



The World Bank
Sustainable Energy Group

Clean Energy Innovations for Development:

Daniel Kammen

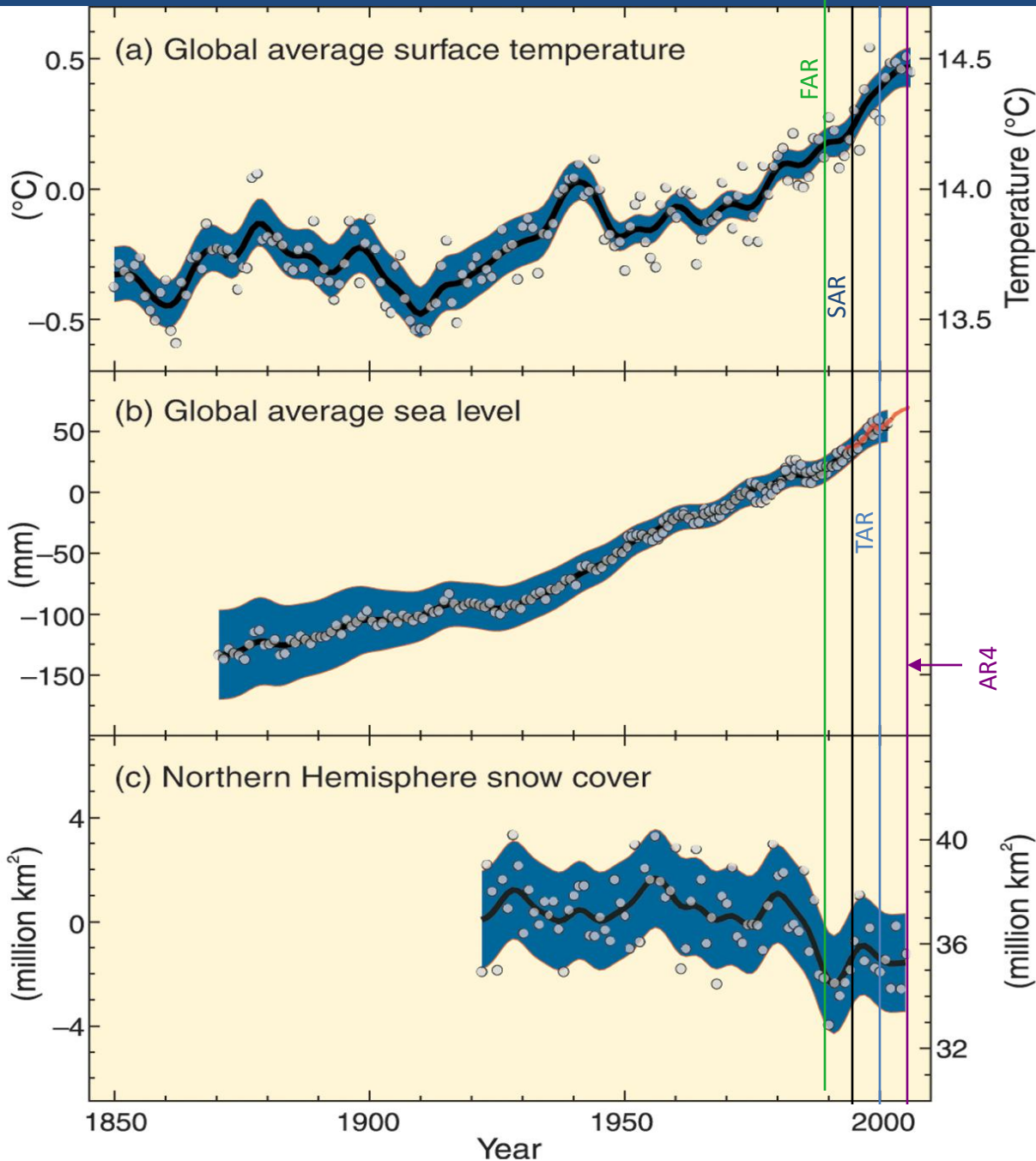
Chief Technical Specialist for Renewable Energy and Energy Efficiency
The World Bank

Class of 1935 Distinguished Professor of Energy, University of California, Berkeley

CTF, Cape Town, South Africa, June 25, 2011



Difference from 1961–1990



1st IPCC Assessment (1990): unequivocal detection of human impact not likely for a decade

2nd (1995): balance of evidence suggests discernible human influence

3rd (2001): most of the warming in the last 50 years is likely (>66%) due to human activities

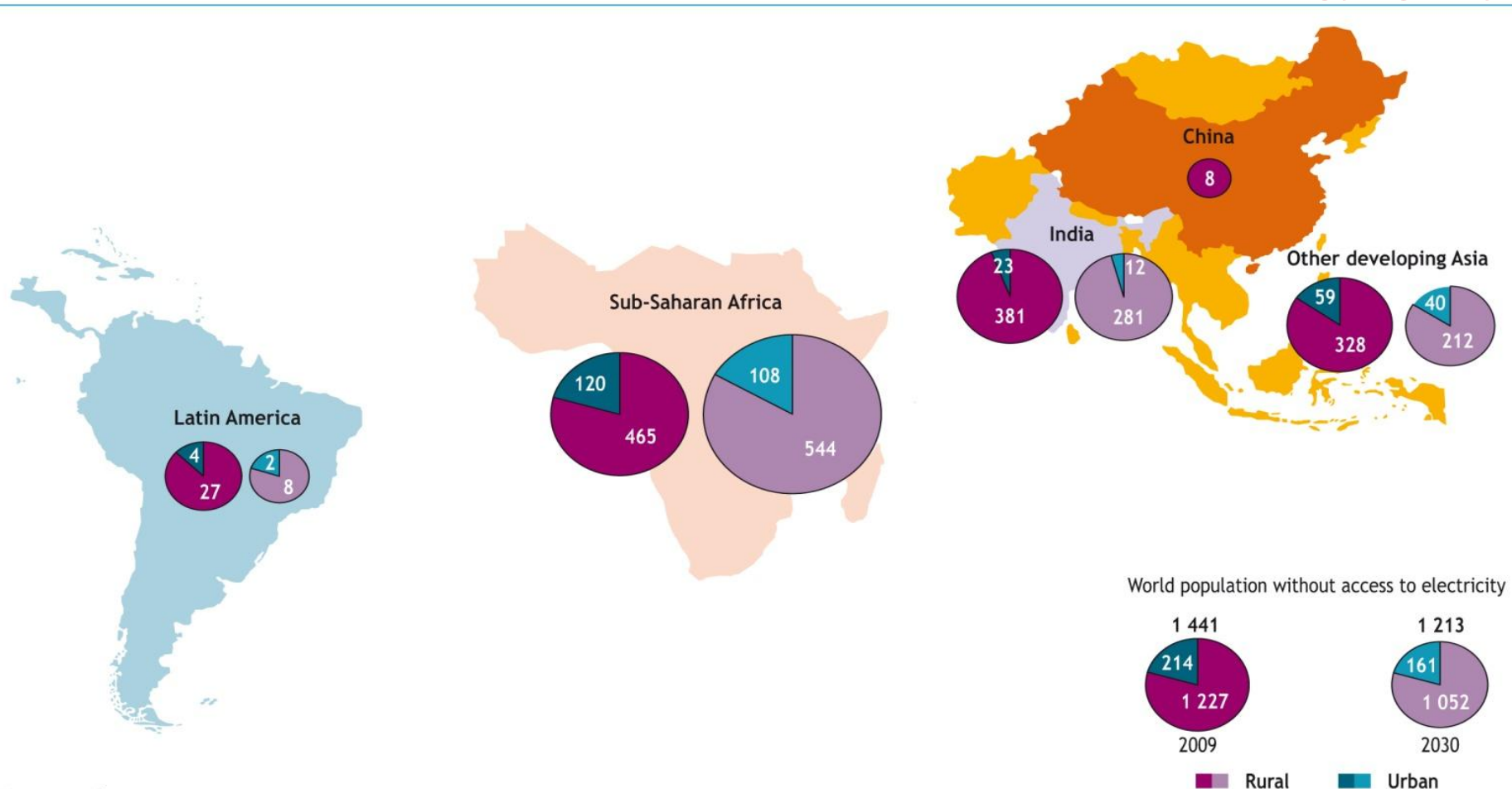
4th (2007): most of the warming very likely (>90%) due human activity

4th (2007): warming will most strongly and quickly impact the global poor

SRREN (2011): 80% clean by 2050 possible, if ...

People without access to electricity (millions)

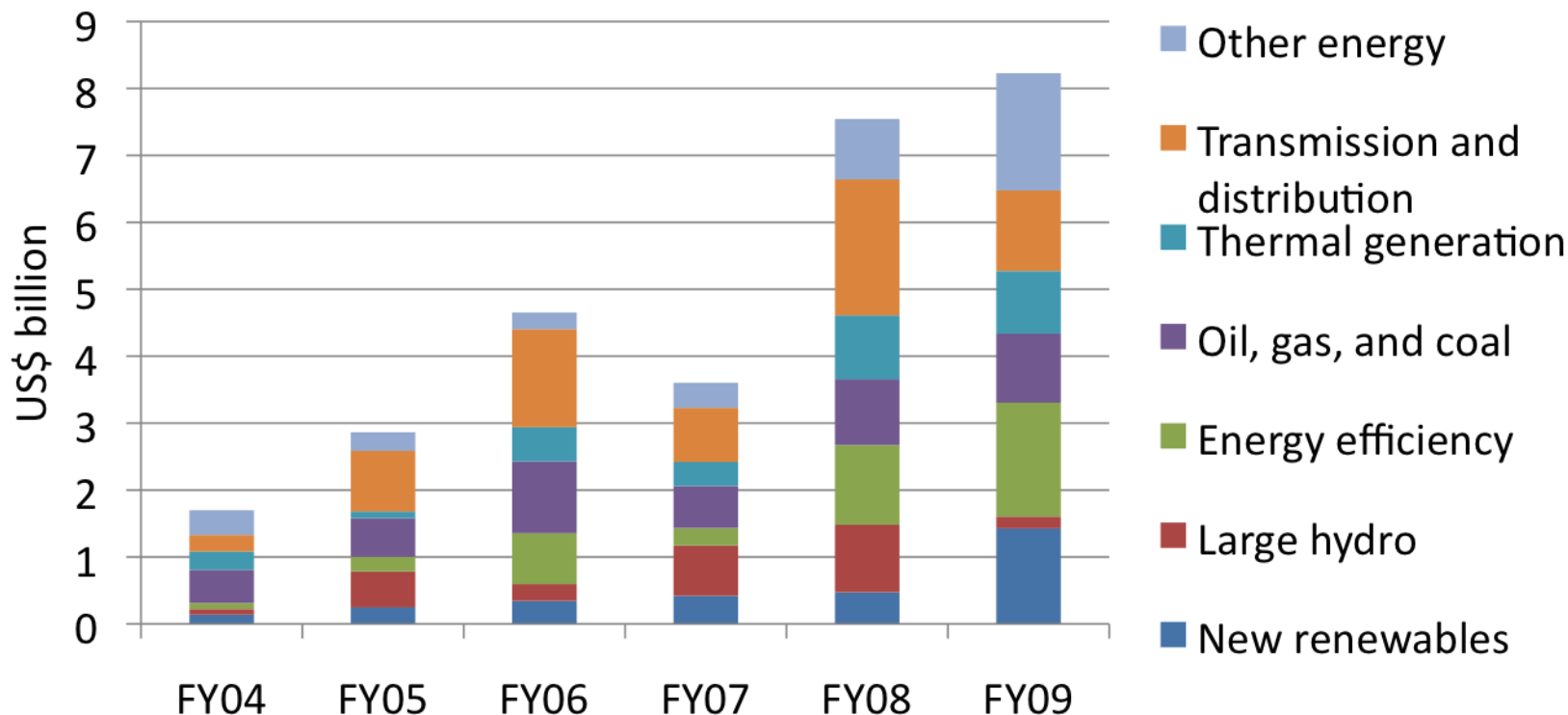
There are **1.4 billion** people lacking access to electricity today
 Based on current trends, **1.2 billion** people will still lack access in 2030
 Another **1+ billion** have intermittent/unreliable access
 International Energy Agency,



Note: not to scale



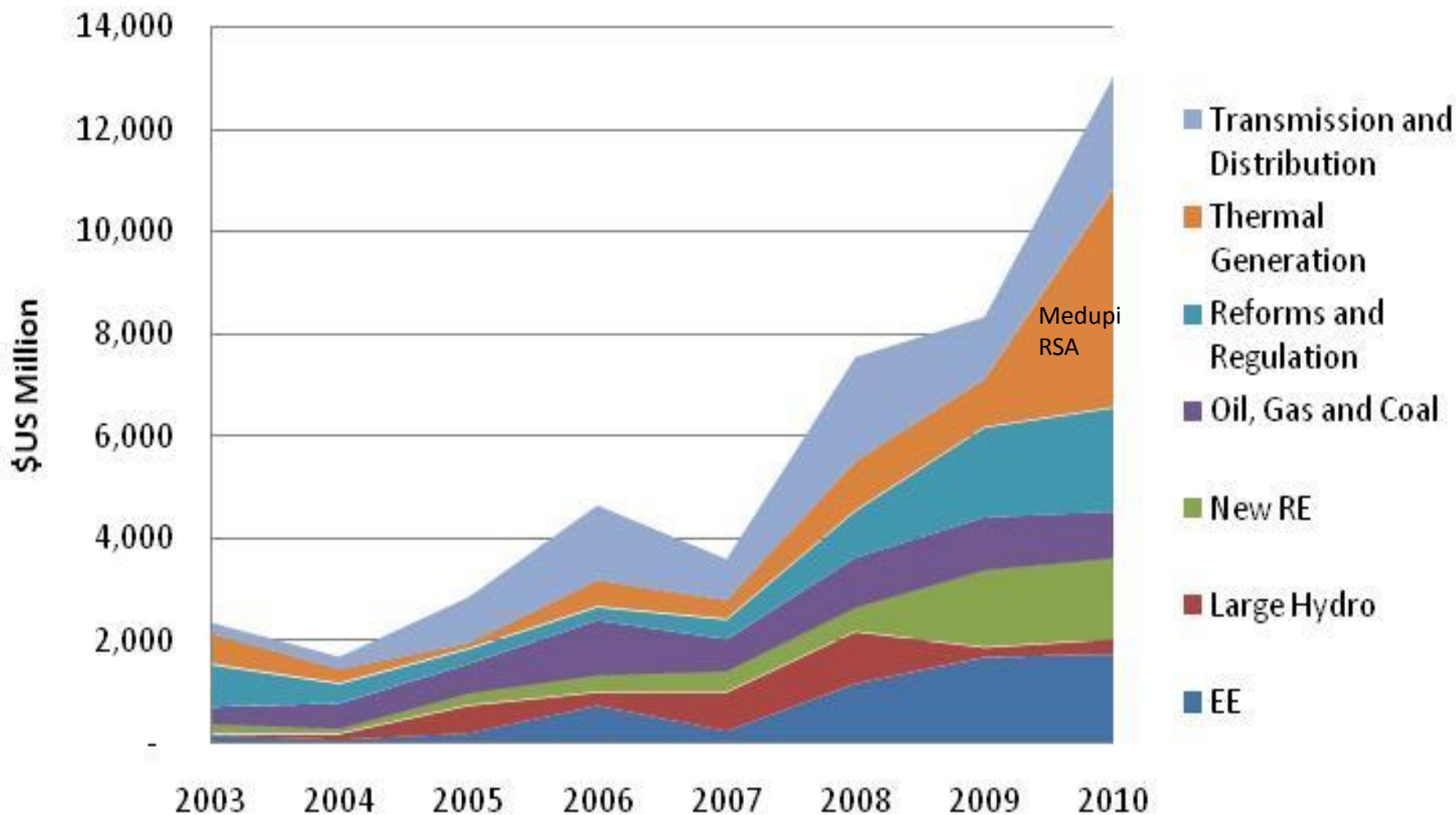
Sectoral Distribution (FY2004–09)



- **40%** energy lending was for RE/EE in FY09—a **24%** increase from FY08; 64% in 2010
- Nearly \$4.5 billion invested in programs directly dealing with energy access
- New Energy Strategy currently under political review



World Bank Energy Lending



2010: Portfolio is 65% non-fossil fuel
2011: New Energy Strategy (in review)



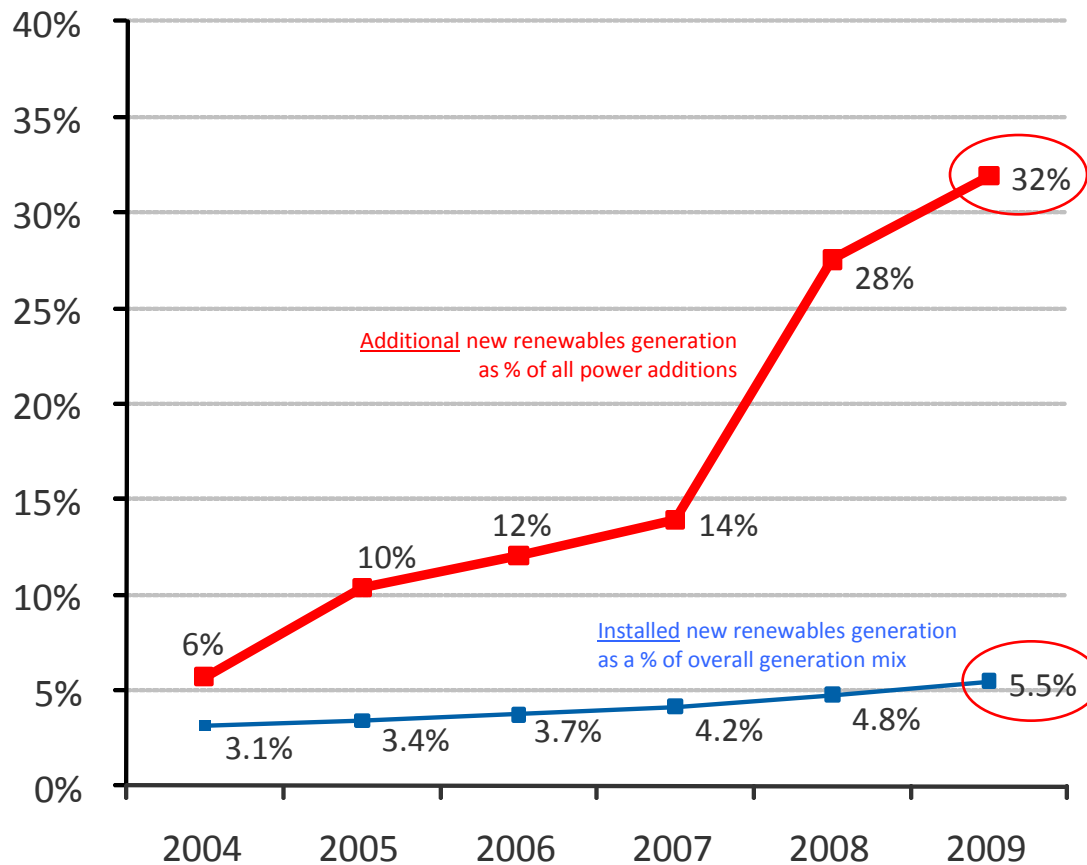
Chief Technical Specialist Portfolio

- **Morocco** **Ouarzazate: world's largest solar plant; 3 GW, \$9 billion**
- **Bangladesh** **One million solar households by 2012**
- **Mexico** **\$1 billion for energy efficiency, rapid transit plans**
- **East Africa** **Regional Power Pool w/Feed-in tariffs, climate policies**
- **C. America** **Regional Power Pool**
- **Turkey** **Integration of transmission expansion to wind sites *and* building efficiency upgrades linked, \$1 billion**
- **Malaysia** **Coal alternative for Sabah selected**
- **E. Europe** **Coal alternative dialog**



Can renewables become 'business as usual' ?

Renewable and Energy Efficiency* Generation as a proportion of global power sector



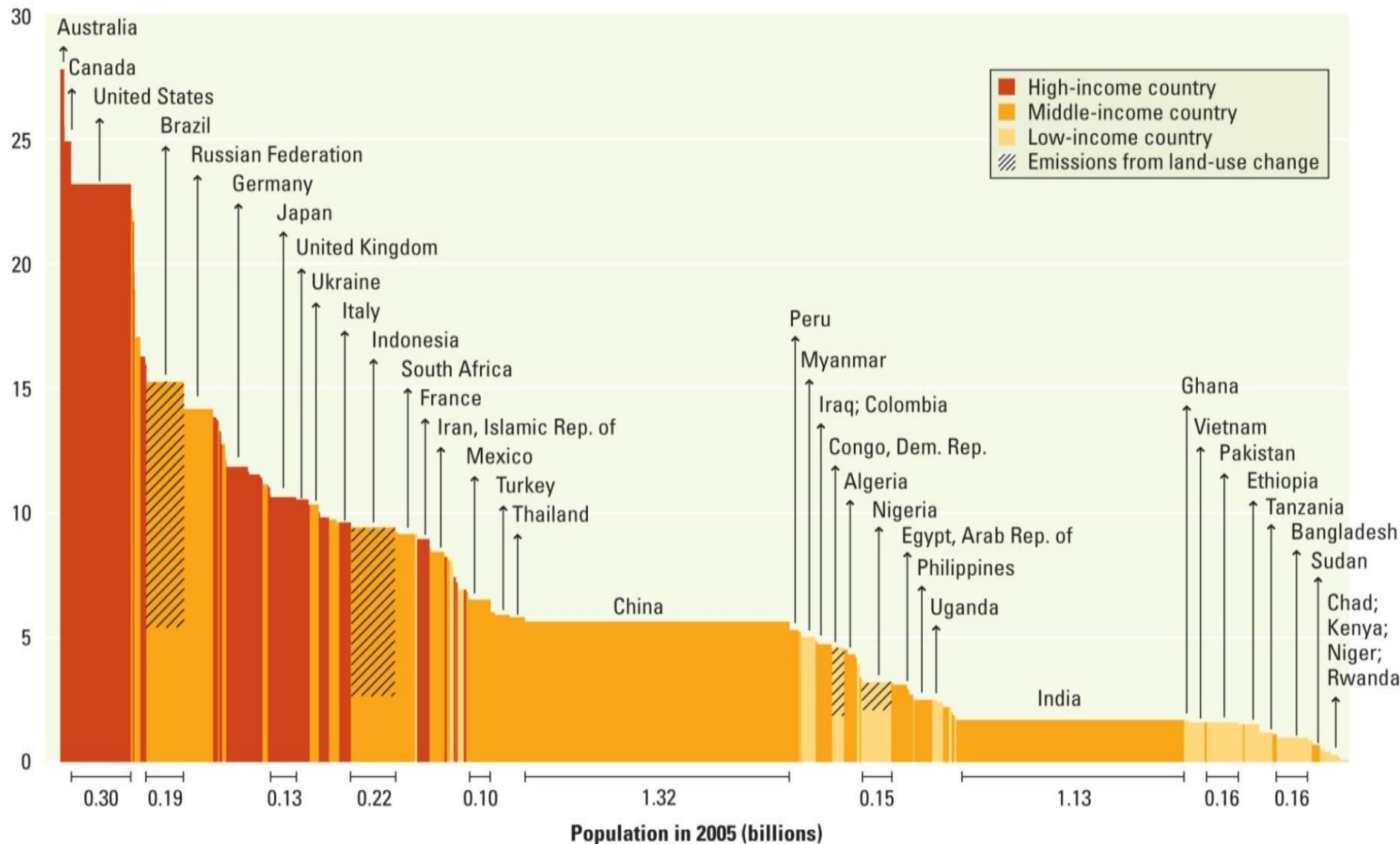
* Excluding Large Hydro

Message: Low carbon technology has become more mainstream, but many barriers remain



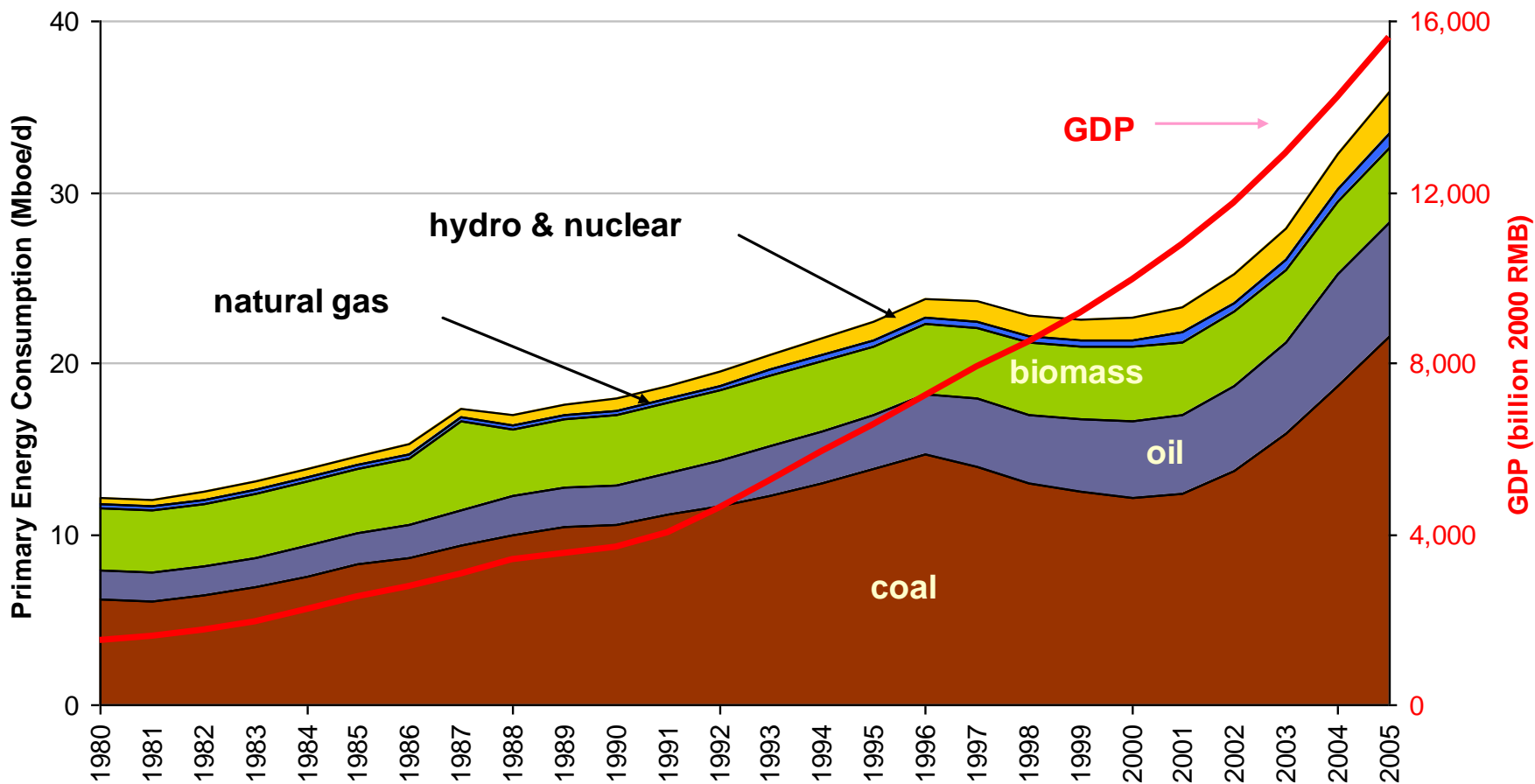
Emissions / Population Snapshot (2005)

CO₂e/person (tons)





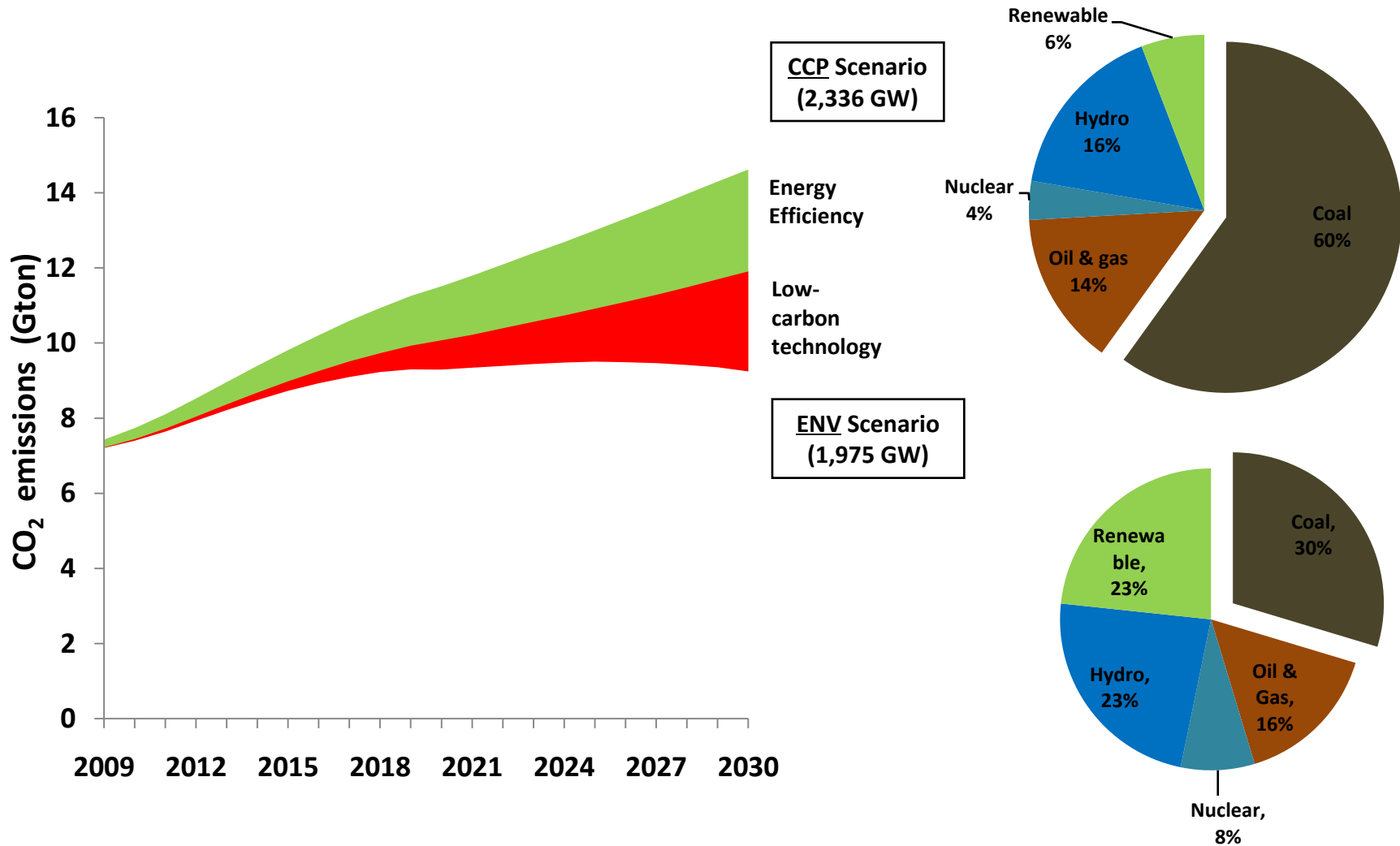
China: Energy consumption and GDP (1980-2005)



10x GDP, 3x Energy Consumption, but still a mixed result on energy intensity



China needs to half its energy intensity and power generation would need to shift dramatically by 2030

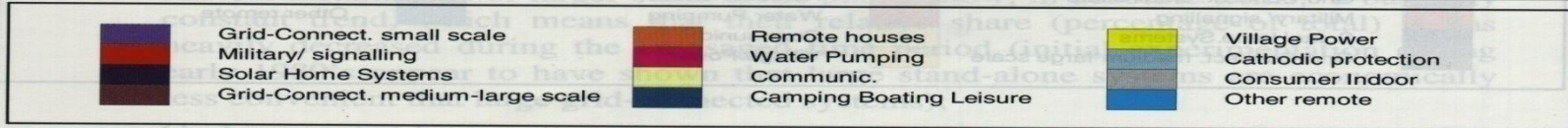
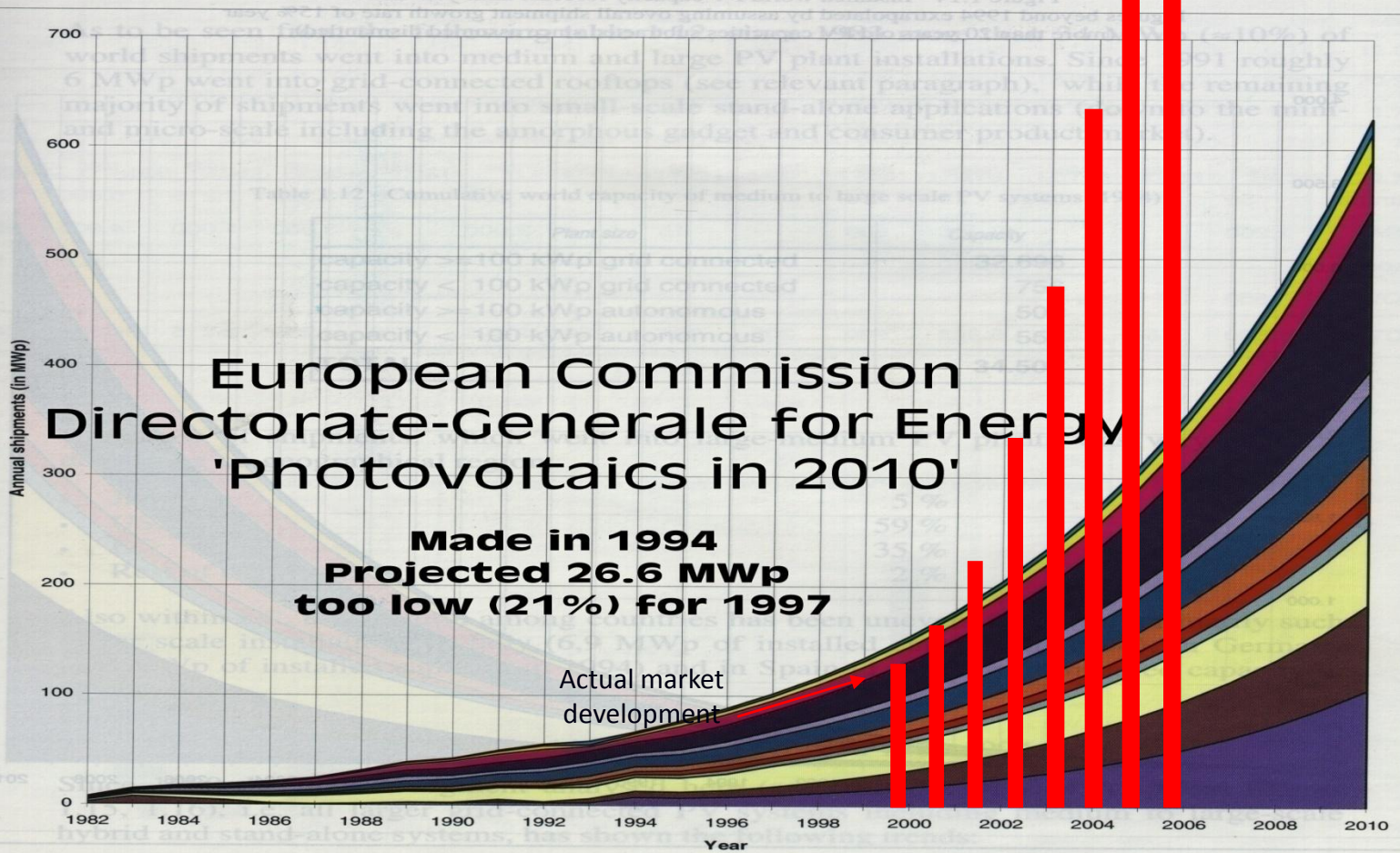




Beating 'expert' forecasts:

the value of learning by doing & getting on with the job

Figure 1.13 - World PV market forecast up to year 2010
(Figures beyond 1994 extrapolated by assuming overall market growth rate = 15% per year)



Solar Advertising in Kenyan papers

FANTASTIC
CHEAPEST
 cost per watt **XMAS**
OFFER

14 Watt Solar Panel

The 14 Watt Solar Panel from Sollatek is ideal for small home solar systems, to provide cheap power for lighting, radios and television.

- Metal frame for easy mounting and security
- More than 10 year expected life span
- 5 year warranty



Sollatek Solar

Available from:
Nairobi:
 Solagen Ltd - Tom Mboya Street
 M-Kays - Tom Mboya Street
 Domestic World - Tom Mboya Street
 Tsiki Electronics - Luthuli Avenue
 Njipi - Luthuli Avenue
 Bhatt Electronics - Luthuli Avenue
Embu:
 Gandhi Brother - Kenyatta Highway
Kitima:
 San Electricals - Oginga Odinga Road
Nyeri:
 Teo General Trading - Kimathi Way
 Luthuli Tailoring House - Kimathi Way
Mera:
 Mohamedi Moin - Moi Avenue
 American Solar Technology - Moi Avenue
Nakuru:
 Solagen - Moi Road
 N.P.I. - Kenyatta Avenue
 M.D. Vaid - Kenyatta Avenue
Kenia:
 Kenia Motor Spares - Garage Road
Kitui:
 A.M. Tailor - Main Road

MOMBASA: P.O. BOX 8181, TEL: 011 311715 / 312323, FAX: 312889
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 WITH
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World Cup Offer!!!

11,985/=


**14W Sollatek panel +
 60 AH Solar Battery +
 14" BW Television**

Amazing Prices on Sollatek
 6A Sollatek Regulator 2,870/= • 8W Sollatek light 895/= • Sollatek
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 E-mail: info@solagen.com web: www.solagen.com
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EMBU: Kenyatta Highway Tel: 608696 0733 850085
MERU: Moi Avenue (Opp. Kobil) Tel: 20366 **KISUMU:** OPENING SOON

**DARKNESS SHOULDN'T COME IN THE WAY
 OF ENLIGHTENMENT**



Step into the light. Install a Solarex Solar System from Chloride Exide in your home and see the light. Ideal for powering TV, radio and general lighting.

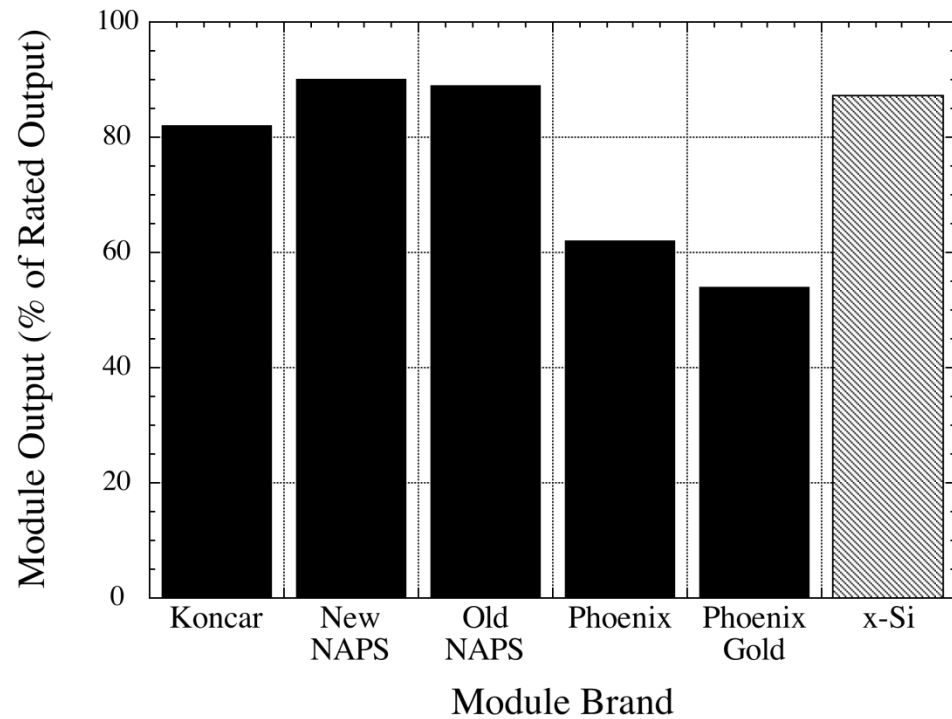
See the light

CHLORIDE EXIDE SOLAREX

Contact your nearest Chloride Exide Dealer:
 Nakuru - Tel 234104 Kisi - Tel 30963 Mera - Tel 25413 Nyeri - Tel 522211 Mombasa - Tel 492926
 Embu - Tel 60826 Nyeri - Tel 2891 Kisumu - Tel 22301

70 Shillings (Ksh)/dollar: 12,435 Ksh = \$170

Performance Comparison by Brand



Sample Size:

Koncar =	31
New NAPS =	33
Old NAPS =	32
Phoenix =	5
Phoenix Gold =	10
x-Si =	17



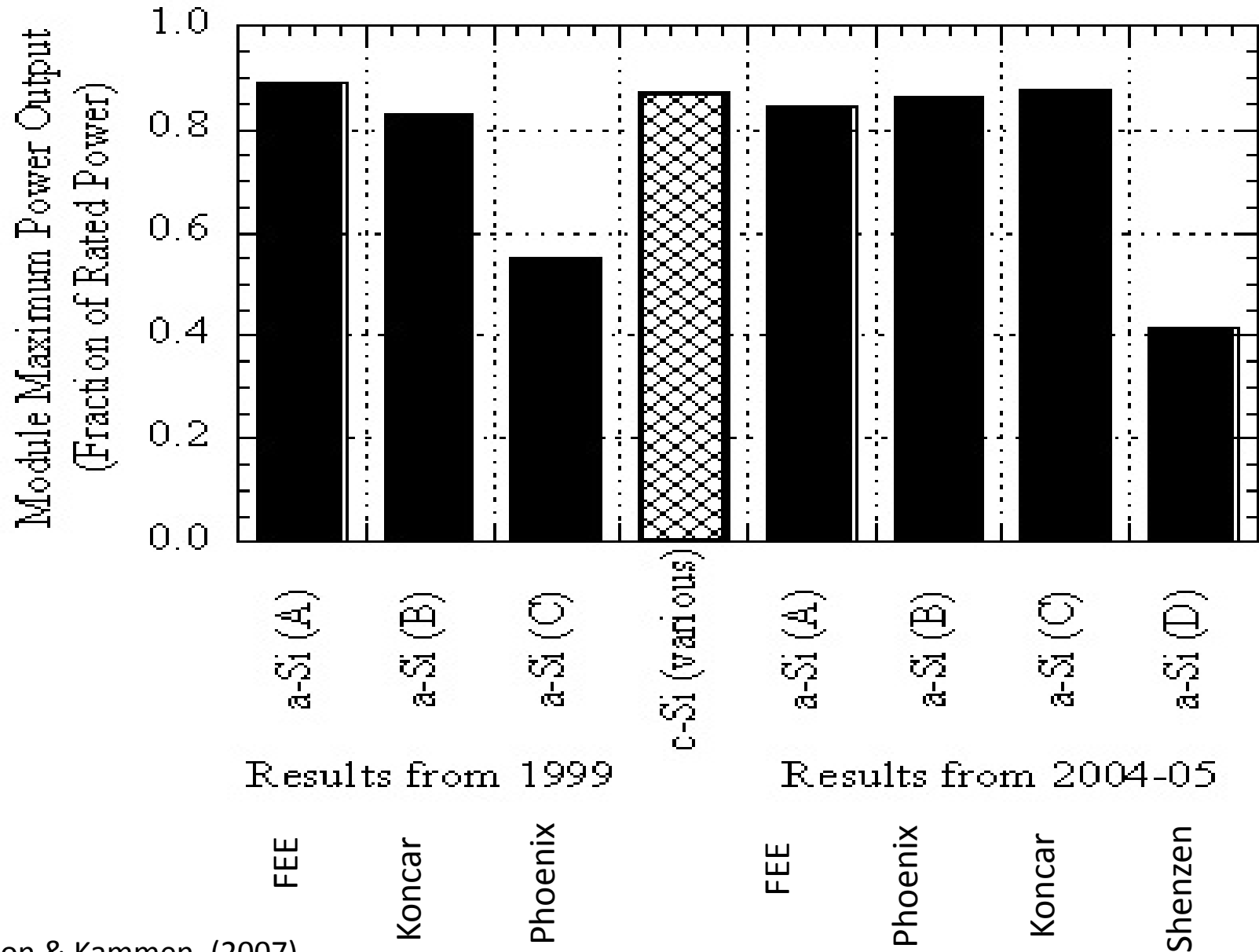
We sell

SOLAR PANELS

Made by Free Energy Europe, France

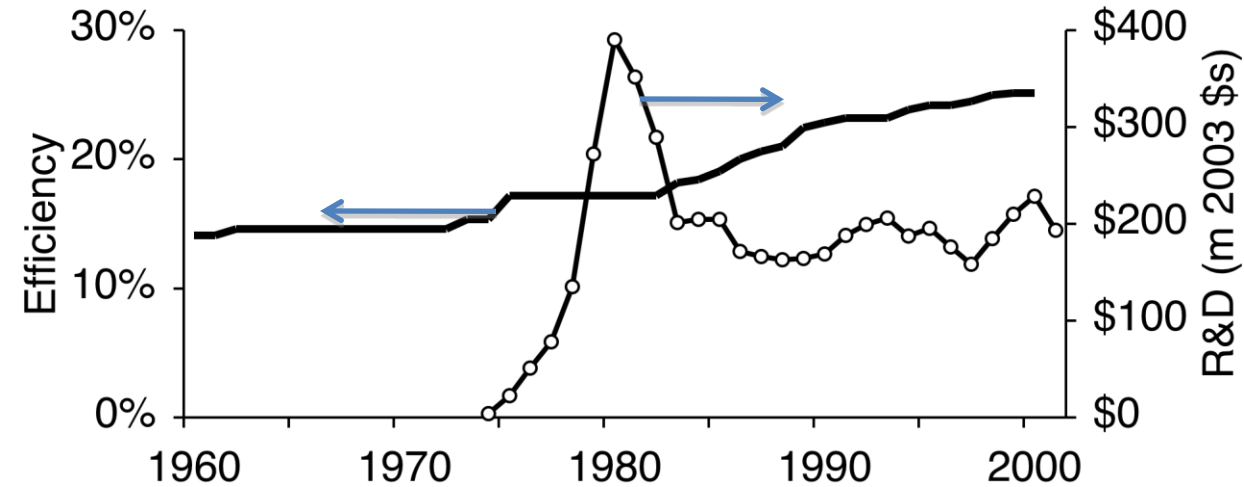
Best tested in Kenya, 1999-2000

A New 'Bad Actor' Enters the Market



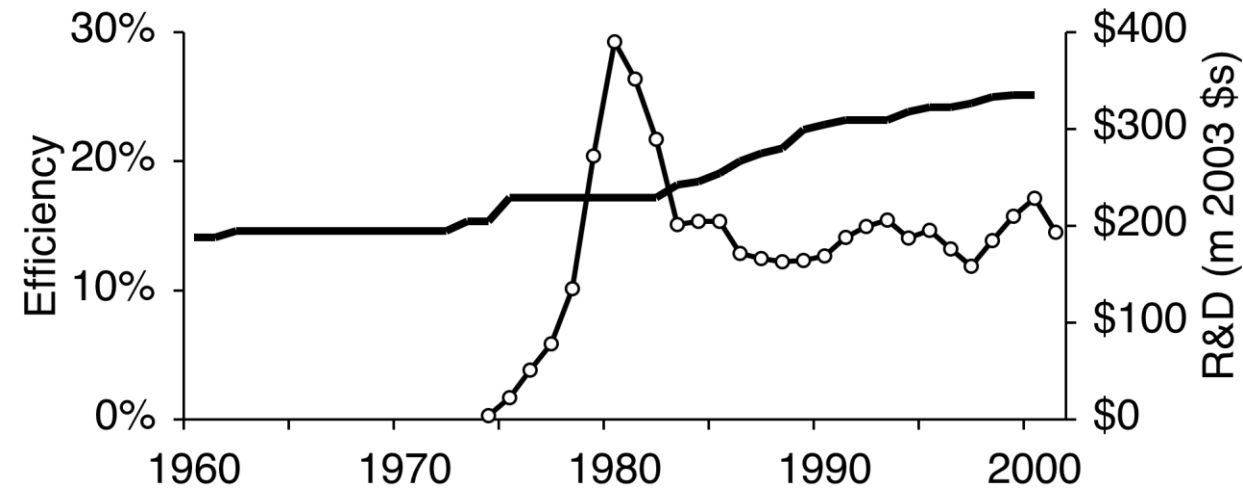
From R&D to Deployment

R&D Funding → Commercial change → Cost reductions



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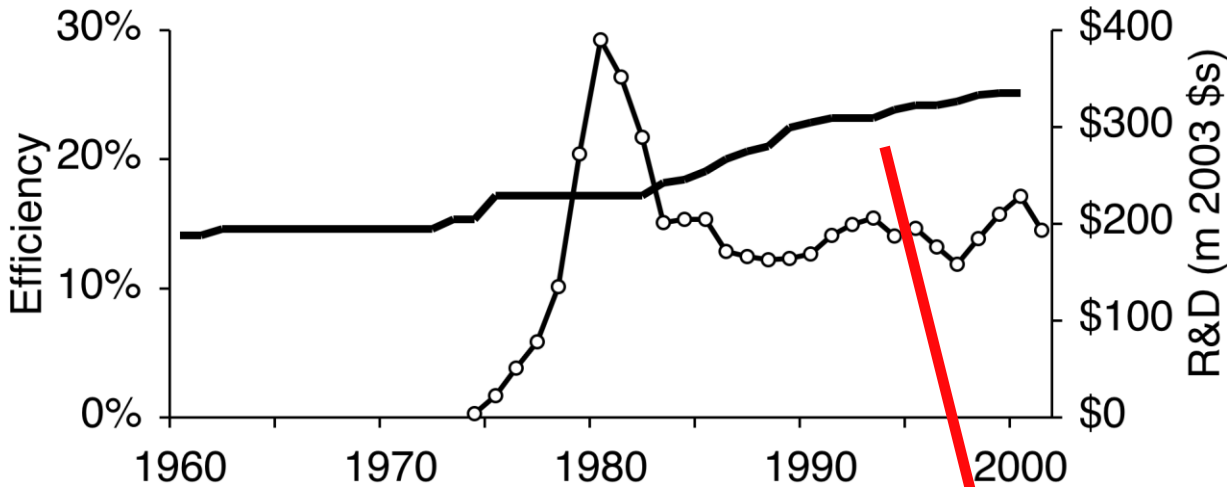
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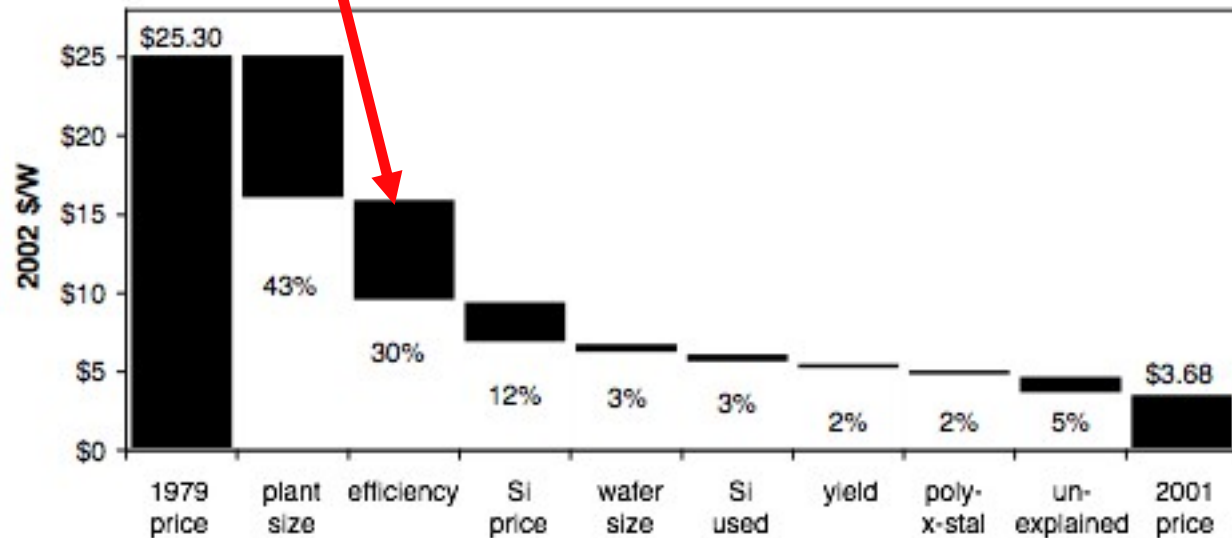
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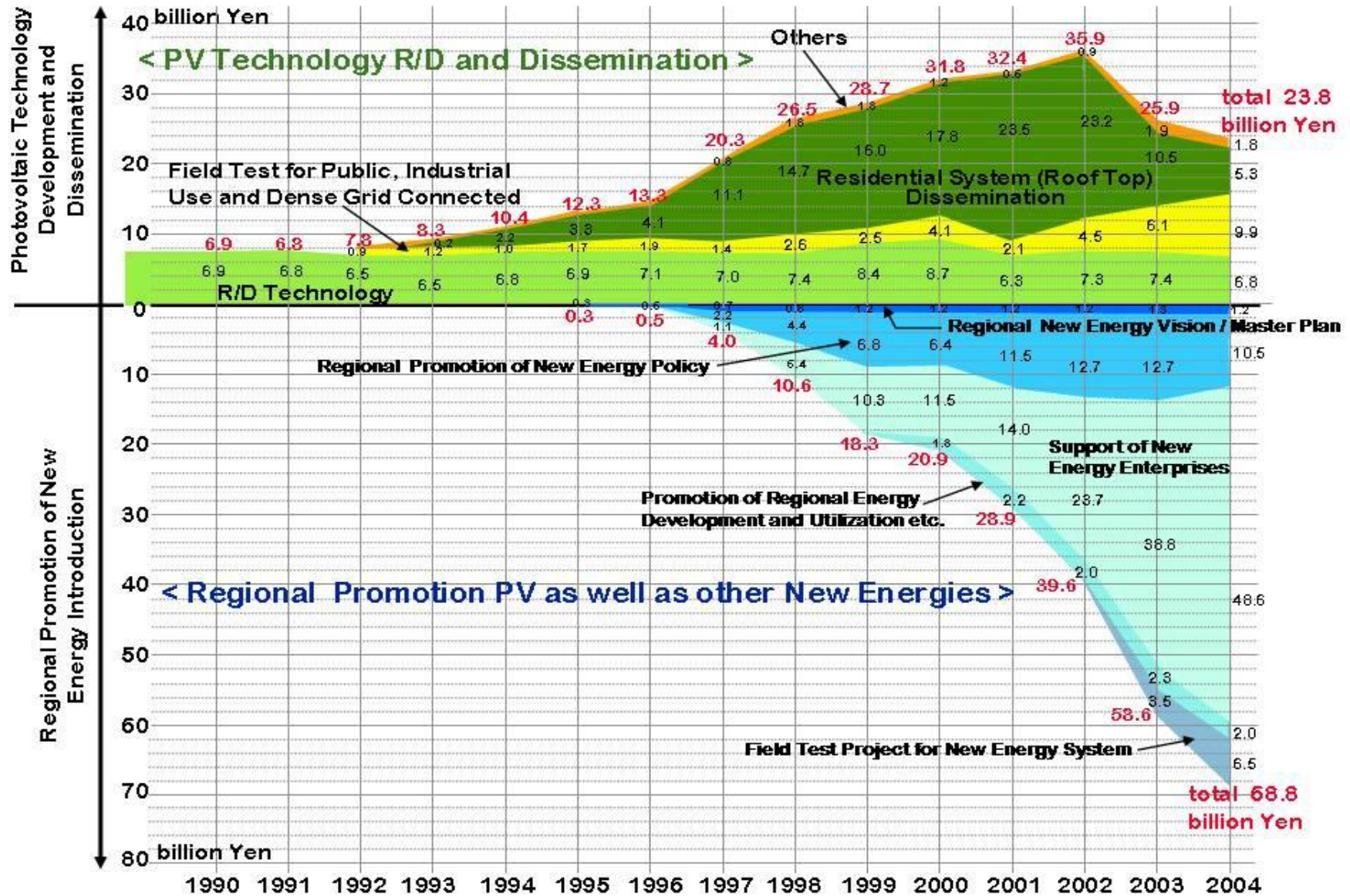
...efficiency improvements account for 30% of the cost reductions in PV over the past two decades.

INCREASE IN PLANT SIZE EVEN LARGE IMPACT





An important model: the Japanese “Sunshine” Program





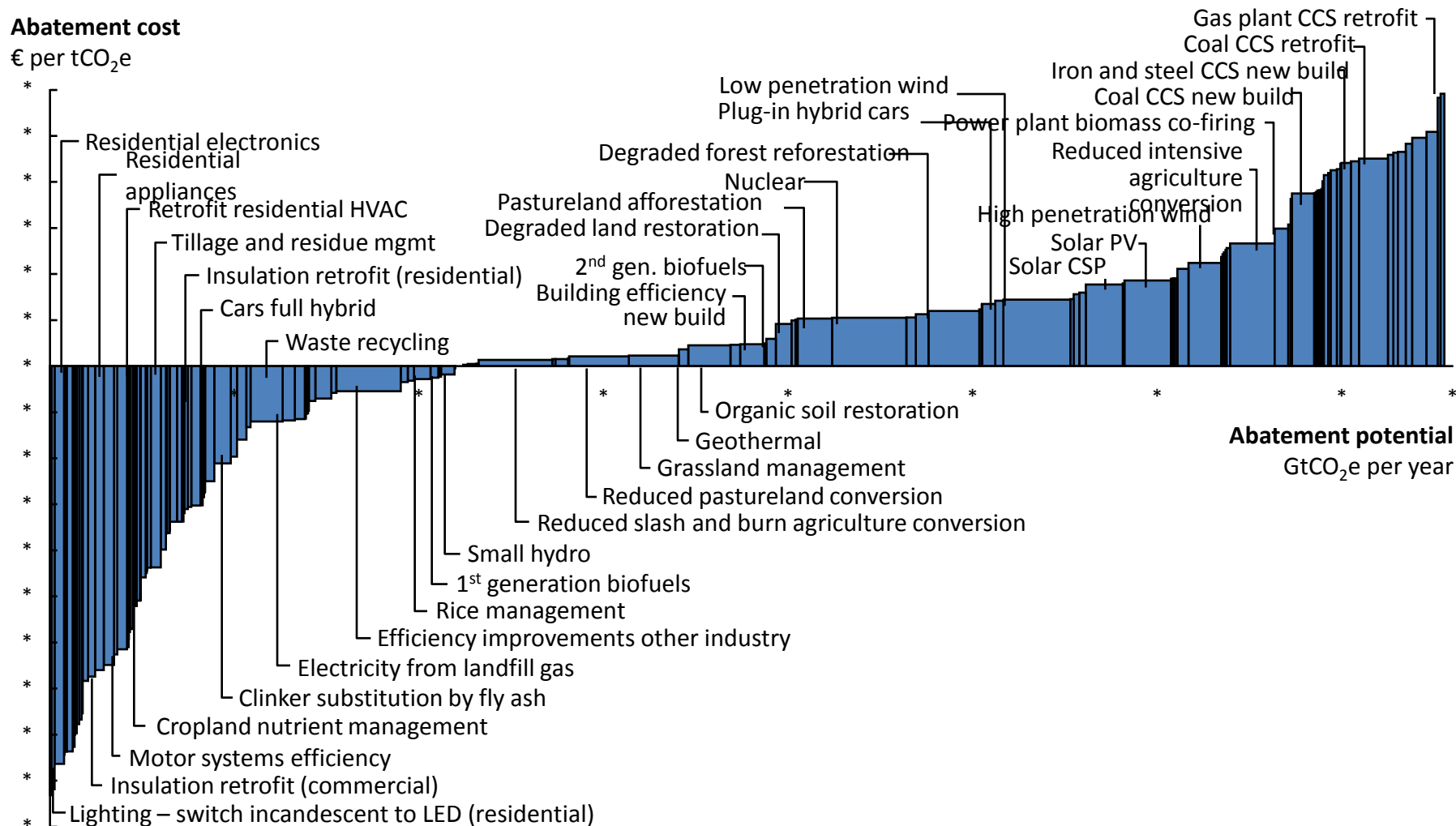
Energy Efficiency Training, Orinoco



Christian Casillas (Energy and Resources Group PhD student)



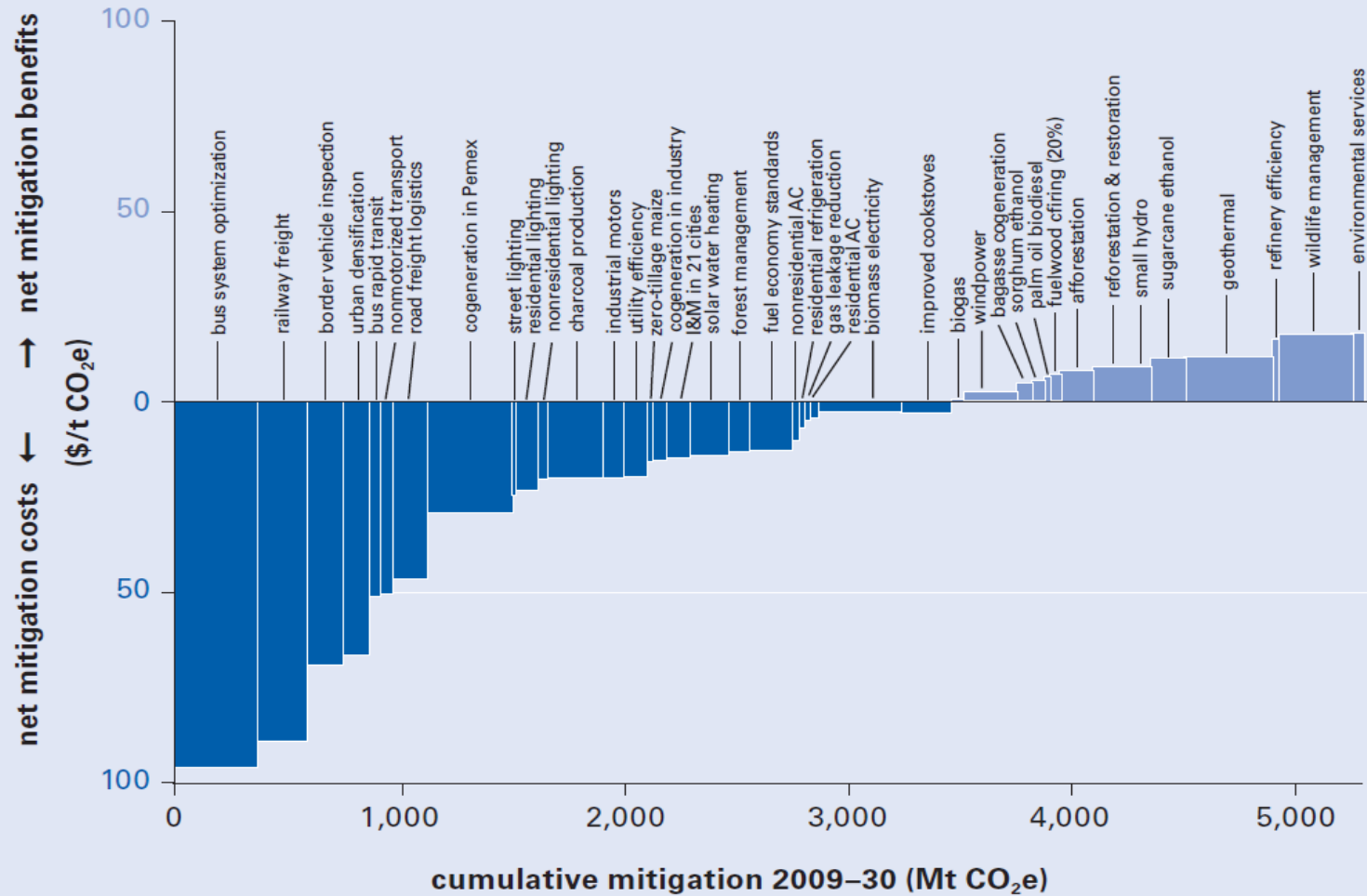
Global Greenhouse Gas Marginal Abatement Curve





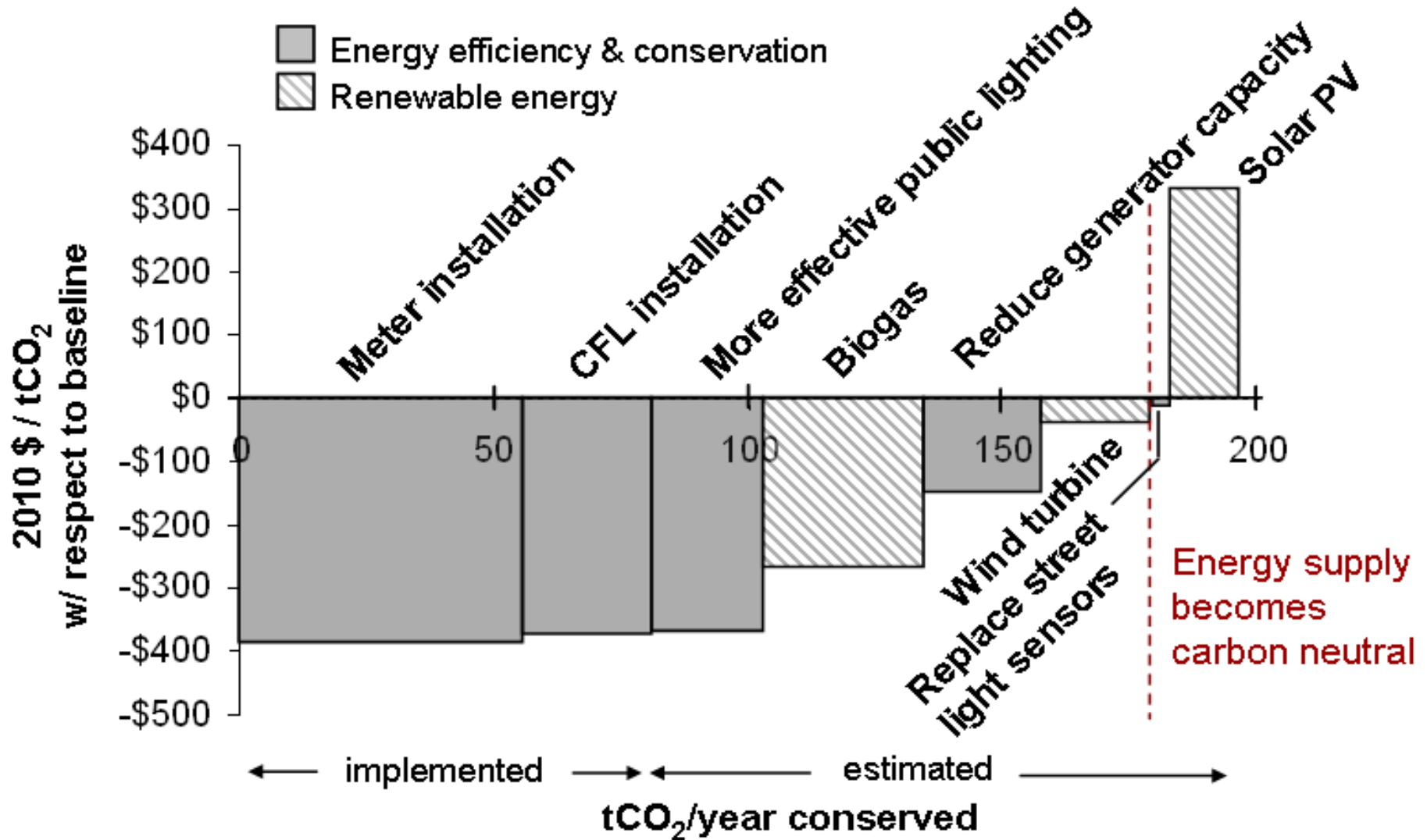
Global Greenhouse Gas Marginal Abatement Curve: Mexico Low-Carbon Study

Figure 2 Marginal Abatement Cost Curve





Greenhouse Gas Marginal Abatement Curves: Communities of Orinoco & Marshall Point, Nicaragua

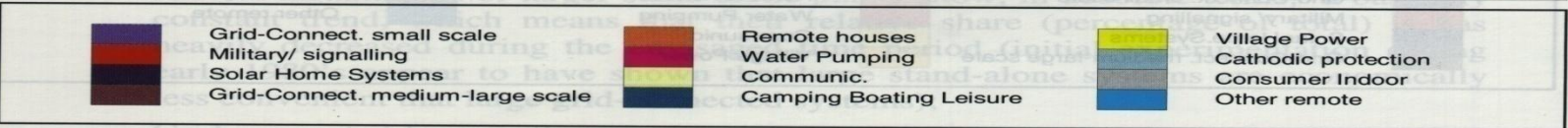
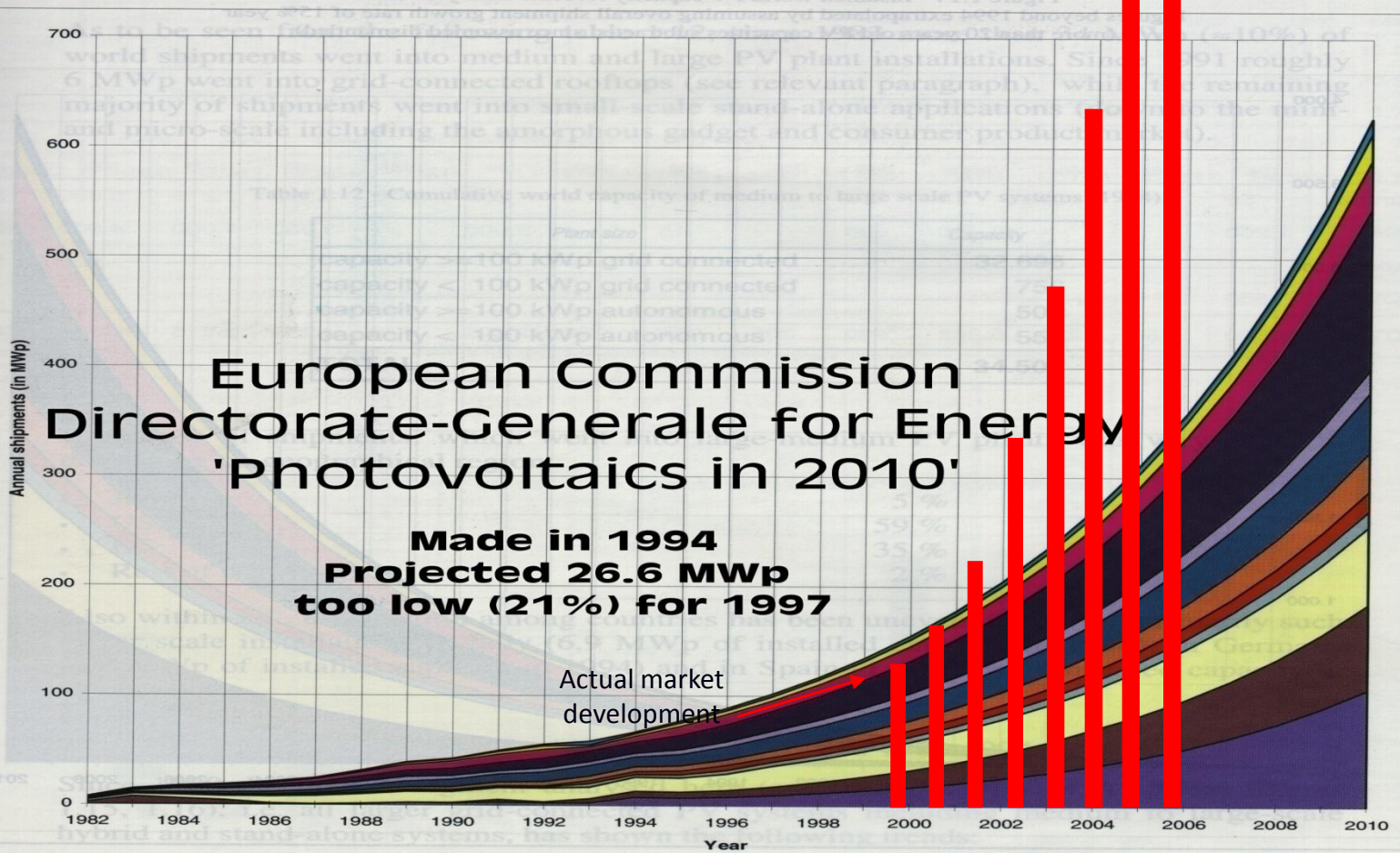




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