TOTAL ECLIPSE

OR, WHAT HAPPENED TO THE SUN?

DRAFT IRP 2010

PRESENTATION 29th NOVEMBER 2010

Mandate

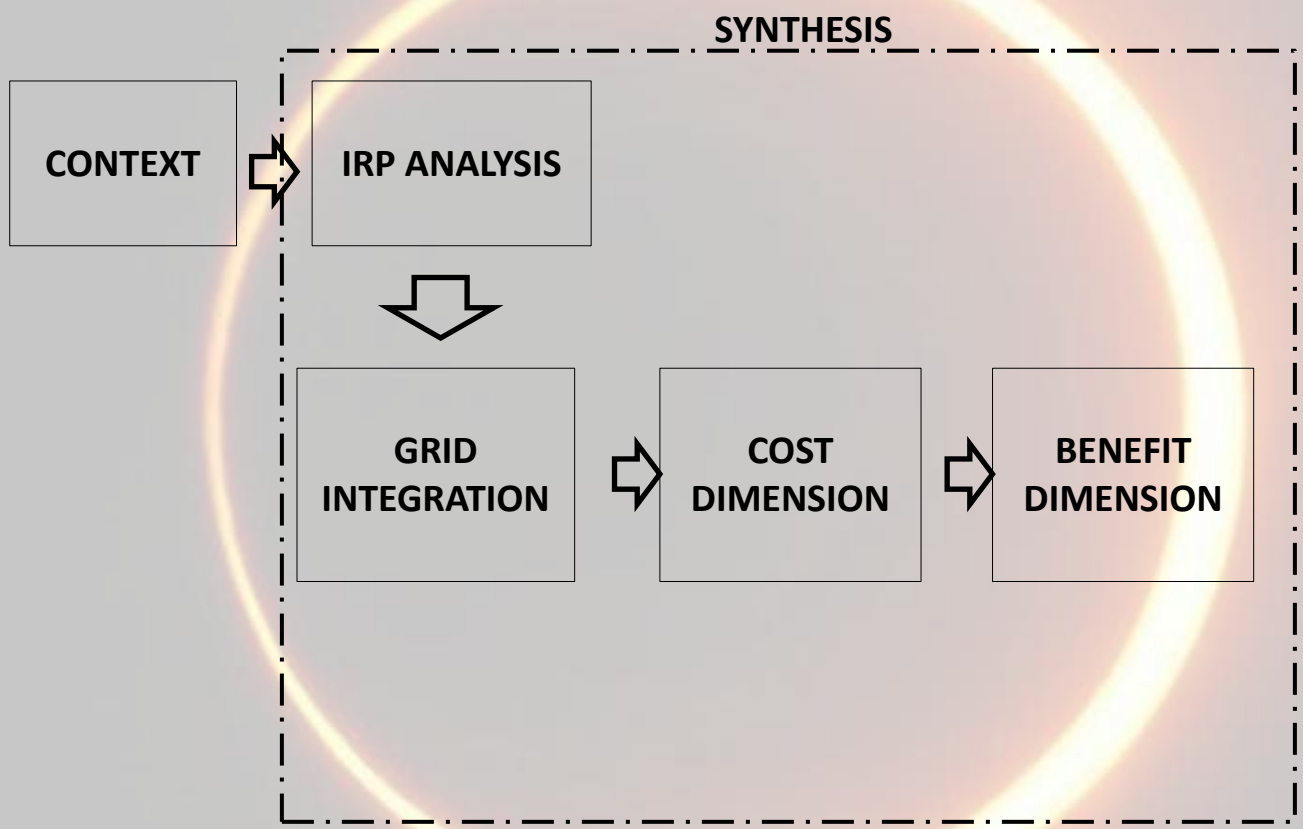
SUSTAINABLE ENERGY SOCIETY OF SOUTH AFRICA (SESSA)

REGIONAL MEMBER OF THE INTERNATIONAL SOLAR ENERGY SOCIETY (ISIS)

CORPORATE MEMBERS	**– 490**
PV / SOLAR MEMBERS	**– 147**
AFRECA	**– 9**
SOLAR WATER HEATING DIVISION	**– 459**
TOTAL	***1105***

PHOTOVOLTAICS IS THE SECOND LARGEST RENEWABLE ENERGY SECTOR IN SA BY INVESTMENT AND TURNOVER

Presentation structure



SOLAR:
"The most promising source of energy"

Eicke Weber: Head of Solar - Fraunhofer Institut Germany

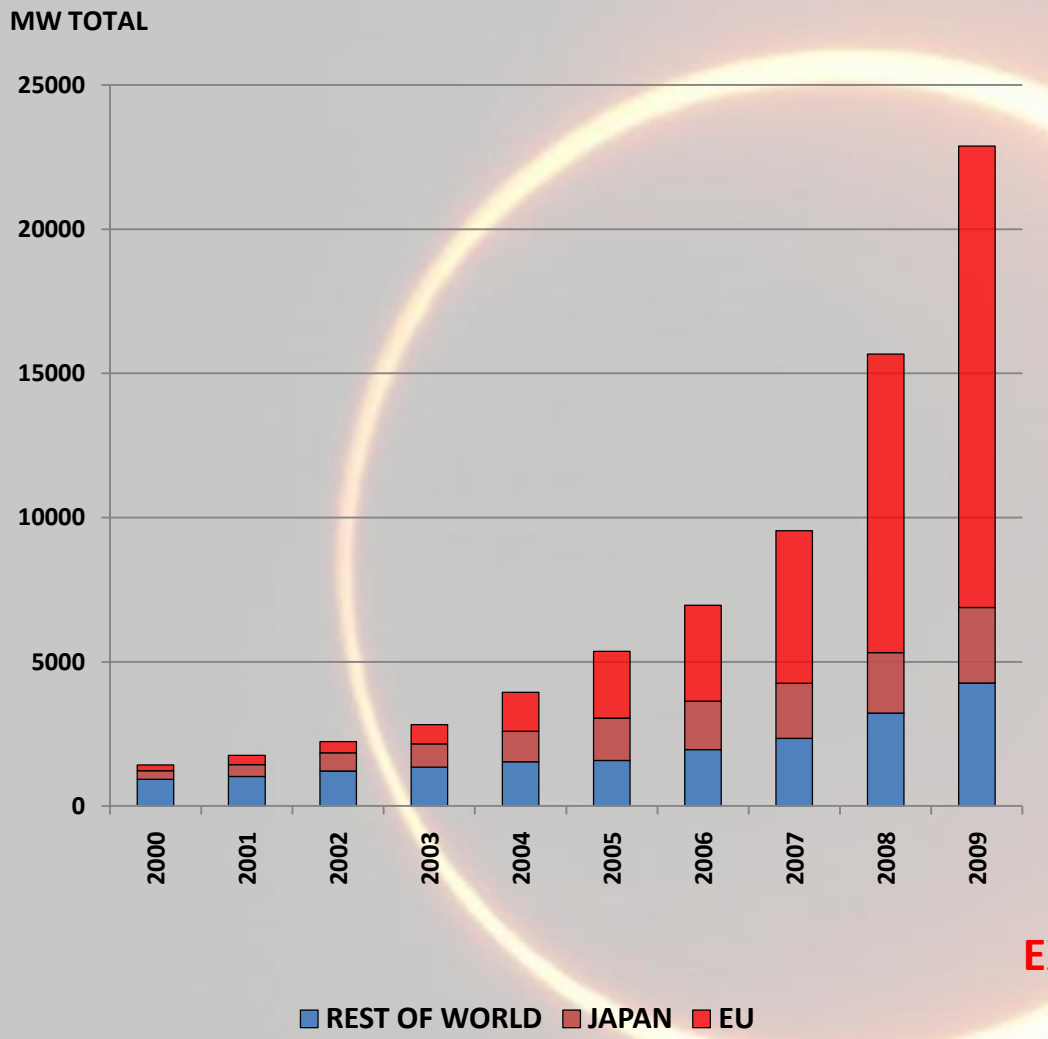
Interview – August 2010:

- **"Solar will grow by factor 50 until 2020"**
- **"Solar has the highest cost reduction potential"**
- **"By 2030 Solar will be cheaper than any other source of energy"**
- **"Solar will soon overtake wind"**

Politics must decide:

"either more nuclear or more renewables = old and new doesn't fit"

Development of PV



KEY DRIVERS

- Government incentives
- Rising energy prices
- PV Technical improvements
- Tightening emission controls
- Electricity demand > supply
- Fast Rollout

EXPLOSIVE GROWTH 40% p.a.

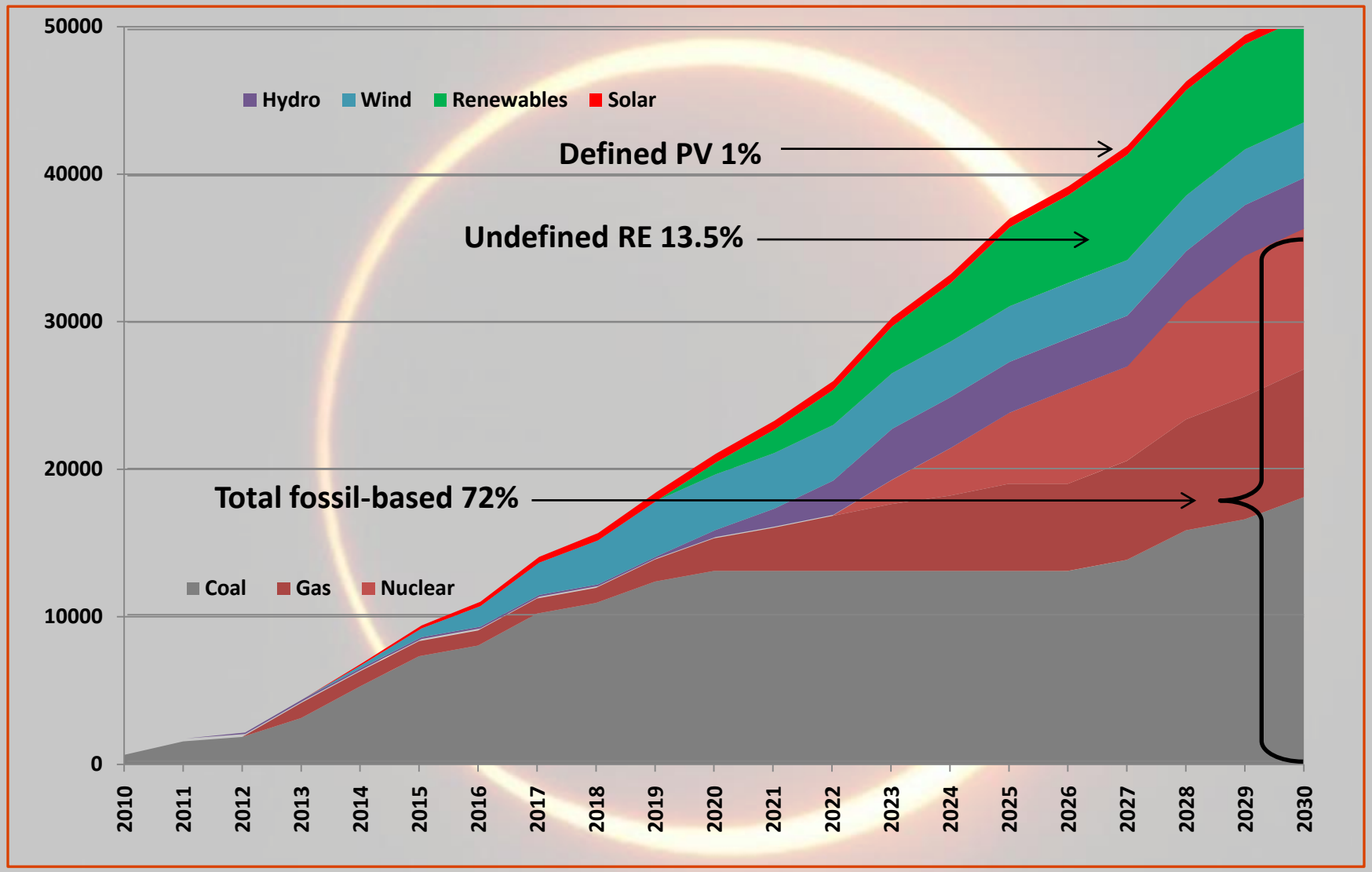
Source: EPIA (European Photovoltaic Association)

Characteristics of PV

1. Mature, commercially available and reliable
2. Industry has huge long term growth-potential
3. Consistent cost reductions
4. Easy grid integration, grid support
5. Scalable from 50W to +100MW
6. Zero emissions, water usage
7. Very high employment ratio & economic stimulation

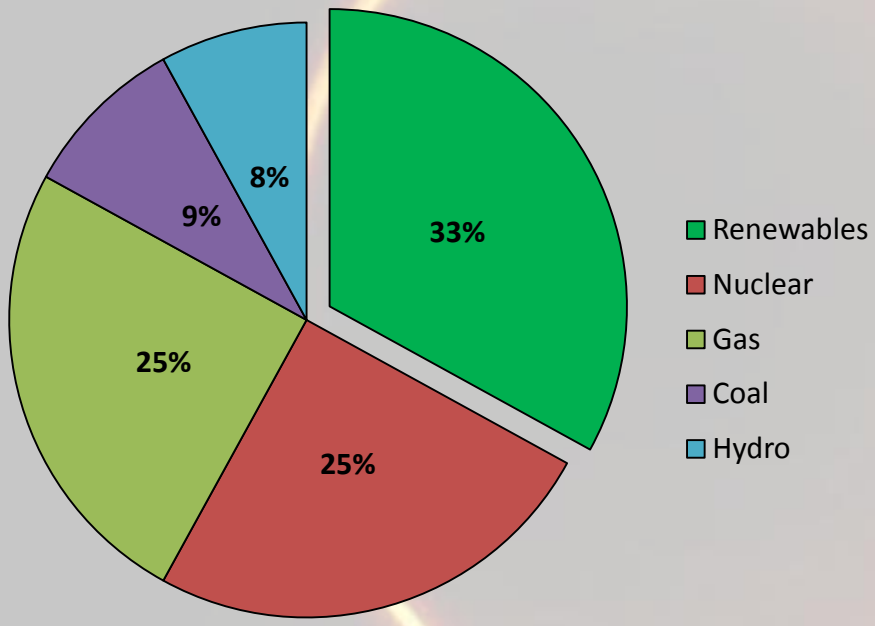
Cumulative New Capacity Contribution*

** Excl. "Decommissioning"*

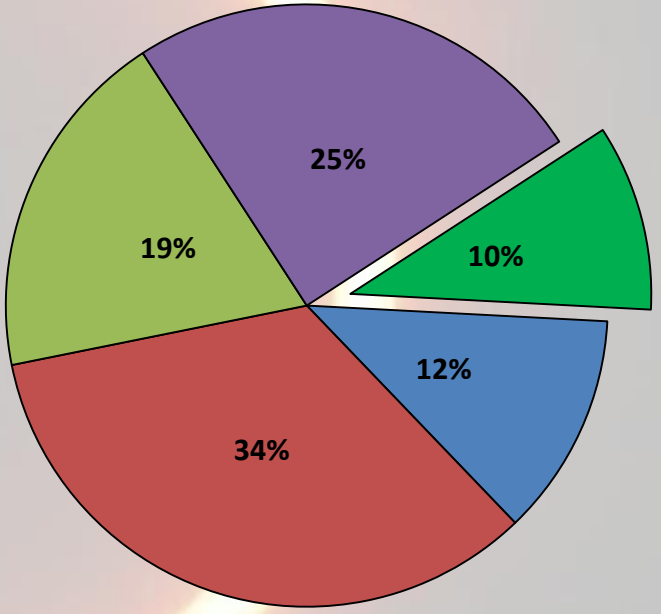


New generation allocation

CAPACITY 2030



GENERATION 2030



IRP2010 and other allocations to 2016

	Table 33		Table 12	NERSA	PV
	CSP	CSP & PV	REFIT other	REFIT 2	
2010	0	0	0	0	0
2011	0	0	0	150	50?
2012	0	0	100	150	85?
2013	0	0	125	150	75?
2014	100	0	100	0	35?
2015	100	0	0	0	0?
2016	0	100	0	0	100

Commitments have not been brought into the IRP2010 revised balanced scenario

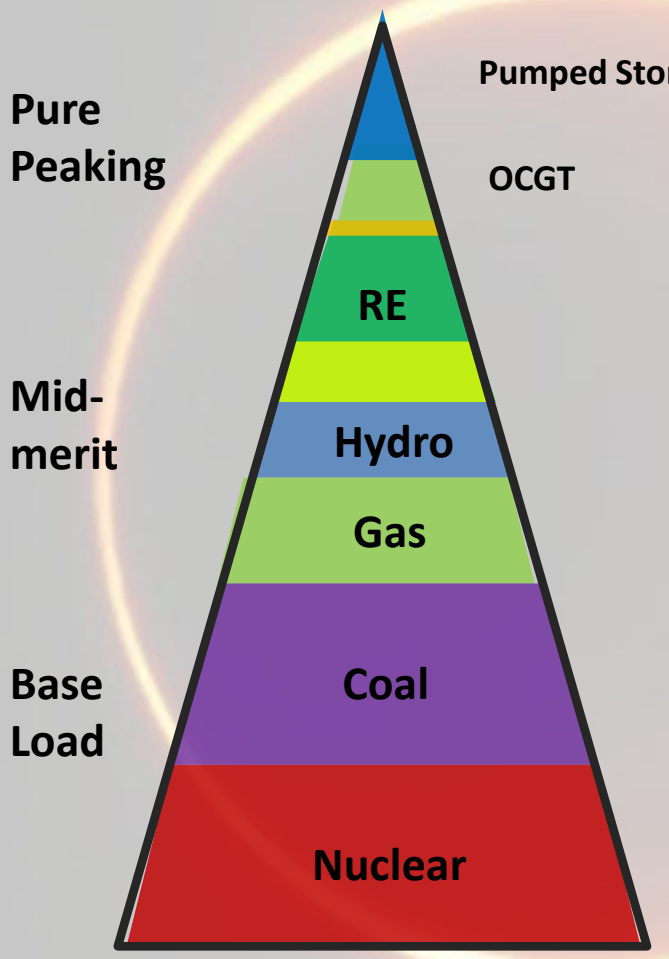
PV needs an early start and consistent growth

Technical characteristics of PV power plants

- Energy availability factor >95%
- Accurately forecasting of output – rolling 24hrs as for coal
- Fleets of power plants minimally influenced by short-term weather
- High capacity factors where radiation good – +60% in desert
- Easy grid integration : PV power plants are modular – match line capacity
- PV power plants rollout rapidly – 1 year start to finish

Why no allocation?

IRP2010 generation system structure



PV inserted as an afterthought

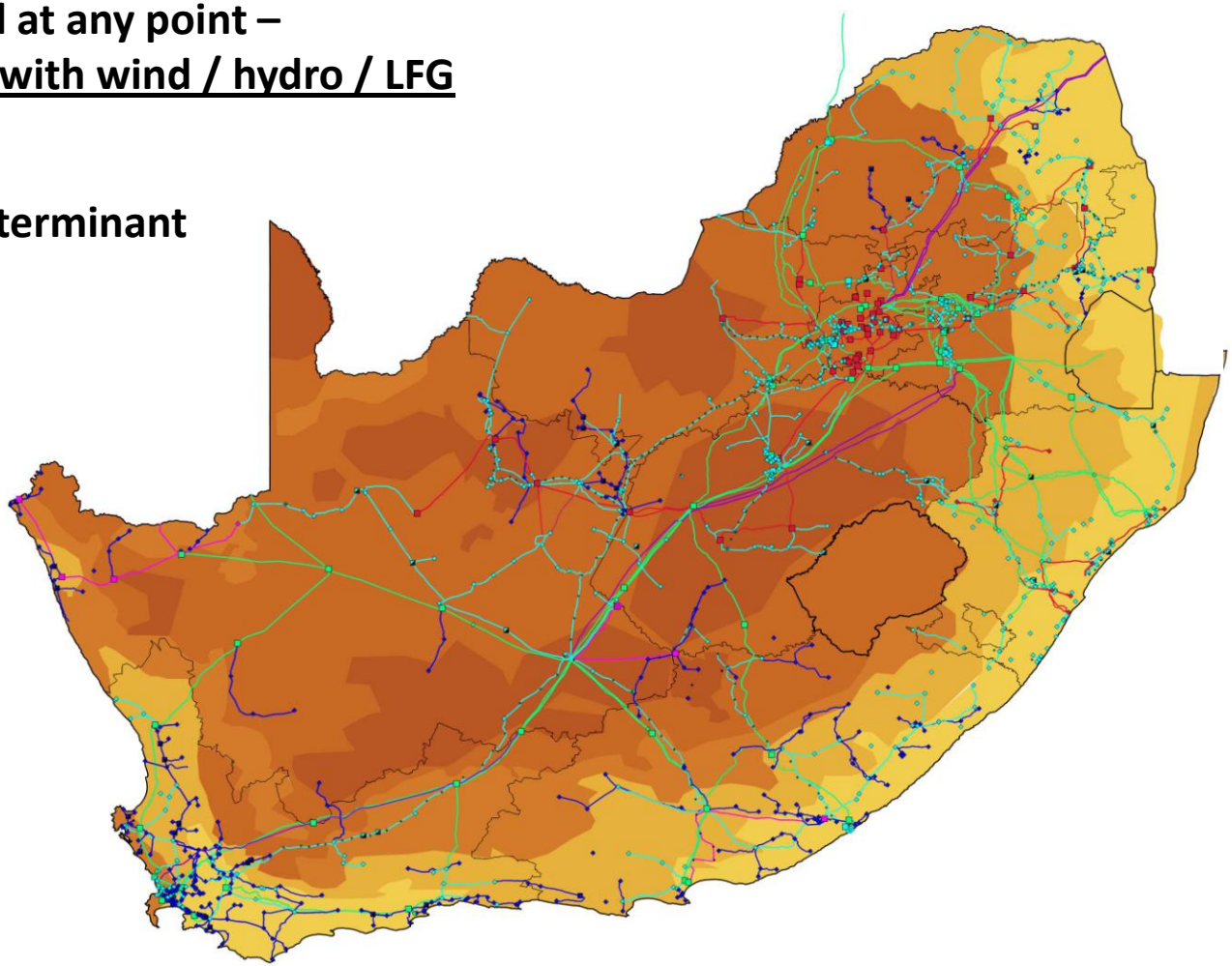
PV power plants treated as mid merit in USA!

Resource & location

- **PV can be located at any point –**
  <u>Not constrained as with wind / hydro / LFG</u>
- **Network is key determinant**
- **Load matching**

Smaller plants
-> local loads

Larger plants -
> line capacities



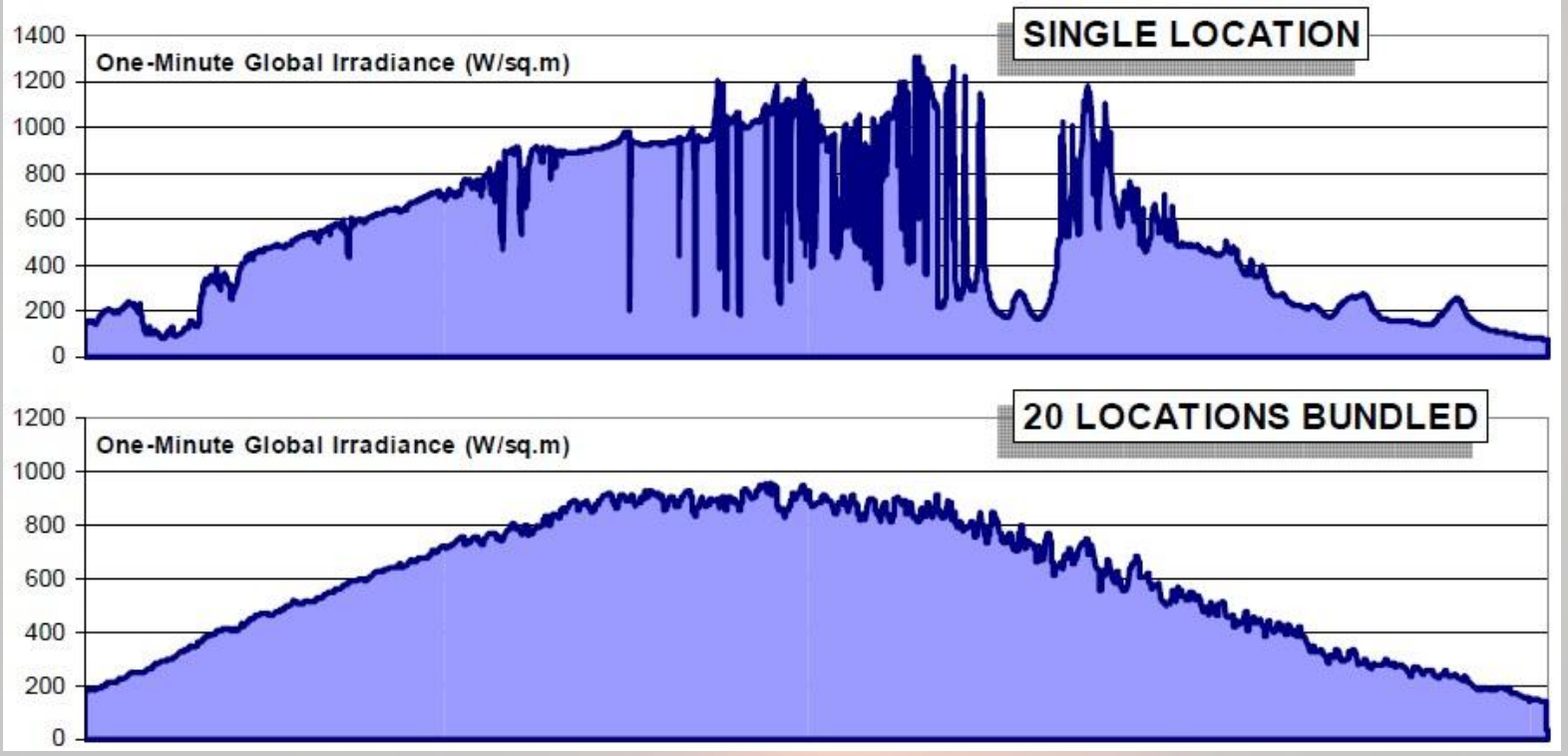
Rollout

- PV most rapid rollout of renewables
- Construction 10MW < 4months
- But, permitting up to 12 months
- Only PV can meet 2013 target!
- NO ROLLOUT WITHOUT ALLOCATION

Capacity credit

High capacity credit in desert - Denver 59%, Pueblo 63%

Capacity credit much higher for a fleet of PV plants



Perception that PV expensive wrong

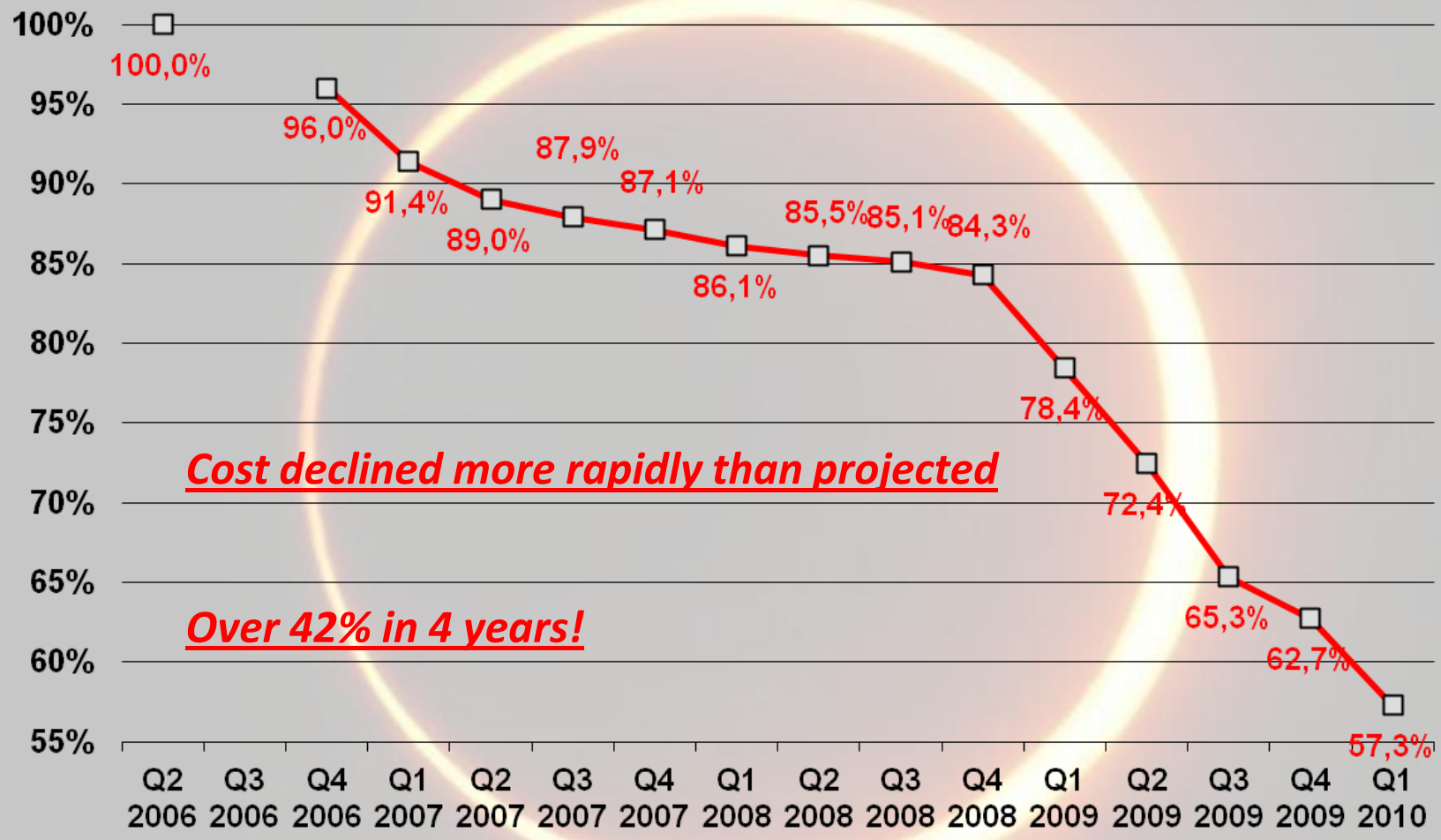
- PV <u>costs</u> governed by international & local prices
- REFIT set by NERSA consultants - costs & acceptable rates of return

Already out of date

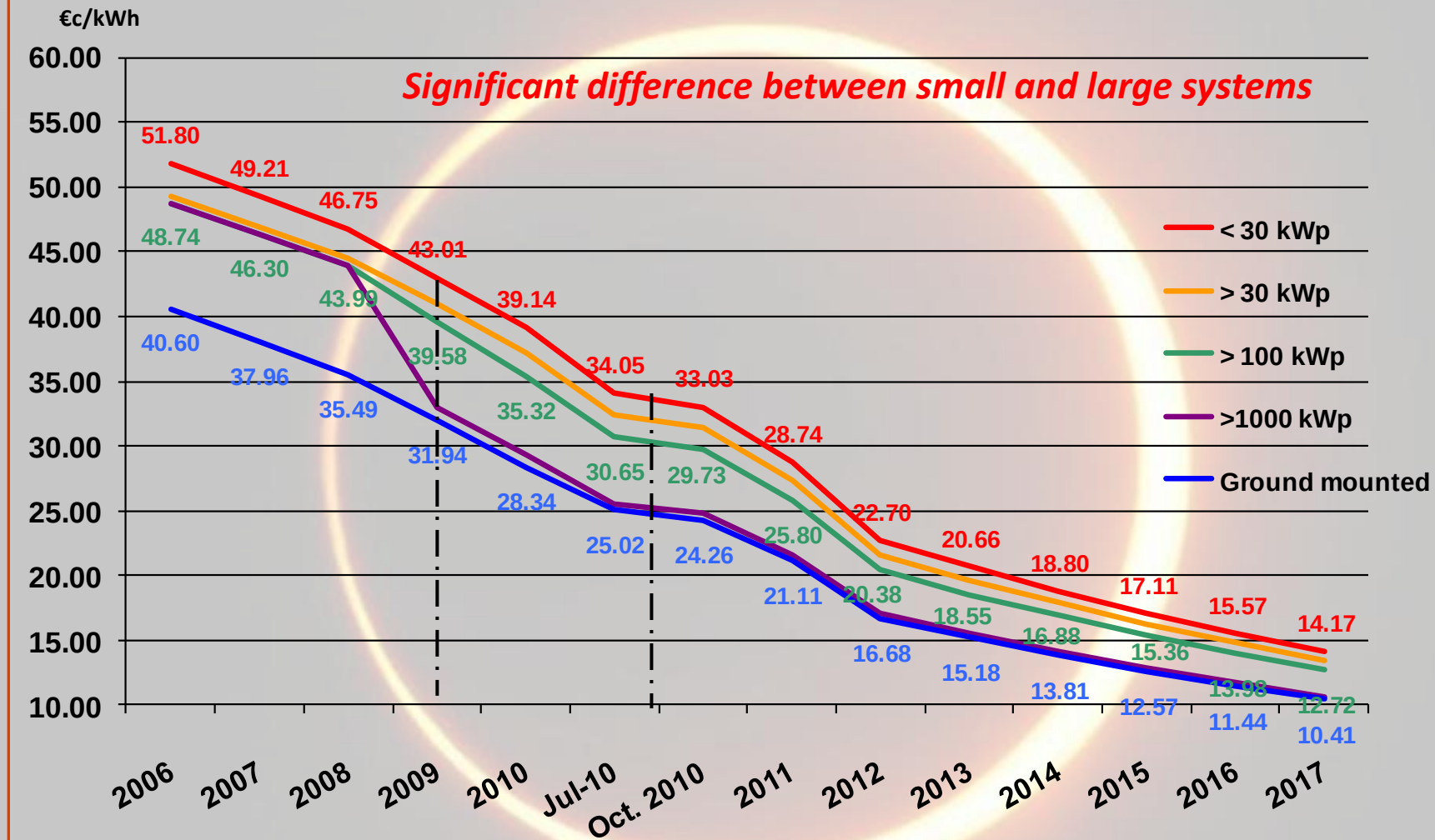
<u>PV costs assumed equal to REFIT tariff – not the case</u>

- *SA 5% OCGT R2.80 /kWh* — *German PV REFIT 2010*
- *SA mid-merit stations R1.18/kWh* — *German PV REFIT 2014?*

Module cost reduction 2006 - 2009



System cost projections in 2010



PV – huge further cost reduction potential

1. **Learning curve**
   -> doubling in production = 18 - 22% cost-reduction
2. **Panel efficiency**
   -> massive world wide R&D
3. **New / improved production technologies**
   -> constant improvement through massive R&D efforts
4. **Economies of scale from GW-factories**
5. **Disruptive / new technologies**

FRAUNHOFER INSTITUTE (August 2010):

In 2050: PV will be the most important source of Energy worldwide

Benefits - Environmental

EMISSIONS REDUCTION
During plant operation

- **Zero CO_2**
- **Zero NOx and SOx**
- **Zero Particulates**

ENERGY

- **Rapid energy payback *<2 years whole plant***
- **No energy for fuel transport**

Benefits - Environmental

VISUAL INTRUSION

- **Low profile – can be easily screened**

NUISANCE

- **Completely silent, no radio / TV interference**

BIODIVERSITY

- **No bird strikes, no foundations**

WATER

- **Water use 0.06l per kWh**

Economic benefits

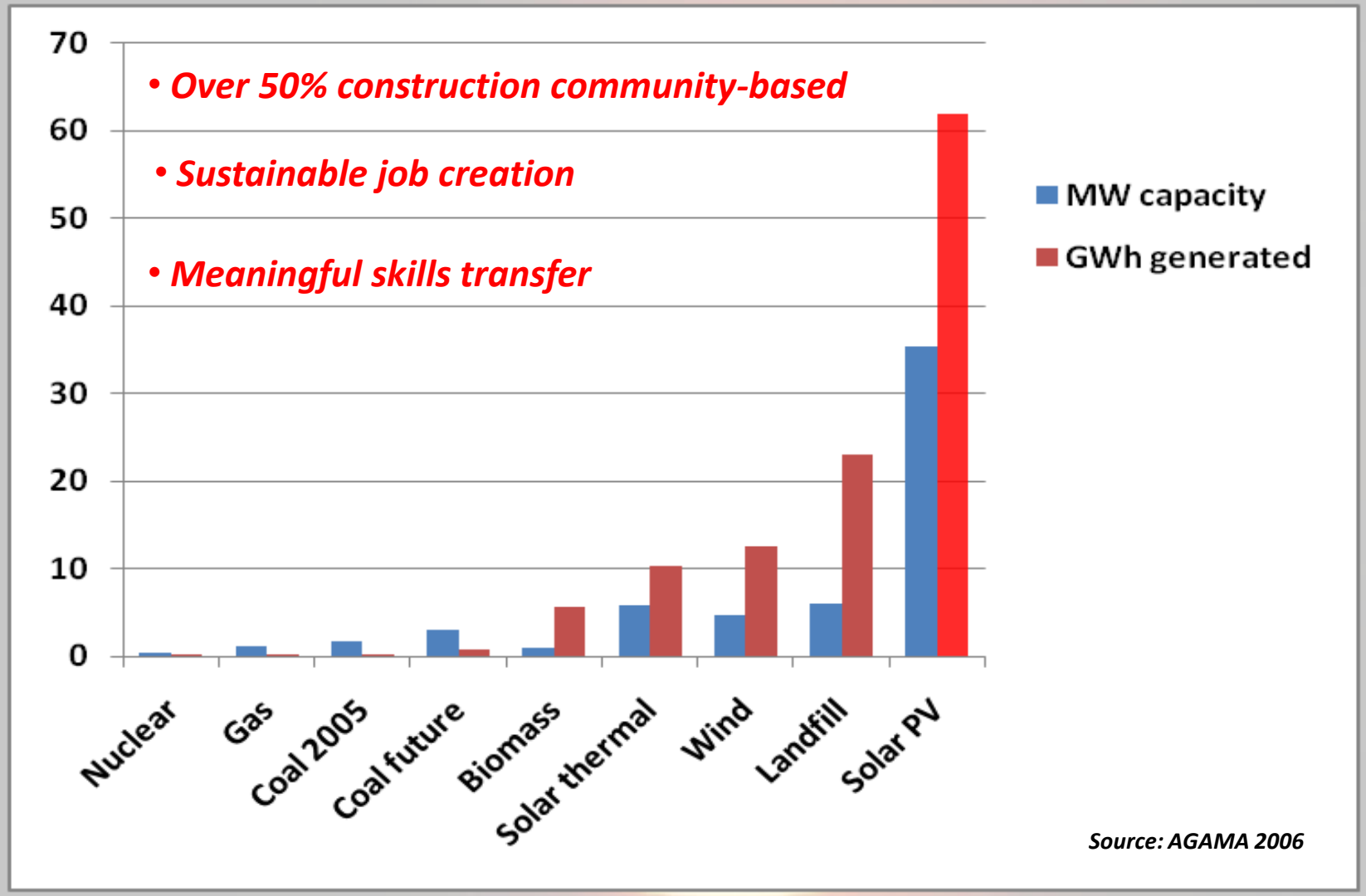
High initial local content – upstream and downstream benefit

- *Fencing, security systems, rack manufacture*
- *Cable, junction and combiner box manufacture*
- *Inverter and transformer systems integration*

High final local content – upstream benefit

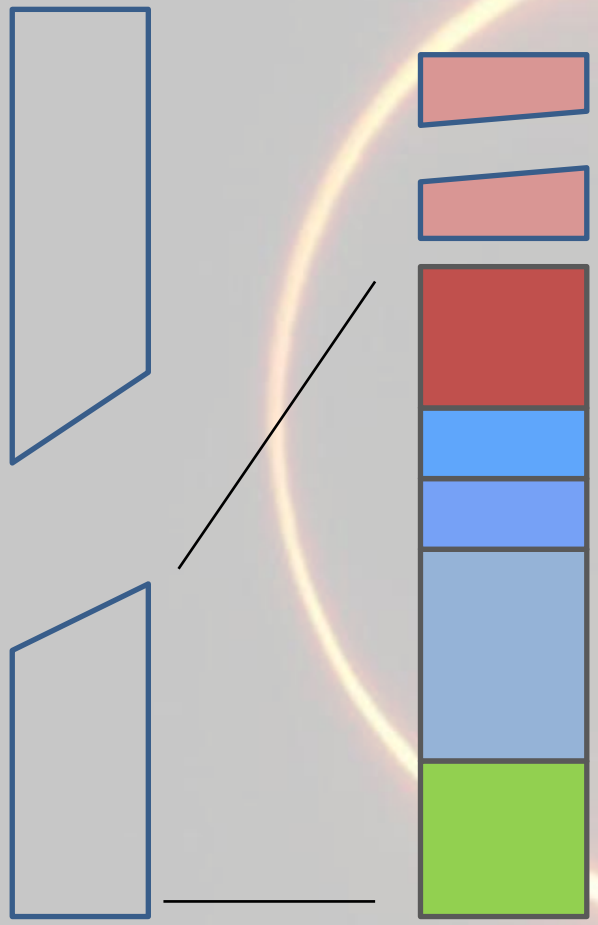
- *Module assembly*
- *Cell and wafer manufacture*
- *Thin film module manufacture*

Benefits - social



Benefit value

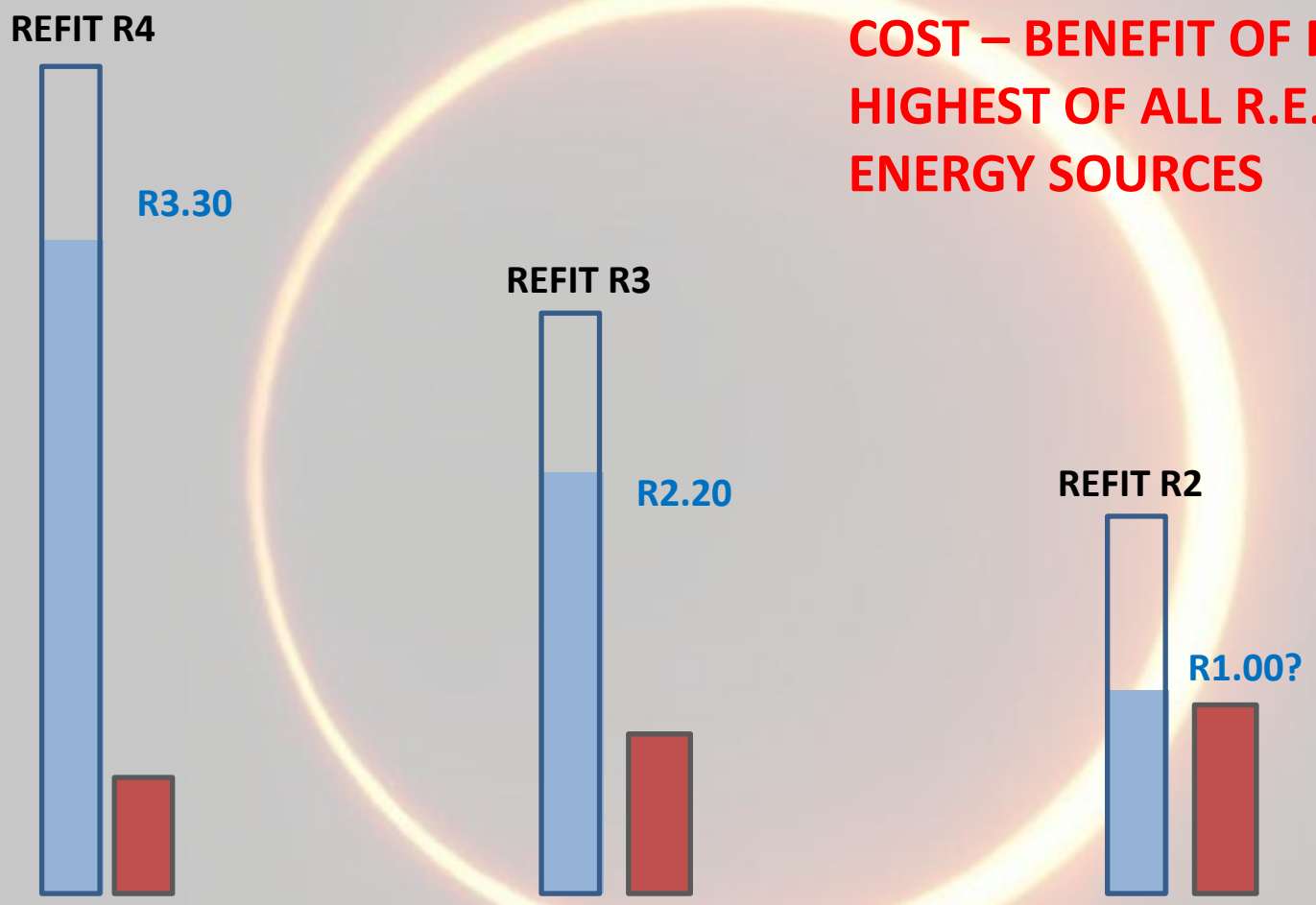
NET COST = REFIT – BENEFIT VALUE



All unique benefits
Conservatively R0.70/kWh

**** – See IRP2010 Input parameters***

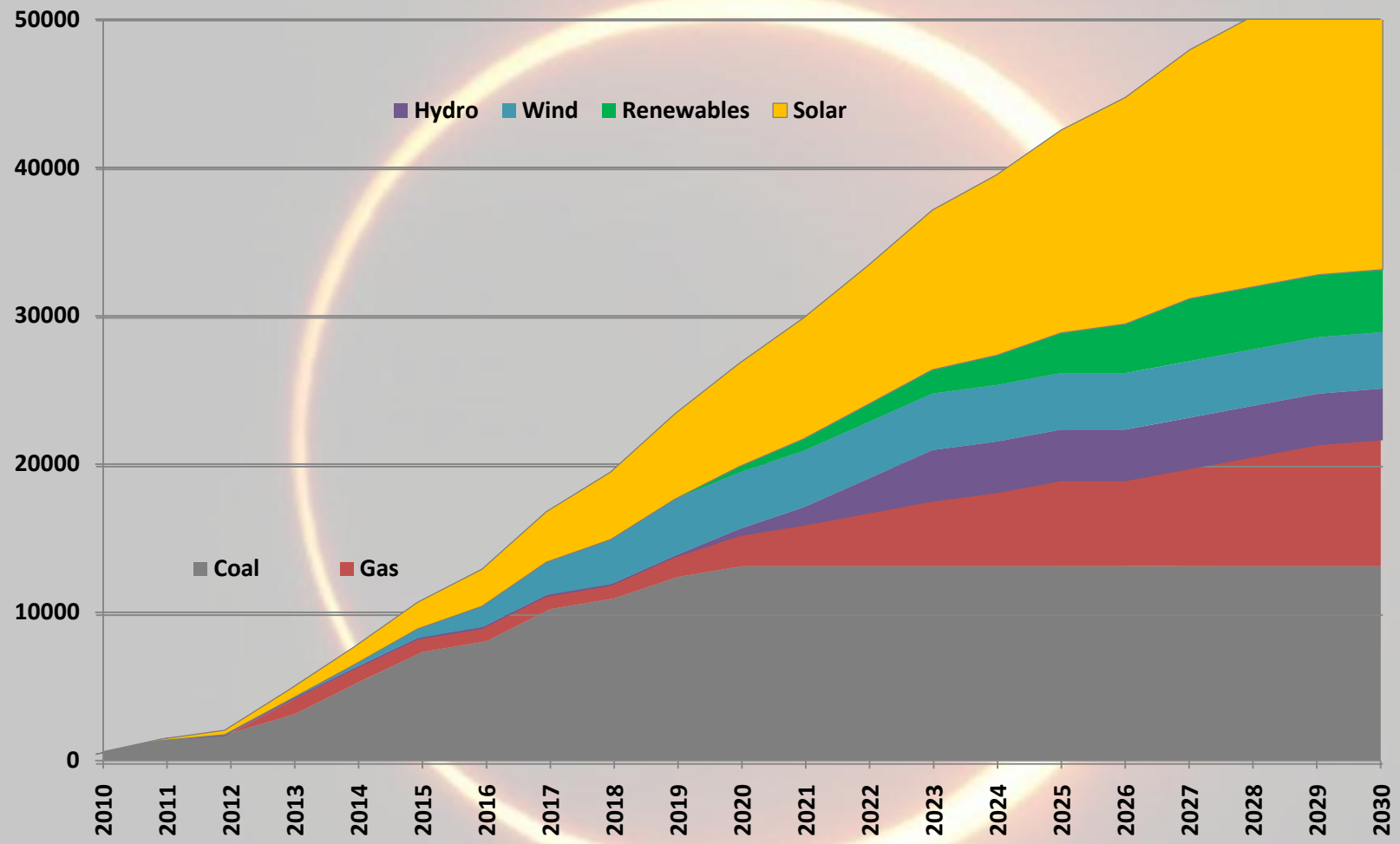
Net cost = REFIT – benefit value



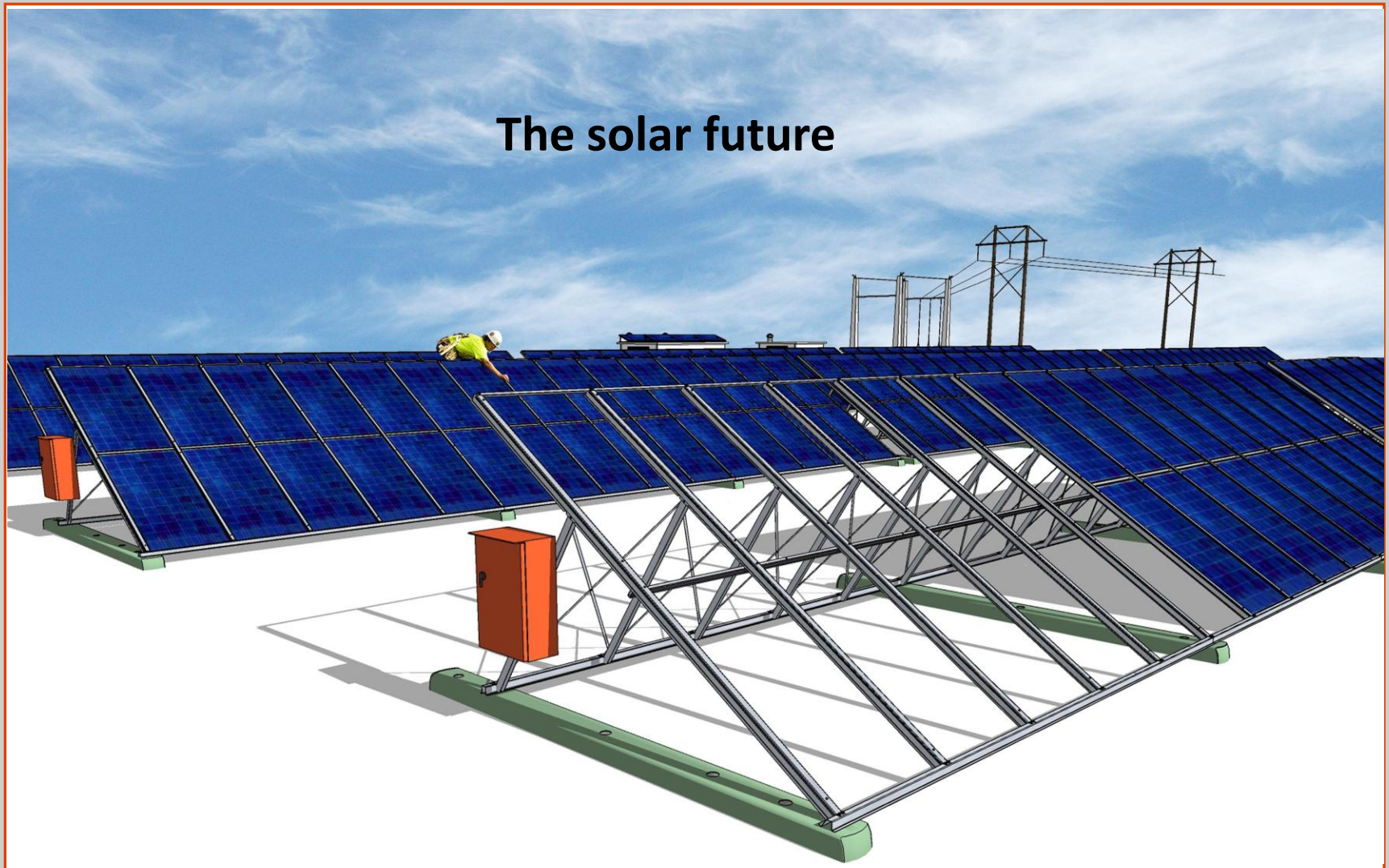
COST – BENEFIT OF PV HIGHEST OF ALL R.E. ENERGY SOURCES

Benefit value rises as capacity increases

The solar future

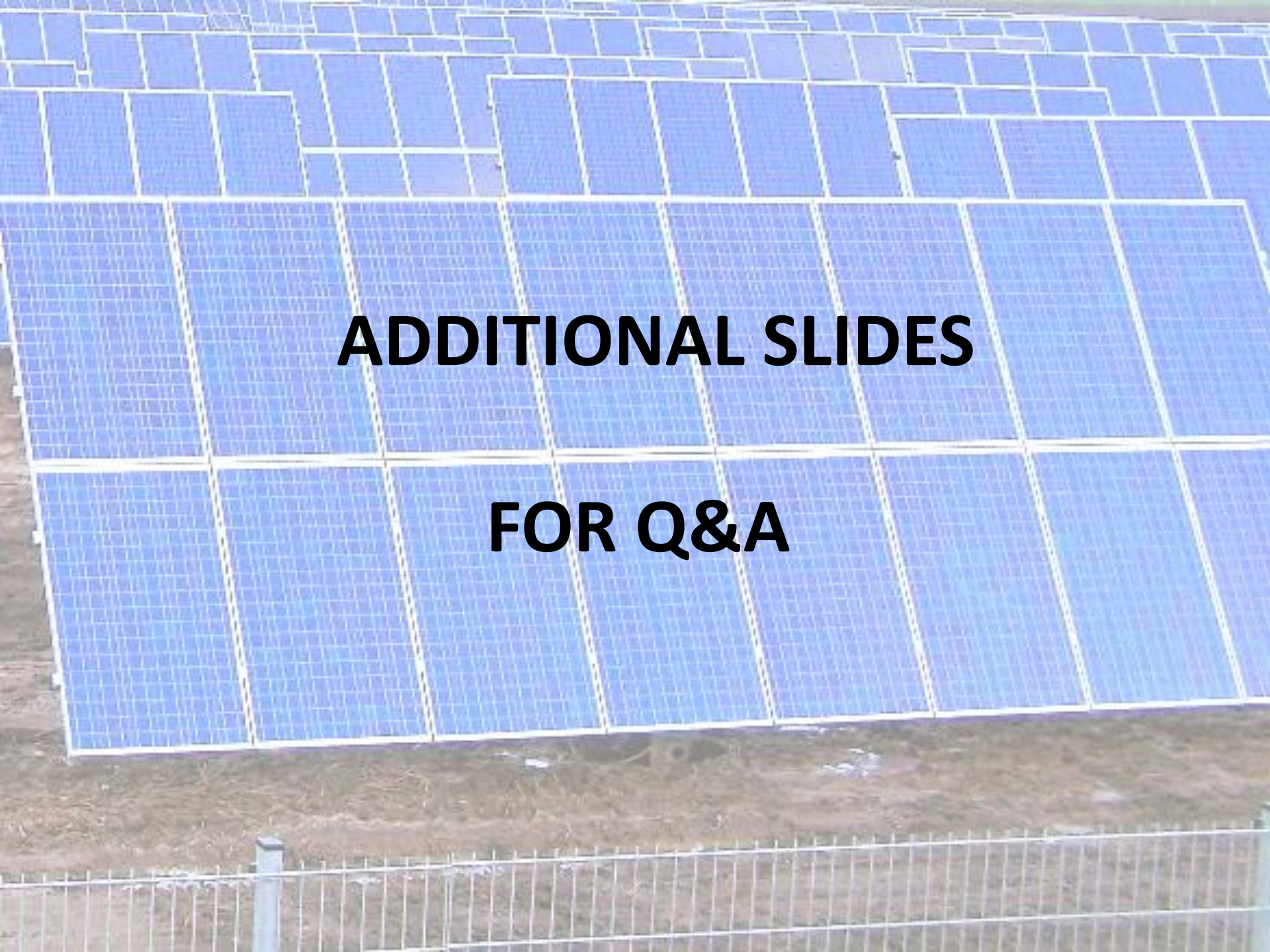


The solar future



retosolar
LARGE SCALE SOLAR


SESSA
Sustainable Energy Society Southern Africa
retosolar
THANK
YOU



ADDITIONAL SLIDES

FOR Q&A

Grid integration of PV

- **PV provides high quality electrical energy**

  Frequency within <1%; Low harmonics

- **PV based on next-generation inverters – usher in smart grids**

  Ability to ride-through faults – stabilise line

  PV provides real time control of power factor / voltage

  Can operate in islanded mode

- **Much easier to integrate than wind**

  Grid integration at 11kV to 132kV

  Next to load centres – no long interconnect lines

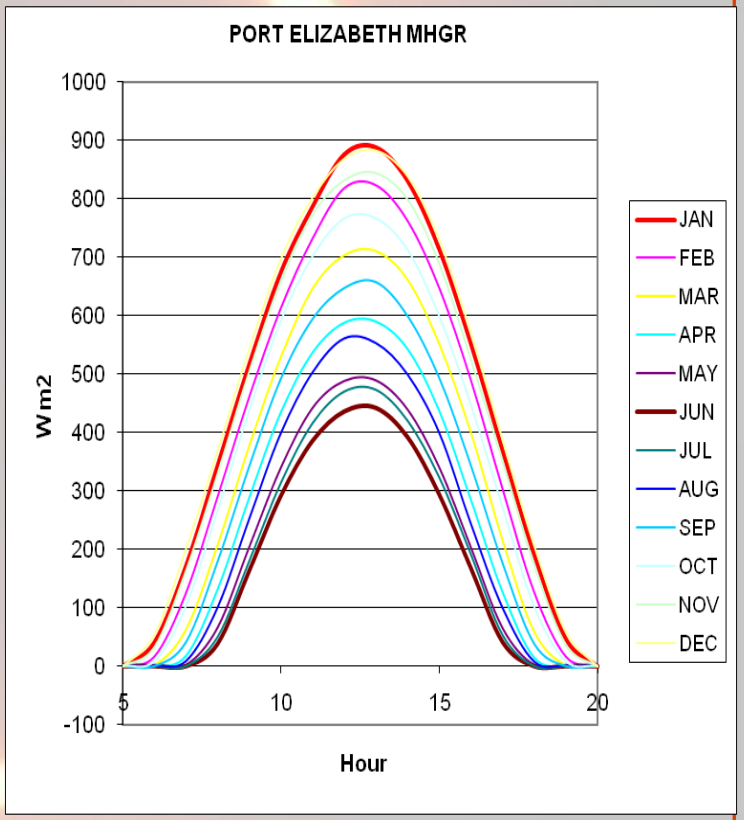
A

Energy availability & capacity factor

EAF measures plant availability, plus external non-controllable energy losses

PV has very high EAF > 95% (ESKOM 2010 ave. 85.5%)

- ***Robust, solid state, rapid fault detection, simple maintenance***



Capacity factor – ave. vs nameplate

- **PV Capacity factor varies seasonally**

Summer 27% winter 22% ESKOM ave. 66.6%
- highly predictable

PV IS DESPATCHABLE OVER 24 ROLLING FORECAST PERIOD

Capacity credit (CC)

Measures contribution to grid reliability under certain conditions
Complex probabilistic calculation – several methods

- **Both load and annual radiation pattern are variables**

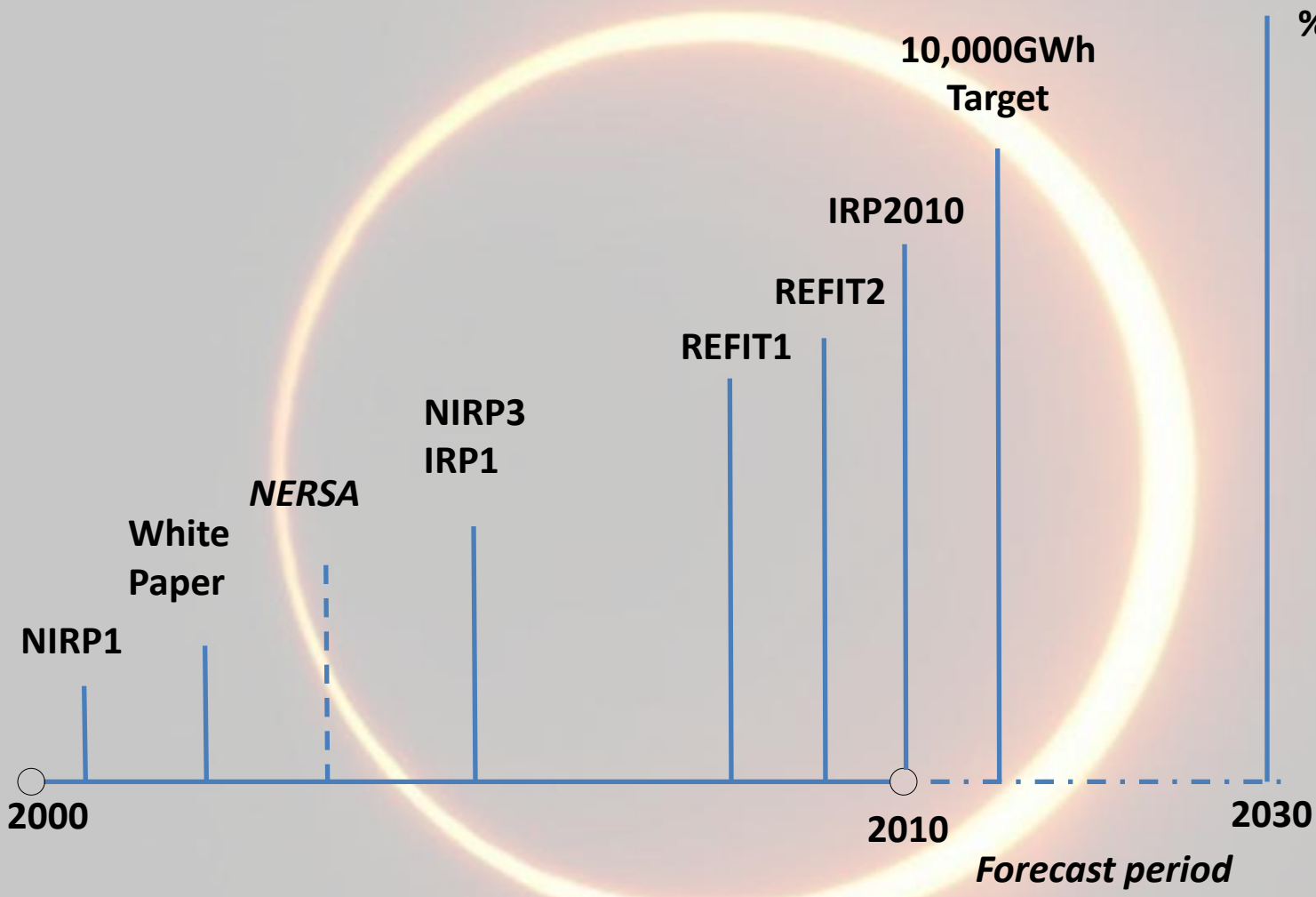
- **US studies (2004/5) show high capacity credits for fixed PV**
  Higher CC in areas of high radiation

  Denver – 59%
  Pueblo – 63%

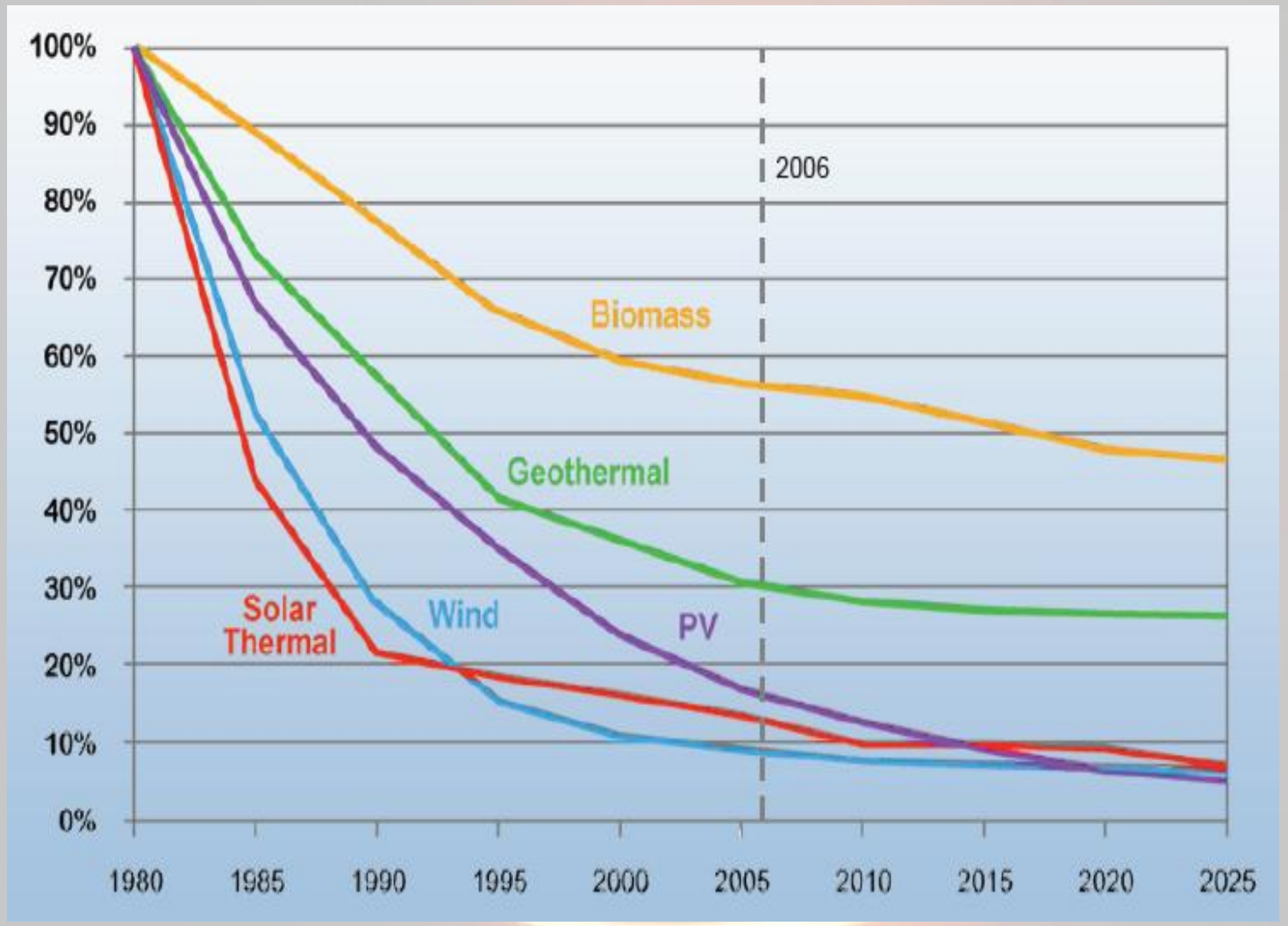
- **Need SA analysis of Relative Firm Capacity - ratio of Firm Generation Capacity to Installed Generation Capacity.**

WILL SHOW CAPACITY CREDIT NOT A FACTOR AT PENETRATION LEVELS <10%

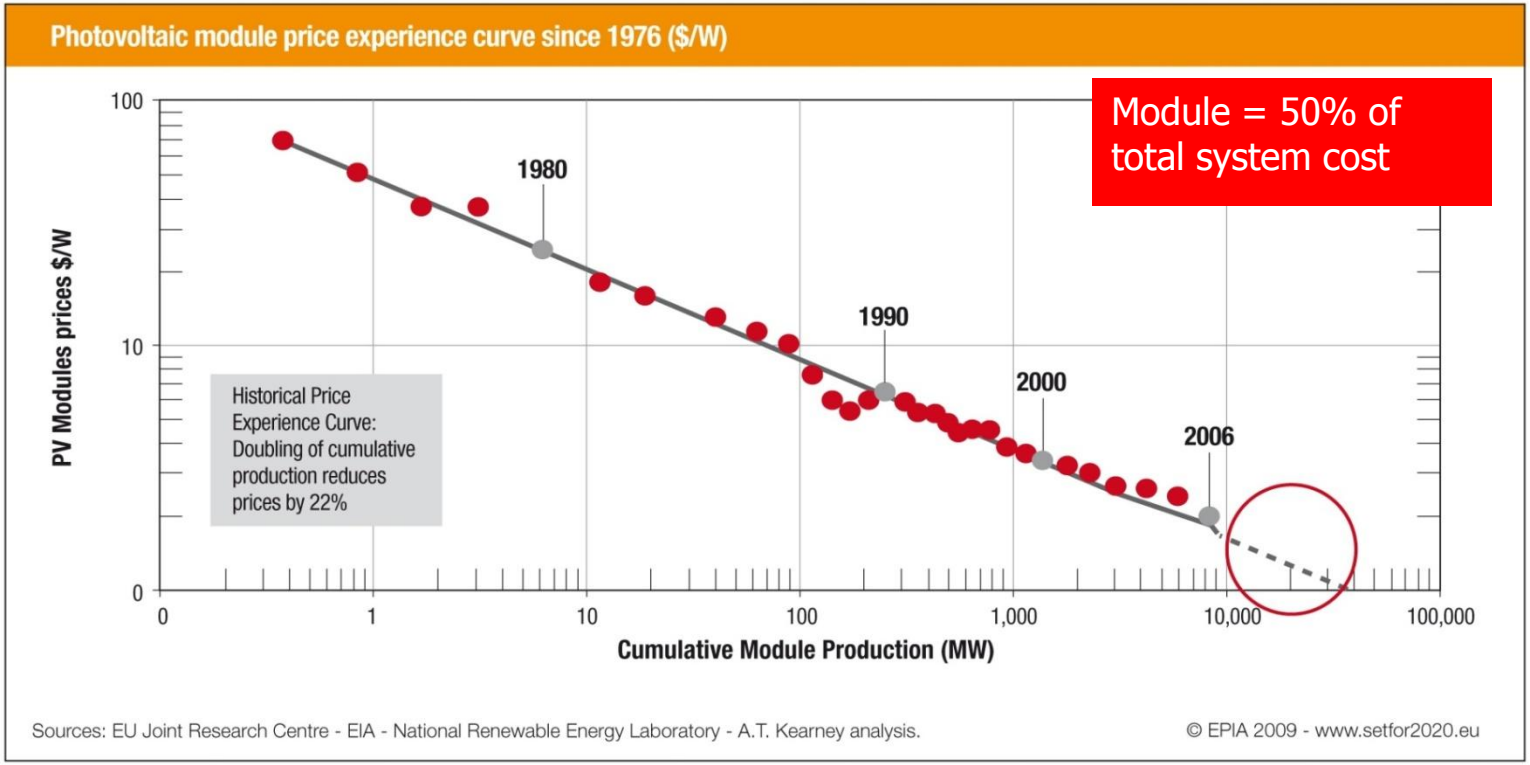
Energy planning process - timeline



Cost projections in 2005



PV – price experience curve

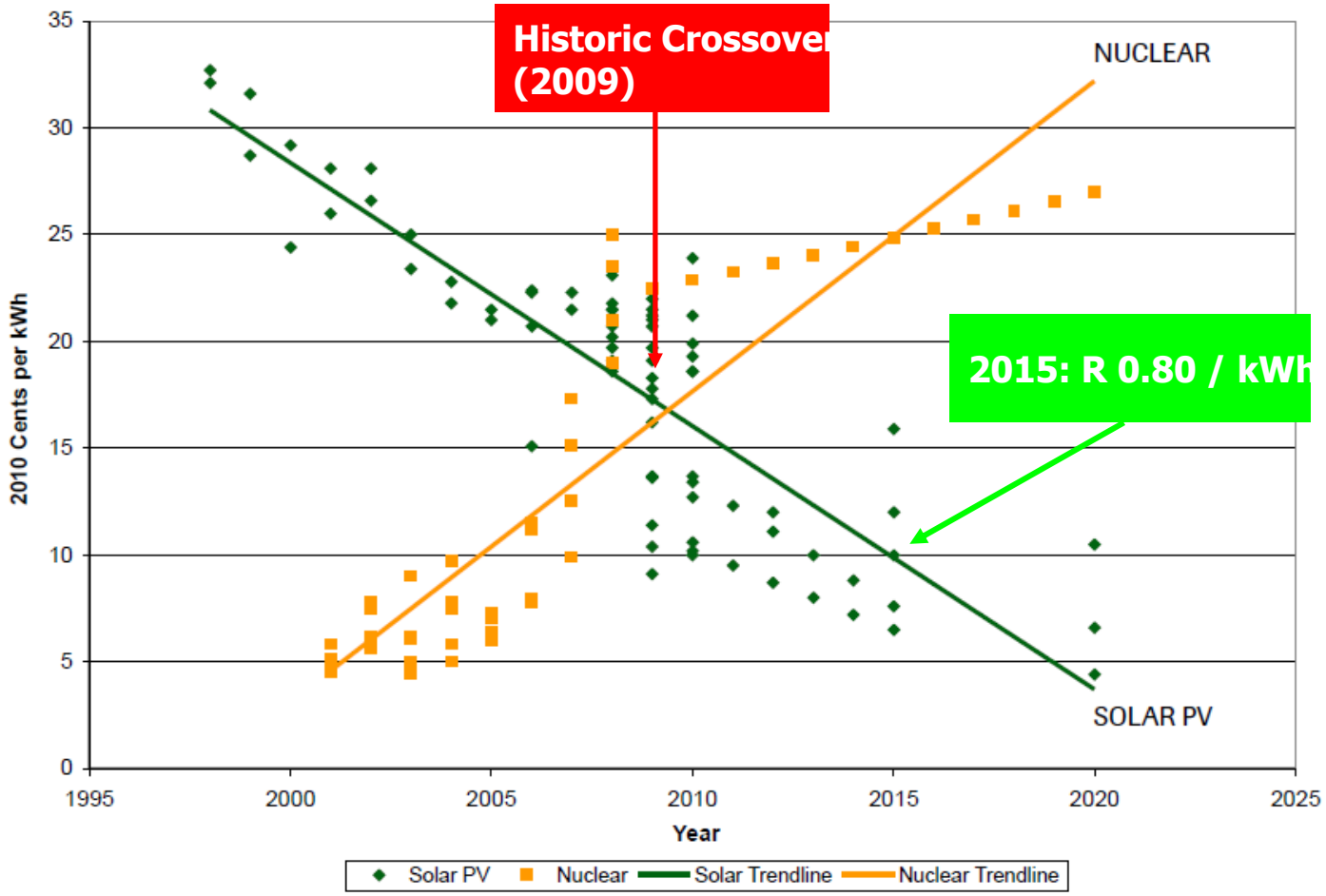


- Module – Prices: continuous price decline
  - 1980: > $ 30 /Wp
  - 2008: appr. $ 3.5/Wp
  - 2009: appr. $ 1.85 - $ 2.25/Wp
  - 2010: appr. $ 1.50 - $ 1.60/Wp

PHOTON – MAGAZINE

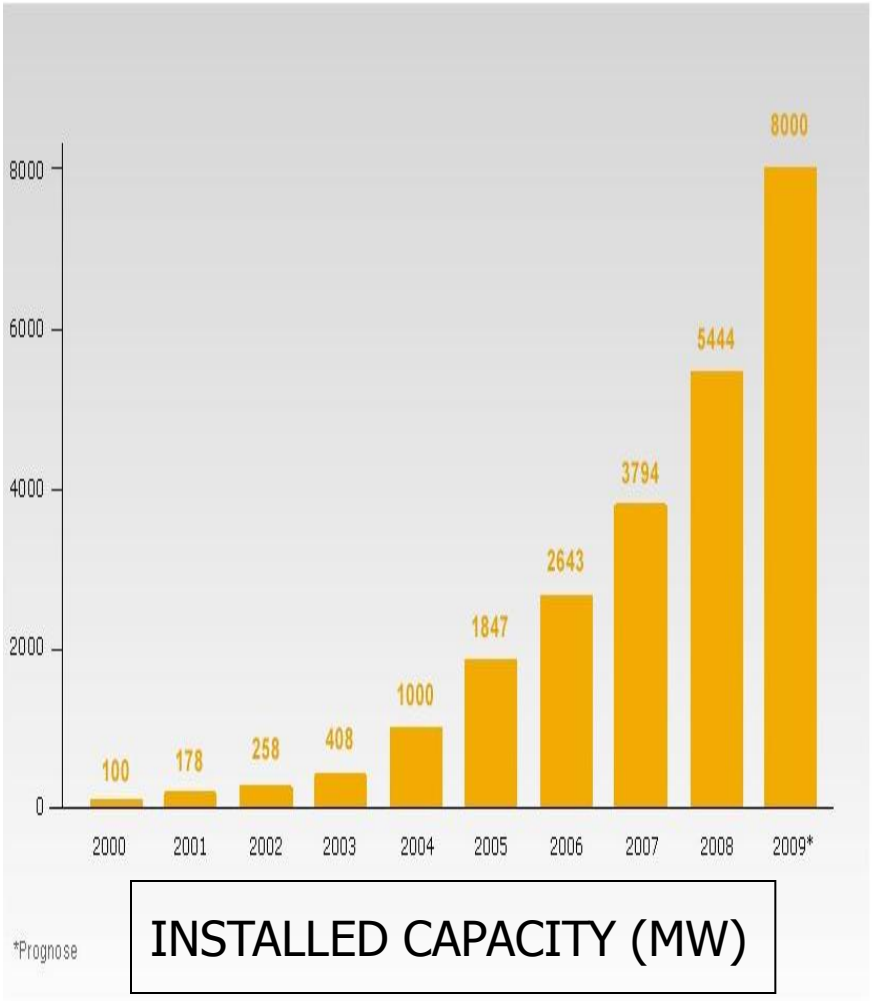
"PV will become the cheapest renewable energy before 2020!"

(PV vs NUCLEAR in the US)



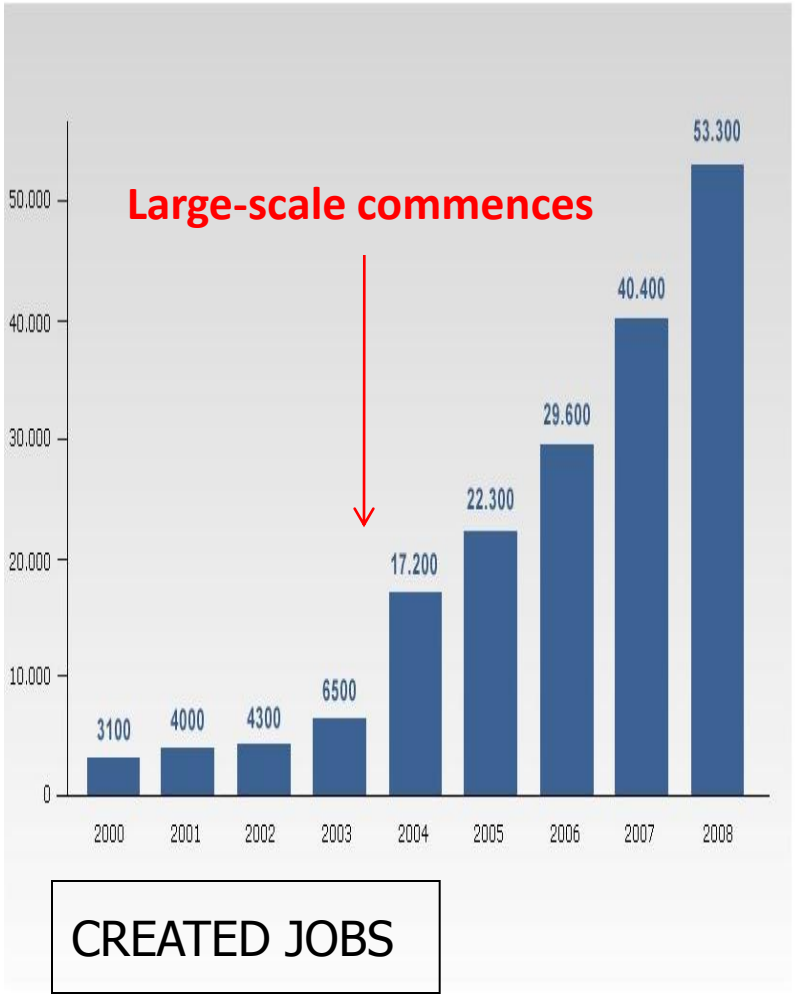
Duke University 2010: PV costs continue to decline – Nuclear costs will go up!!

PV – Job creation (Germany)



INSTALLED CAPACITY (MW)

Quelle: Bundesverband Solarwirtschaft



CREATED JOBS

Quelle: Bundesverband Solarwirtschaft

Social benefits