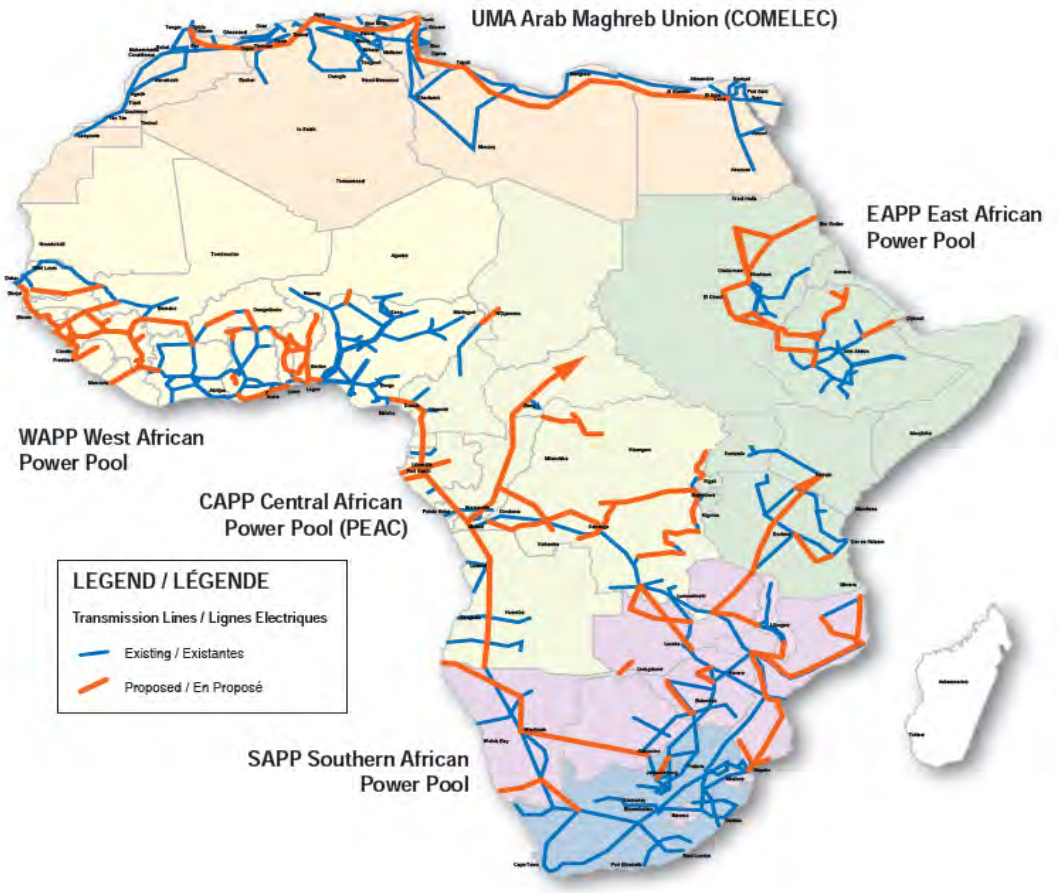
ELECTRICITY NETWORK

Some RES are already competitive, both on and off grid. We see as PV is also competitive in sunny regions connected to existing grids or their extensions. Flexibility of RES is key.



Decentralised renewables: Mini grids, the small cells of a successful new energy model in DP's

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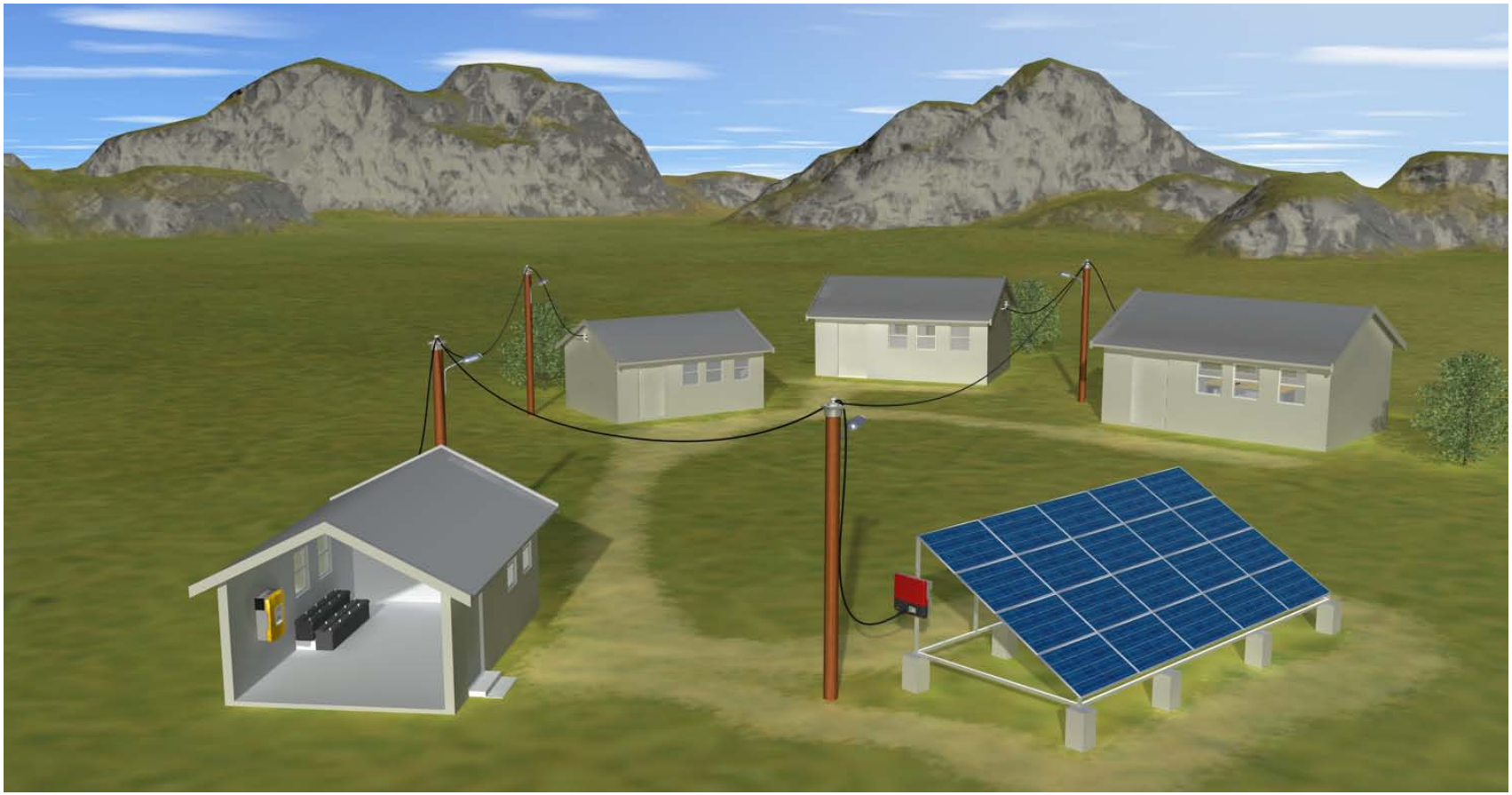
Modular energy supply



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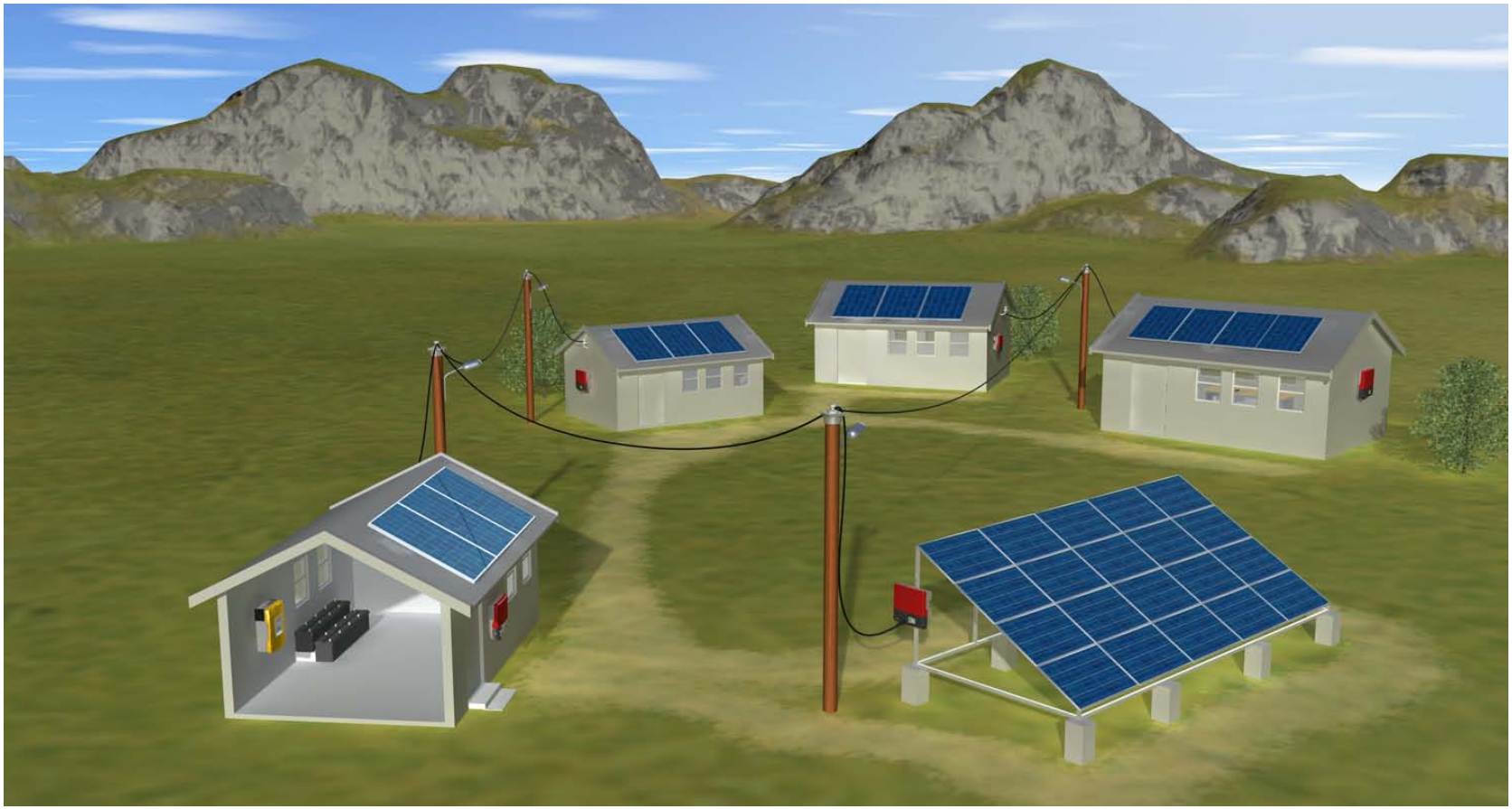
Simple enlargement



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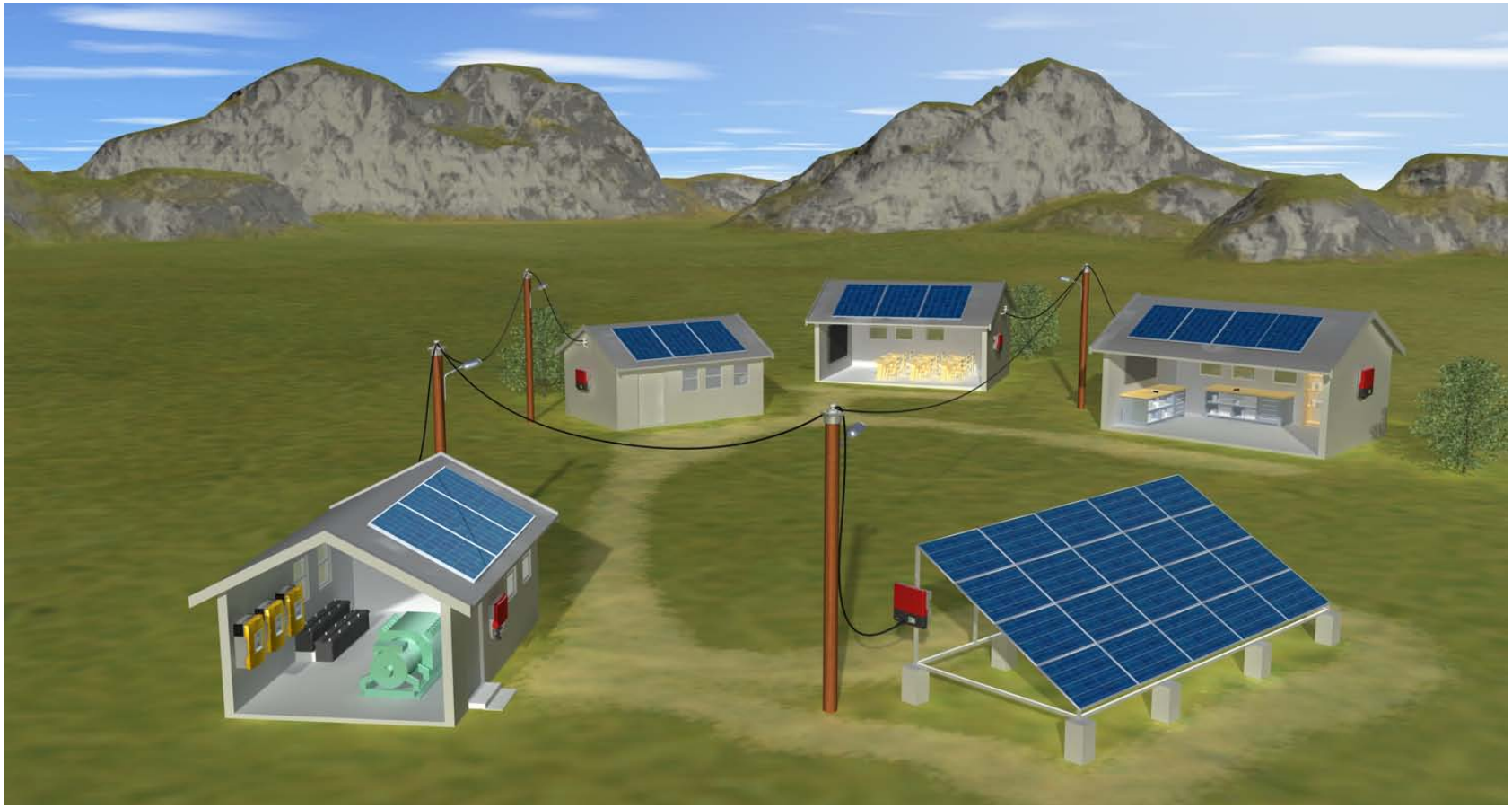
Higher flexibility by coupling all consumers and generators on AC bus line



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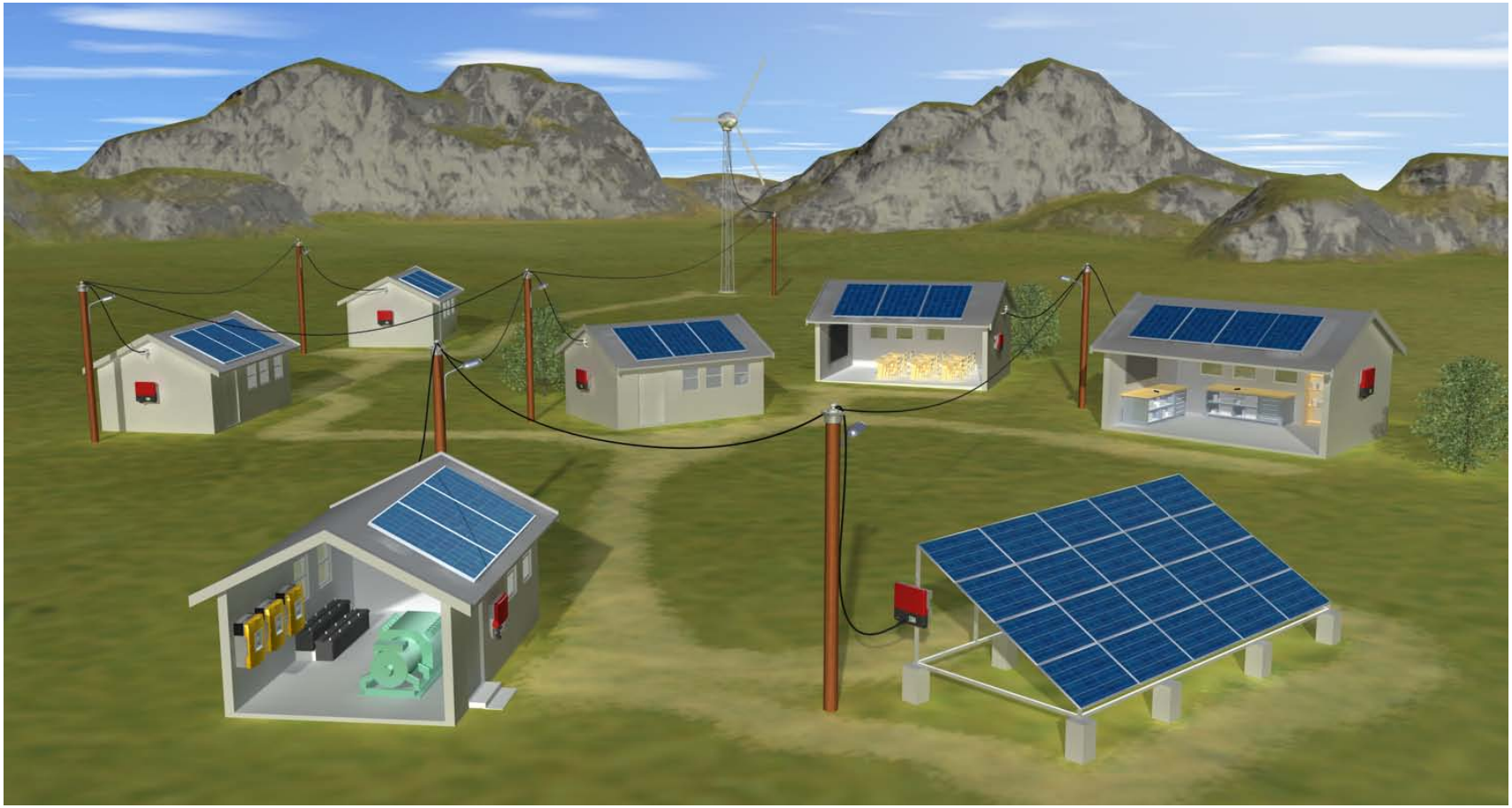
Different local renewable energy sources are suitable to form a hybrid grid



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Electricity in network quality

A real energy (r)evolution

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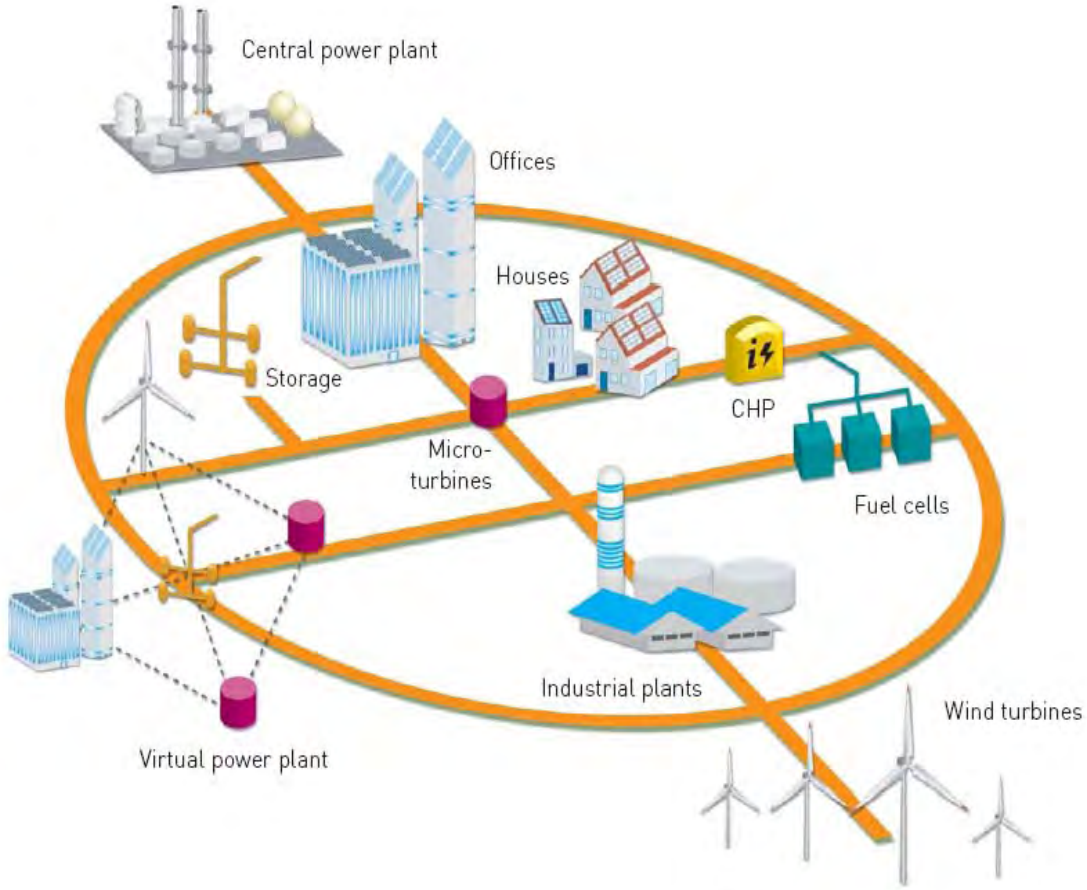

Decentralised Energy: The solution for both: Developed and developing Countries

Rural Electrification: A political challenge

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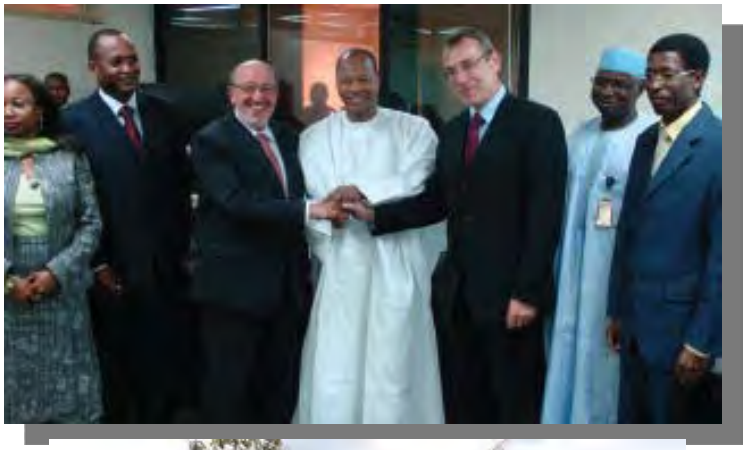
- Access to electricity must be in the governments agenda and fully integrated in the national power plans.
- Access to electricity should follow a reliable long term strategy and the legal framework must allow for private and local initiatives
- Subsidies can be legitimate but should be phased out in the long run
- Funds from rich industrialized countries must finance this initiatives.
- We recommend ECOWAS to submit a proposal asking for this compromise in the upcoming COP 16 Conference in Cancún (Mexico)



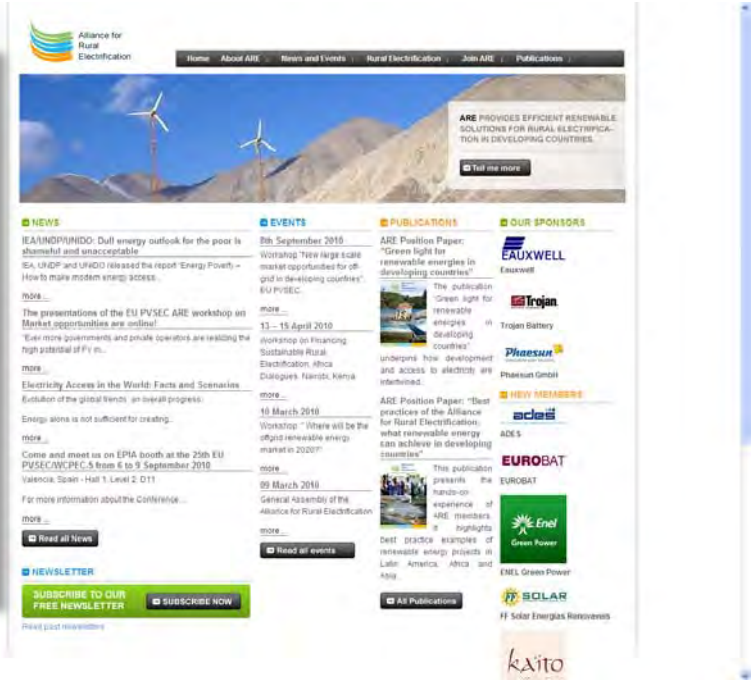


Photo credit: ARE members

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