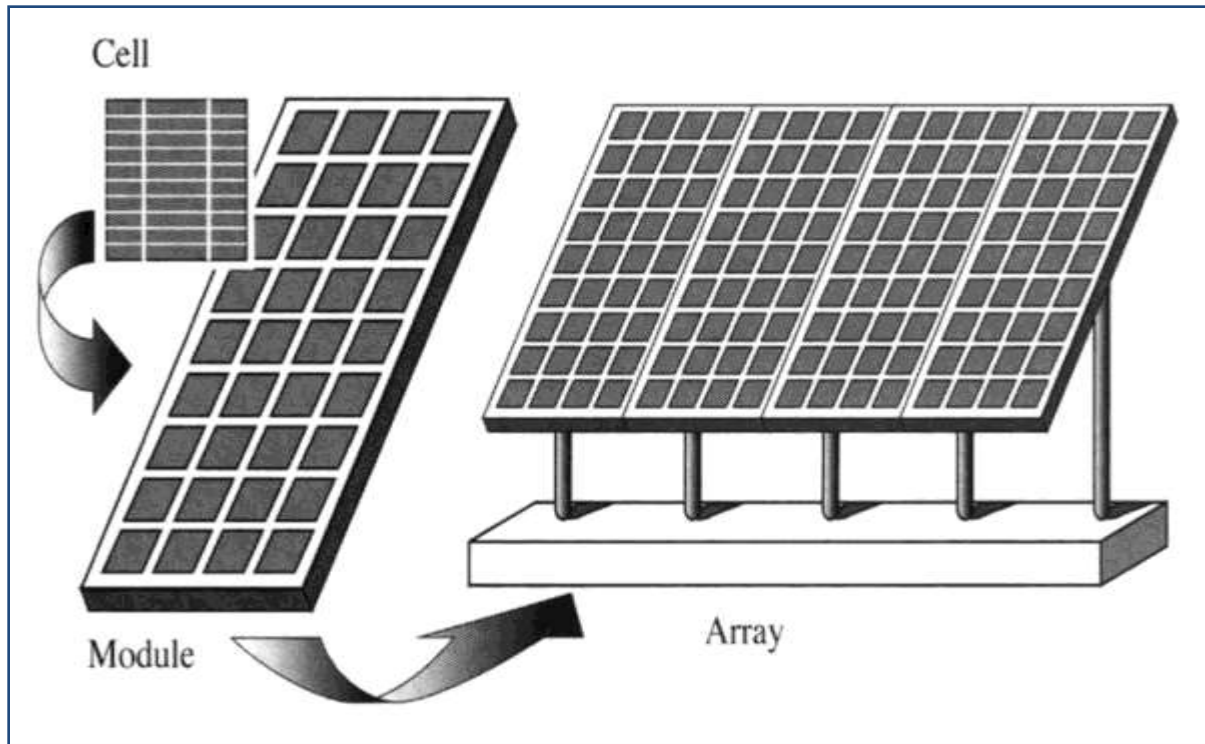


Photovoltaics





Cell, Module, Panel



PV Panel Installation

Fixed

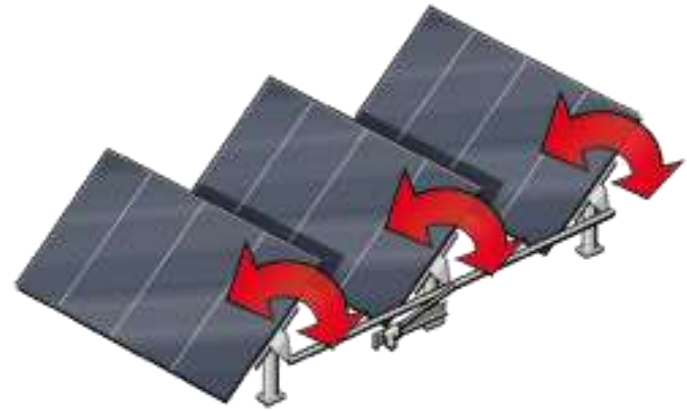


Faces towards the equator
Normally tilted at the same angle as the latitude of that location. E.g. tilted at 34' in Cape Town,
Mounted flat on the equator

Single Axis Tracking(1) - Seasonal Adjustment



Seasonal adjustment of the panels
(typically every few days)



PV Panel Installation

Single Axis Tracking(2) - Daily Tracking



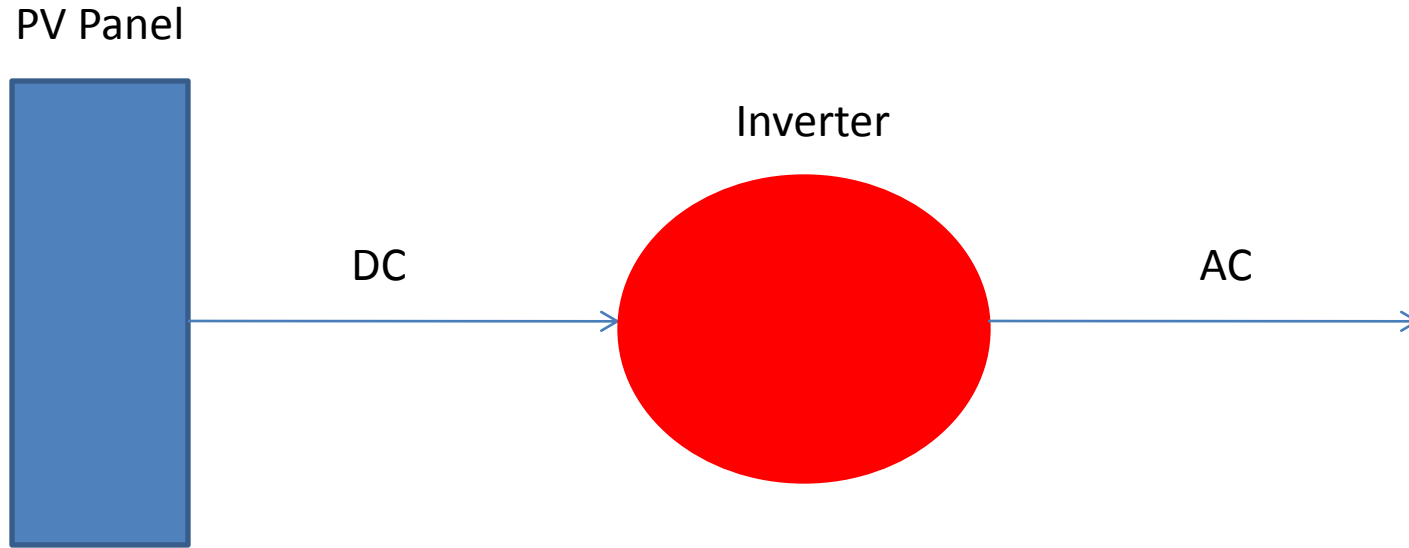
Two Axis Tracking



Building Mounted PV



PV Systems

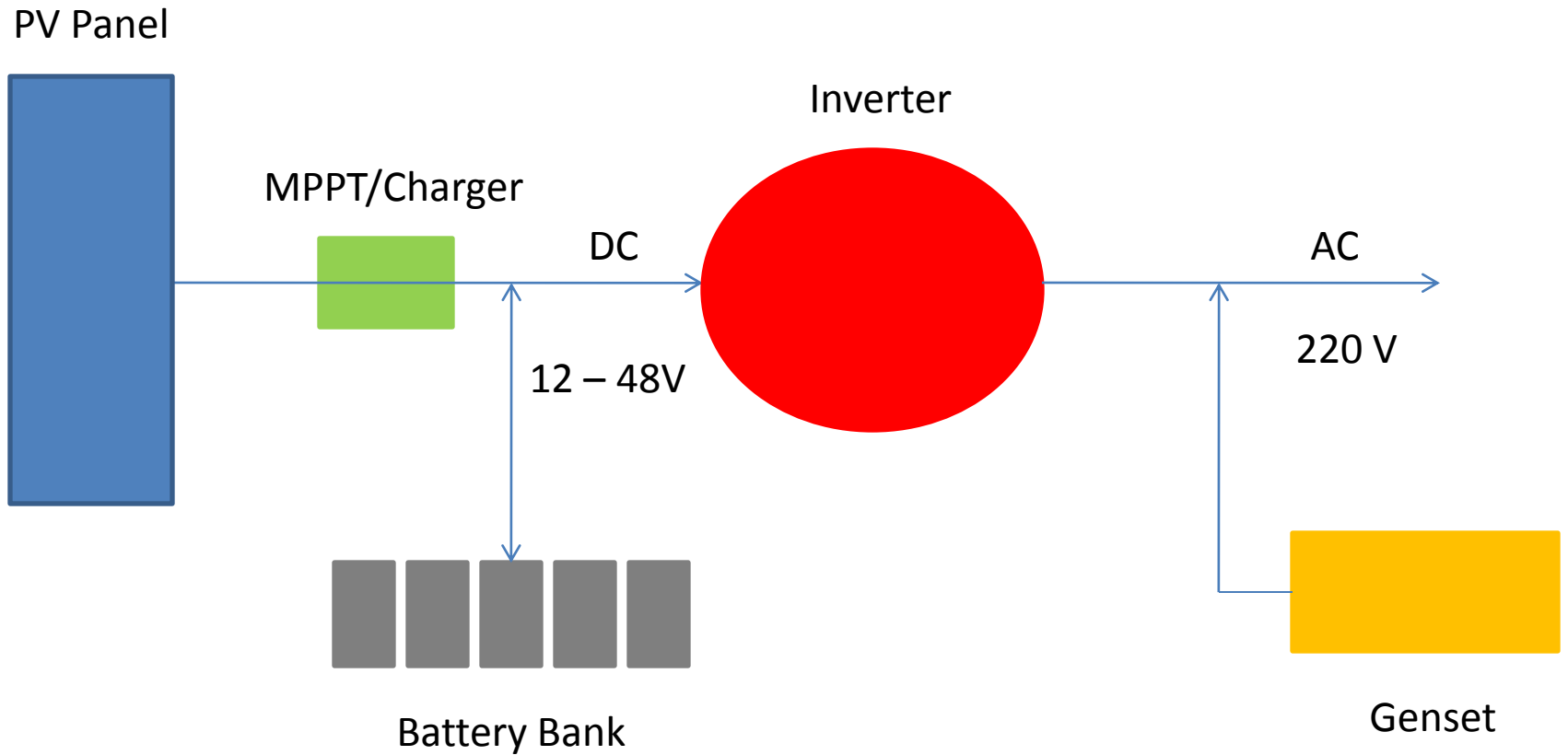


Inverters

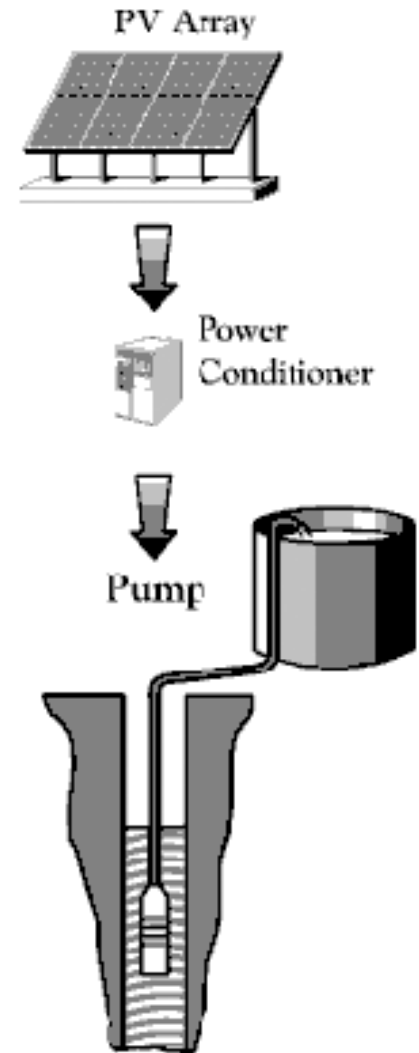
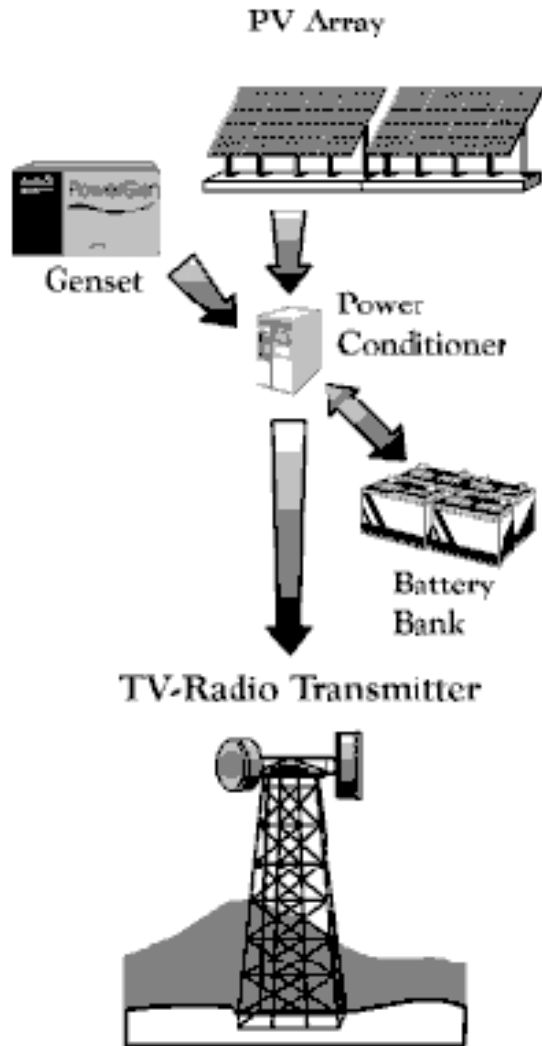


Power Electronics = Expected life of around 10 years

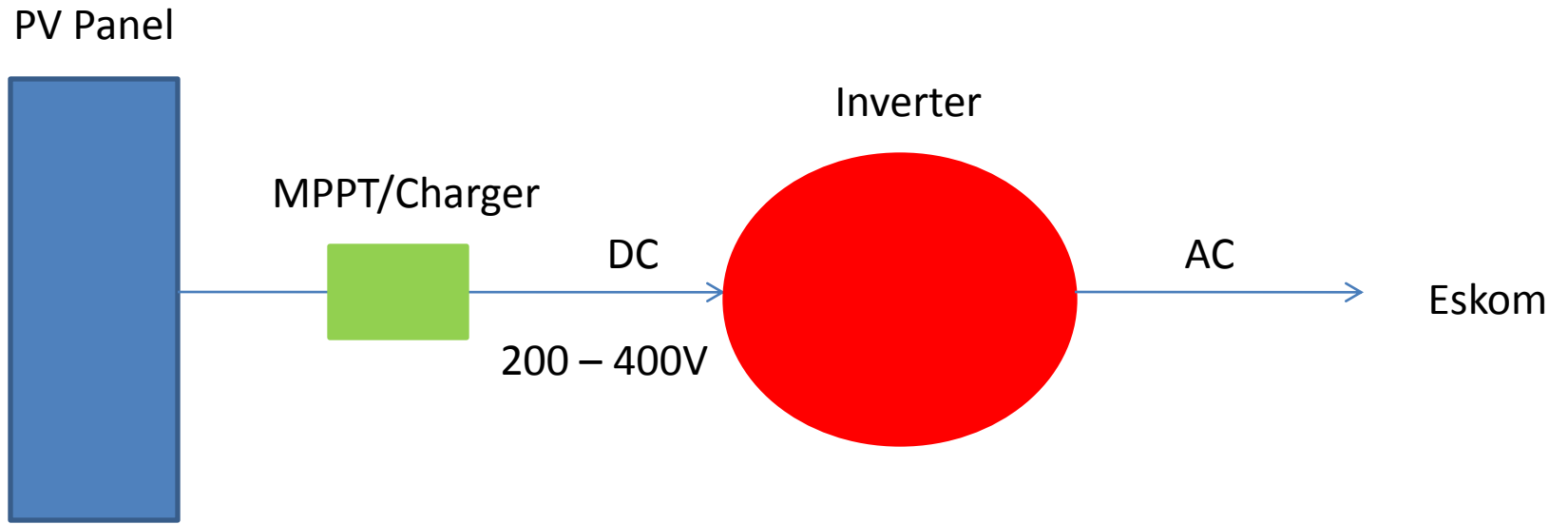
Off-Grid



Off-Grid



Grid-tied



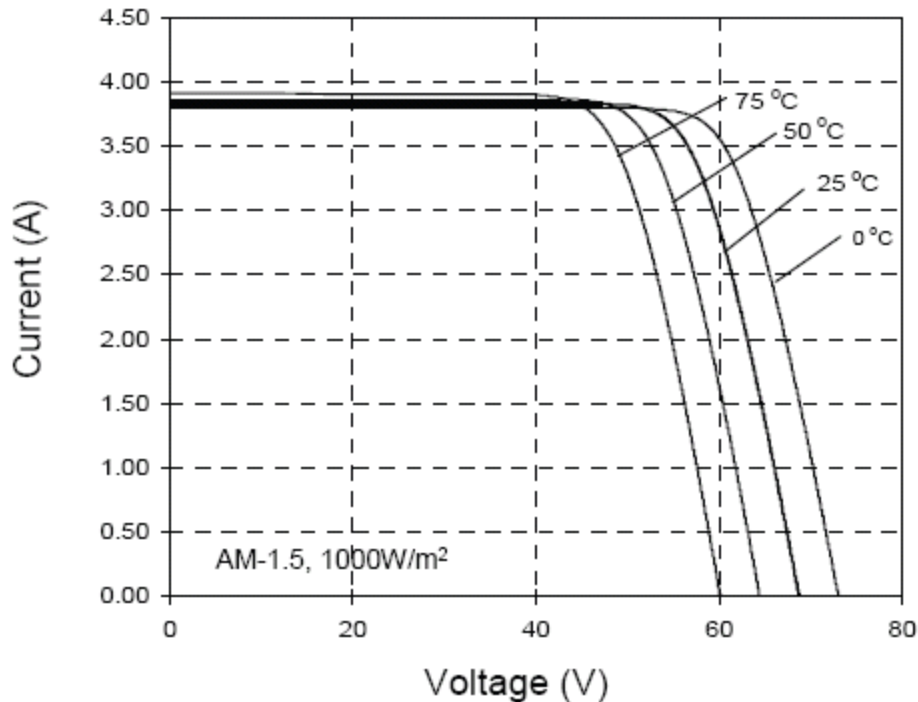
Cell Types

	Efficiency	Production share 2007	Production share 2008
Single crystal silicon	14 – 18 %	33 %	35 %
Poly crystalline silicon	13 – 16 %	53 %	49 %
Total Crystalline Si		86 %	84 %
α -Si	6 – 8 %	4 %	5 %
Ribbon Si	15 – 16 %	3 %	3 %
Total Silicon		93 %	91 %
CdTe	9 – 10 %	6 %	8 %
CIGS	8 – 11 %	1 %	<1 %

Effect of Temperature

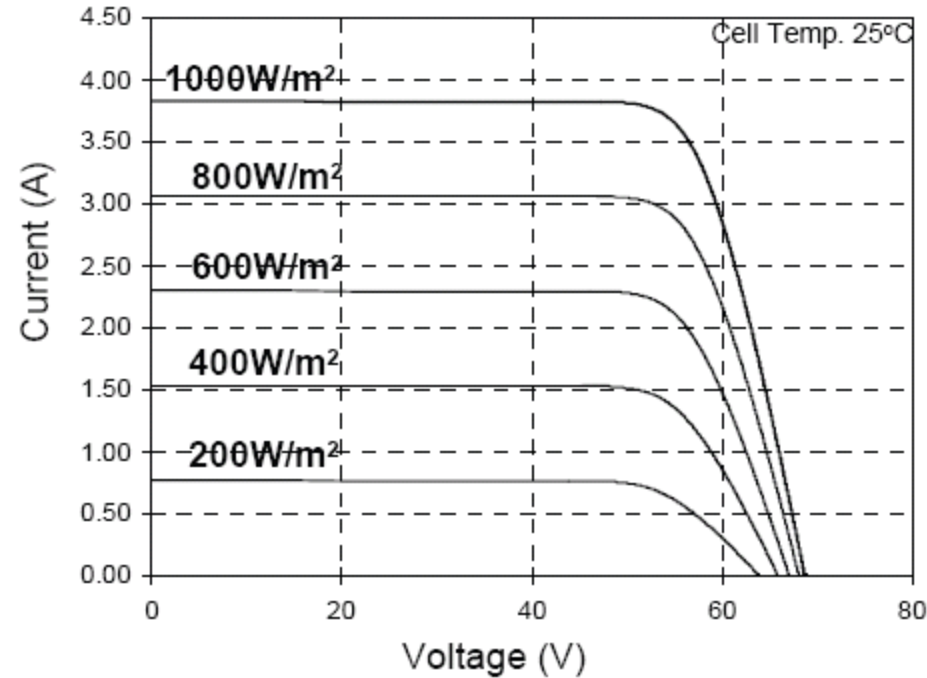
Dependence on Temperature

(Reference Data for 200 Watt Model)



Dependence on Irradiance

(Reference Data for 200 Watt Model)



Crystalline Silicon Module: $-0.5\%/^{\circ}\text{C}$ above STC

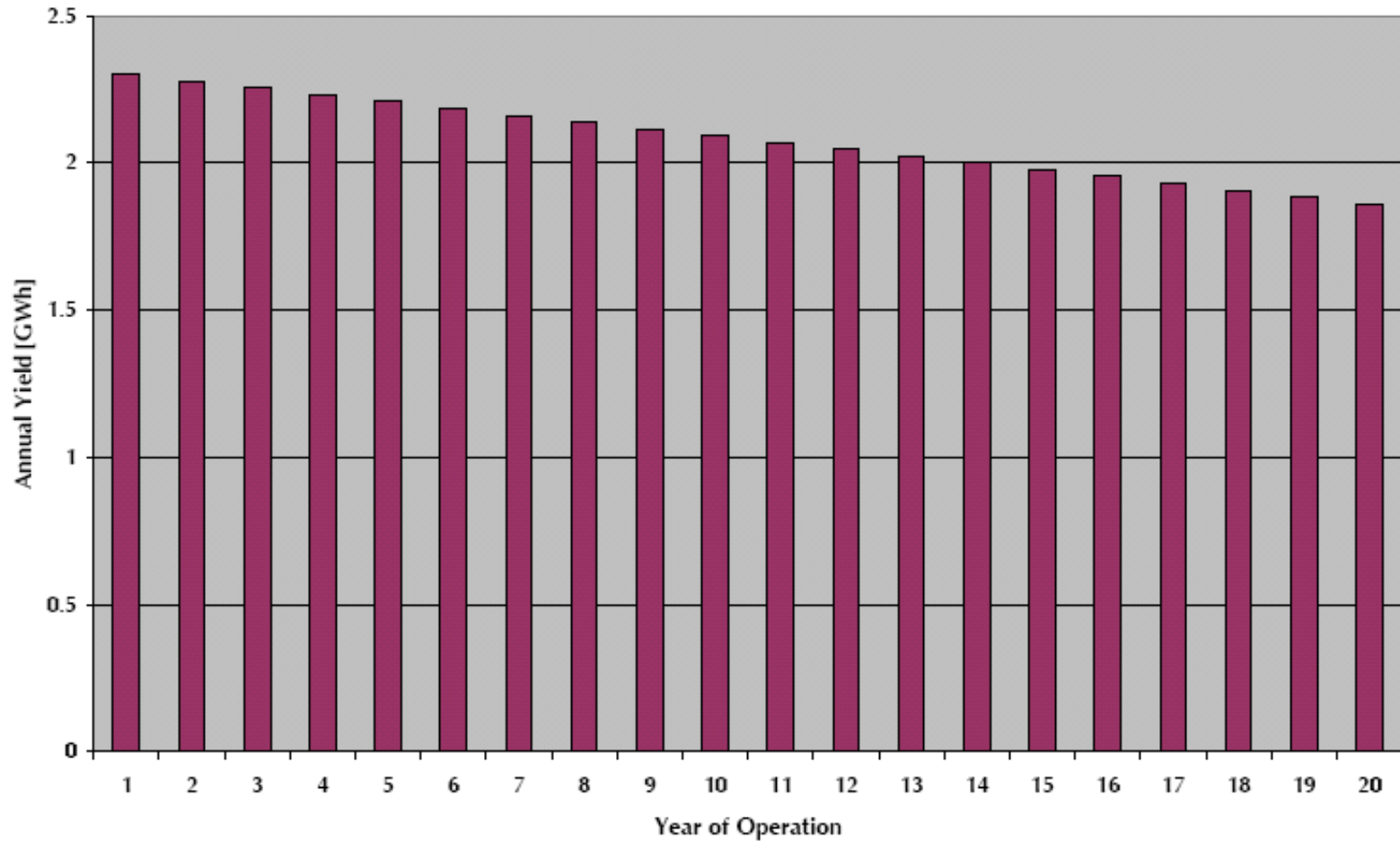
Thin Film Module: $-0.25\%/^{\circ}\text{C}$ above STC

STC = Standard Test Conditions

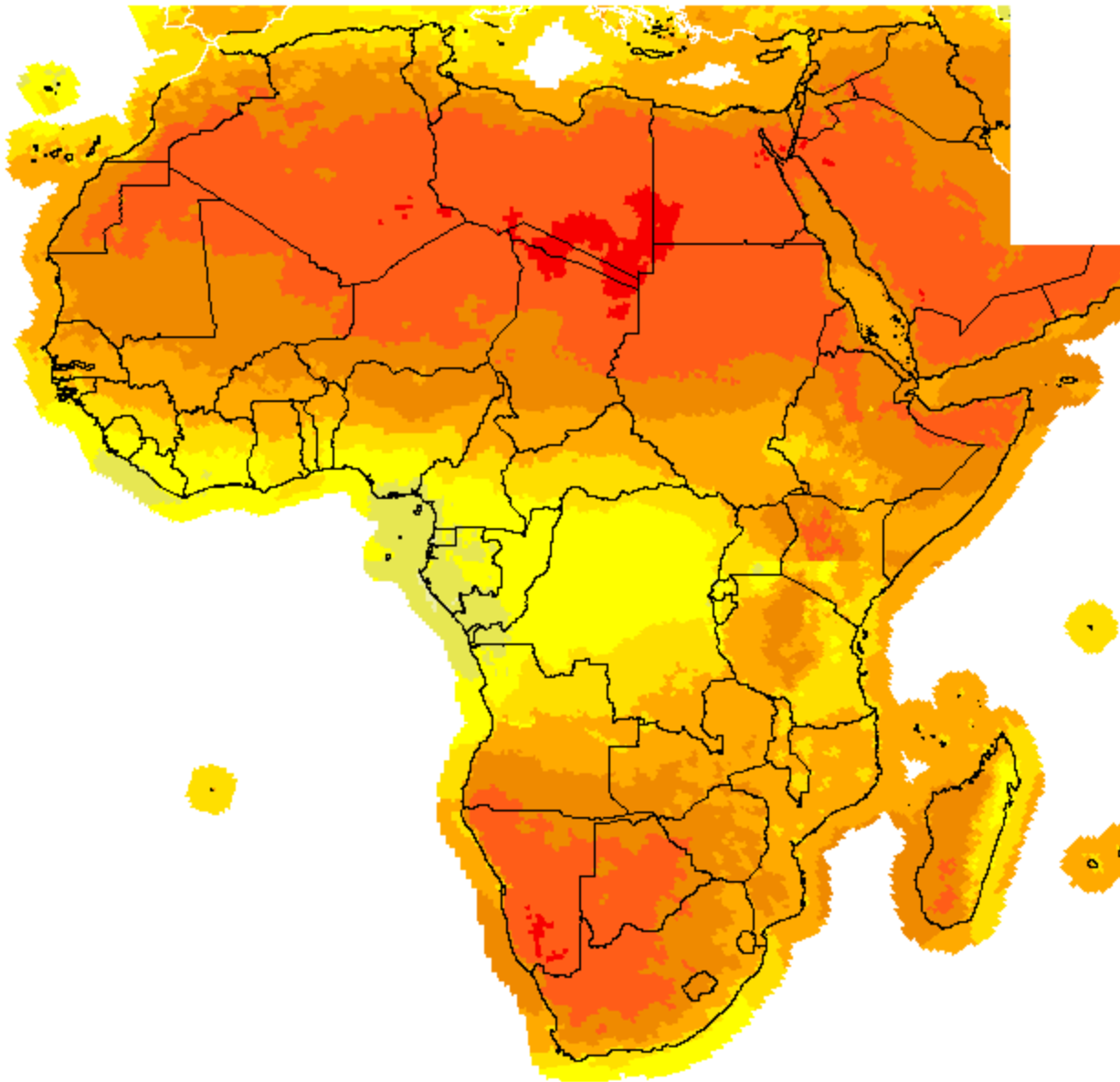
Temperature = 25°C

Degradation

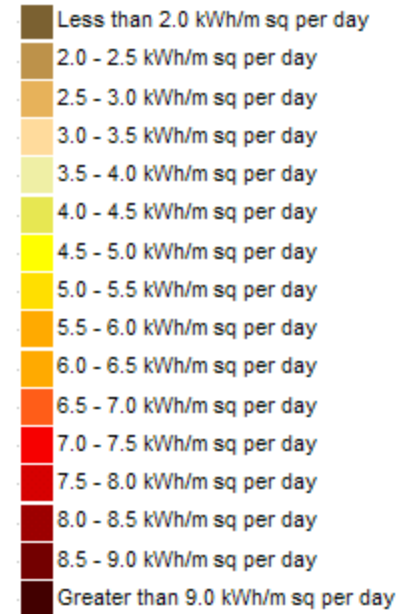
Most suppliers guarantee that their PV panels wont degrade more than 1 % per year



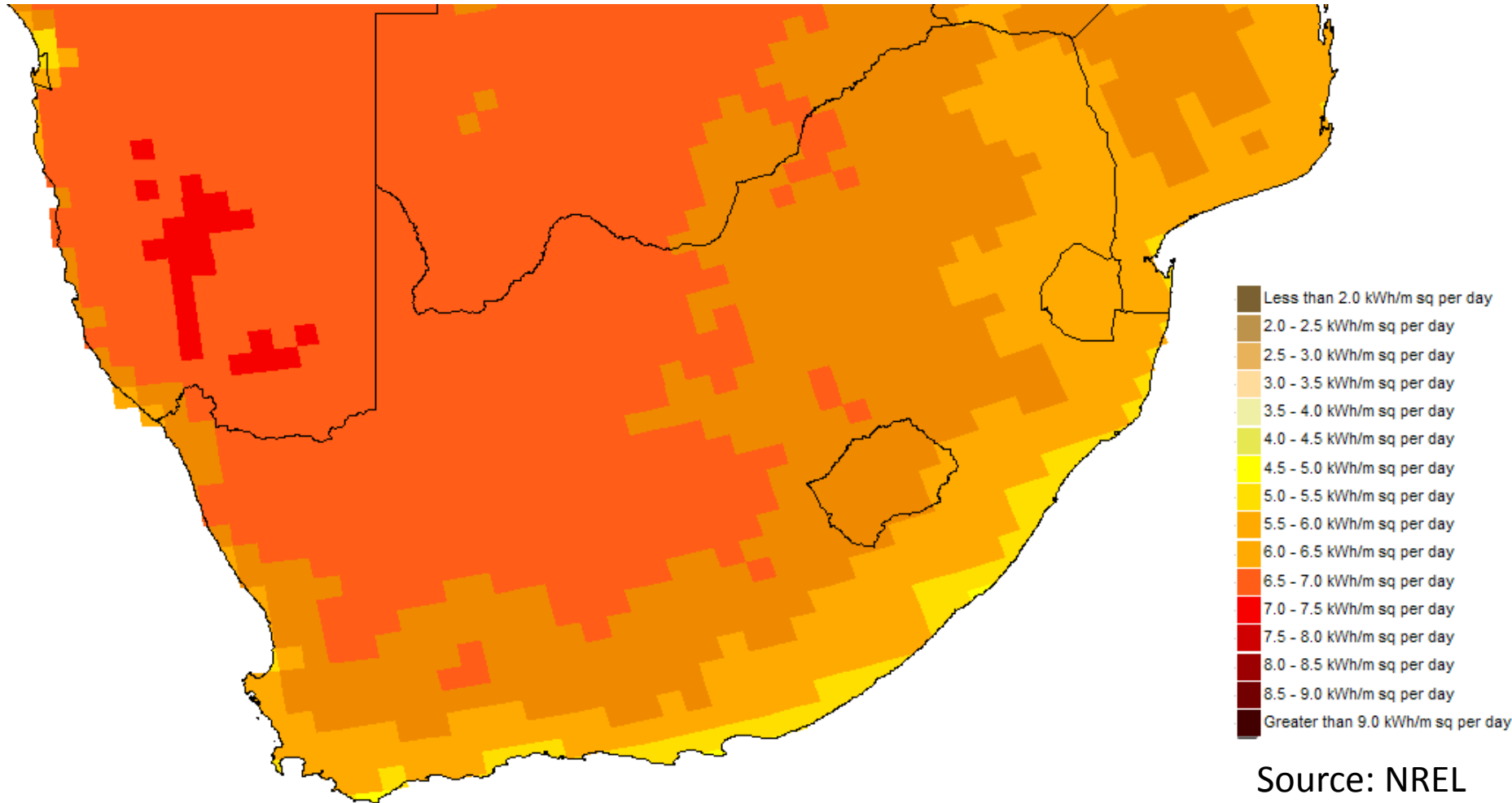
Africa LTI

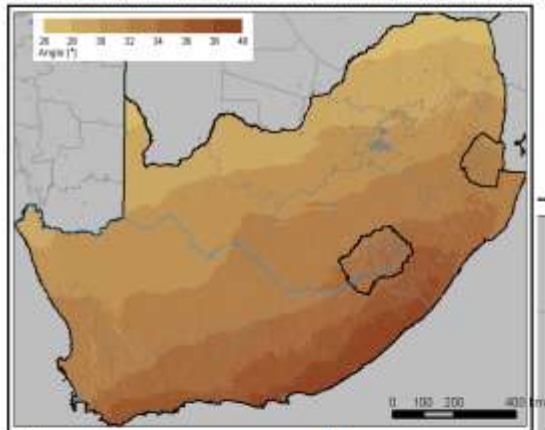


Source: NREL

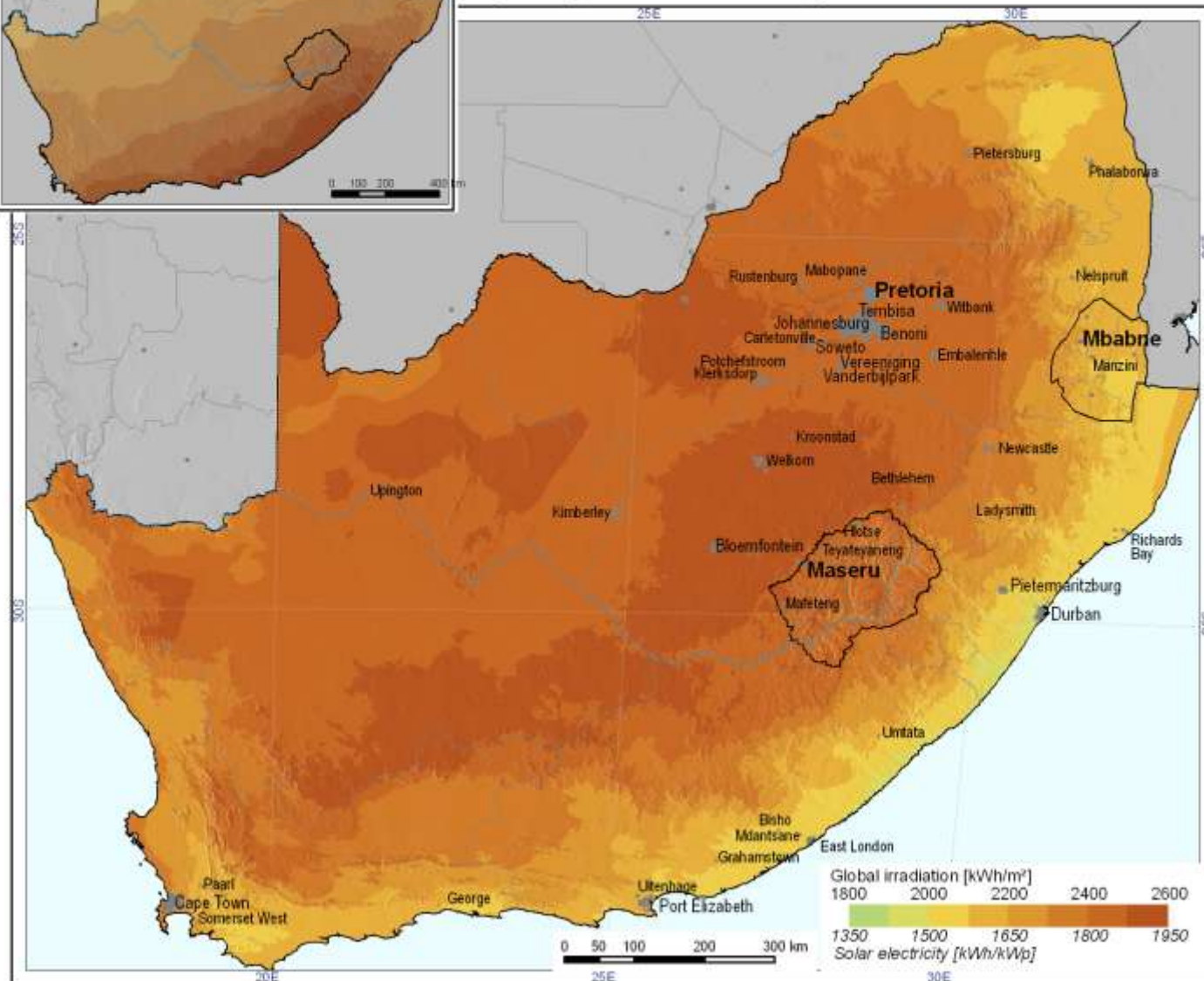


SA LTI

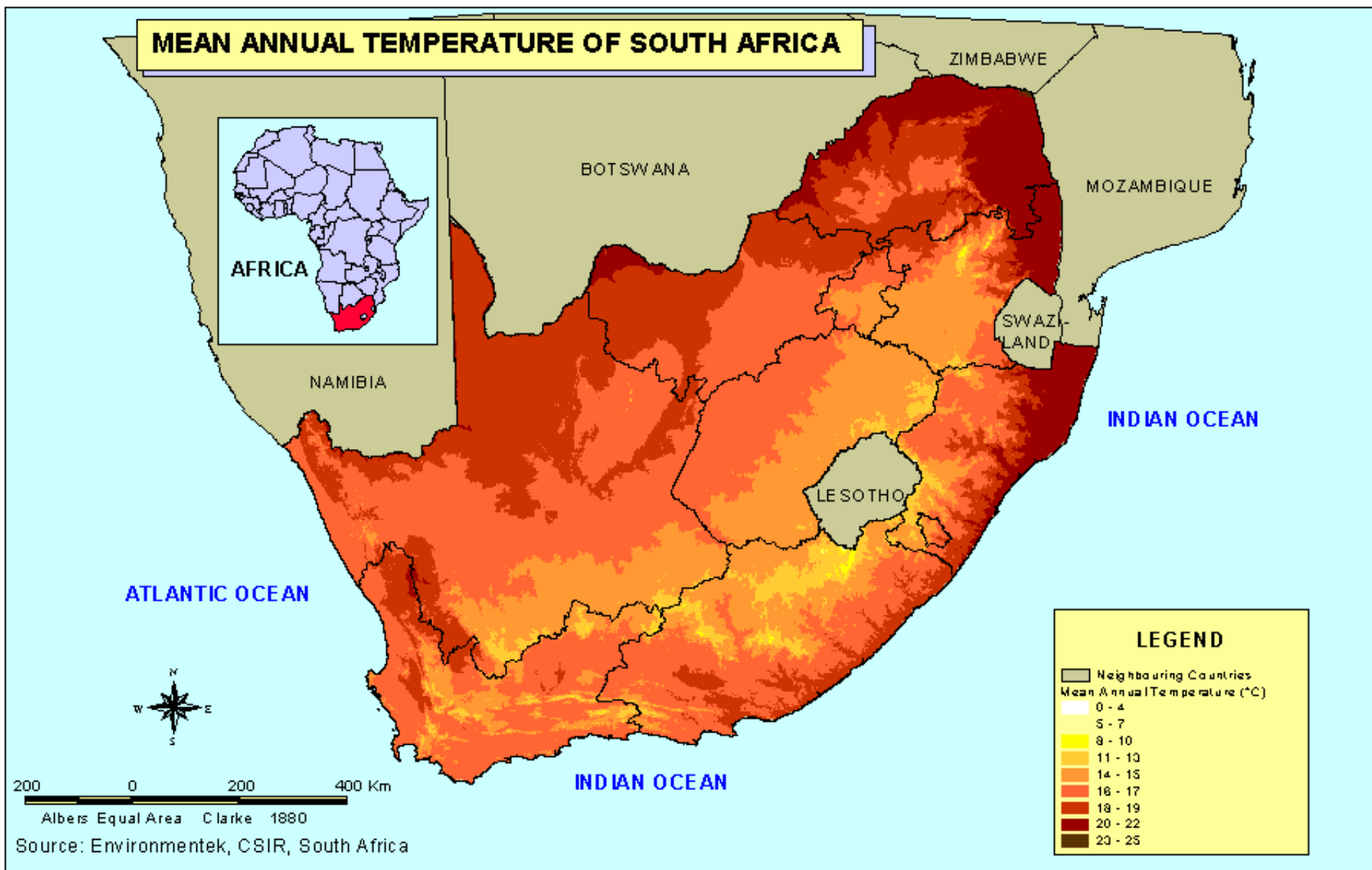




Yearly sum of global irradiation incident on optimally-inclined surface
Yearly sum of solar electricity generated by 1 kWp system with
optimally-inclined modules and performance ratio 0.75



SA Mean Annual Temperatures



Questions?