



El papel fundamental de la energía solar en el futuro de países del "cinturón solar". De micro-redes a mini-redes a un abastecimiento solar eléctrico completo.



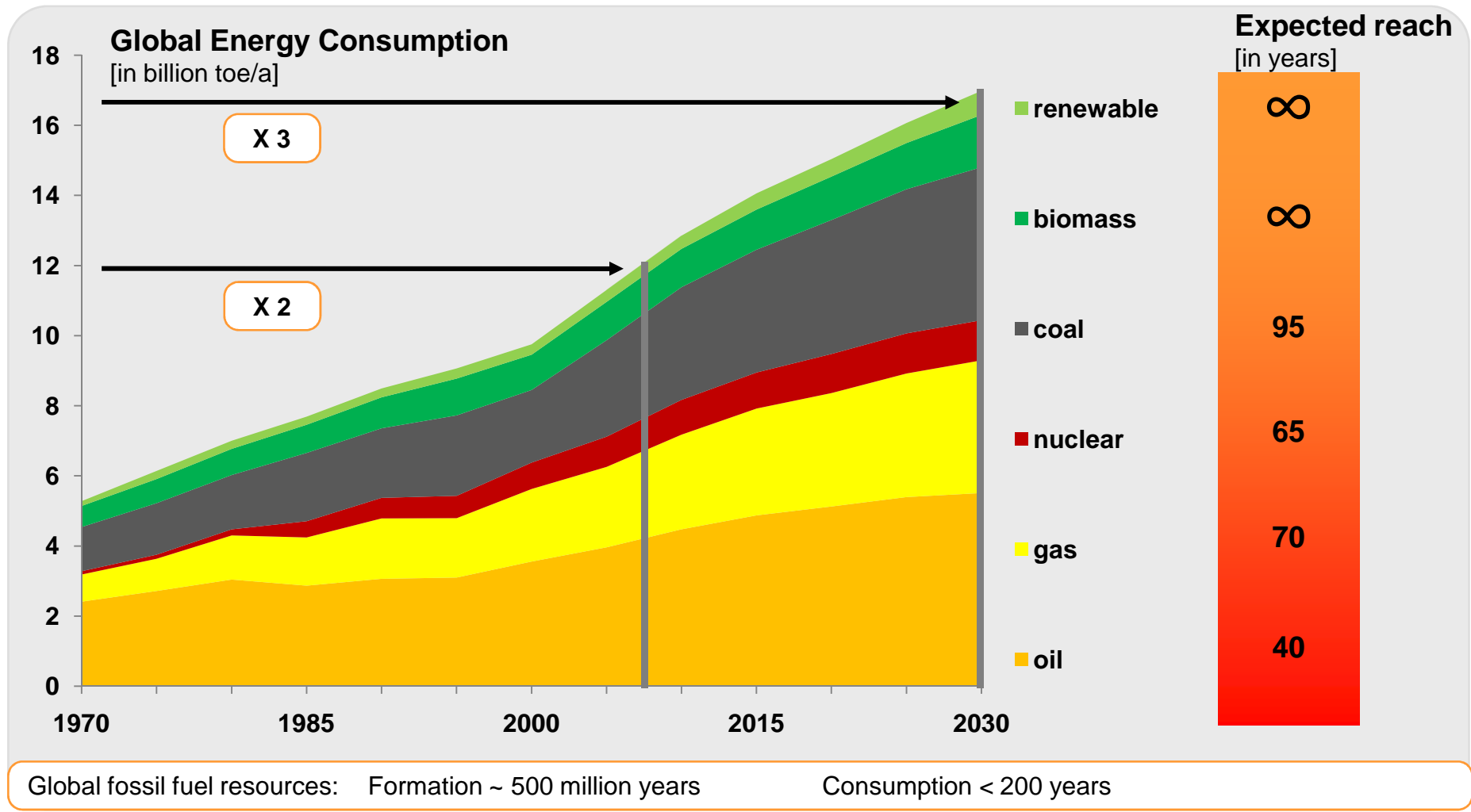
Willi Ernst, Centrosolar Group, Europa

Jean Jacques Sylvain, Green Energy Solutions, Haiti

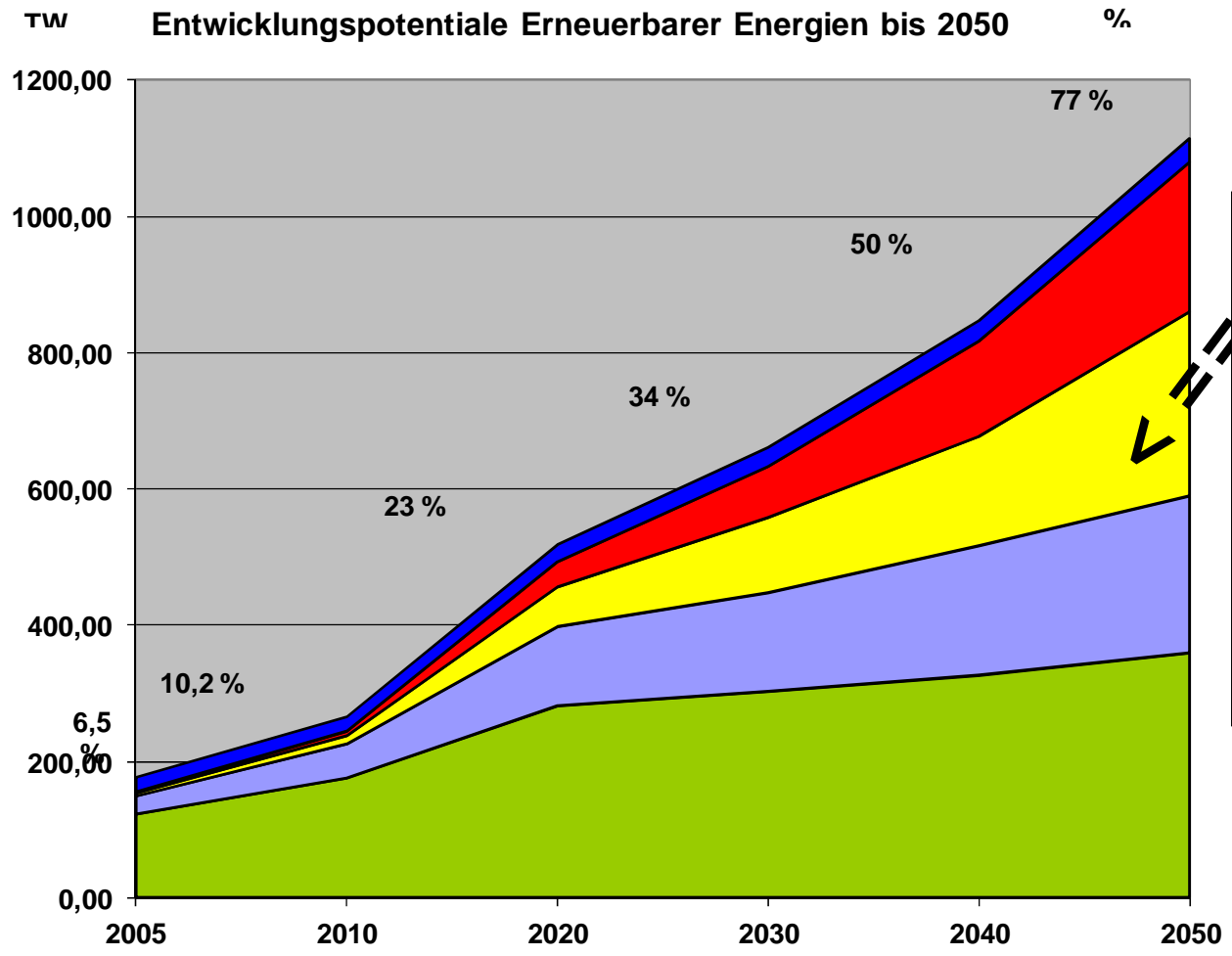
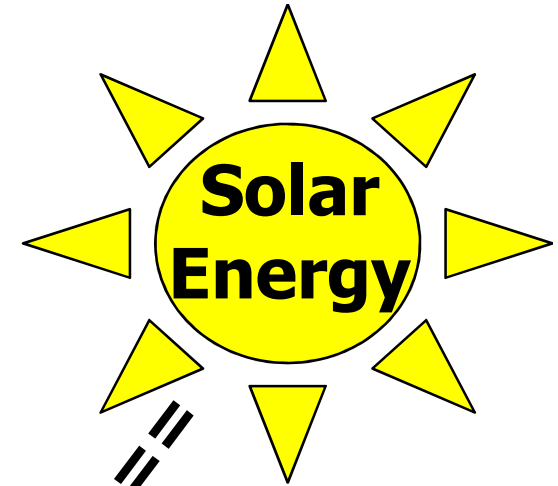
Fukushima !



Global resources of fossil fuels have limited reach

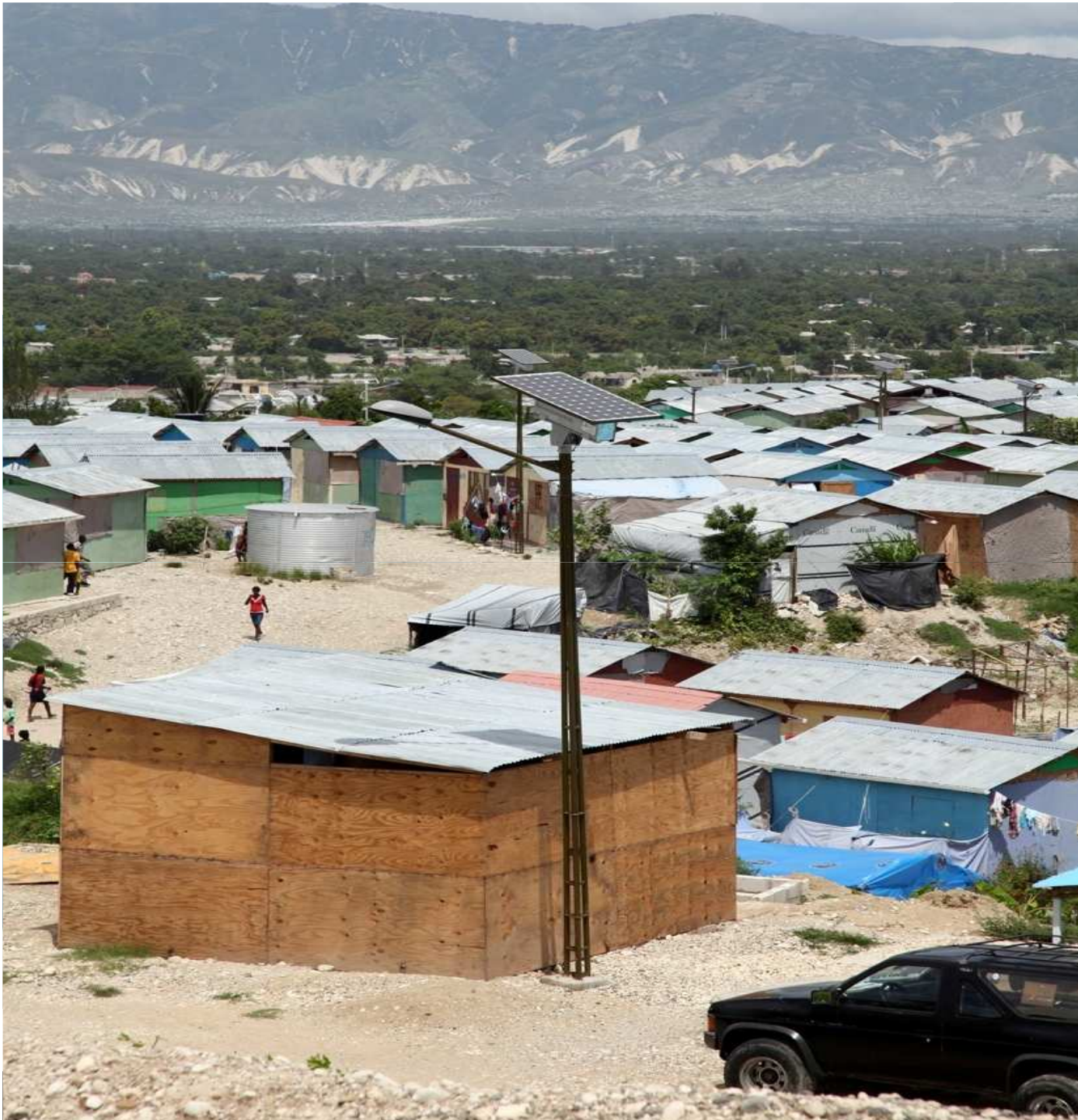


Potentials of Renewable Energies



- Wasserkraft
- Geothermie
- Solarenergie
- Windenergie
- Bioenergie








5000 inhabitants
450 shelter
62 PV-LED lights

„traditional“ Solar Home System:



Efficiency of pv systems depends on light source

Source		El. Power Consumption	Optical Efficiency (lumen)		
Type	Detailed	Watt	min	typical	max
Electric Bulb 	Standard	25		9,2	
	230V	60	11,5	12	12,5
Halogen 	12 V	55	27	27,5	28
LED 	blue	0,05 - 1	1	8,5	16
	red	0,05 - 1	5	47,5	90
	white	< 5		65	140

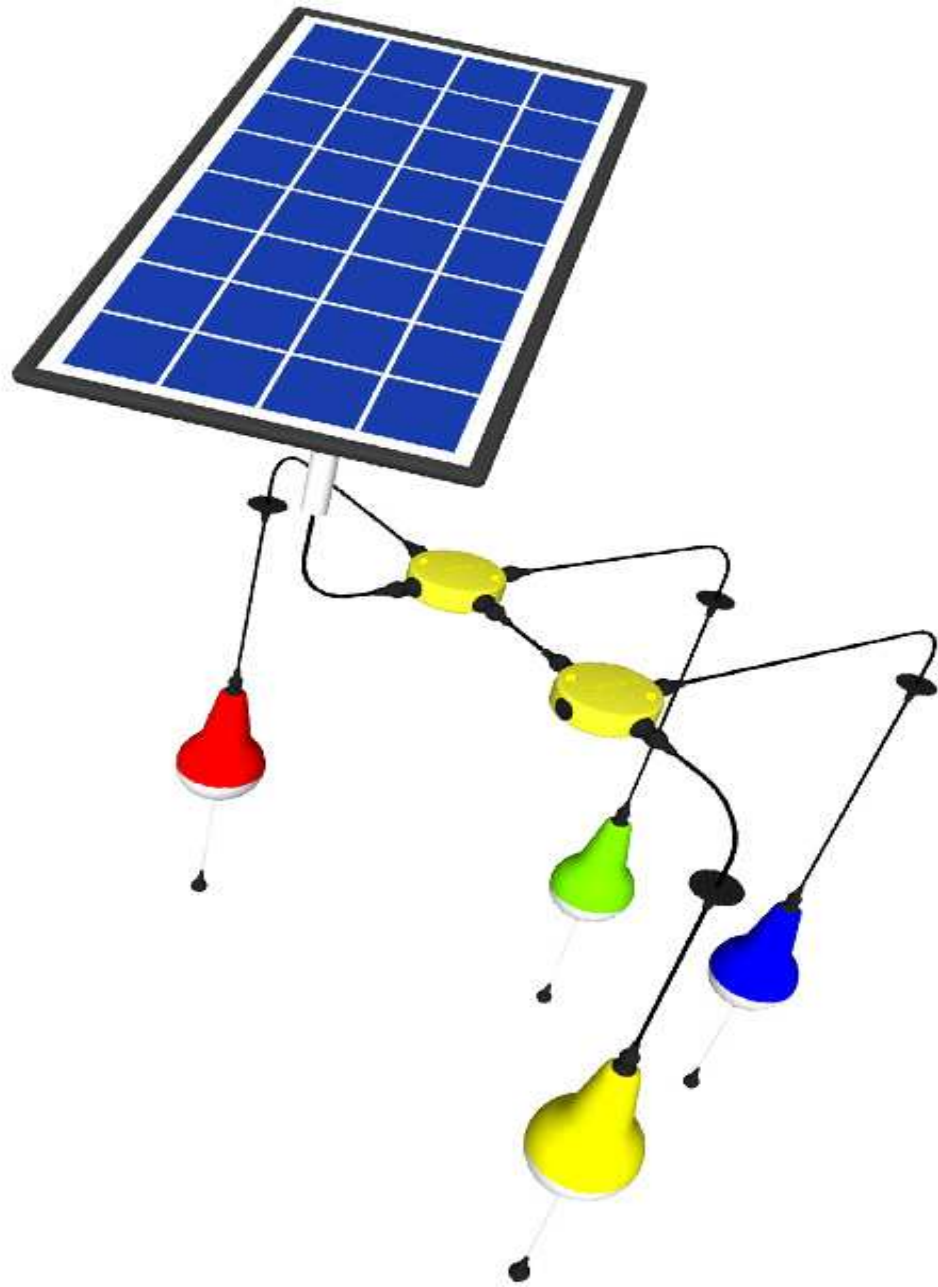


Lumen generated by 1 W_{el}:

LED = much better than traditional bulb

Light Bulb Type	Lumen generated by 1 W _{el}
LED	0,2
Compact Fluorescent Bulb (CFL)	0,5
High-Pressure Sodium (HPS)	47,5





PV Water Pump, Koboyo, Togo



840 Wp PV

120 V DC Pump

Grundfos



Fisherman's Cold Store, Haiti



5 kWp PV
48 V / 200 Ah
Inverter 2 kW



**Farm Project,
Koboyo,
Togo,
Western Africa**



4,5 kWp PV

3,3 kW c-Si modules

1,2 kW a-Si modules





1 Sunny Island 5048
1 Inverter SB 6000
48 V / 910 Ah Batteries



Hospital in Au Borgne, Haiti



5KW back up system for the lab and some essential loads



Bombardopolis, North West of Haiti



48 panels in 3 groups of 16 modules
= **8,9 kW PV** for public Illumination +
Charging Station for Batteries 12/24 V



Vocational School in Léogâne, Haiti



84 kWp PV
250 kWh Batt.
9 Sunny Island
45 kVA Gen.

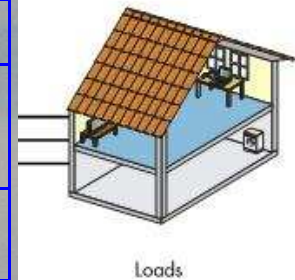
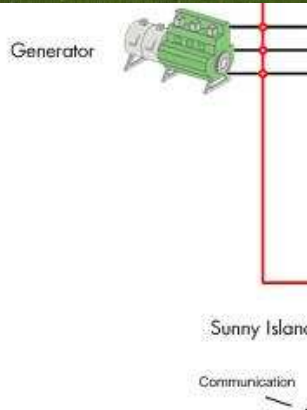
Hybrid Sys

Average of Energy Production of NORDEX N 27 Off Shore: **250.000 - 300.000 kWh / a**



NORDEX	N 29 / 250
Nominal Power	250 kW
Rotor diameter	29,7 m.
Swept area	693 m2
Power regulation	Stall
RPM	39,5 / 29,5 RPM
Cut-in / cut-out wind	3-4 / 25 m/s
Nominal output at	16 m/s
Survival wind speed	55 m/s
Resting life time of turbine	10 years

NORDEX	N 27 / 150
Nominal power	150 kW
Rotor diameter	27 m.
Swept area	572 m2
Power regulation	Stall
RPM	36 / 26 RPM
Cut-in / cut-out wind	3-4 / 25 m/s
Nominal output at	16 m/s
Survival wind speed	55 m/s
Resting life time of turbine	10 years



www.SMA.de



SI5048 Custom / 090211



Costs of Hybrid System without / with Wind Turbine

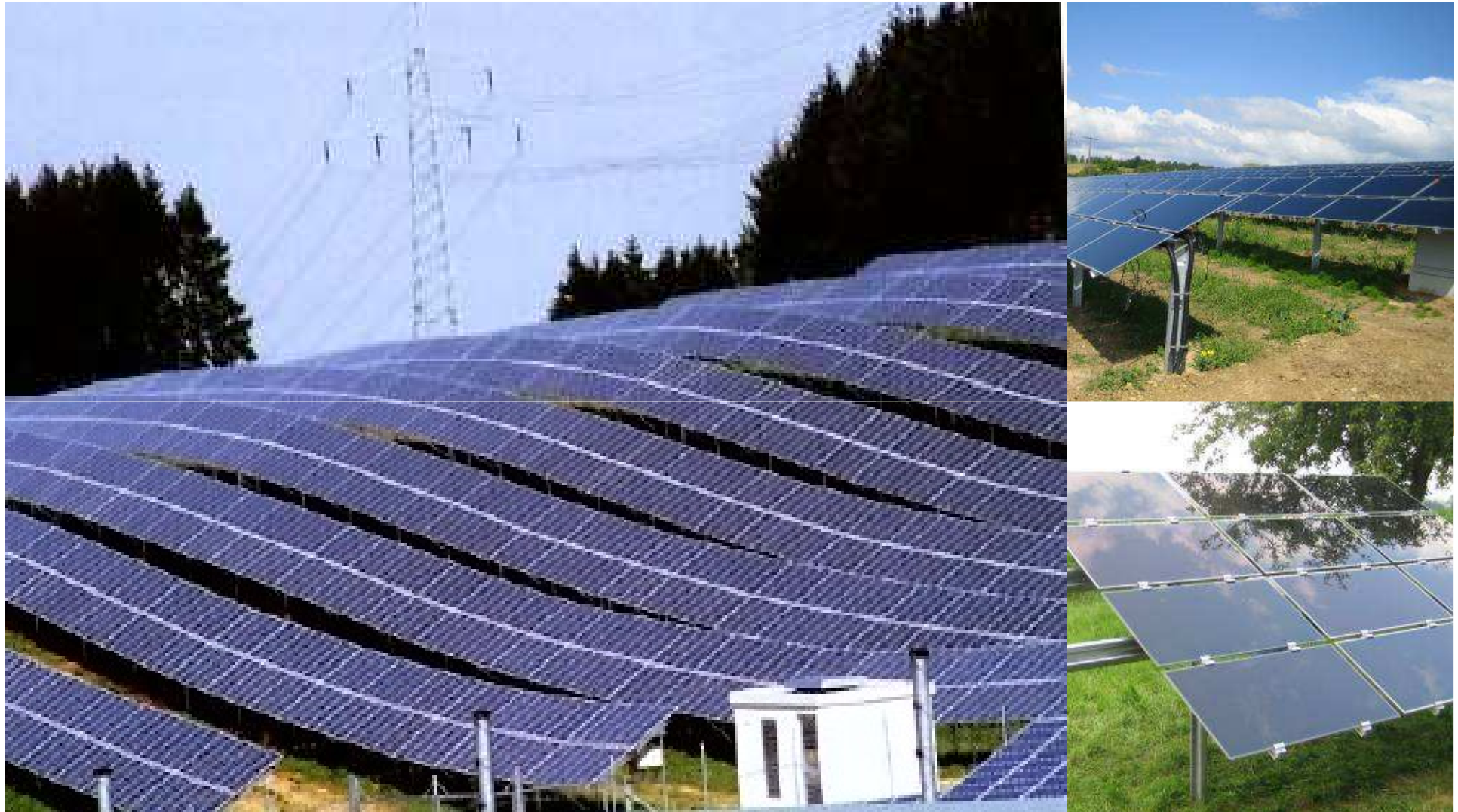
Hybrid System Sunny Island		
PV 300 kW		Diesel 100 kVA
PV	300 kW	330.000
Fixing		85.000
Inverters	300 kW	
Sunny Islands		75.000
		50.000
Diesel-Gen	100 kVA	25.000
Batteries	1.000 kW	135.000
total cost	USD	1.000.000

5 Cordobas / kWh
 = 0,22 USD / kWh

Hybrid System Sunny Island with Wind			
PV 300 kW		Wind 150 kW	Diesel 100 kVA
PV	300 kW		330.000
Fixing			85.000
Inverters	300 kW		
Sunny Islands			75.000
			50.000
Diesel-Gen	100 kVA		25.000
Batteries		500 kW	70.000
NORDEX		N 27 / 150	75.000
total cost	USD		1.010.000

3,3 Cordobas / kWh
 = 0,14 USD / kWh

Next Generation: Grid connected PV Plants



MW-Size 0,5 – 2 MW (Cost Efficiency from 1 MW on)



Financial aspects of Grid Connected Solar Plants :

RI012: “At an irradiance level of 2100 kWh/m²a, PV generation capacity of 1680 kWh/kWp, system cost of 1.8 EUR/Wp (= **2,28 USD / Wp**), yield **during 20 years** is 33.6 kWh/Wp - that results in a minimum generation cost of 0.054 EUR/kWh (= **0,069 USD / kWh**)
[no degradation, 0% interest rate]

or as a **business model:** for a 0.12 EUR/kWh (= **0,15 USD / kWh**) sales price at an interest rate of 9%/a (module degradation is compensated by increase of electricity price).”

	Net cost	Cost based on investment	Cost of kWh based on invest of Government (loan at 4 % interest)
20 years	> 0,069 USD / kWh	> 0,228 USD / kWh	< 0,10 USD / kWh
15 years	> 0,10 USD / kWh	> 0,175 USD / kWh	< 0,12 USD / kWh
10 years	> 0,10 USD / kWh	> 0,20 USD / kWh	< 0,14 USD / kWh

2,3 Cordobas / kWh

Mounting Structures – Ground Based

2005



2 modules above each other
Horizontal bar: street barrier
170kg/kWp steel, aluminium

2010



4 modules above each other
Horizontal bar: own design(100km)
120kg/kWp steel, aluminium



Pre-assembled DC cables

2004



x-Si approach: 10 times
the strings, fuses, etc...
for TF
very flexible, high failure
rate

2005



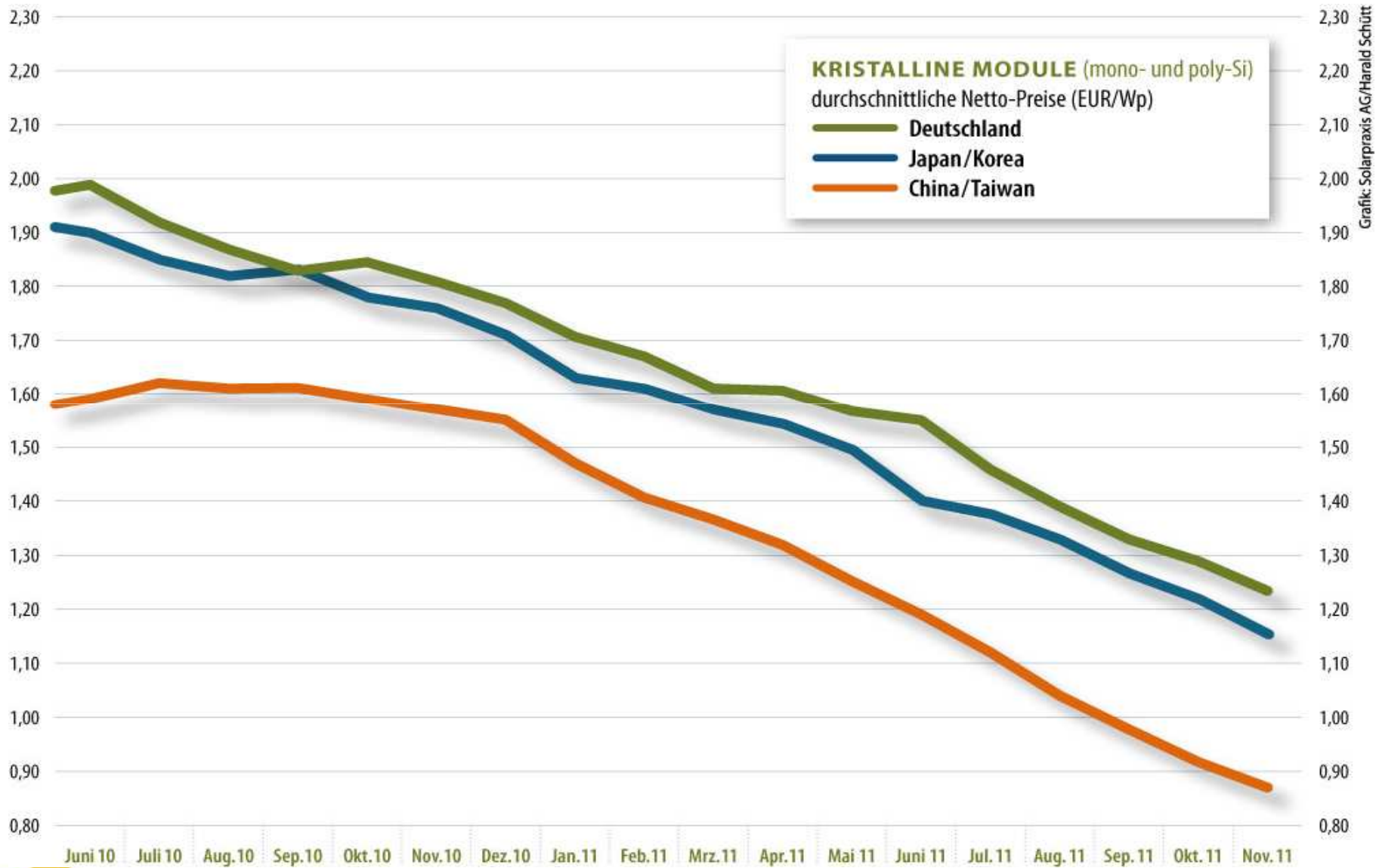
Semi-automated
manufactured cables
flexible,
modest failure rate

2006

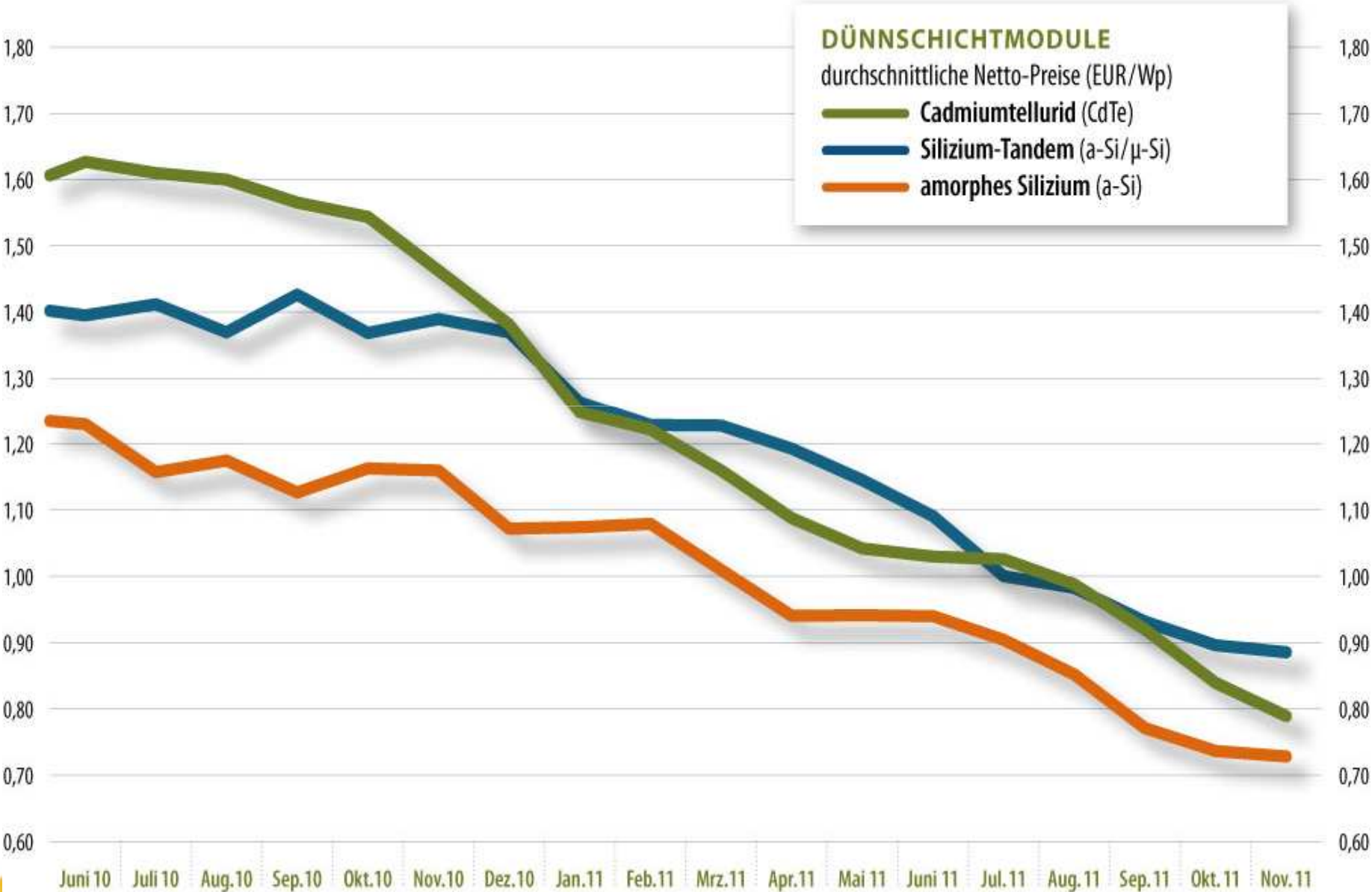


Molded injected cable
trees (connectors,
junctions)
not flexible, low failure
rate – standardisation!

Module prices shut down drastically - Cristalline

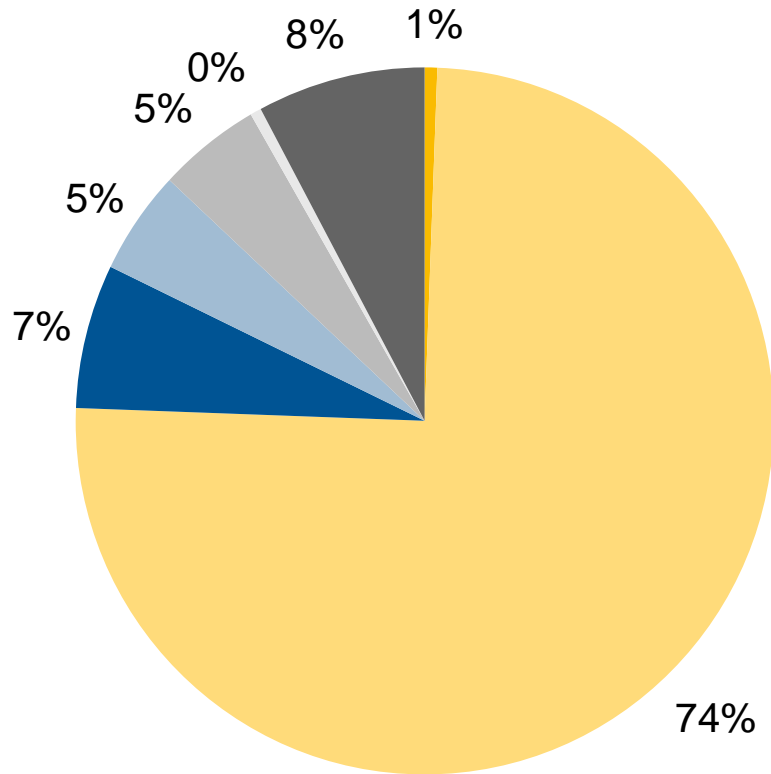


Same with Thin Film



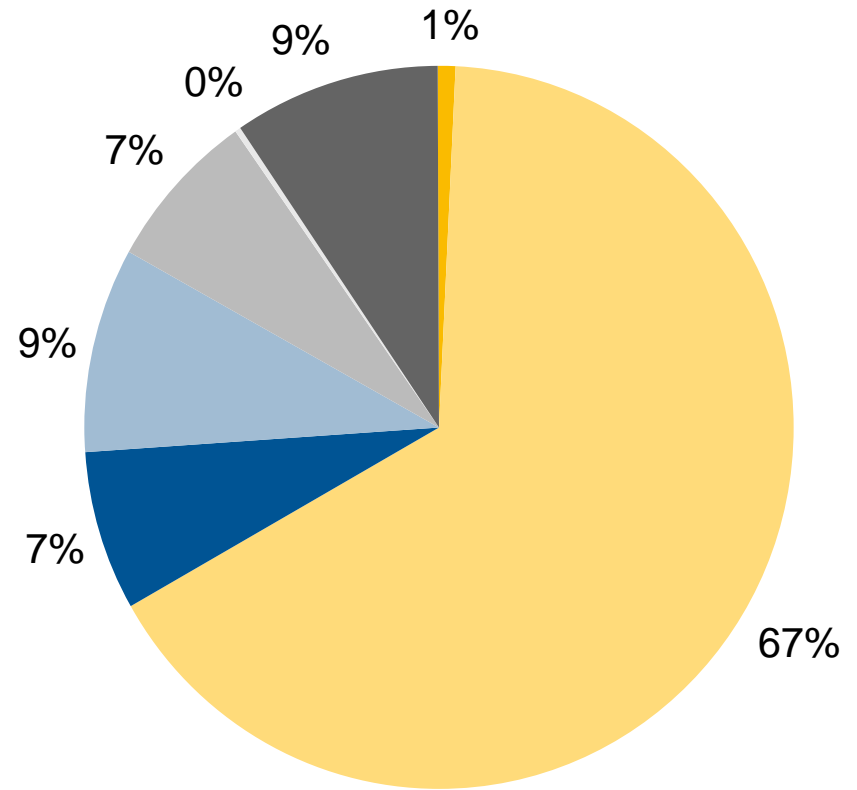
Cost Structure Development – Crystalline

2006 (3.9 - 4.2 €/Wp)



- Engineering
- Modules
- Inverters
- Support Structure
- DC Cables
- Other
- Construction

2010 (2.6 - 2.8 €/Wp)

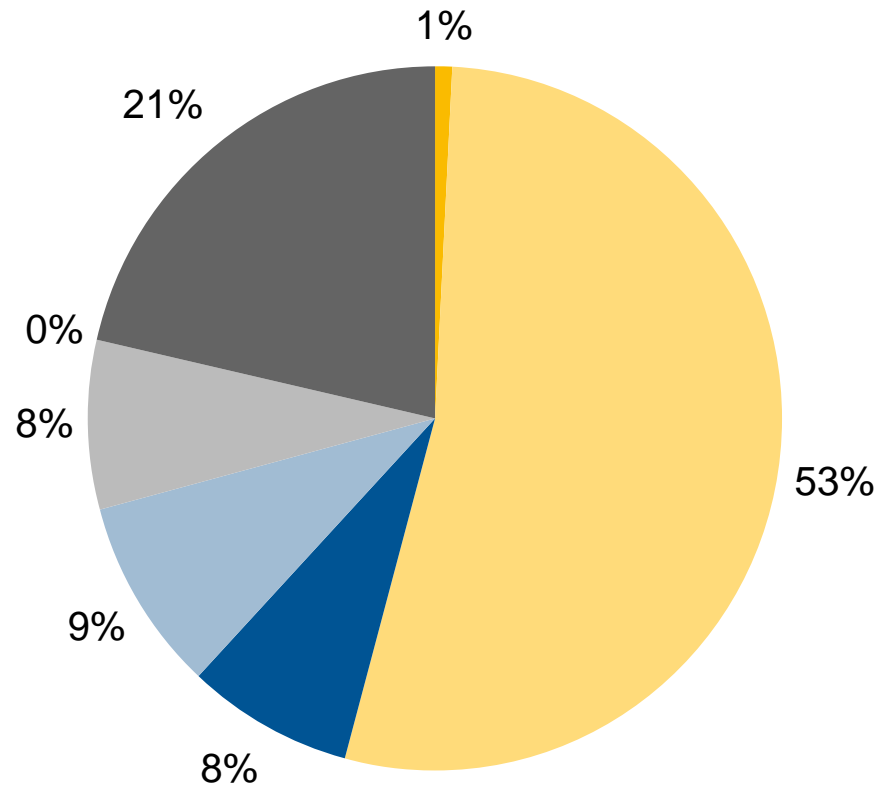


- Engineering
- Modules
- Inverters
- Support Structure
- DC Cables
- Other
- Construction



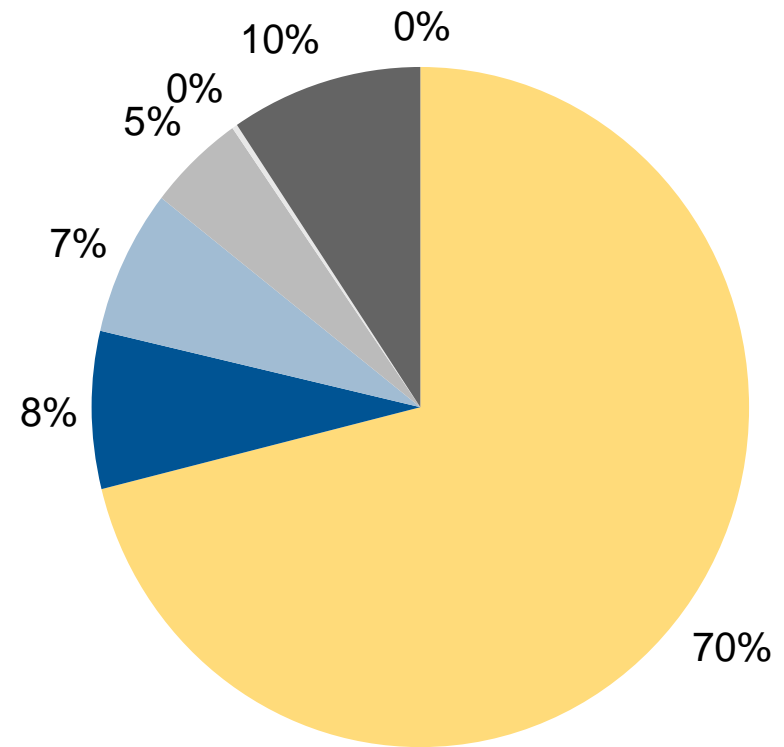
Cost Structure Development – Thin Film

2006 (3.9 - 4.1 €/Wp)



- Engineering
- Modules
- Inverters
- Support Structure
- DC Cables
- Other
- Construction

2010 (2.4 - 2.6 €/Wp)



- Engineering
- Modules
- Inverters
- Support Structure
- DC Cables
- Other
- Construction



Some Experiences with amorphous Modules:

Léogâne, Haiti

a-Si UniSolar

a-Si Masdar PV



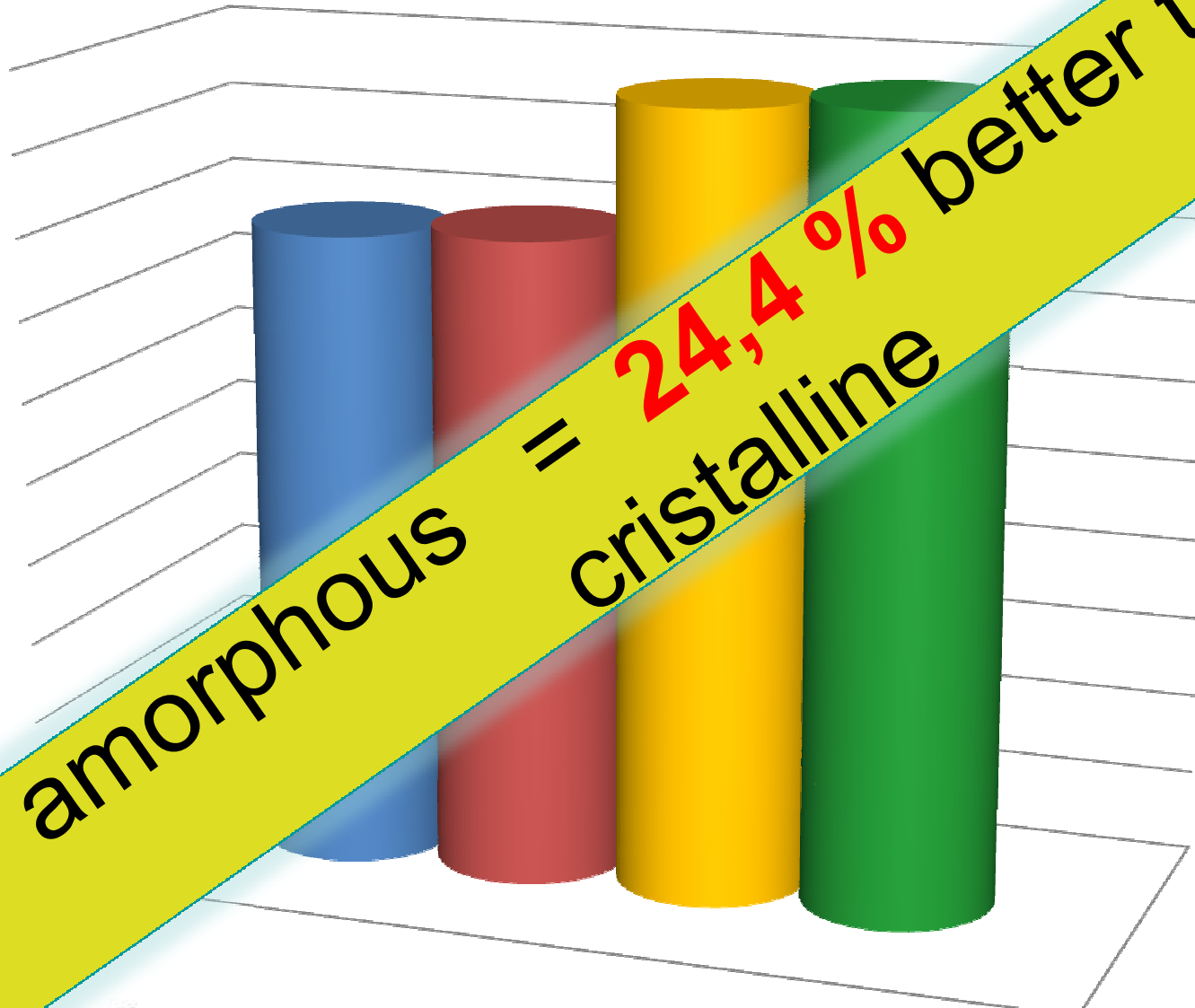
From: okahou kaba [mailto:okaba21@gmail.com]
Sent: Wednesday, January 04, 2012 10:59 PM
To: Ernst, Willi
Cc: Fousseni MOROU

Bonsoir, Mr Willi,
En attaché recevez les données du samedi le 31 12 2011

	1300 Wp mono	2000 Wp poli	620 Wp a-Si Plaques isolées	620 Wp a-Si Plaques ventilées
PAC	333 W	501 W	181 W	181 W
Upv	301 V	276 V	169 V	173 V
E-Jour	1,66 KWH	2,61 KWH	0,96 KWH	0,95 KWH
E-Total	1859 KWH	2866 KWH	1087 KWH	1095 KWH



Why a-Si ?



- 1300 Wp
- 2000 Wp
- 620 Wp
- 620 W



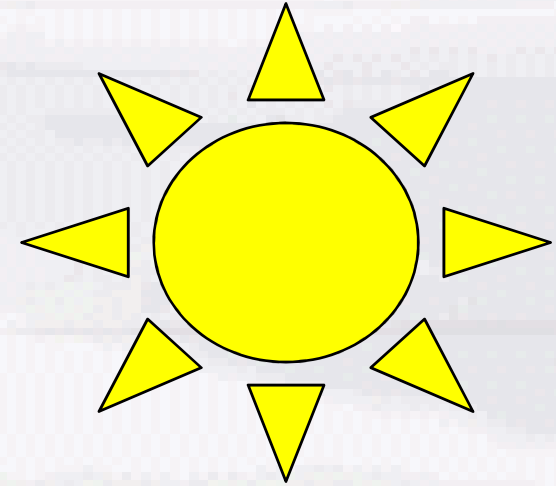
So: Why not amorphous silicon ?

Comparison of energetic life time effects:

Cell Type	Module Efficiency	Payback Period	Earning Factor
mono	14 - 18 %	75 months	4,8 - 7,4
poly	13 - 15 %	25 - 57	6,2 - 14
a-Si	5 - 10 %	17 - 41	8,6 - 21

2 Cordobas / kWh
 = 0,09 USD / kWh





Thank You for Your Attention !

