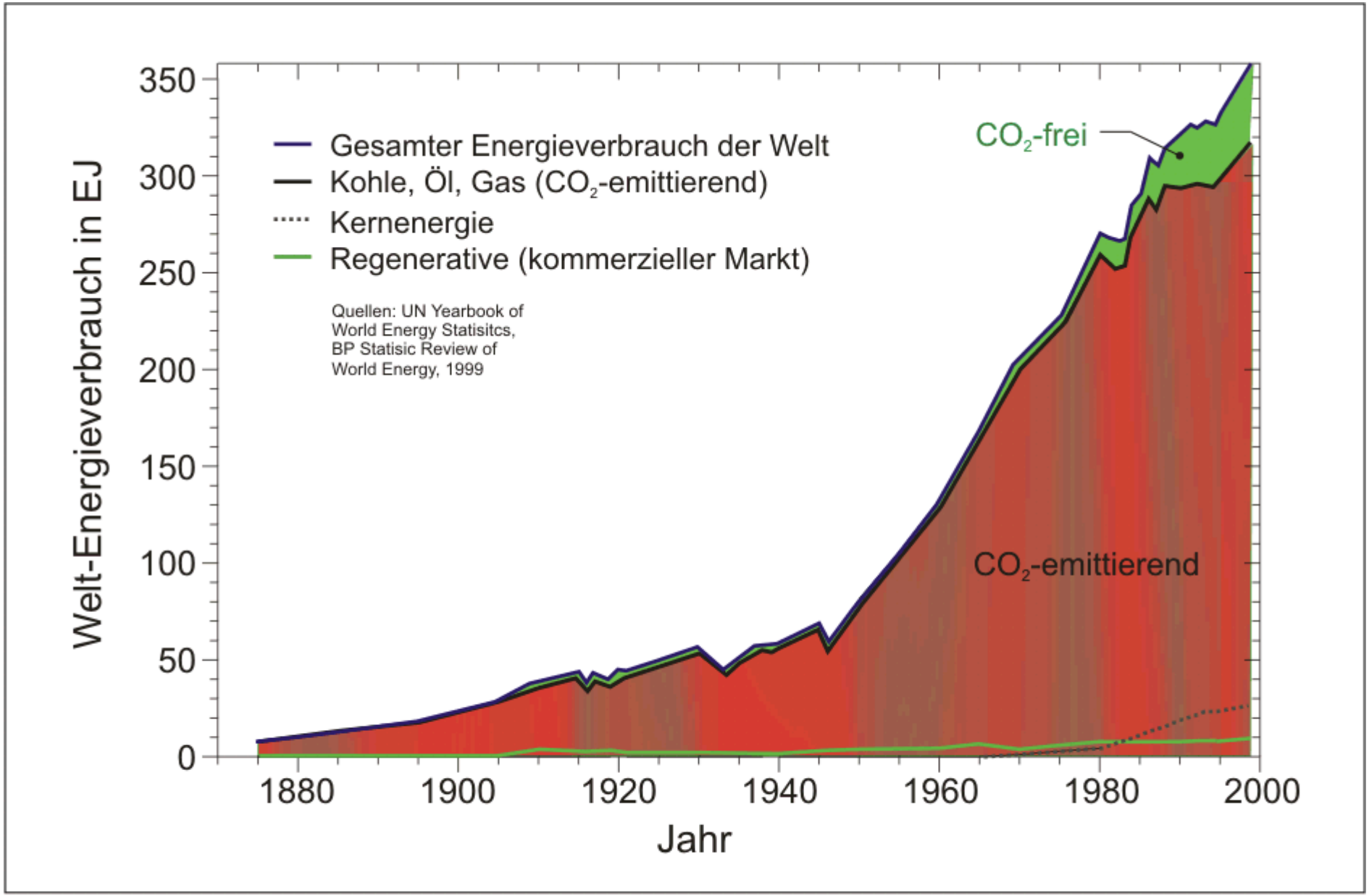
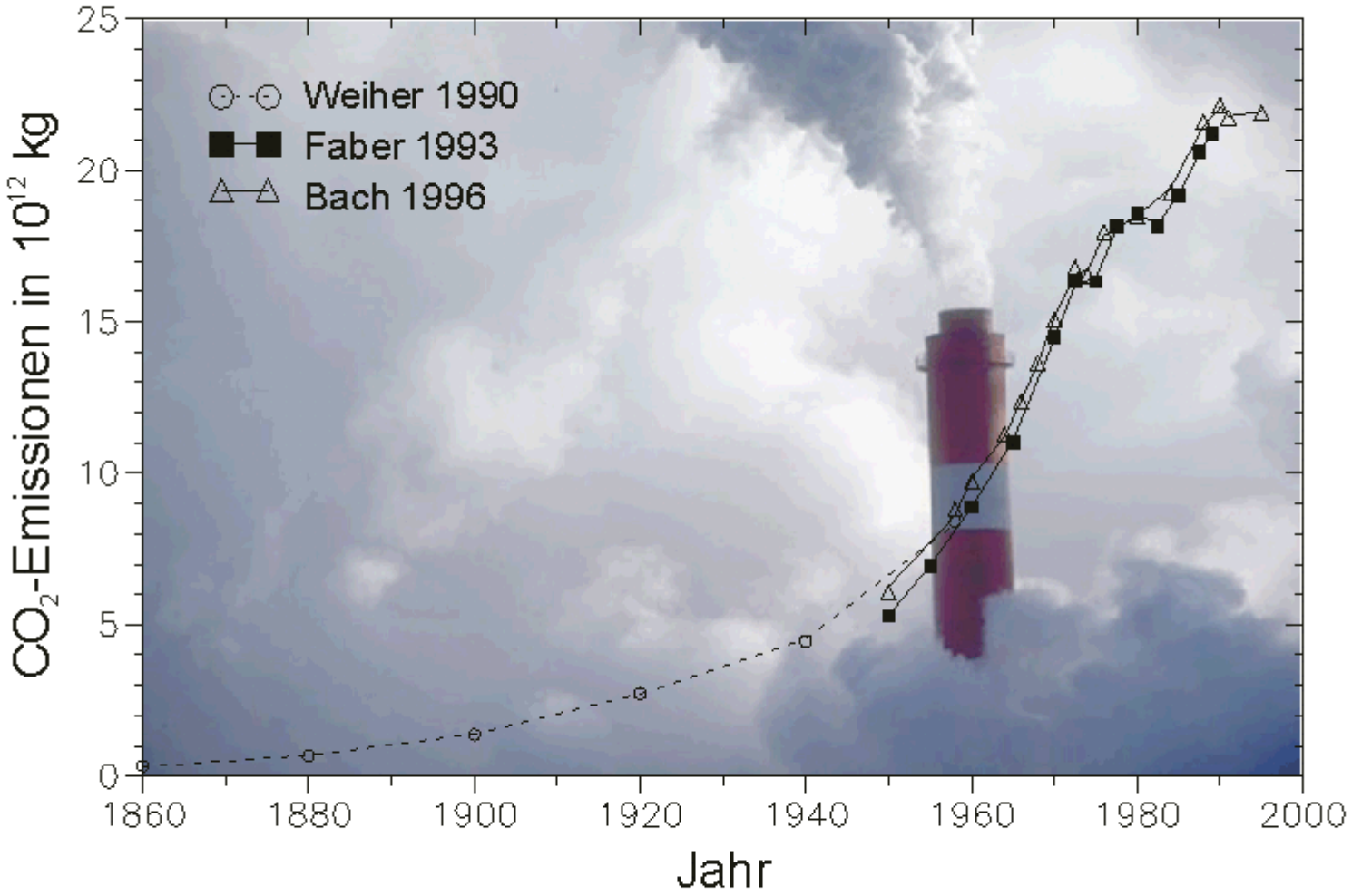
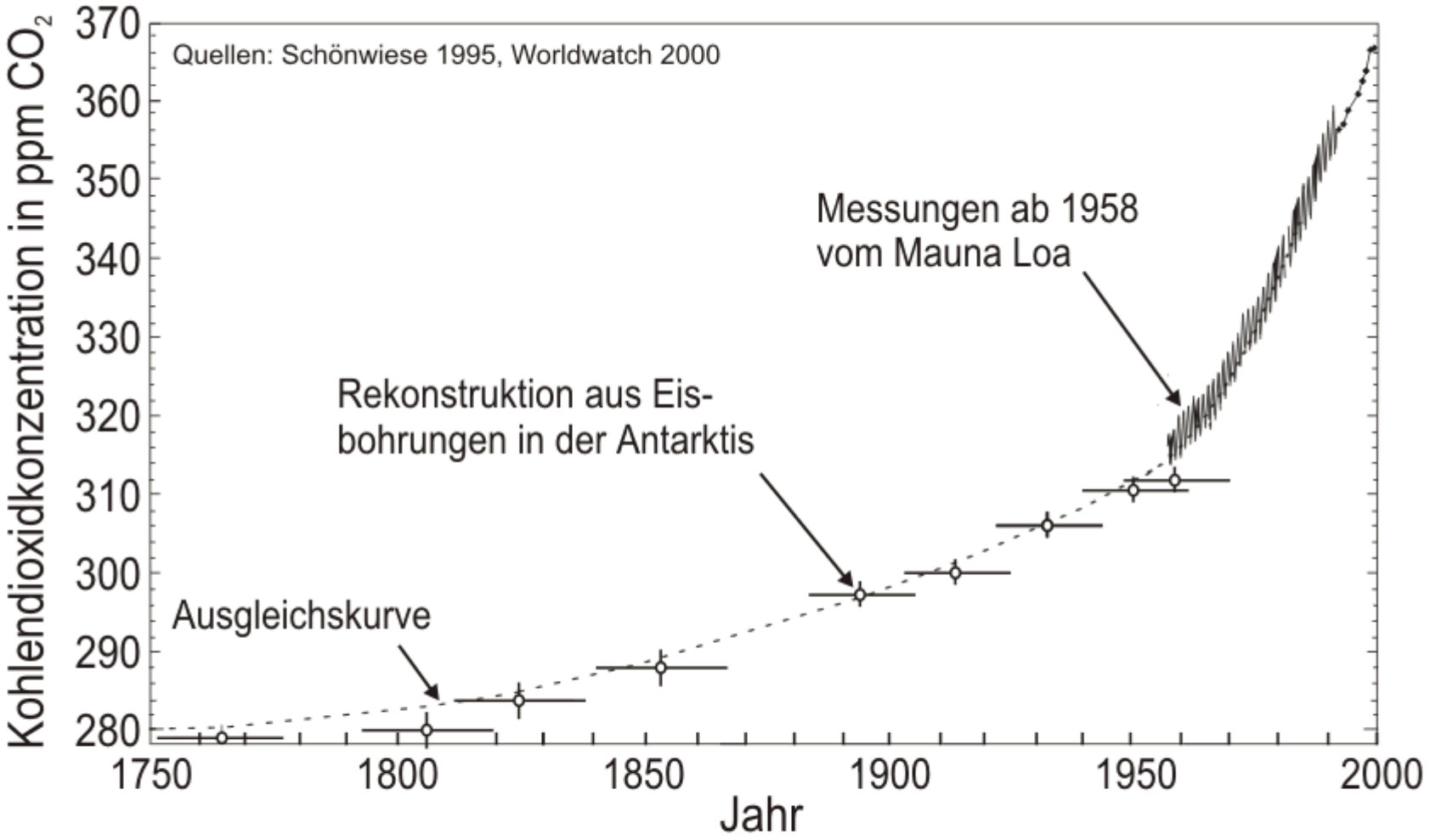

Anwendungen von PV in Brasilien
1 Potential PV, LCA Relevanz
2 Einstrahlung, Wandlung
3 Anwendungen, Beispiele
4 Eigene Entwicklungen



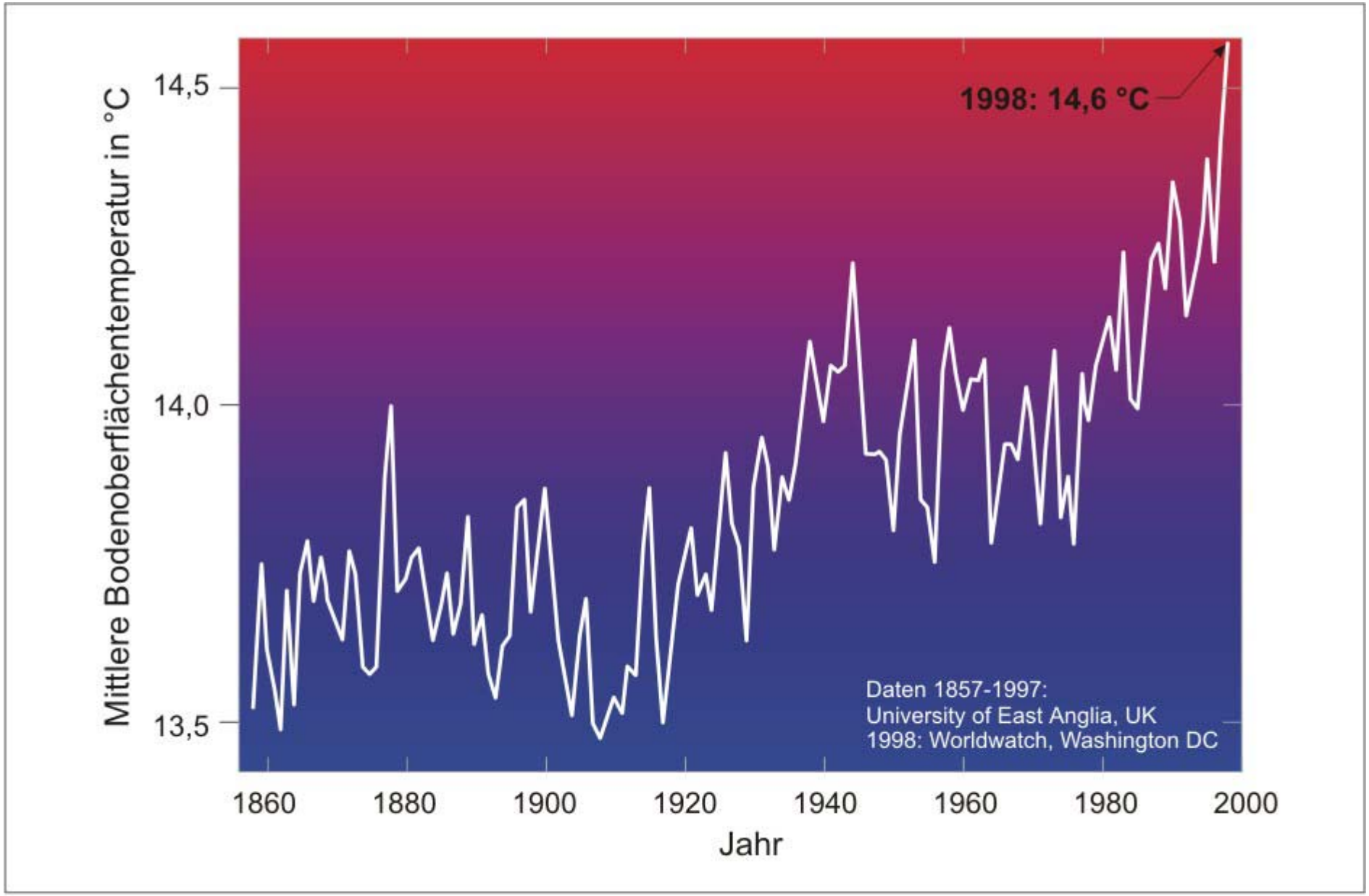
Stefan Krauter	Weltenergieverbrauch nach Energieträgern 1875 bis 1998	UFRJ COPPE



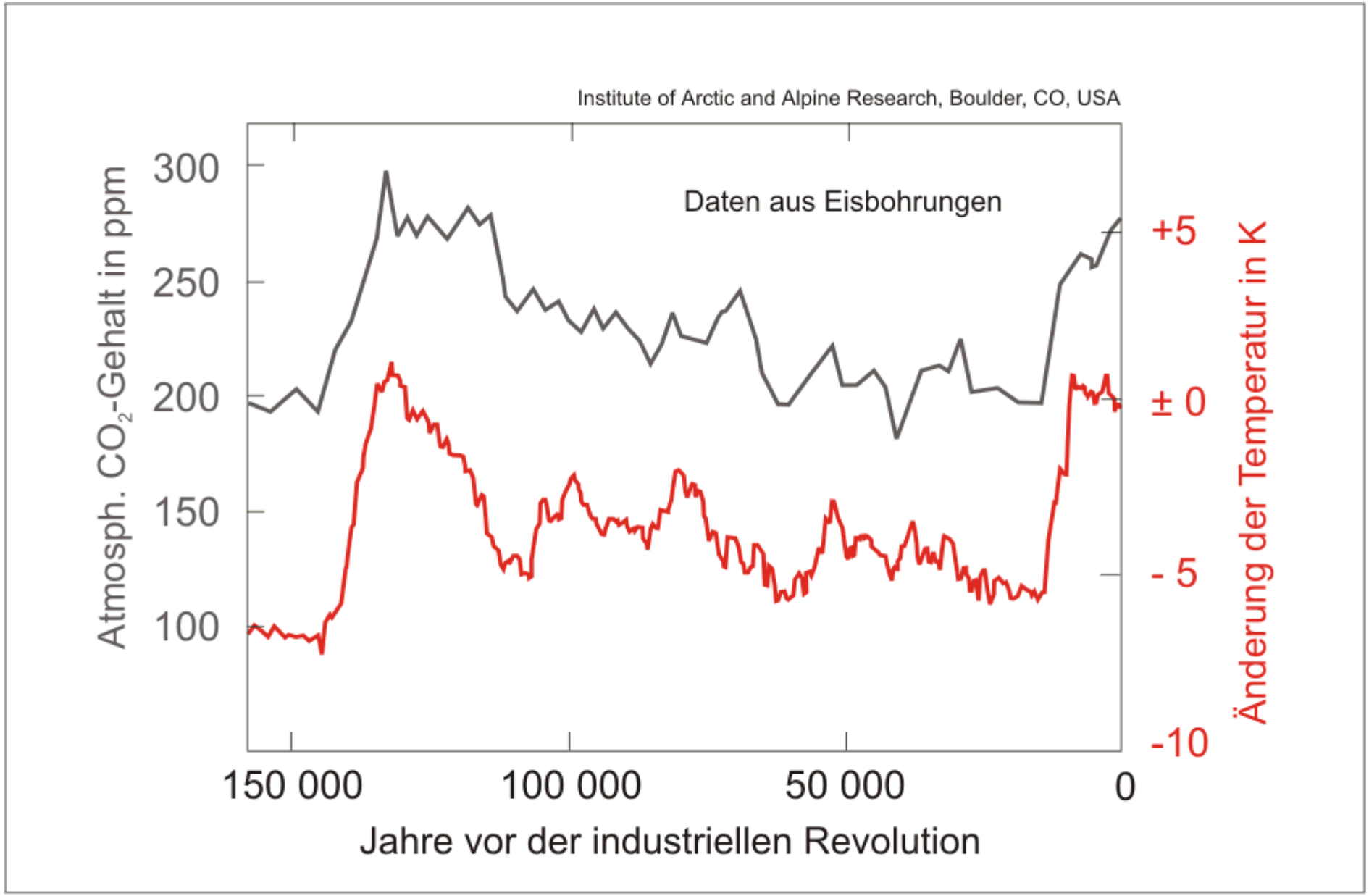
Stefan Krauter	Anthropogene CO_2-Emissionen	UFRJ COPPE



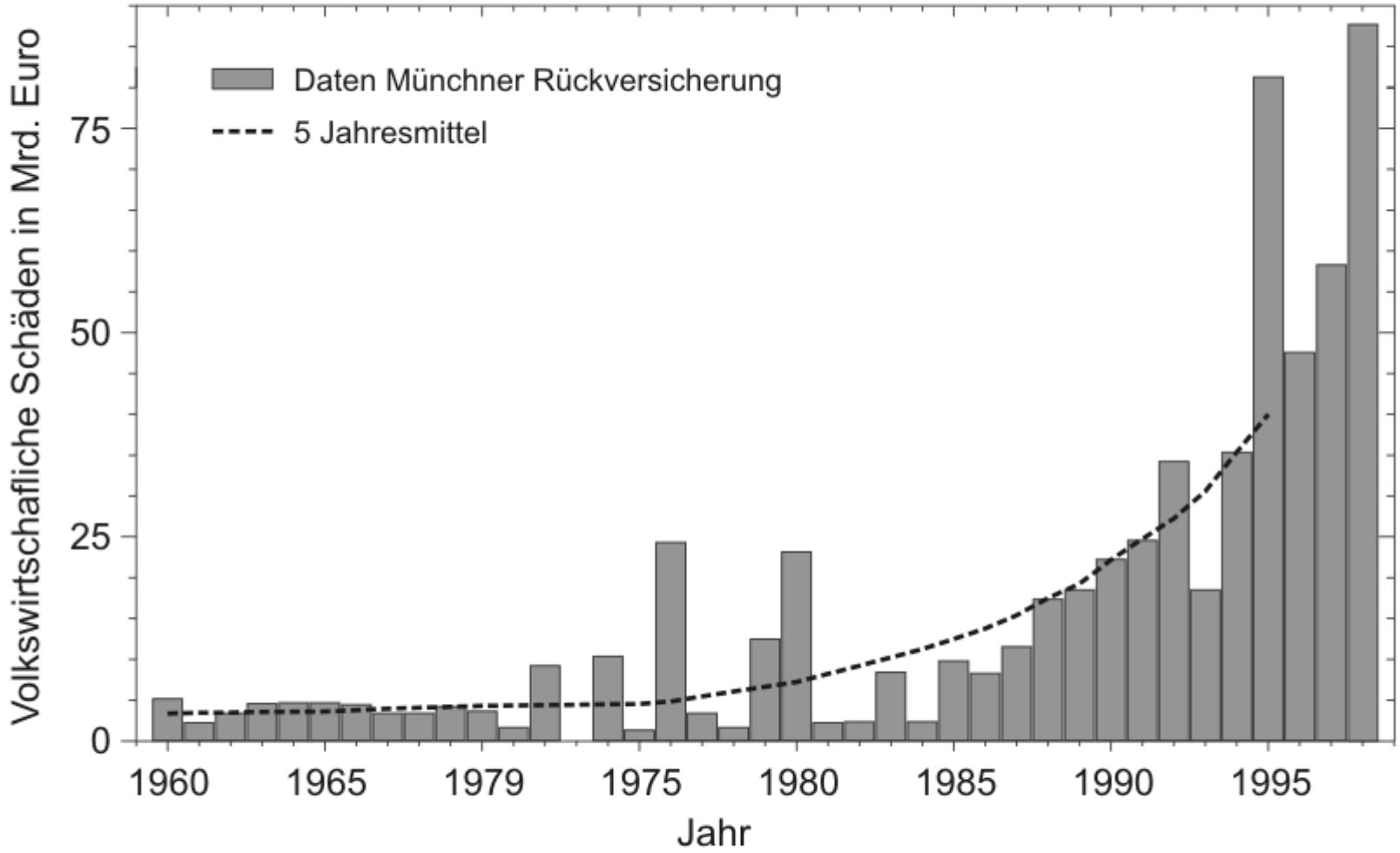
Stefan Krauter	Entwicklung des CO_2-Gehaltes der Erdatmosphäre	UFRJ COPPE



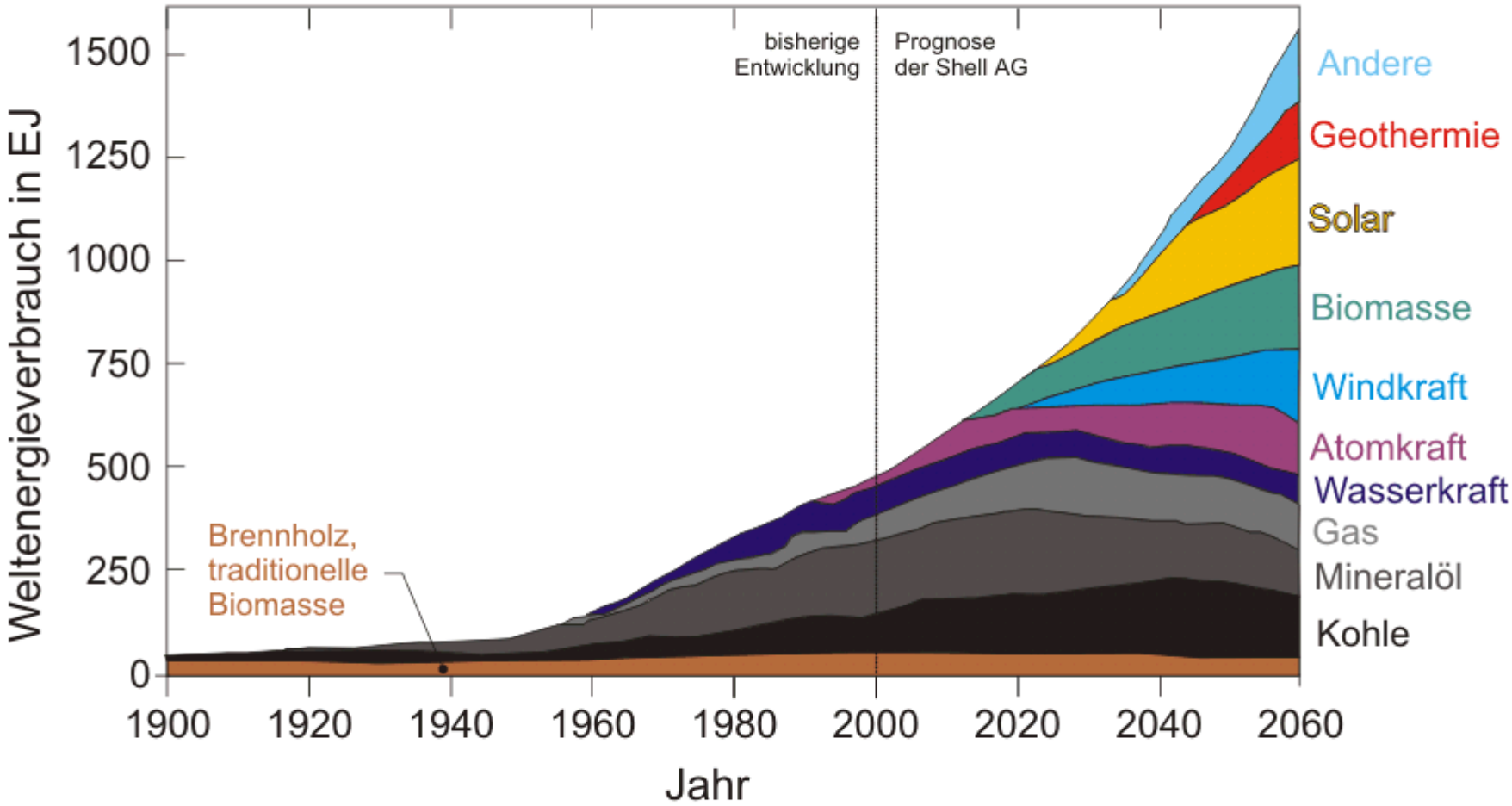
Stefan Krauter	Entwicklung der globalen Bodenoberfächentemperatur	UFRJ COPPE



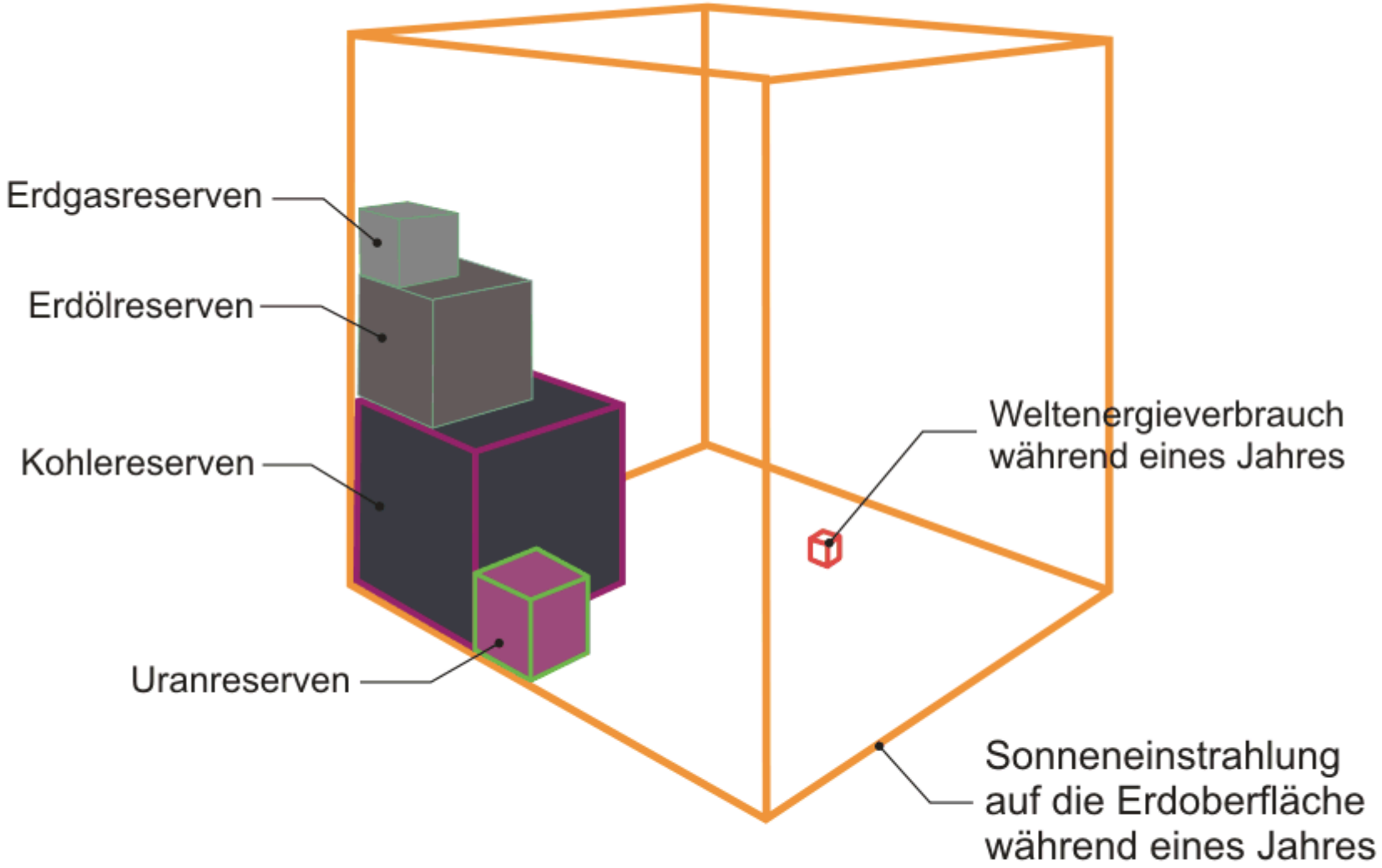
Stefan Krauter	Vergleich zwischen CO_2-Gehalt und Temperatur der Atmosphäre	UFRJ COPPE



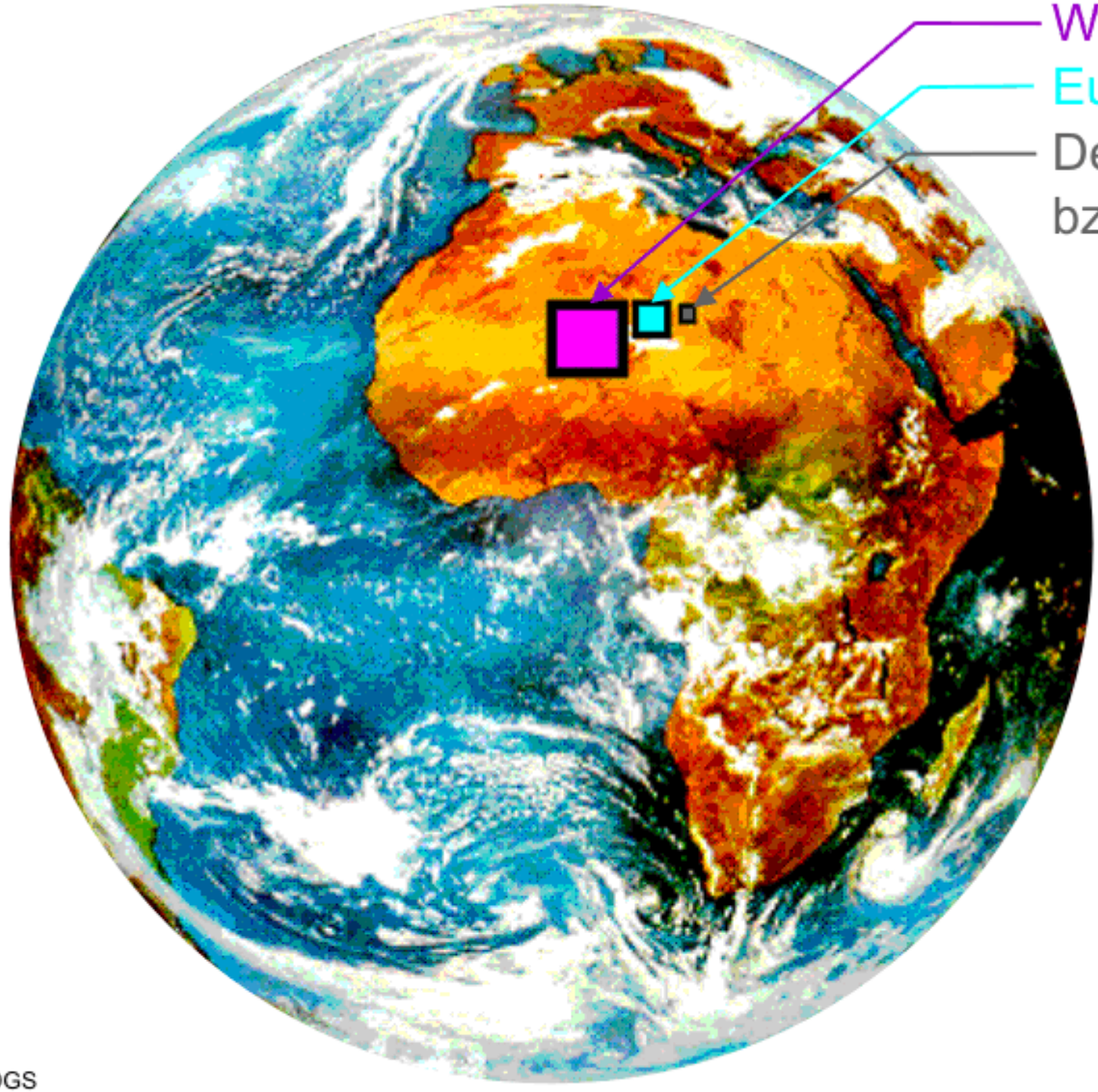
Stefan Krauter	Durch Naturkatastrophen verursachte Schäden	UFRJ COPPE



Stefan Krauter	Energieträger: Bisherige Entwicklung und Zukunft	UFRJ COPPE

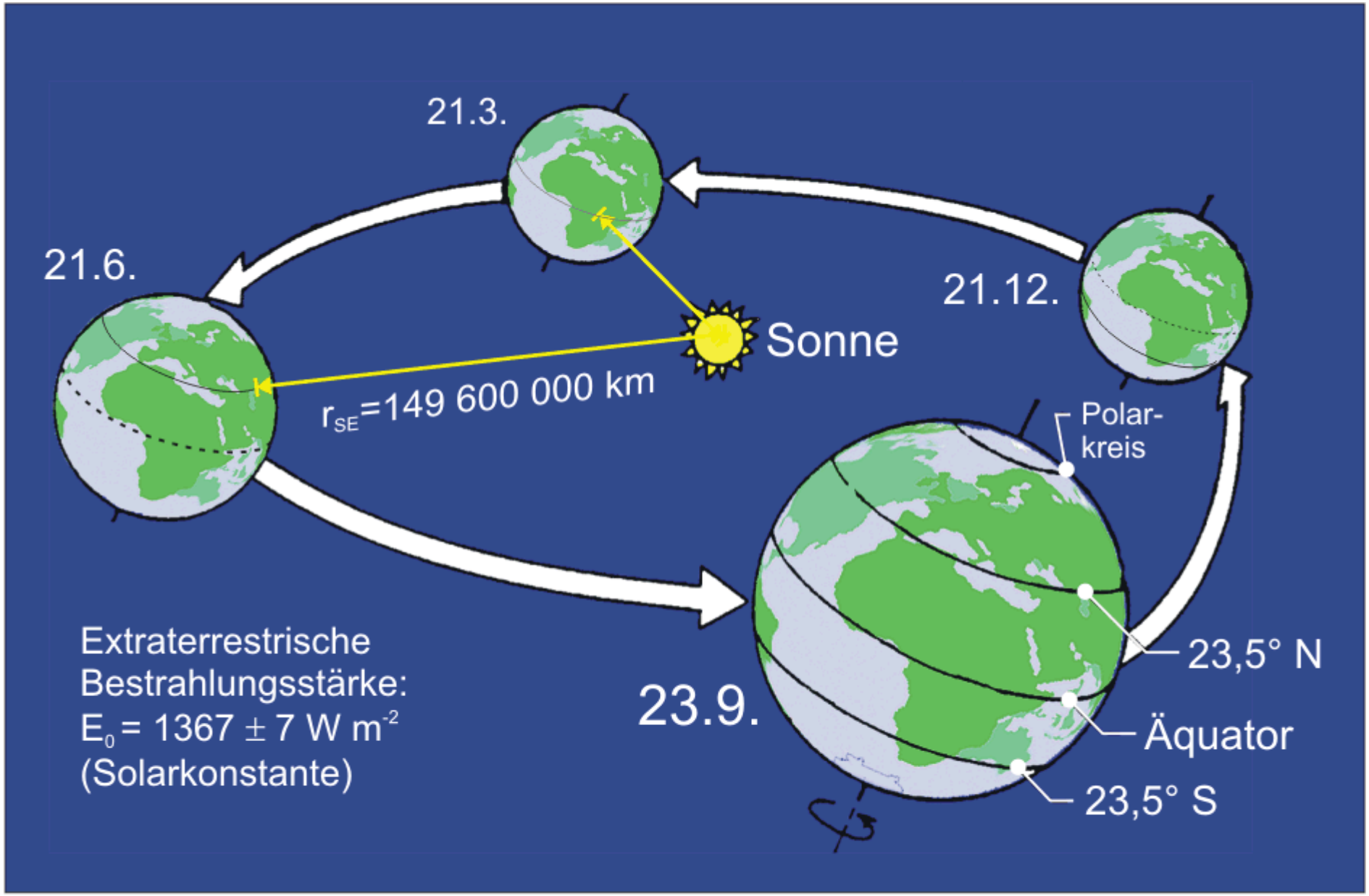


Stefan Krauter	Energiereserven, Verbrauch und Sonnenenergiepotential	UFRJ COPPE

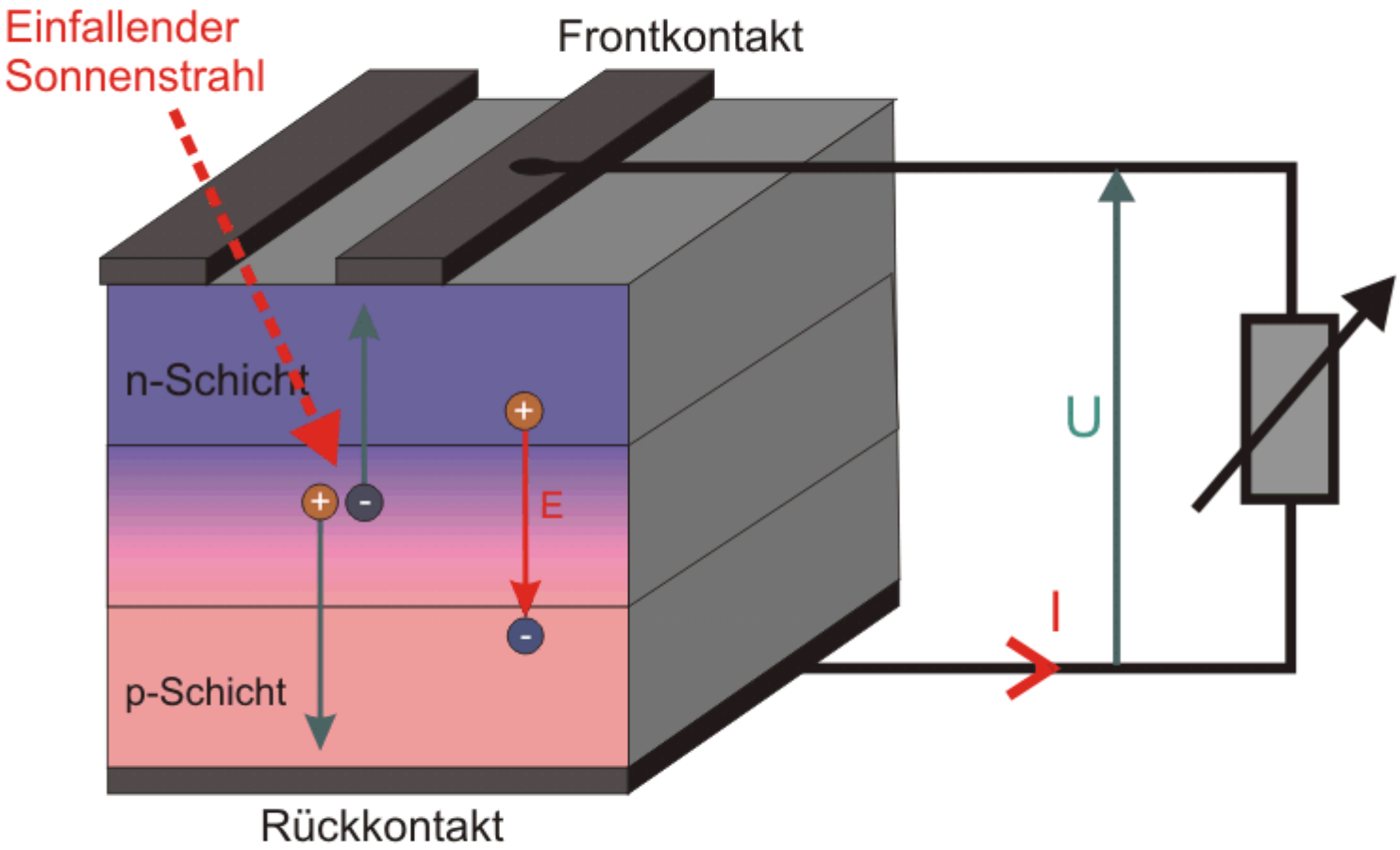


Quellen: DGS
Lutwig-Bölkow-Systemtechnik

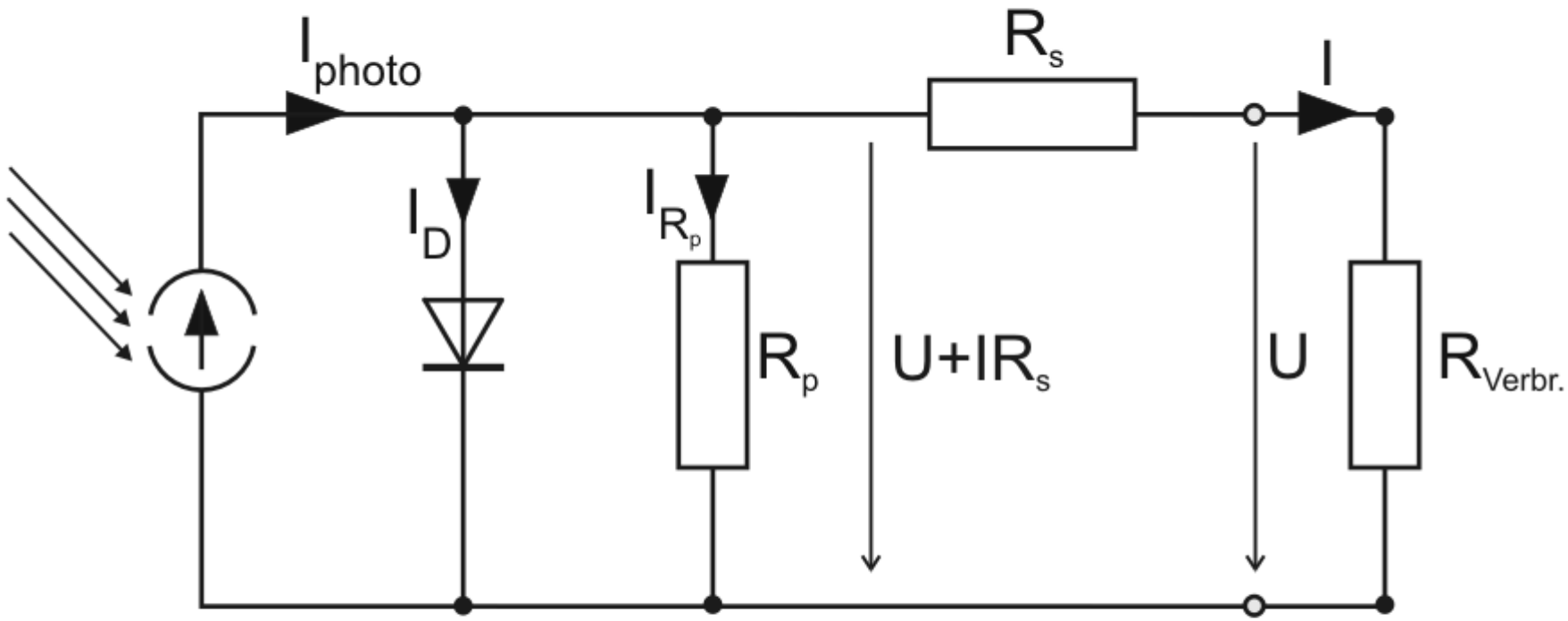
Stefan Krauter	Notwendige Flächen zur Energieversorgung durch Photovoltaik	UFRJ COPPE



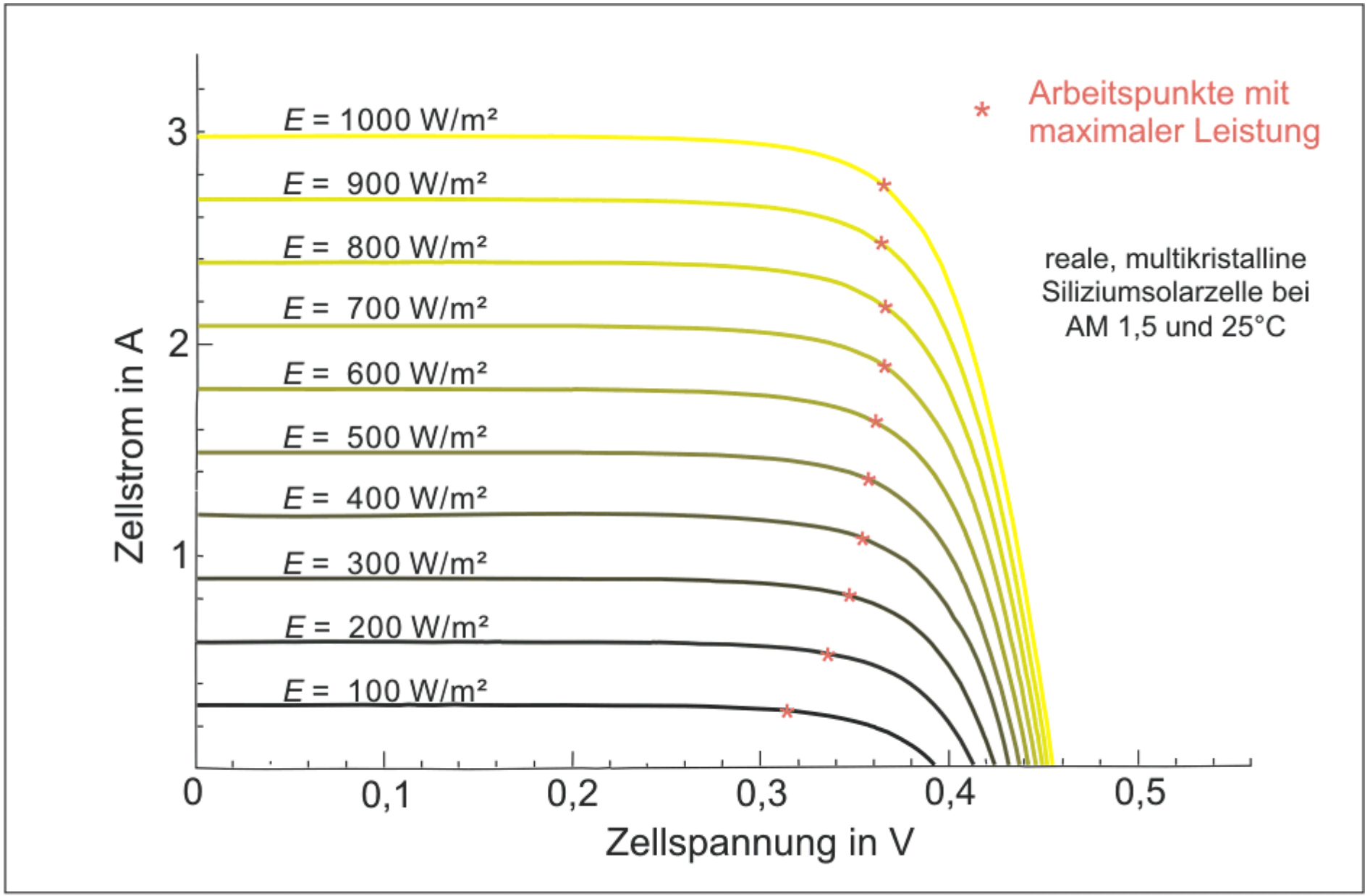
Stefan Krauter	Astronomische Gegebenheiten zum Strahlungsangebot	UFRJ COPPE



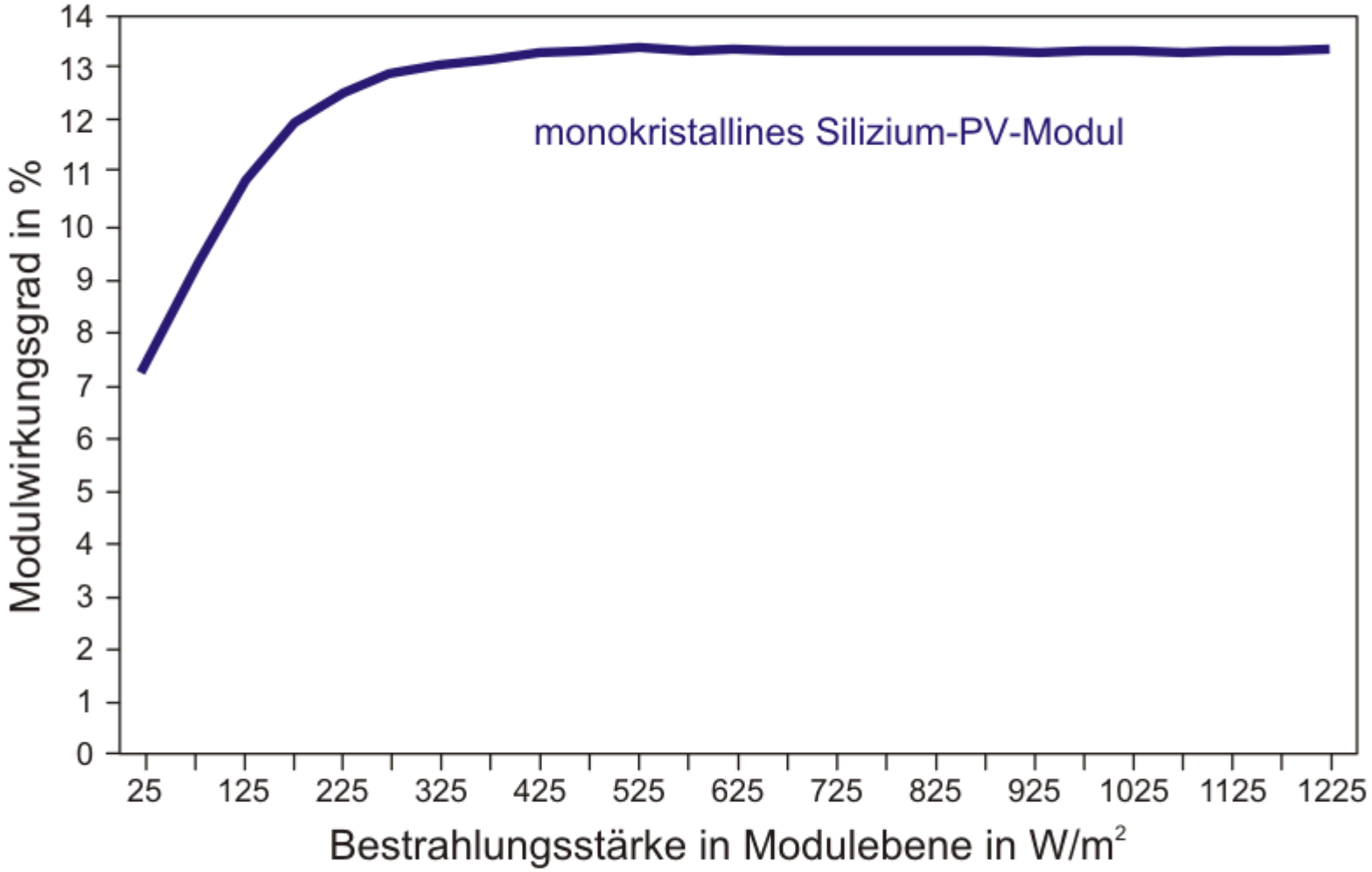
Stefan Krauter	Photovoltaischer Effekt bei einer Solarzelle	UFRJ COPPE



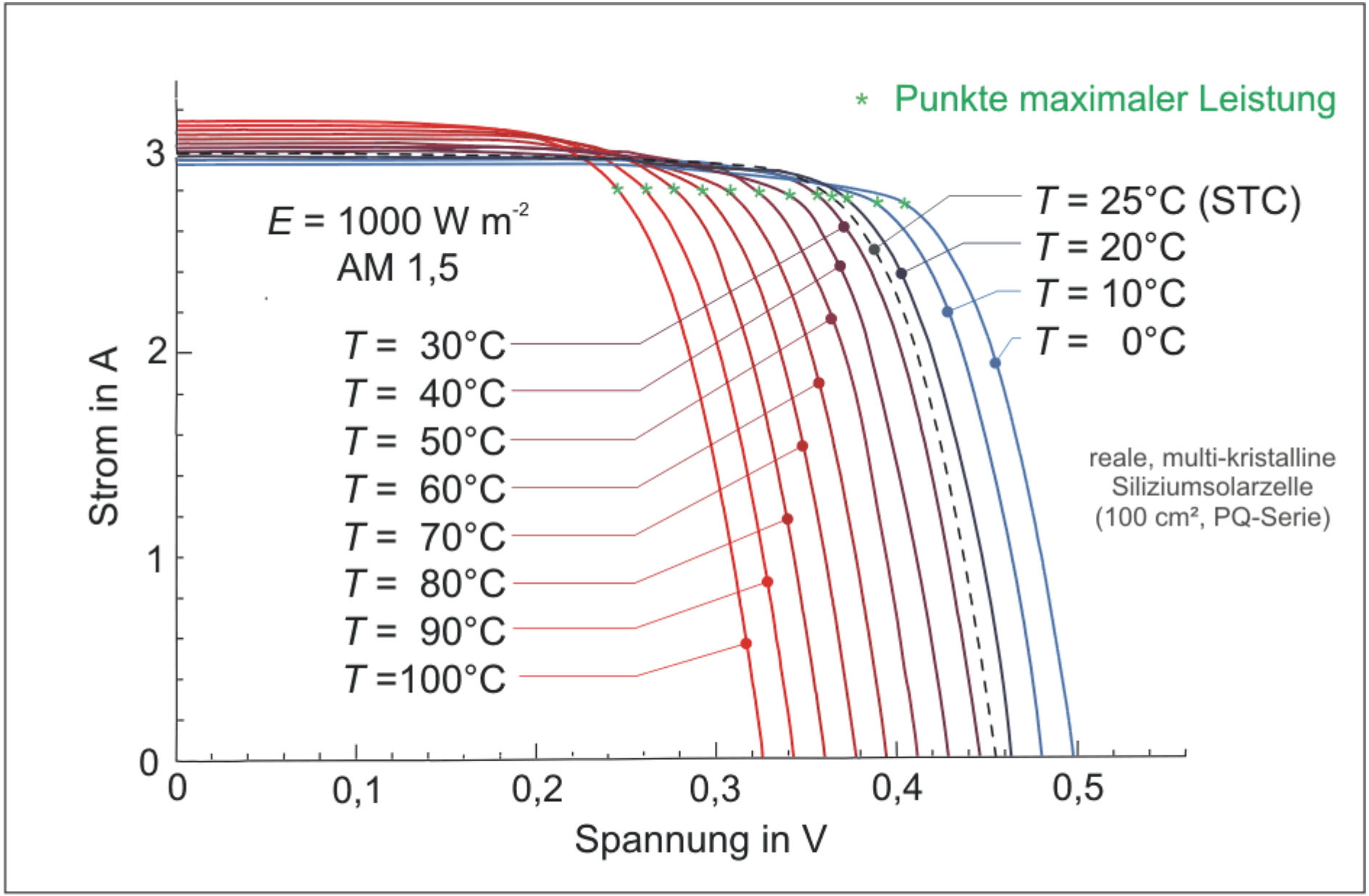
Stefan Krauter	Elektrisches Ersatzschaltbild einer Solarzelle	UFRJ COPPE



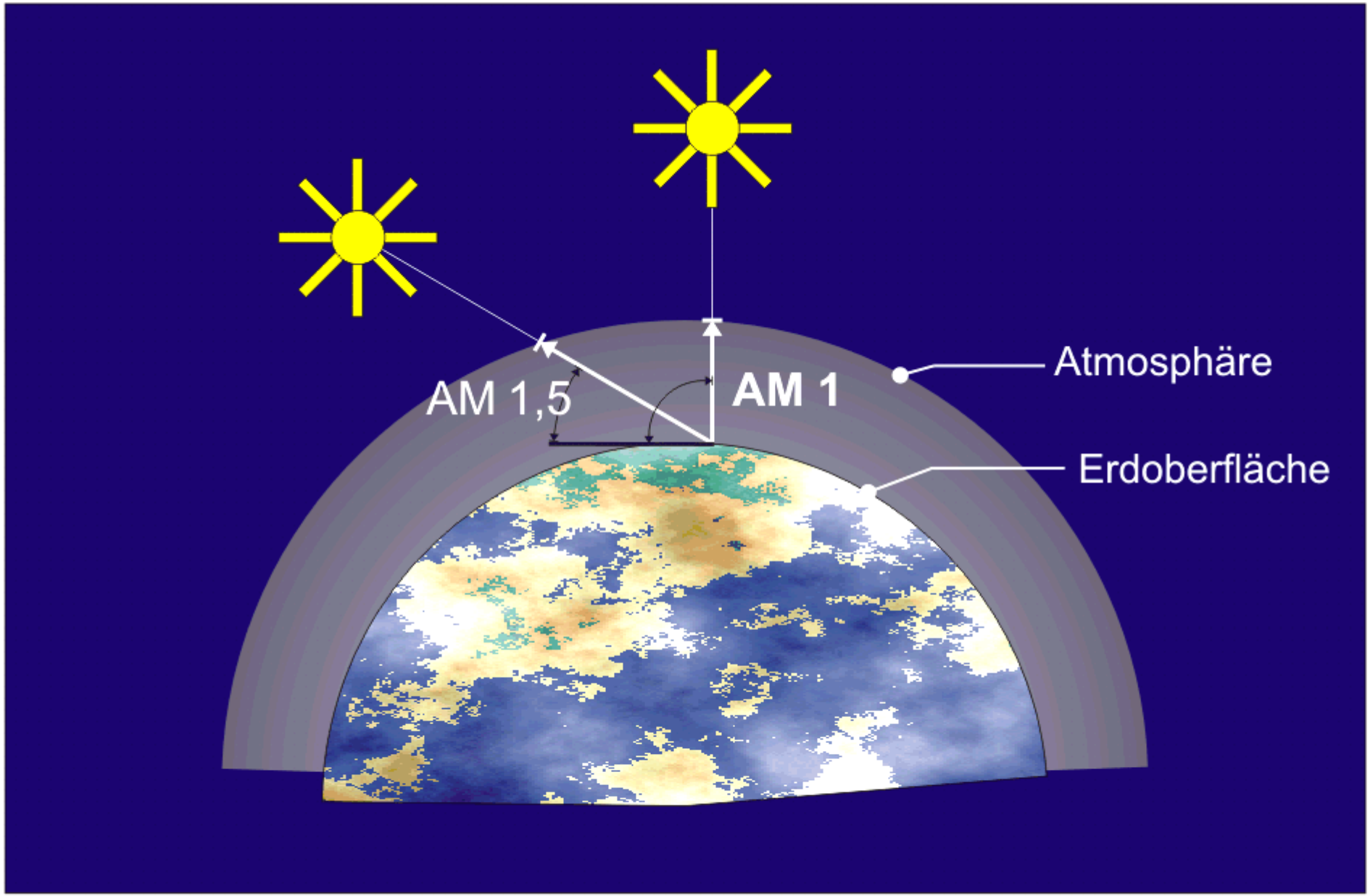
Stefan Krauter	Strom-Spannungskennlinien bei variabler Bestrahlungsstärke	UFRJ COPPE



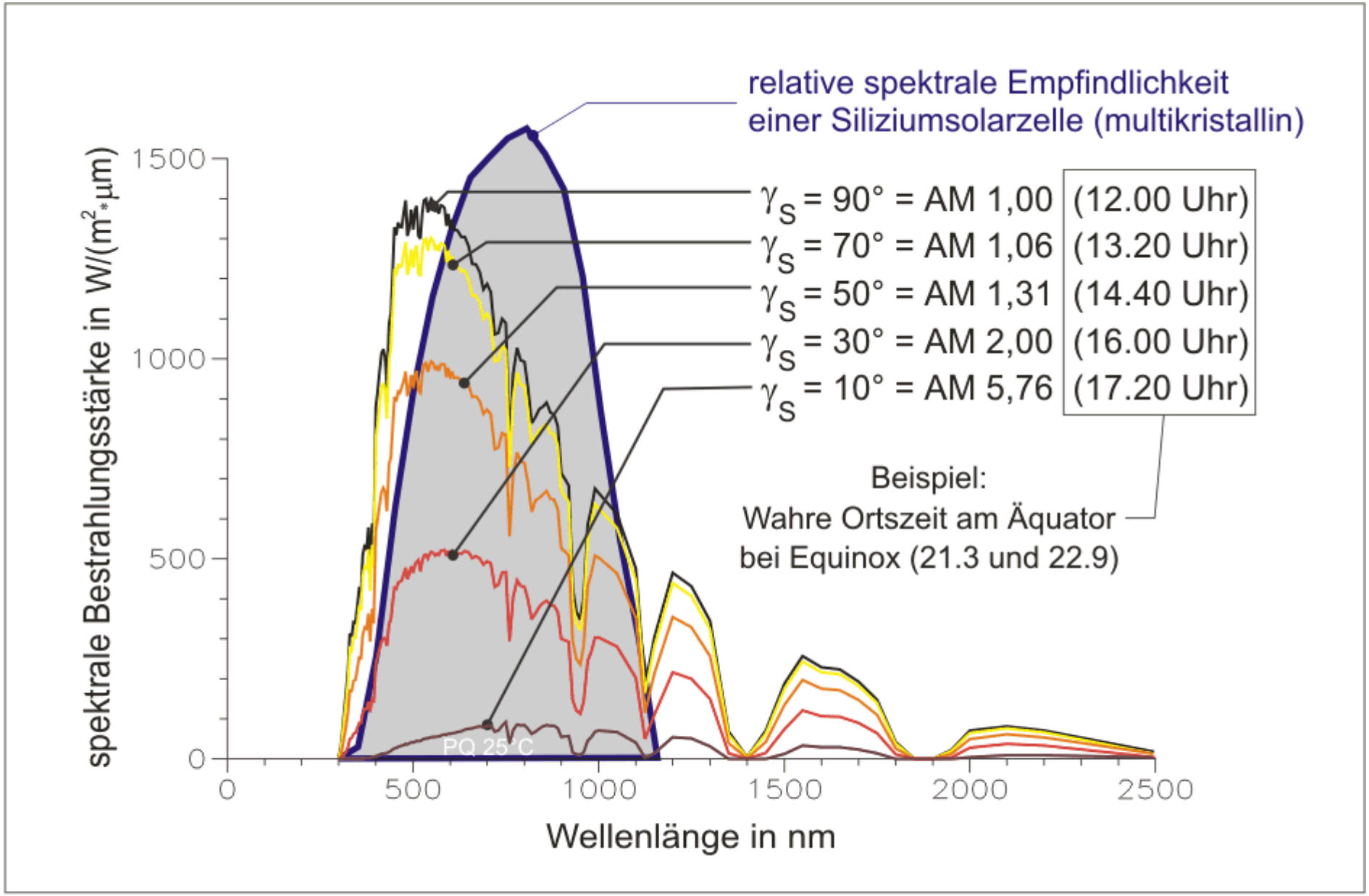
Stefan Krauter	Modulwirkungsgrad in Abhängigkeit der Bestrahlungsstärke	UFRJ COPPE



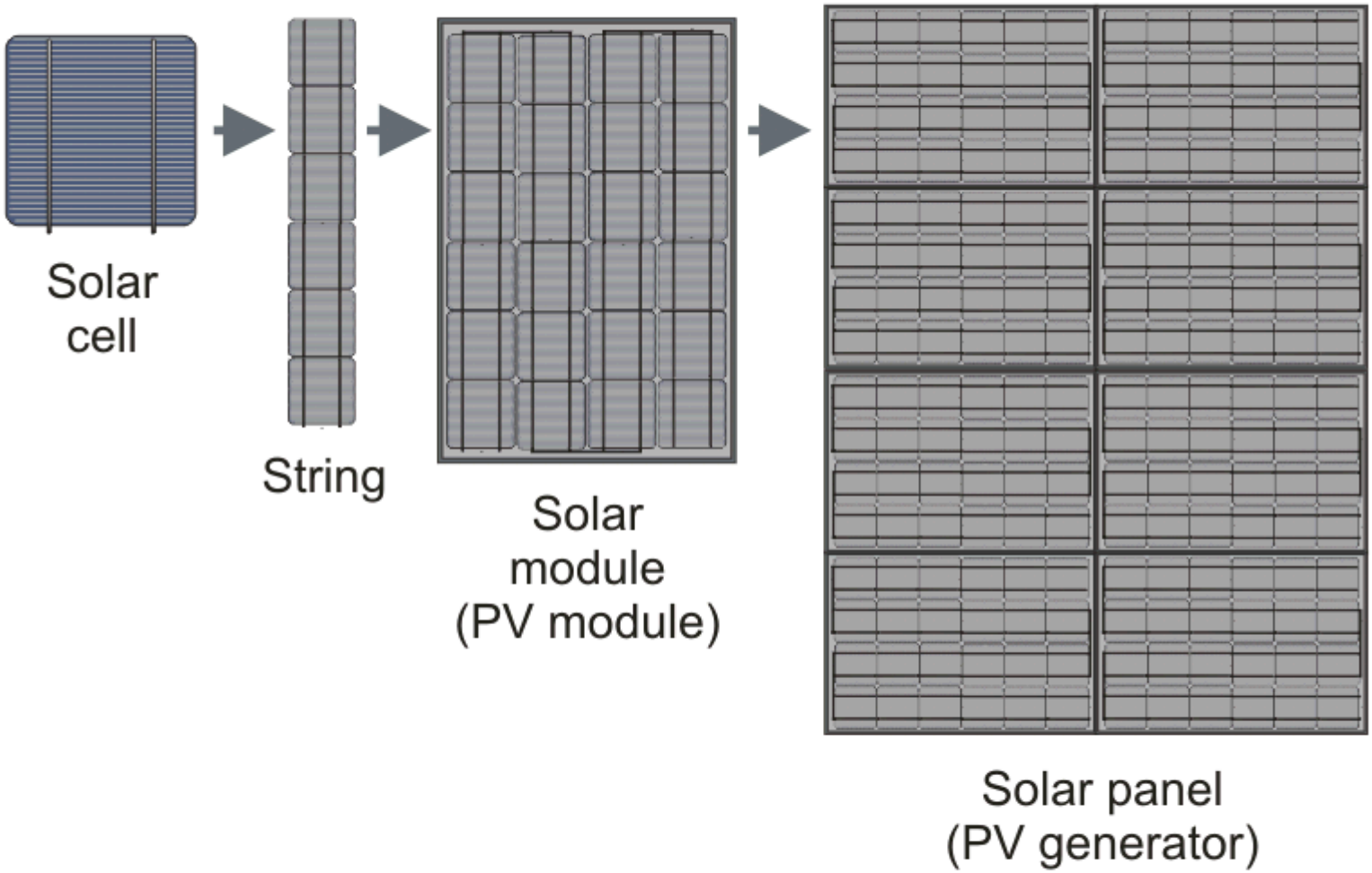
Stefan Krauter	Strom-Spannungskennlinie einer Solarzelle bei Temperaturvariation	UFRJ COPPE



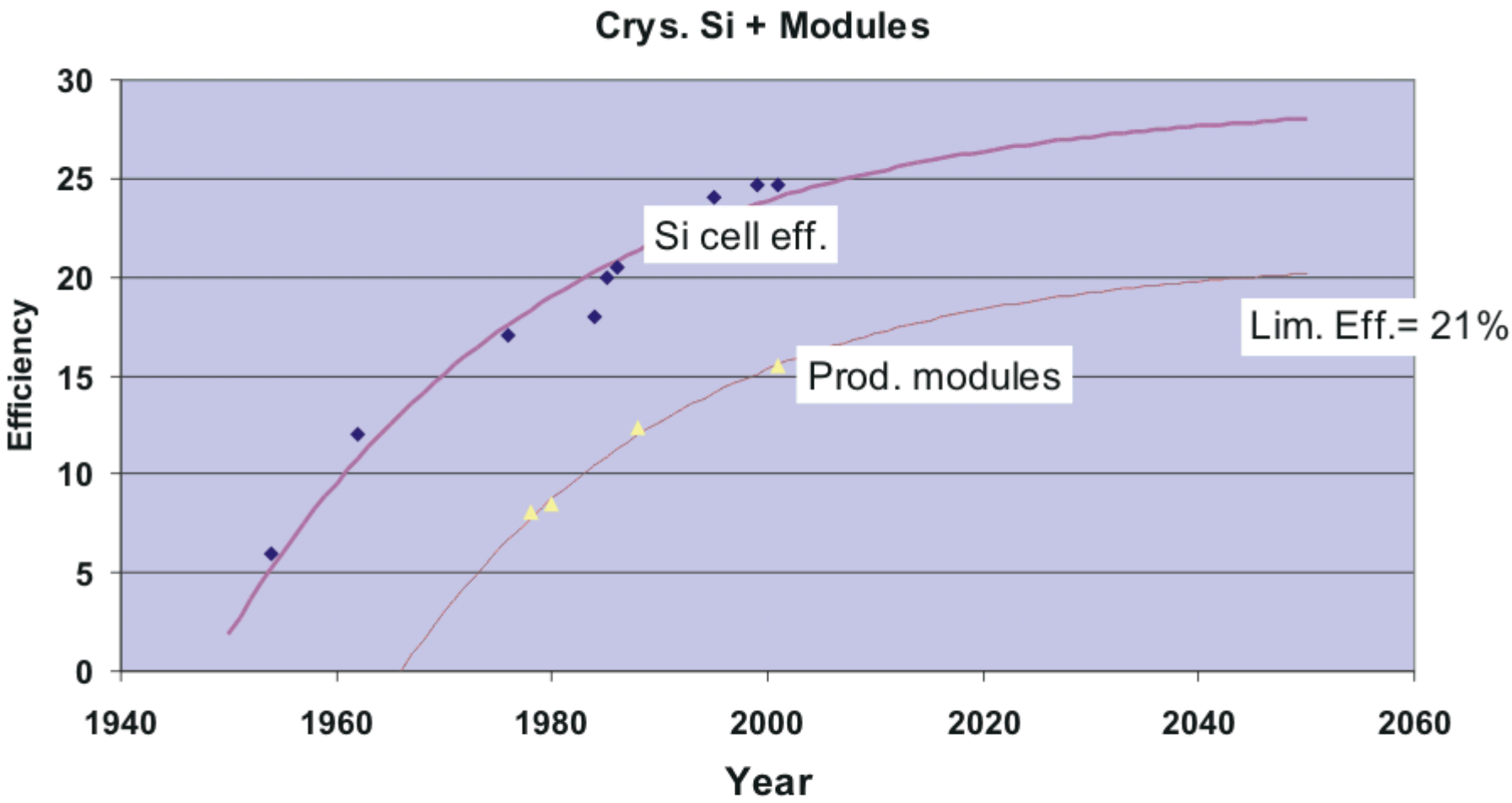
Stefan Krauter	Definition der relativen Luftmasse (Air Mass)	UFRJ COPPE



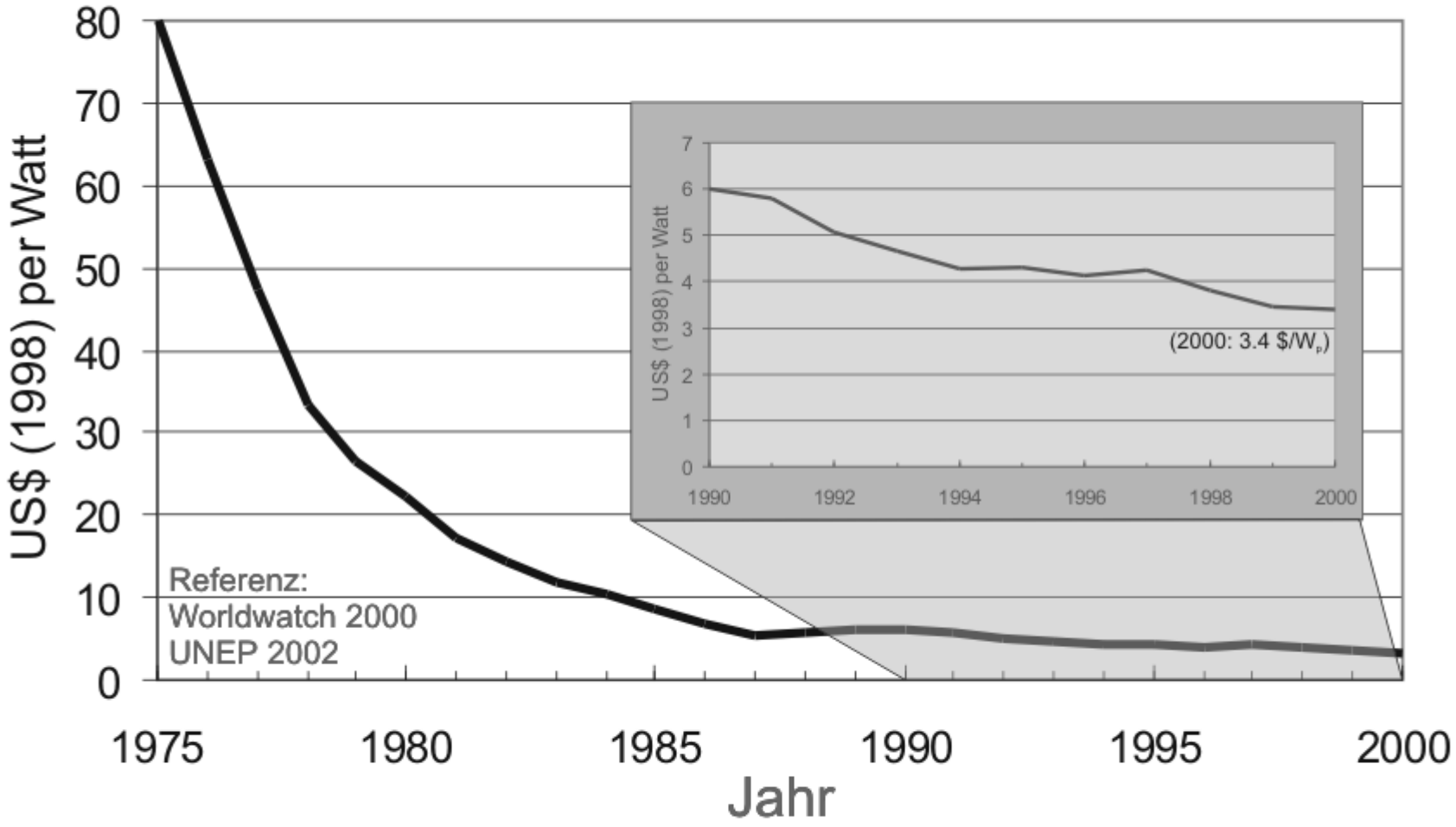
Stefan Krauter	Sonnenspektrum im Tagesverlauf und Solarzellenempfindlichkeit	UFRJ COPPE



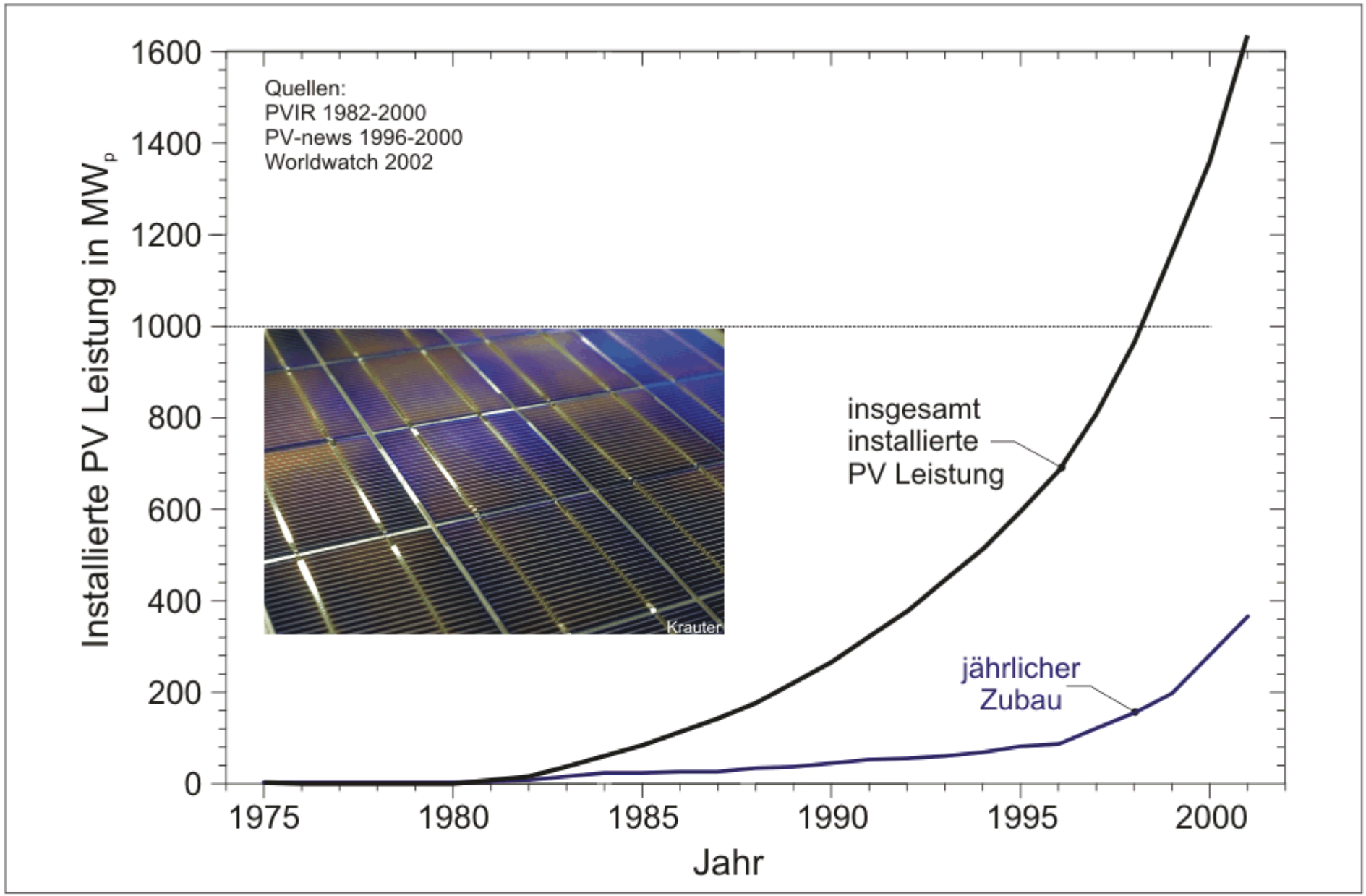
Stefan Krauter	Definition of components of a PV generator	UFRJ COPPE



Stefan Krauter	Desenvolvimento do rendimento para células e para módulos	UFRJ COPPE



Stefan Krauter	Preisentwicklung von PV-Modulen in US $ von 1998	UFRJ COPPE



Stefan Krauter	Weltweit installierte Photovoltaikkraftwerke (terrestrisch)	UFRJ COPPE

Medium irradiance in Rio de Janeiro: **1800 kWh/(m² a)**

Electrical energy yield of a photovoltaic energy system (efficiency: 10-12%): **180-220 kWh/(m² a)**

Thermal yield of a solar thermal system (eff. 30-50%):

540-900 kWh/(m² a) = 1944-3240 MJ/(m² a)

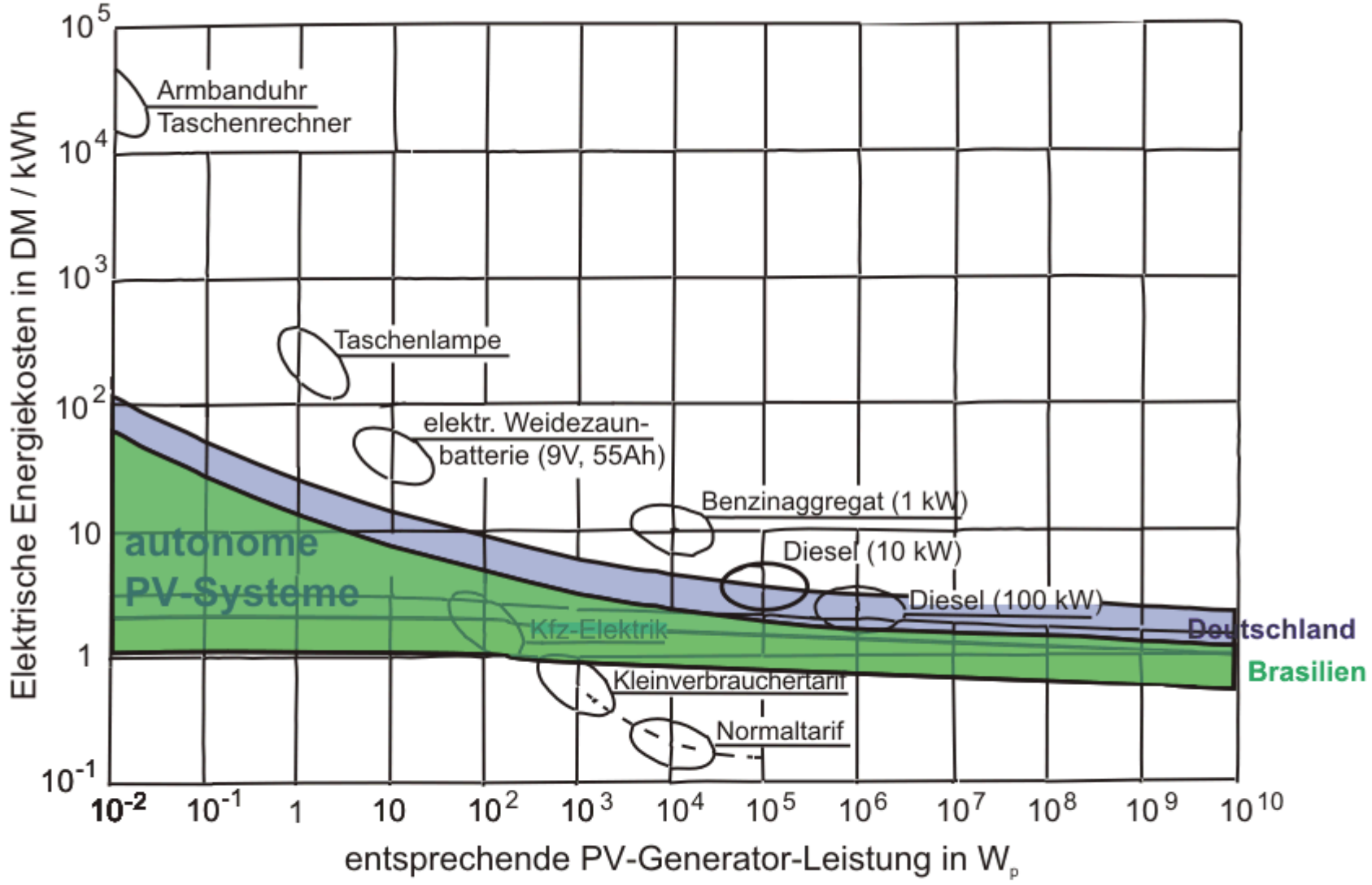
Ertrag über die Lebensdauer (25 Jahre) (unter Berücksichtigung von Reflexion, Erwärmung, spektralen Effekten):	20 830 kWh
Energieverbrauch zur Kraftwerksproduktion:	- 5 810 kWh
Materialwiederverwendung nach 25 Jahren:	1 950 kWh
Netto-Ertrag:	16 970 kWh

Nennleistung der Anlage (25°C; AM 1,5; 1000 W/m^2): 1 kW$_p$

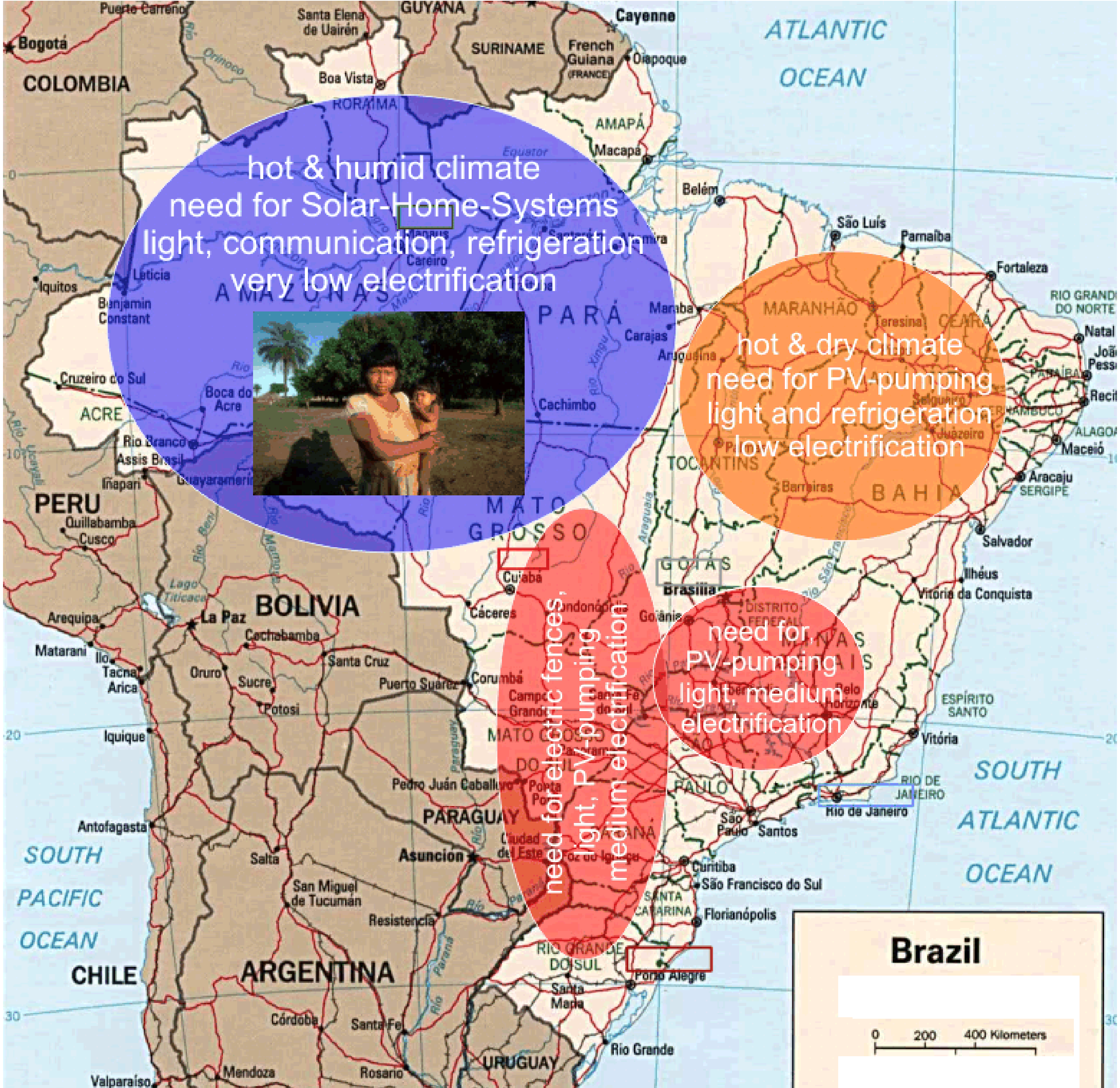
Module: Siemens SM 50, γ_M=35°; Südausrichtung, Standort: Stuttgart

CO_2-Verminderung in kg/kW_p durch PV-Kleinkraftwerke mit multikristallinen Siliciumsolarzellen bei einer Lebensdauer von 25 Jahren

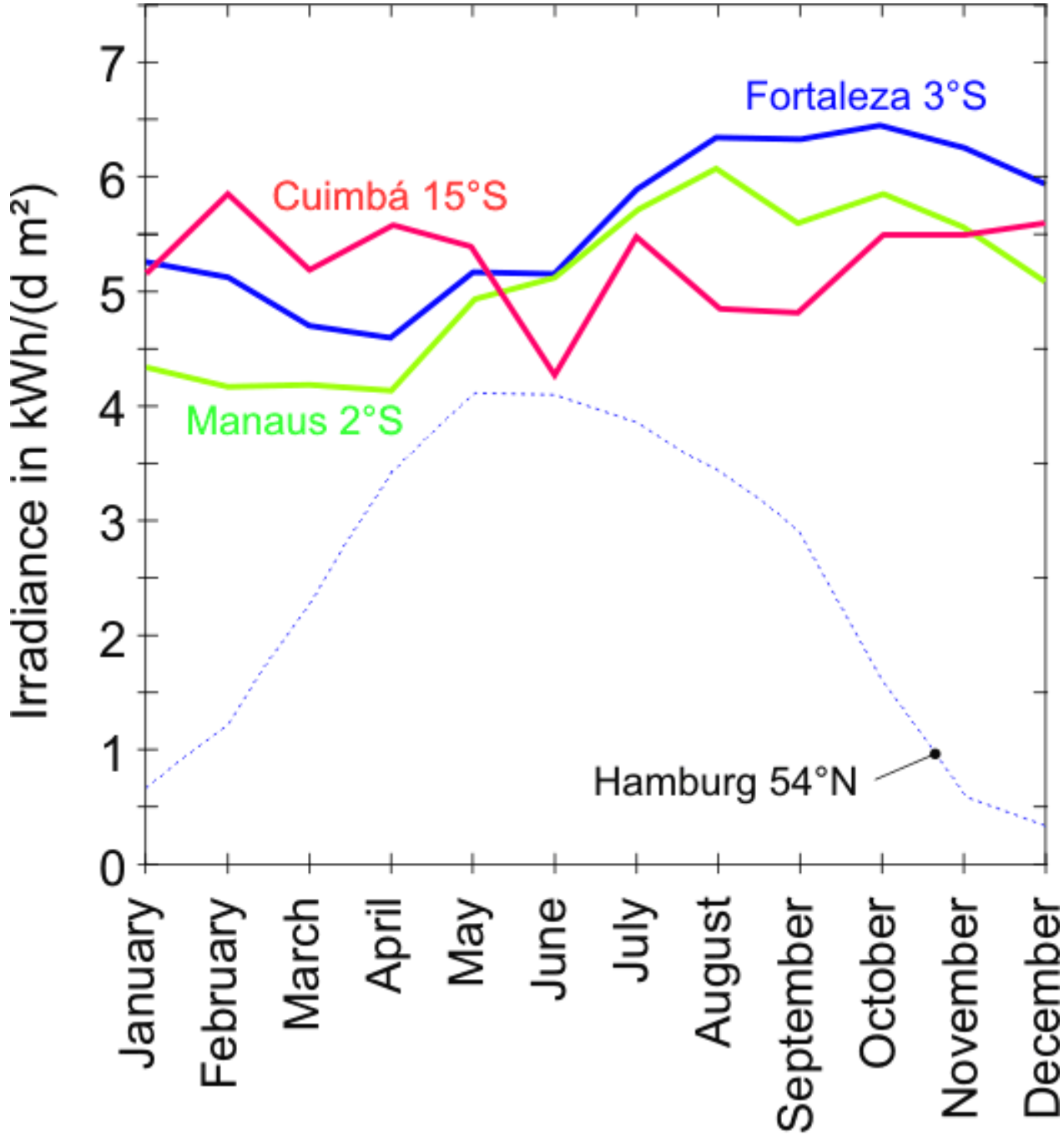
Betrieb des PV-Kraftwerkes in:	**Herstellung** des PV-Kraftwerkes in:	
	Deutschland	Brasilien
Deutschland (Netzverbund)	8 677	9 805
Brasilien (Netzverbund heute)	162	1 359
Brasilien (autonome Systeme: Substitution Diesel-aggregat, Zubau)	25 372	26 570

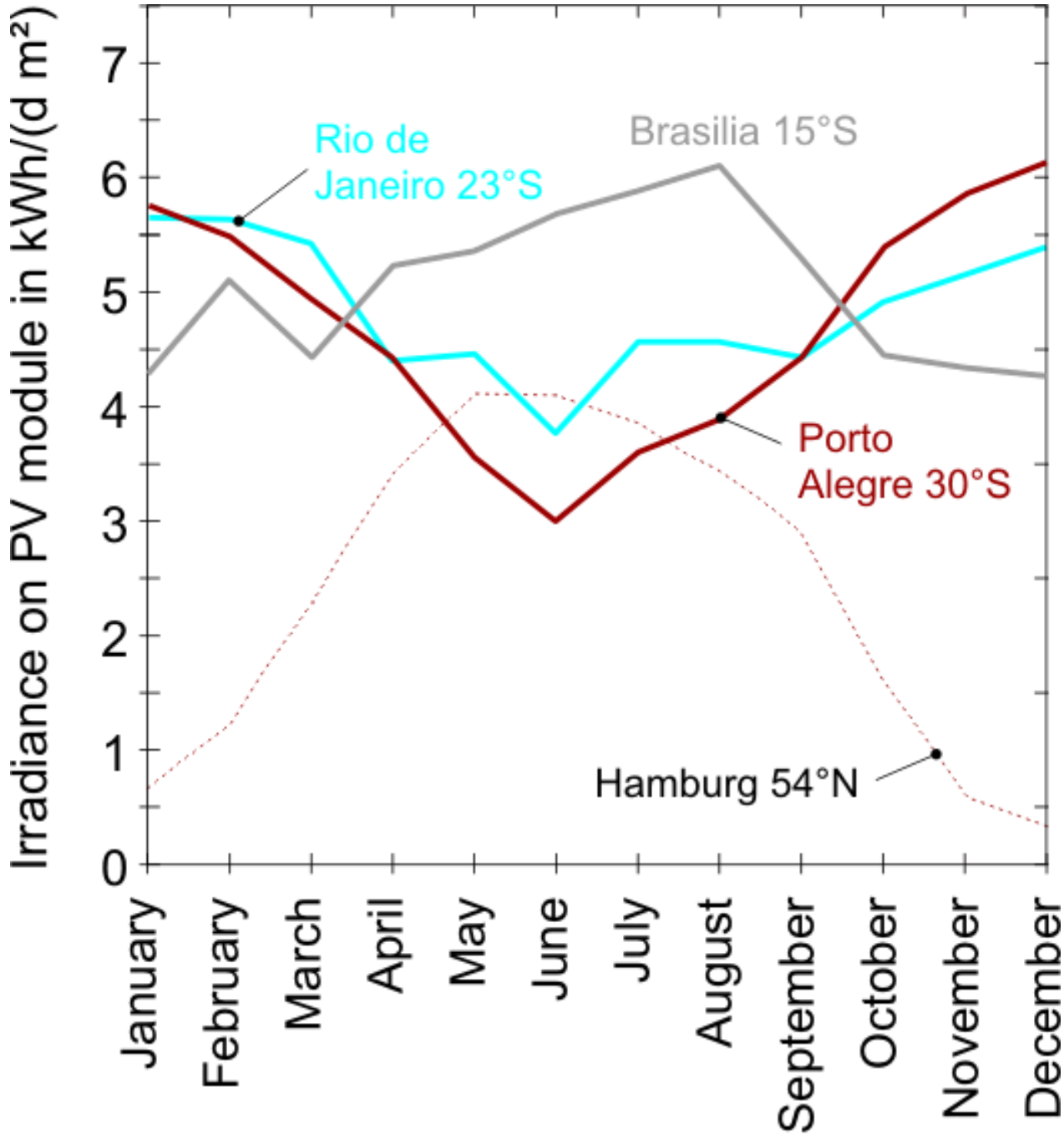


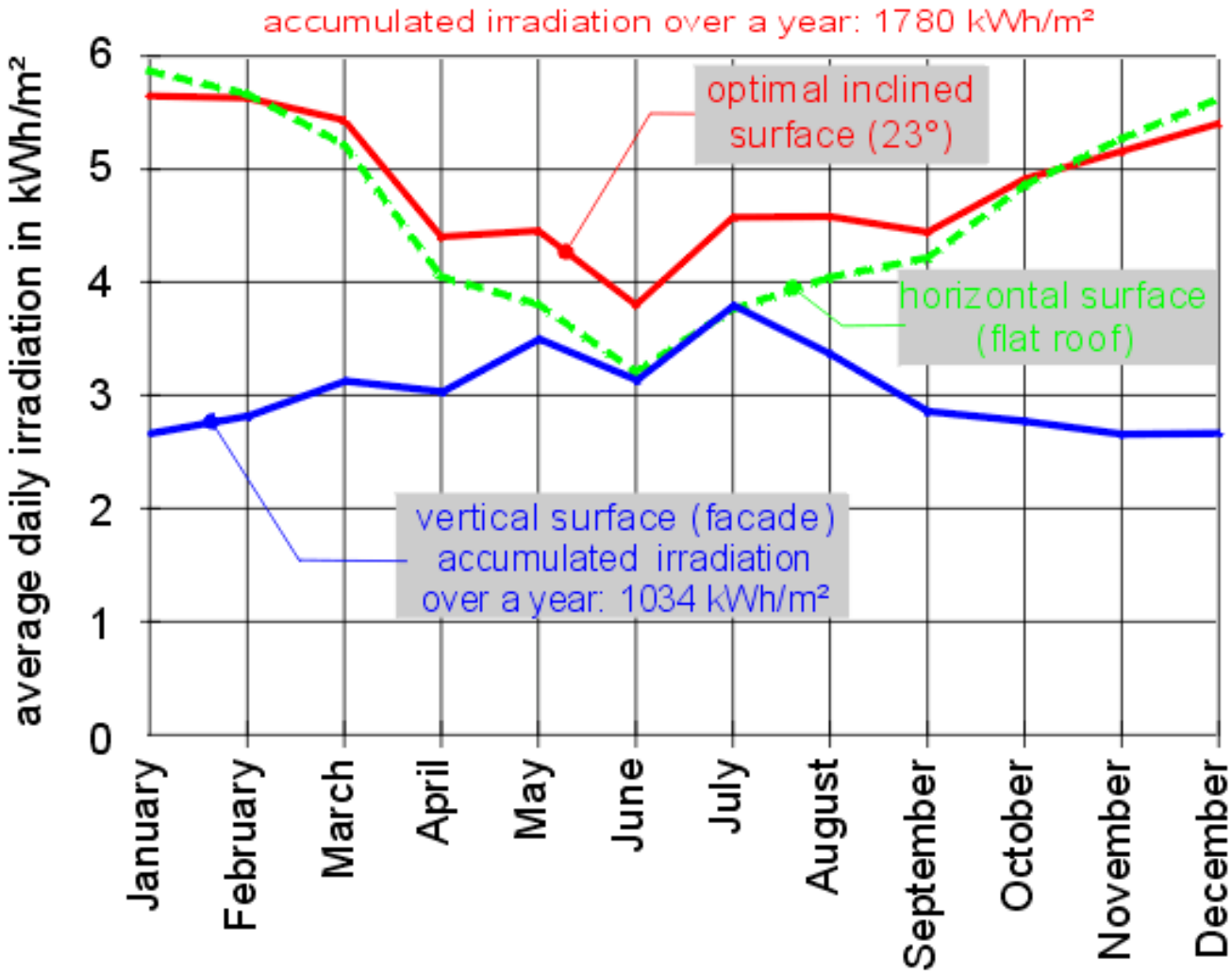
Stefan Krauter	Kostenvergleich von Energieversorgungssystemen	UFRJ COPPE


hot & humid climate
need for Solar-Home-Systems
light, communication, refrigeration
very low electrification
hot & dry climate
need for PV-pumping
light and refrigeration
low electrification
need for electric fences,
light, PV-pumping
medium electrification
need for
PV-pumping
light, medium
electrification
Brazil
0 200 400 Kilometers

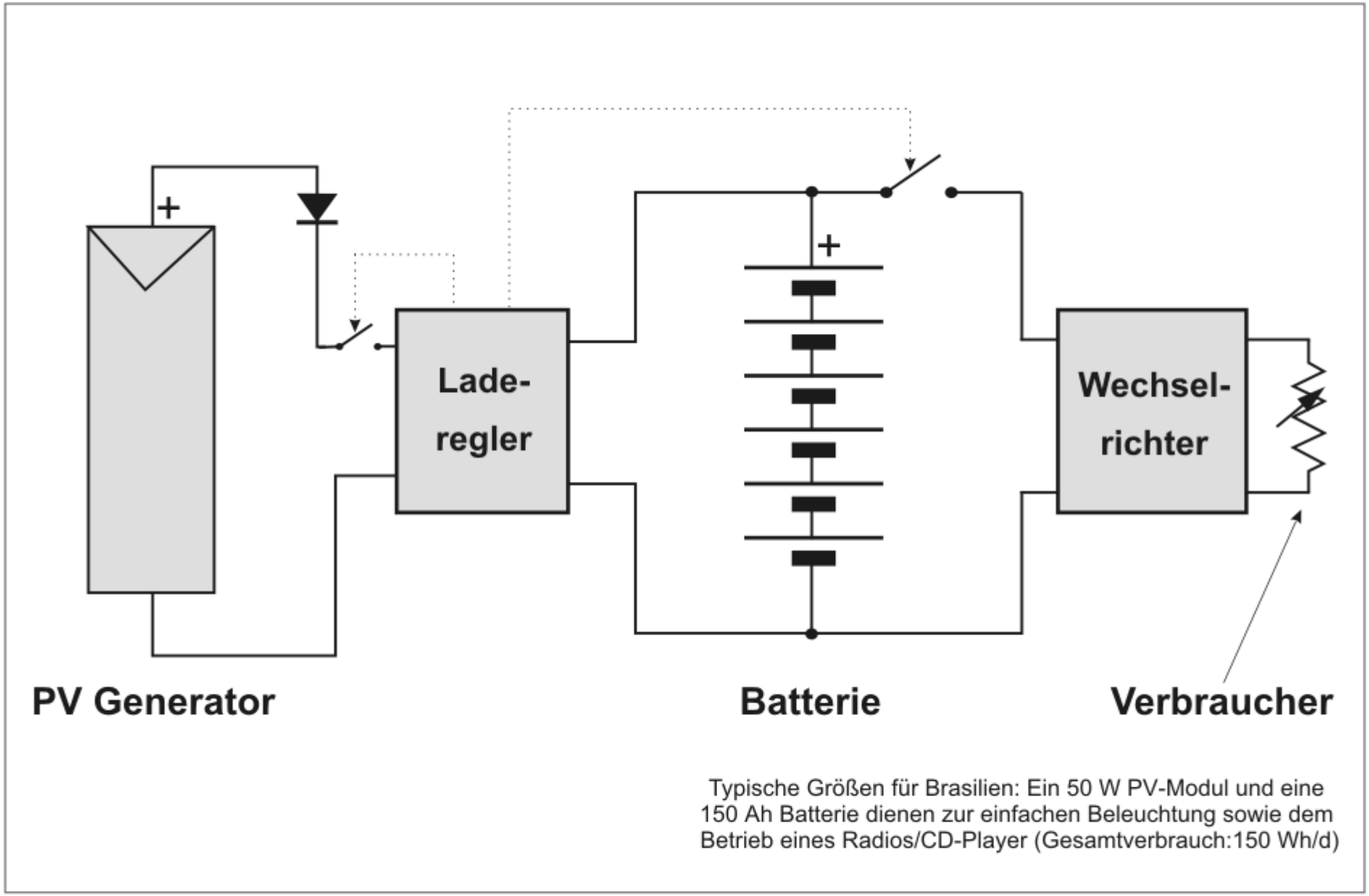
Krauter


Irradiance in kWh/(d m²)
0
1
2
3
4
5
6
7
Fortaleza 3°S
Cuimbá 15°S
Manaus 2°S
Hamburg 54°N
January
February
March
April
May
June
July
August
September
October
November
December


Irradiance on PV module in kWh/(d m²)
0
1
2
3
4
5
6
7
January
February
March
April
May
June
July
August
September
October
November
December
Rio de Janeiro 23°S
Brasilia 15°S
Porto Alegre 30°S
Hamburg 54°N



Stefan Krauter	Potential of Solar Energy: Irradiation in Rio de Janeiro	UFRJ COPPE



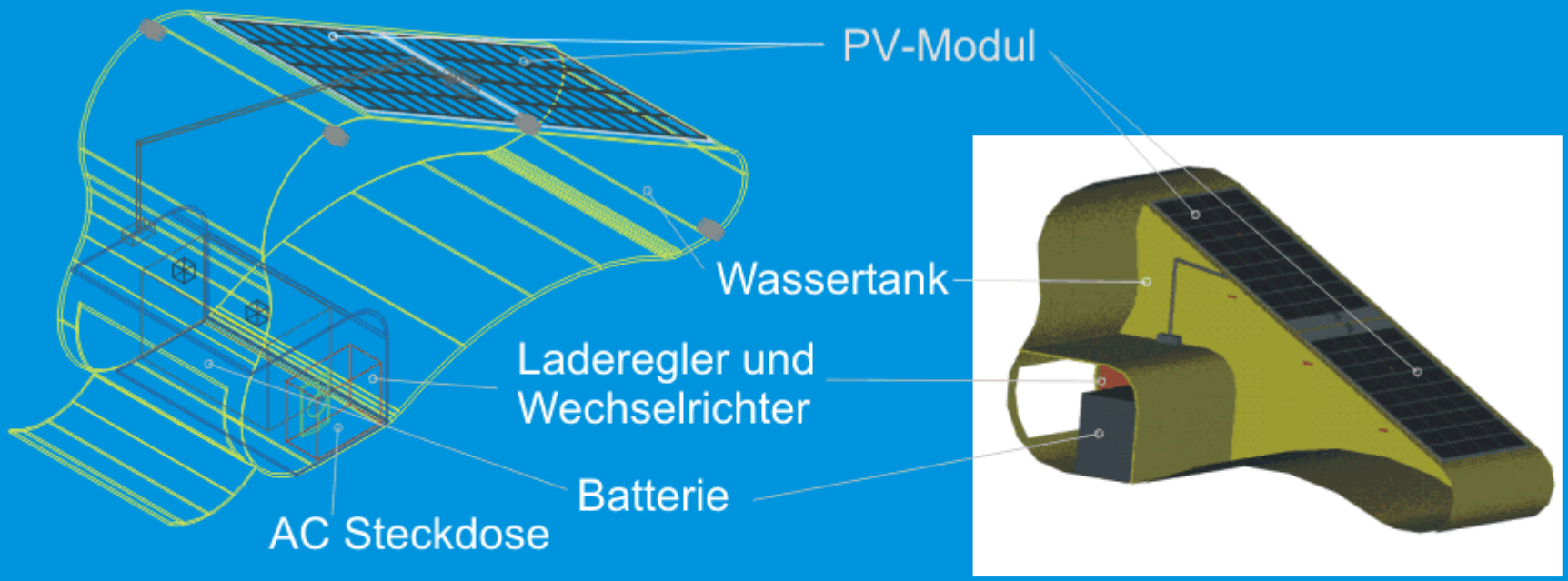
Typische Größen für Brasilien: Ein 50 W PV-Modul und eine 150 Ah Batterie dienen zur einfachen Beleuchtung sowie dem Betrieb eines Radios/CD-Player (Gesamtverbrauch:150 Wh/d)

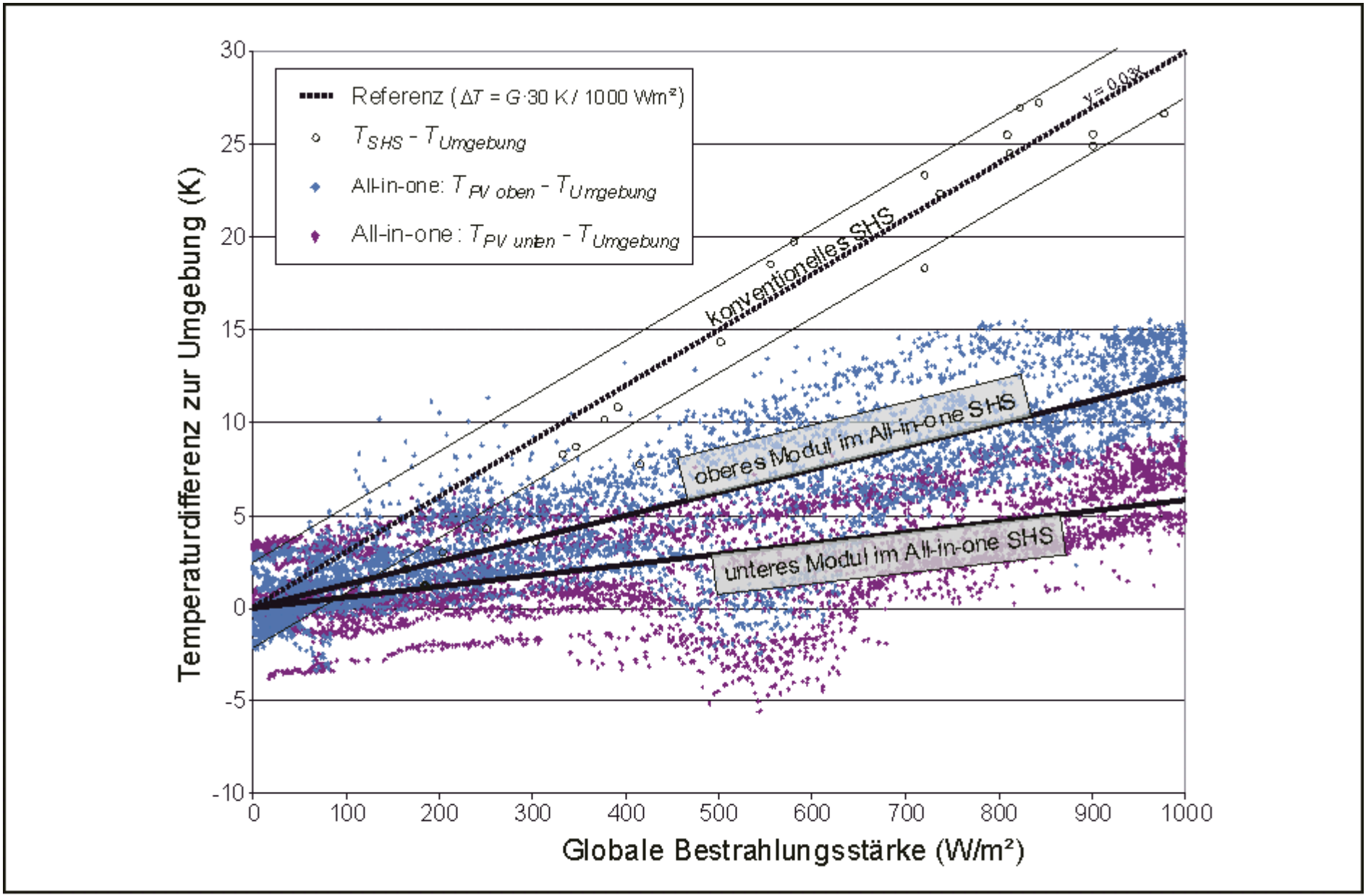
Stefan Krauter	Schema eines PV-Systems für die Basiselektrifizierung	UFRJ COPPE

Stefan Krauter	Solar-Home-System (SHS): Beleuchtung und Radio	UFRJ COPPE

Integriertes Solar-Home-System

Kühlung für PV und Batterie
sämtliche Komponenten ab Fabrik eingebaut
keine Installation: *Plug & Play*





Stefan Krauter	Temperaturzunahme All-in-one vs. konvent. SHS	UFRJ COPPE

Niedrige Betriebstemperatur

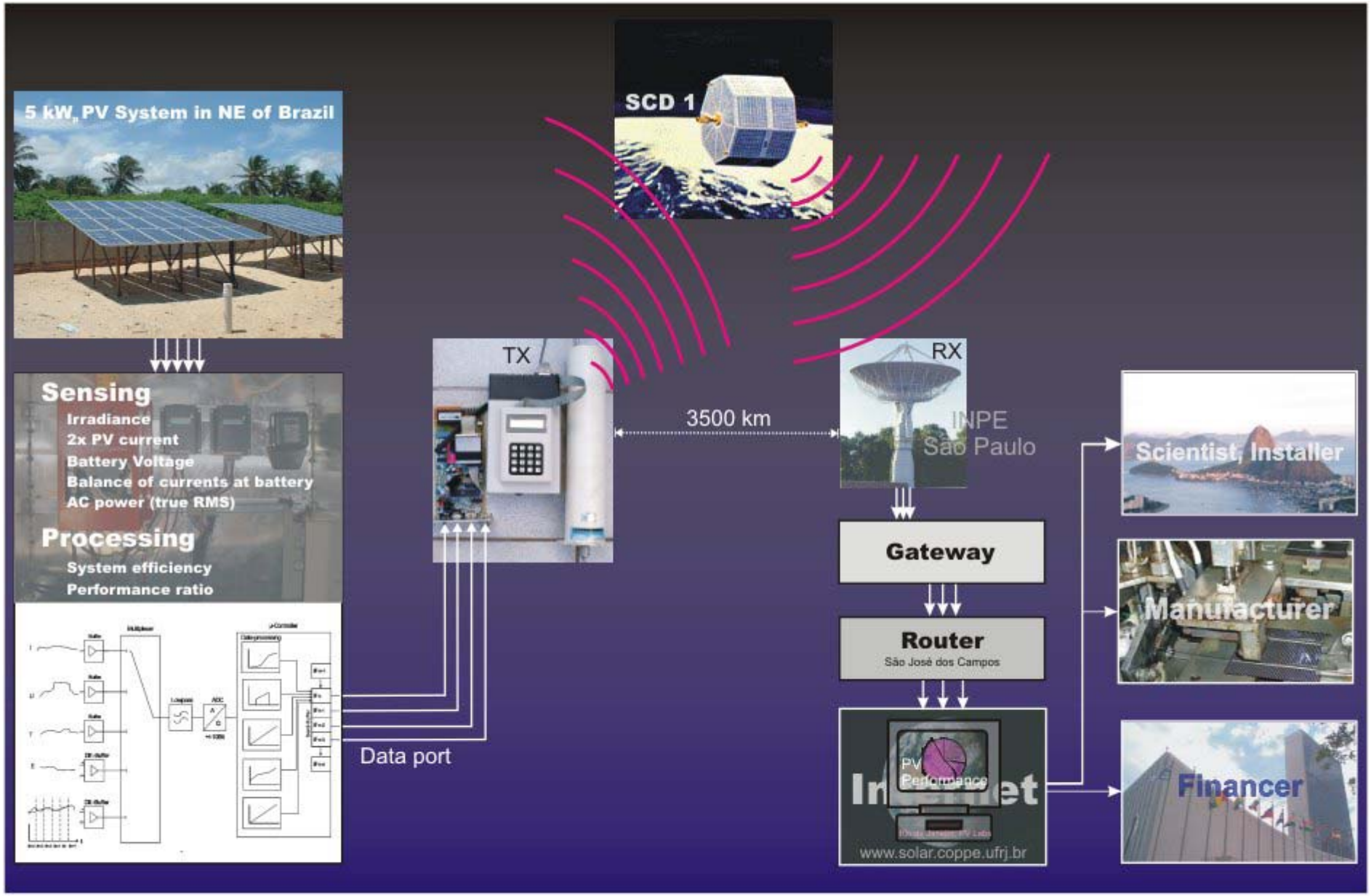
Erhöhter Wirkungsgrad

9% höherer Ertrag

erhöhte Zuverlässigkeit

keine Installation

keine Fixierung



Stefan Krauter	Structure of sensing, transmission and visualization system	UFRJ COPPE

Cost comparison of conventional monitoring (data logger) with satellite monitoring over a period of 20 years for a remote PV system in NE-Brazil

Type of cost	Conventional data logger	Satellite monitoring
Equipment	1* 1,000 €	1*1,500 €
Transportation	20* 500 €	1* 500 €
Personnel	20* 50 €	1* 200 €
Accommodation	20* 50 €	1* 150 €
Total costs	13,000 €	2,350 €