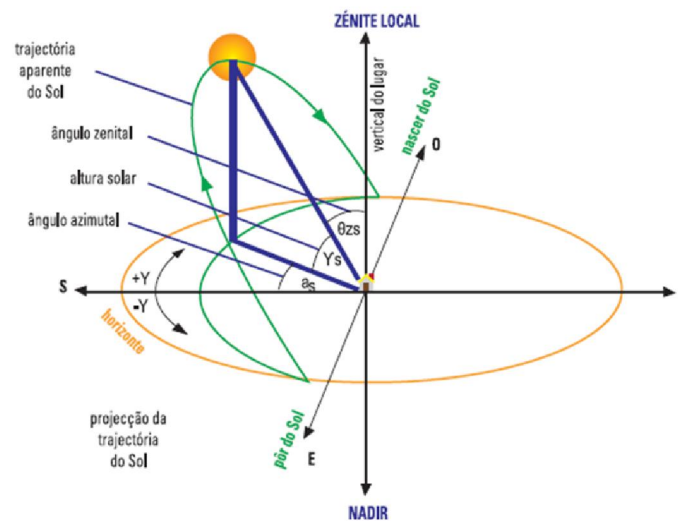


# ENERGIA SOLAR FOTOVOLTAICA

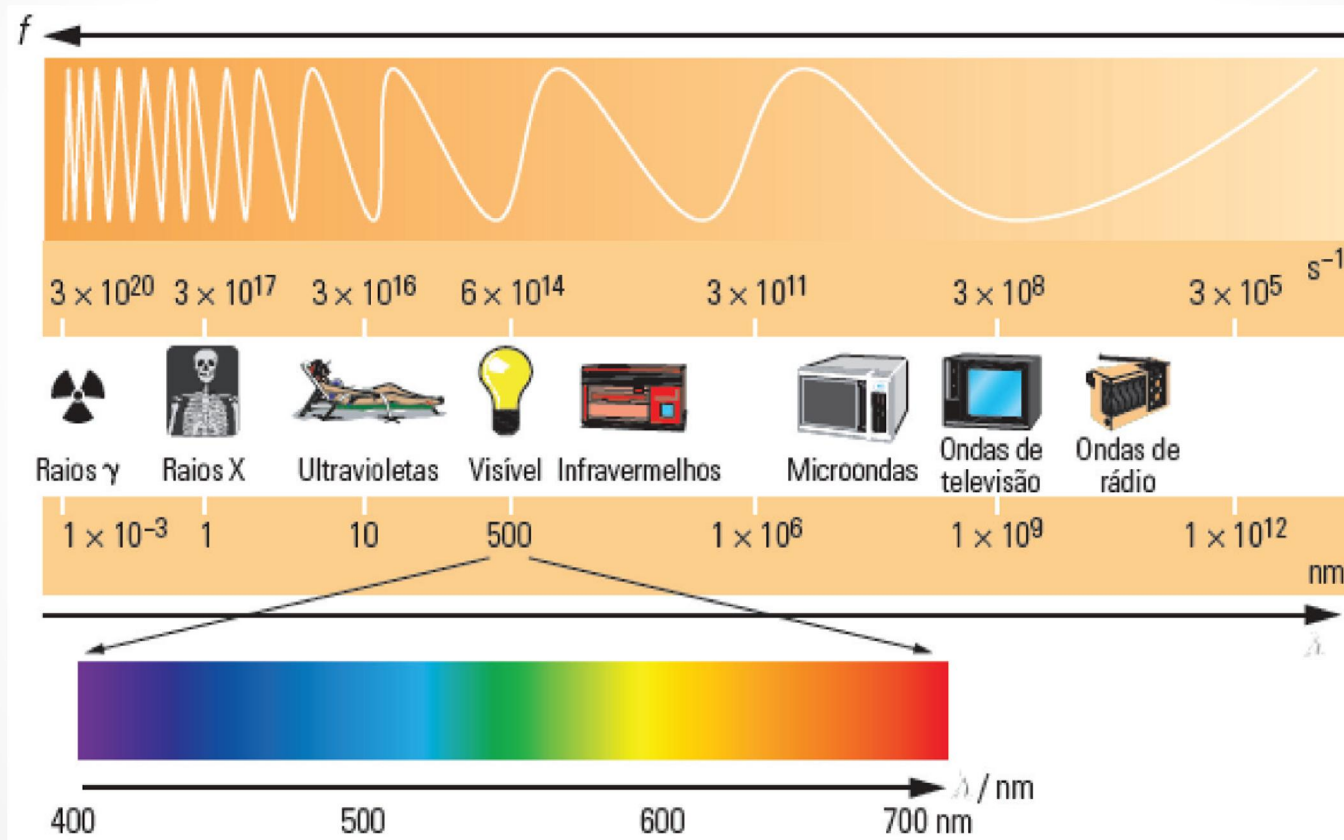
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Universidade Federal do Tocantins



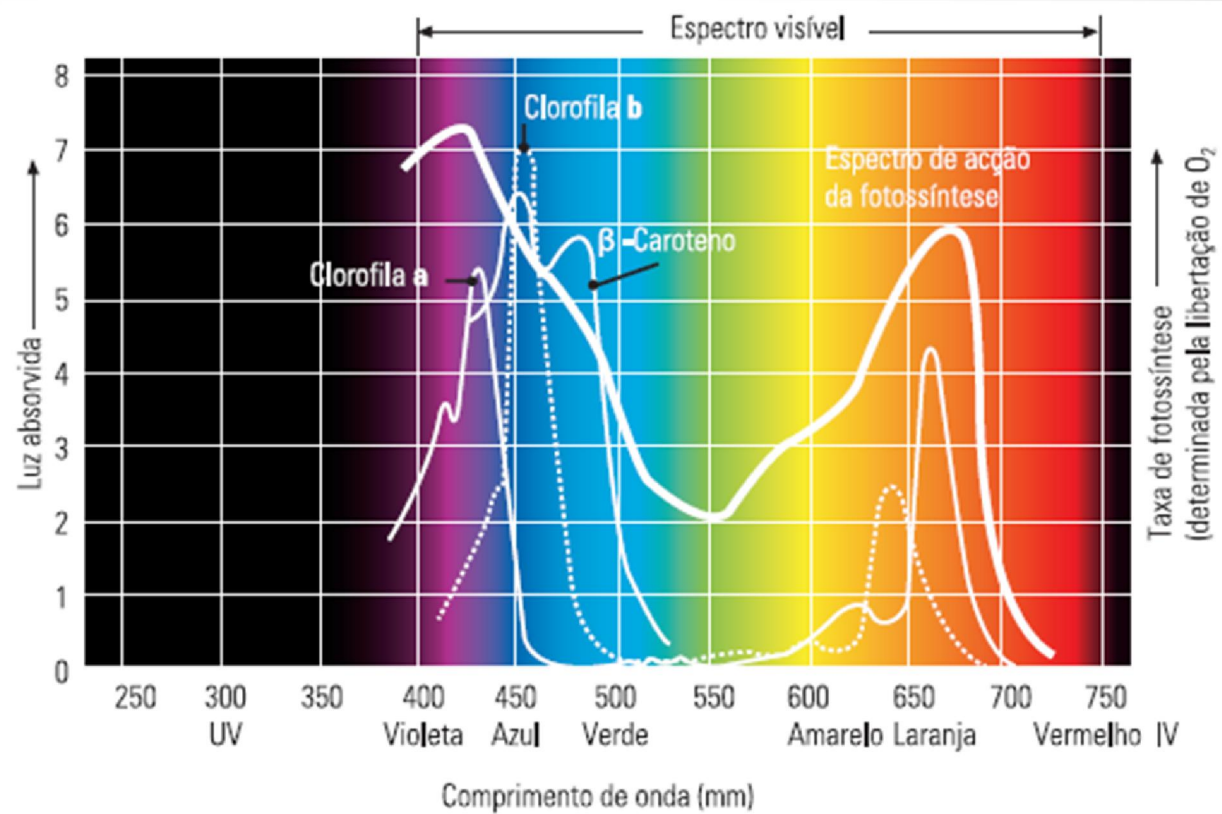
## Capítulo 1 – Conceitos básicos

**“Energia fornecida à Terra anualmente pelo Sol:  $1,5 \times 10^{18}$  kWh  
(10000 vezes superior ao consumo mundial anual de energia elétrica)”**



Fonte: <http://commons.wikimedia.org/wiki/File:Spectre.svg>

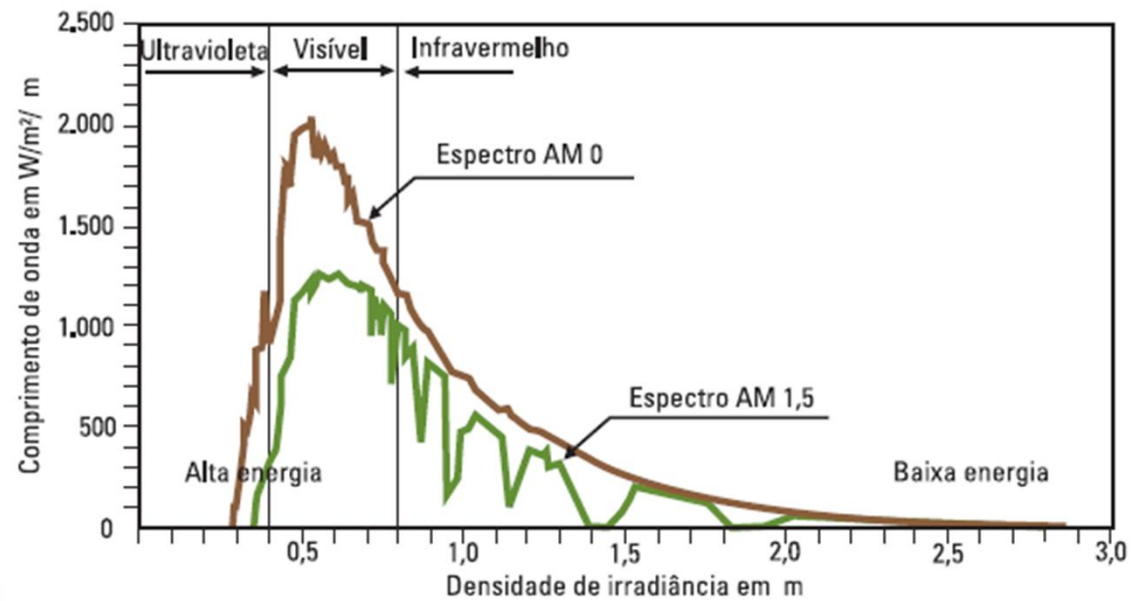
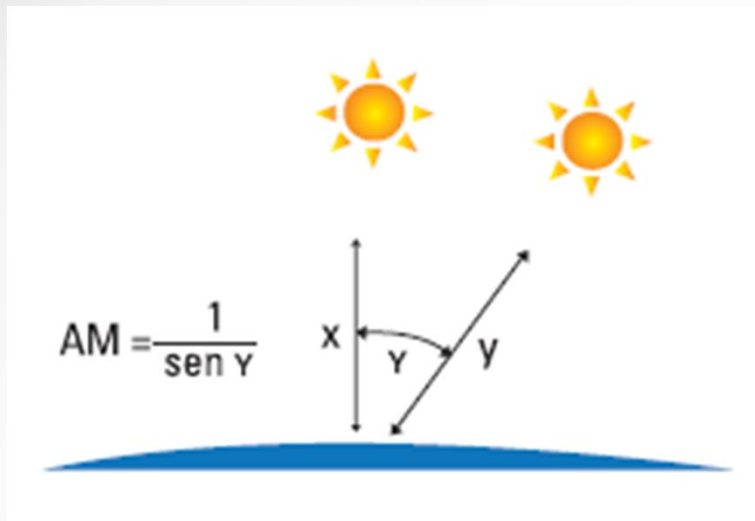
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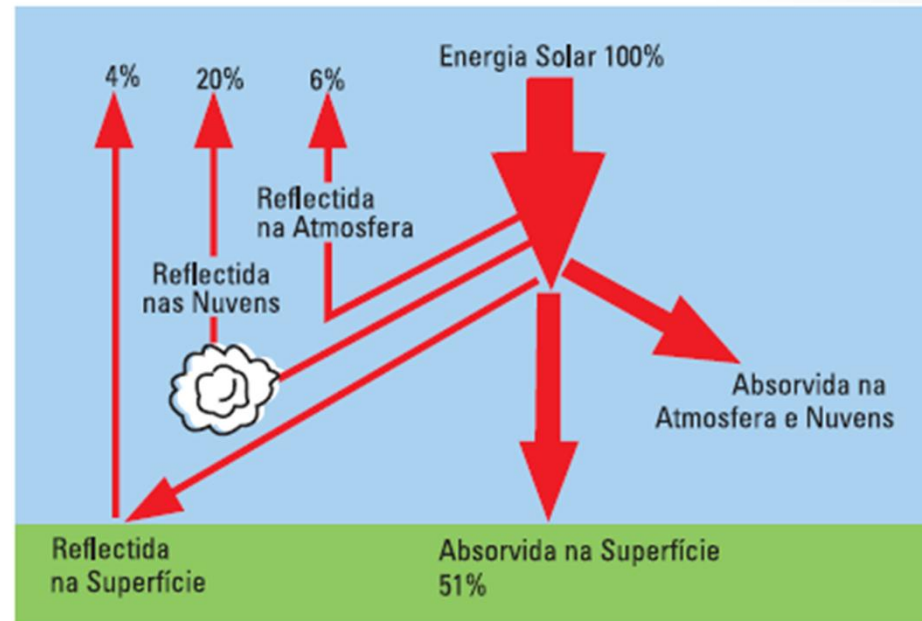
Comprimento de onda (nm)	< 380 (ultravioleta)	380 – 780 (Espectro de radiação visível)	780 (Infravermelho)
Porcentagem de energia	7%	47,3%	45,7%

Fonte: <http://www.prof2000.pt/users/geologia/testes/quiz.htm>

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Fonte: "Sistemas Fotovoltaicos – da Teoria à Prática", Josué Morais



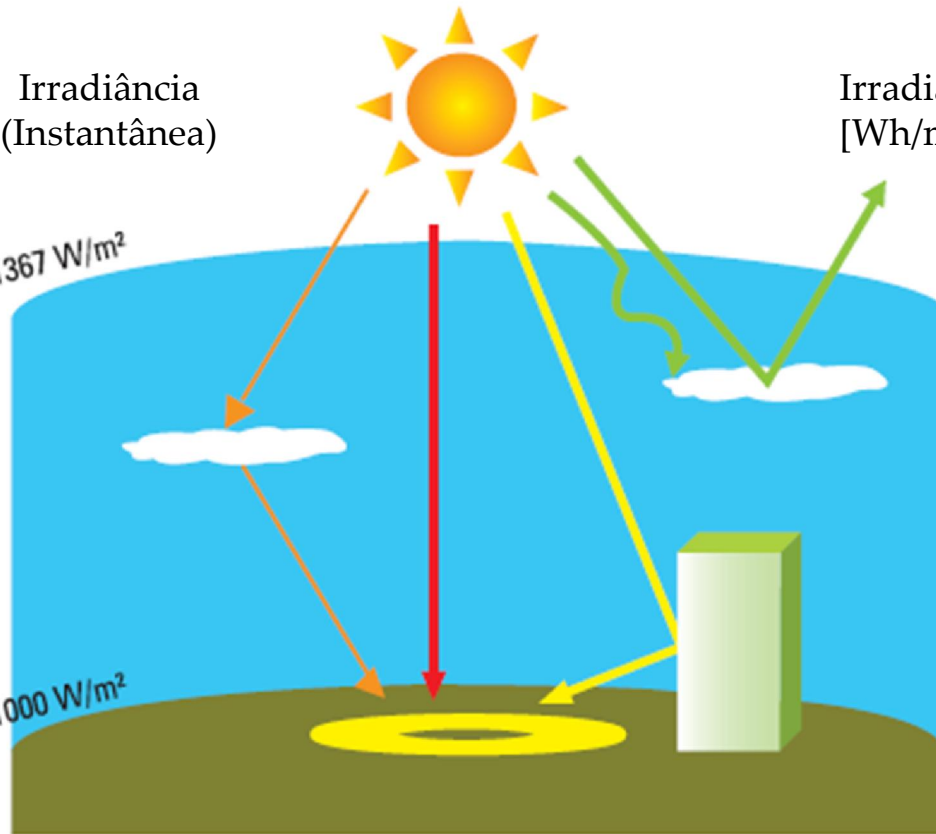
Fonte: <http://www.rapplus.pt/termico3.GIF>

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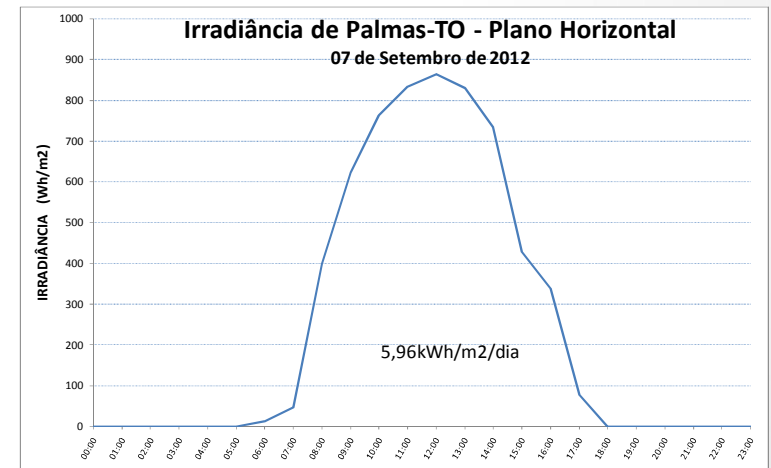
Irradiância  
(Instantânea)

1367 W/m<sup>2</sup>

1000 W/m<sup>2</sup>

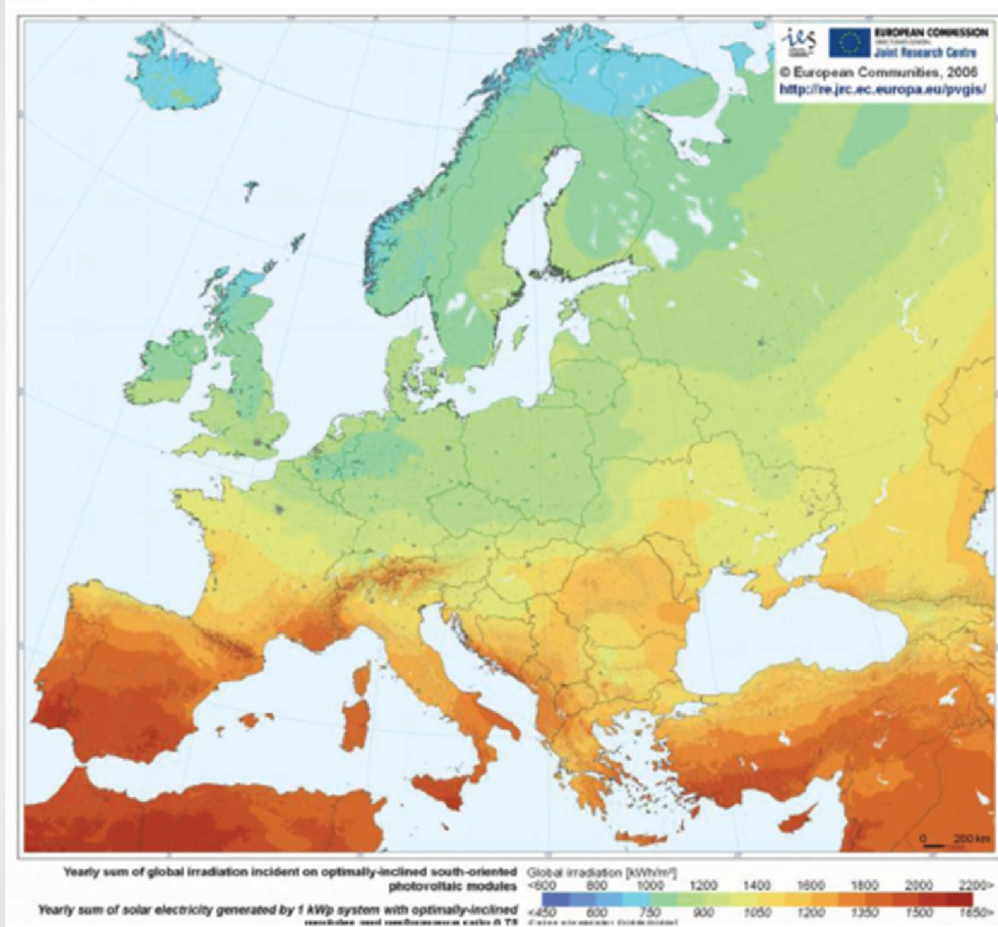


Irradiação ou insolação (integral da irradiância)  
[Wh/m<sup>2</sup>] ou [Wh/m<sup>2</sup> por dia] ou [kWh/m<sup>2</sup> por ano]



Fonte: <http://solaris02.blogspot.com/2010/01/heliotecnia.html>

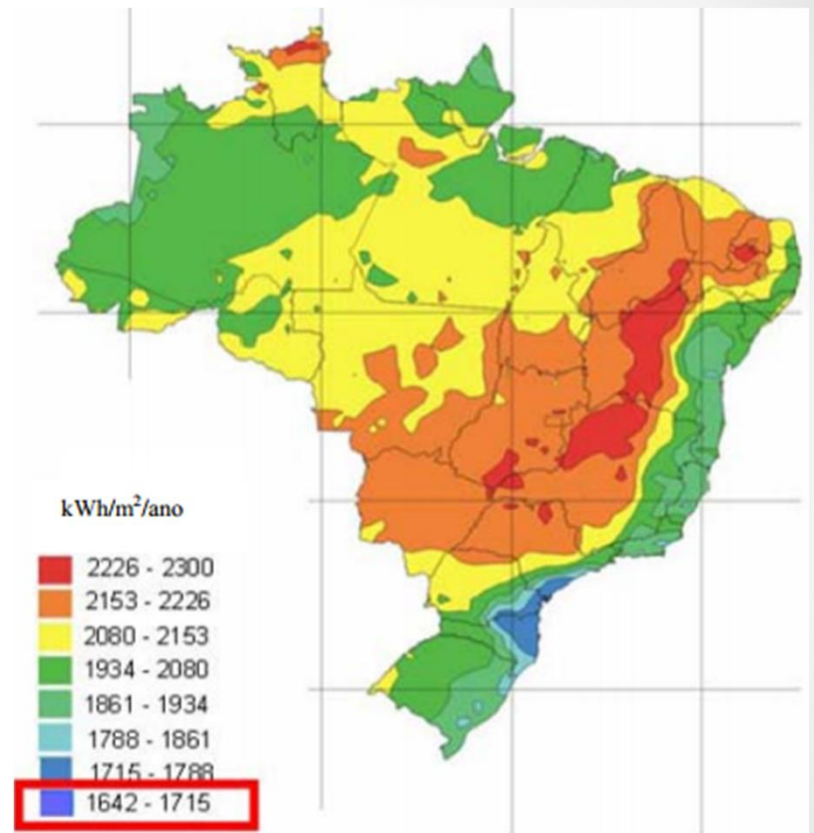
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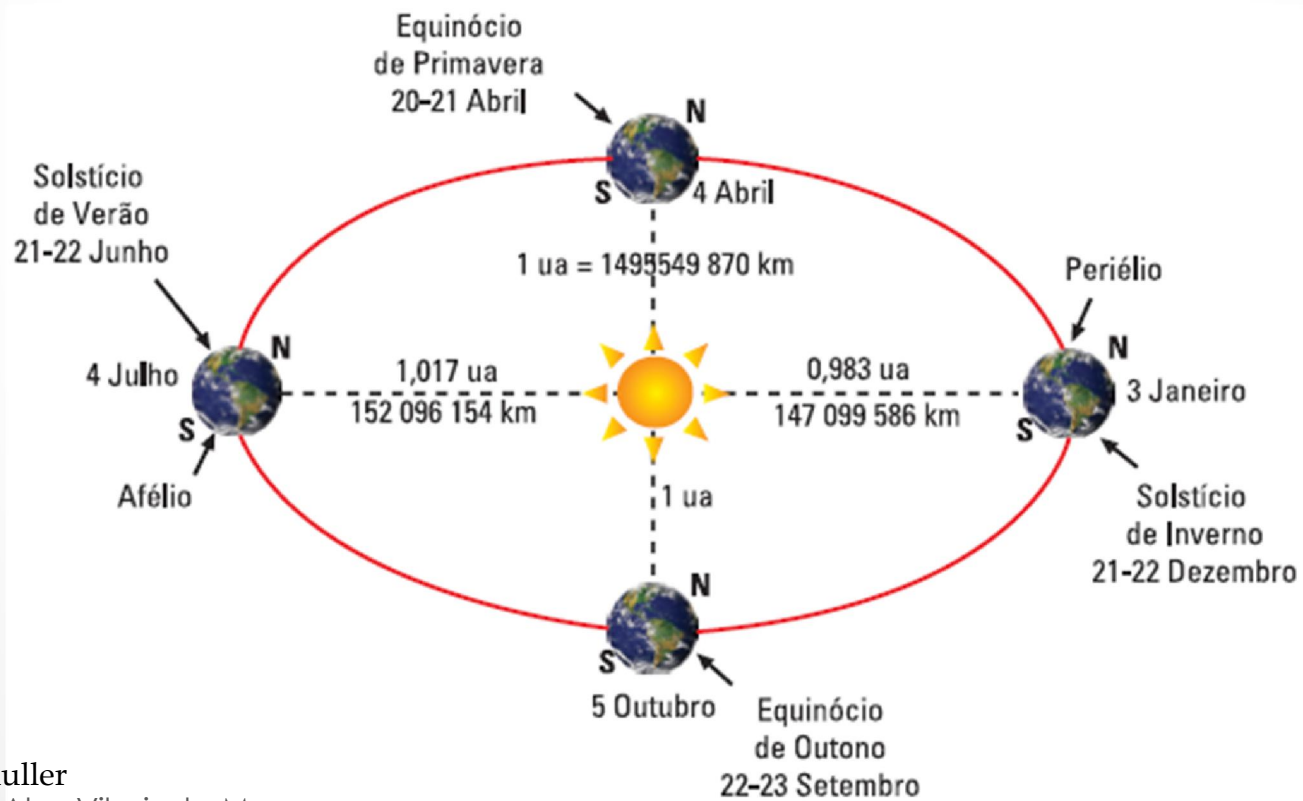
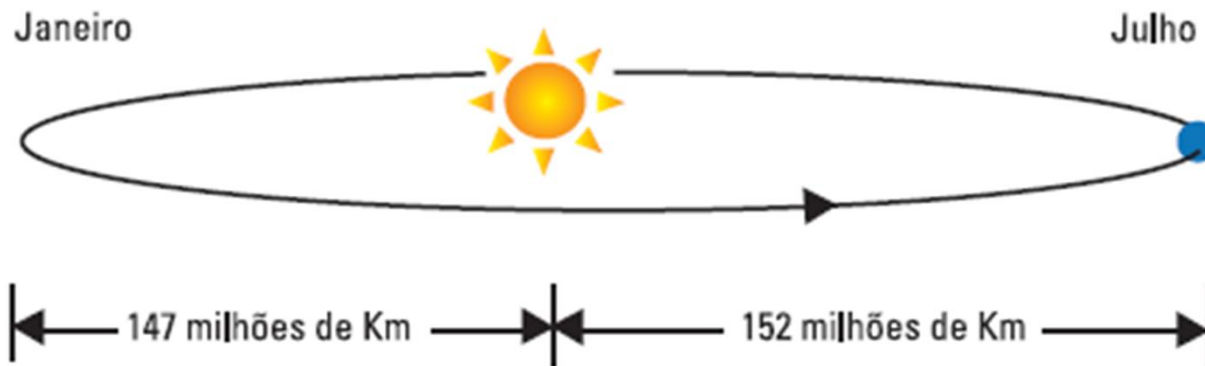
**Melhor** situação na europa:  
**1900 kWh/m<sup>2</sup> por ano**

Fonte: Atlas Brasileiro da Energia Solar, 2006.

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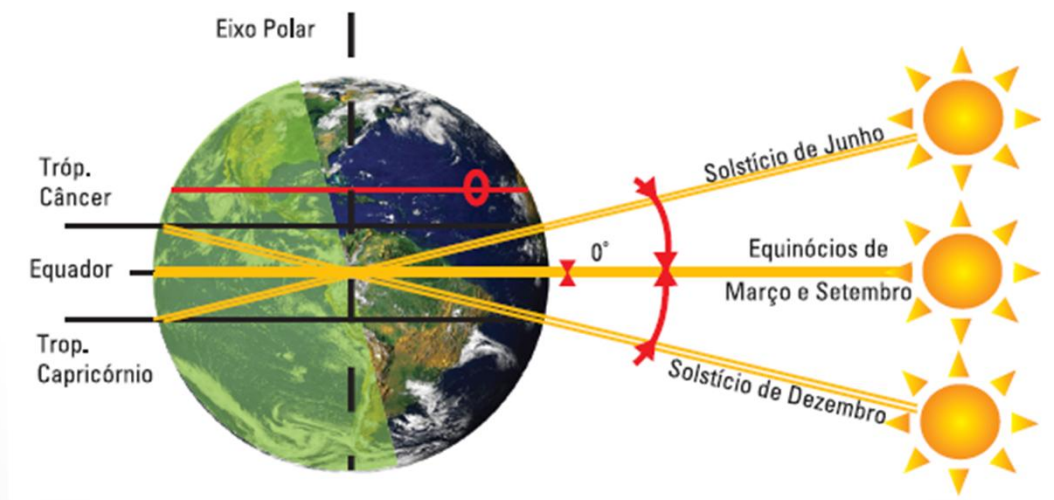
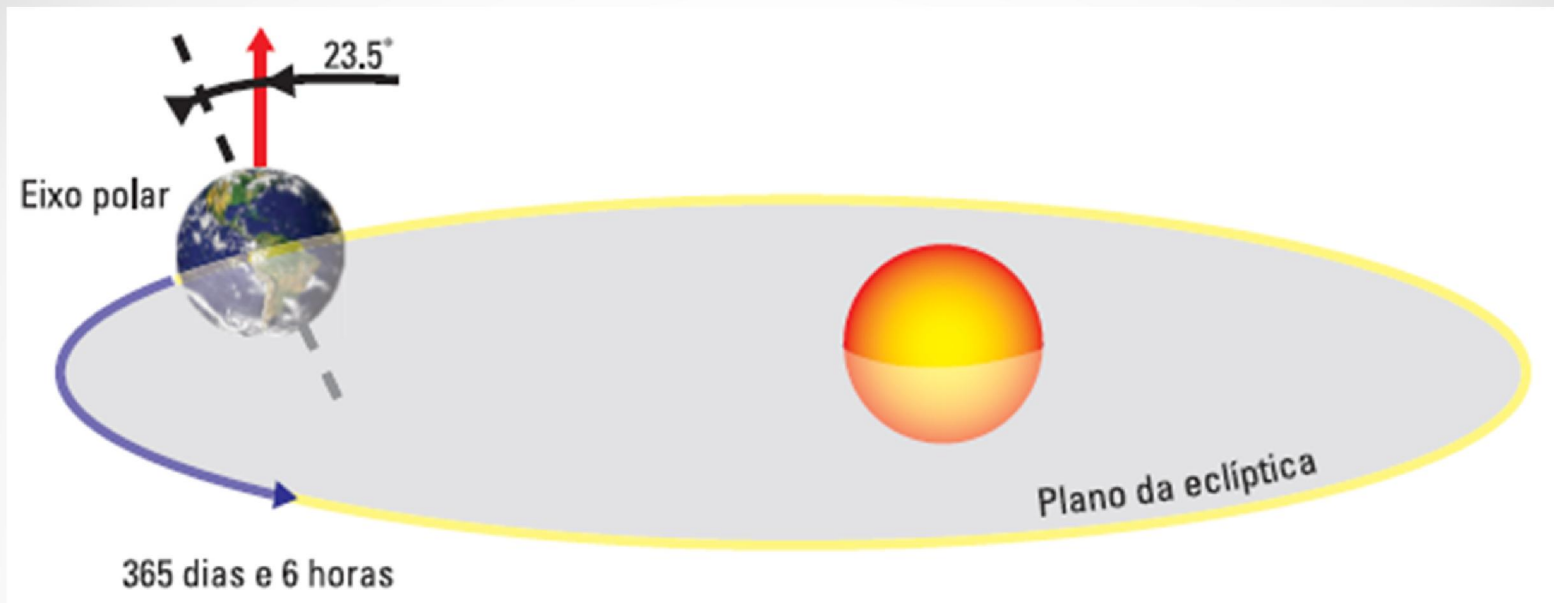
**Pior** situação no Brasil:  
**1642 kWh/m<sup>2</sup> por ano**



Fonte: Weidmuller

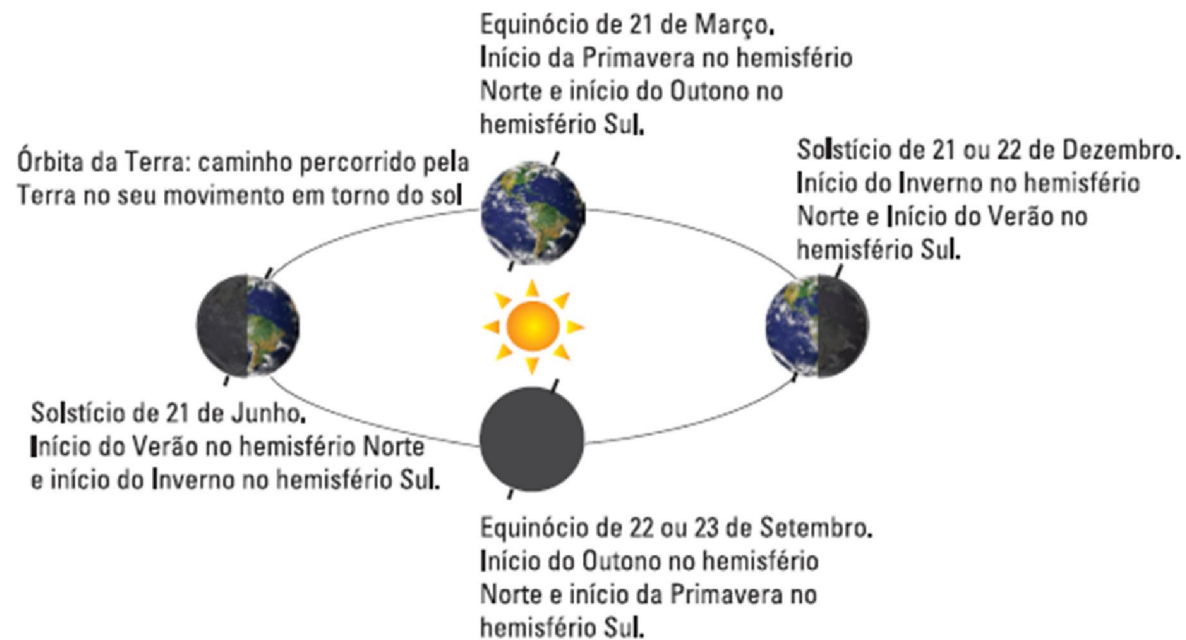
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Fonte: Seminários Weidmüller

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Fonte: Seminários Weidmüller

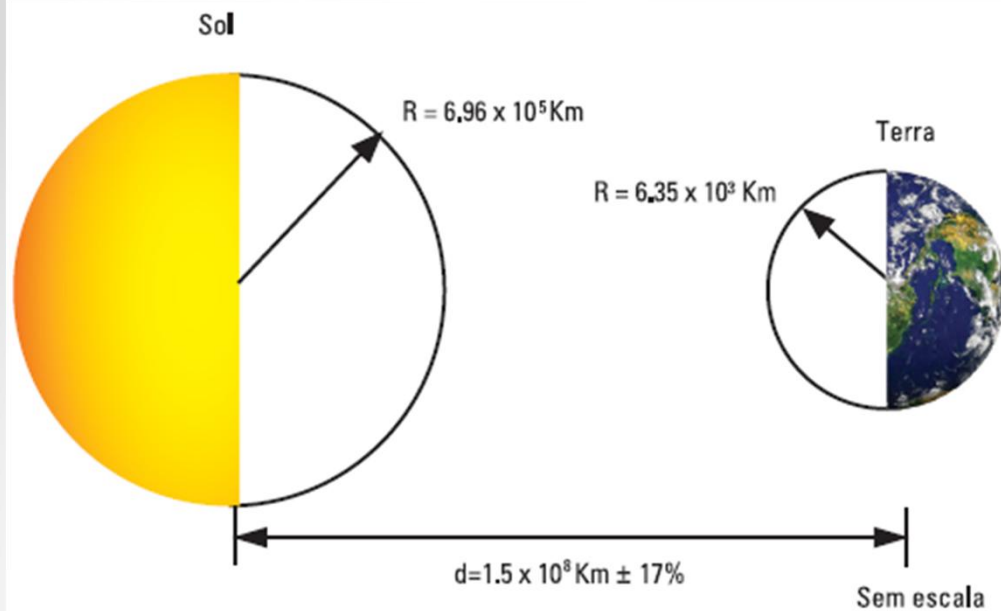
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Fonte: Seminários Weidmüller

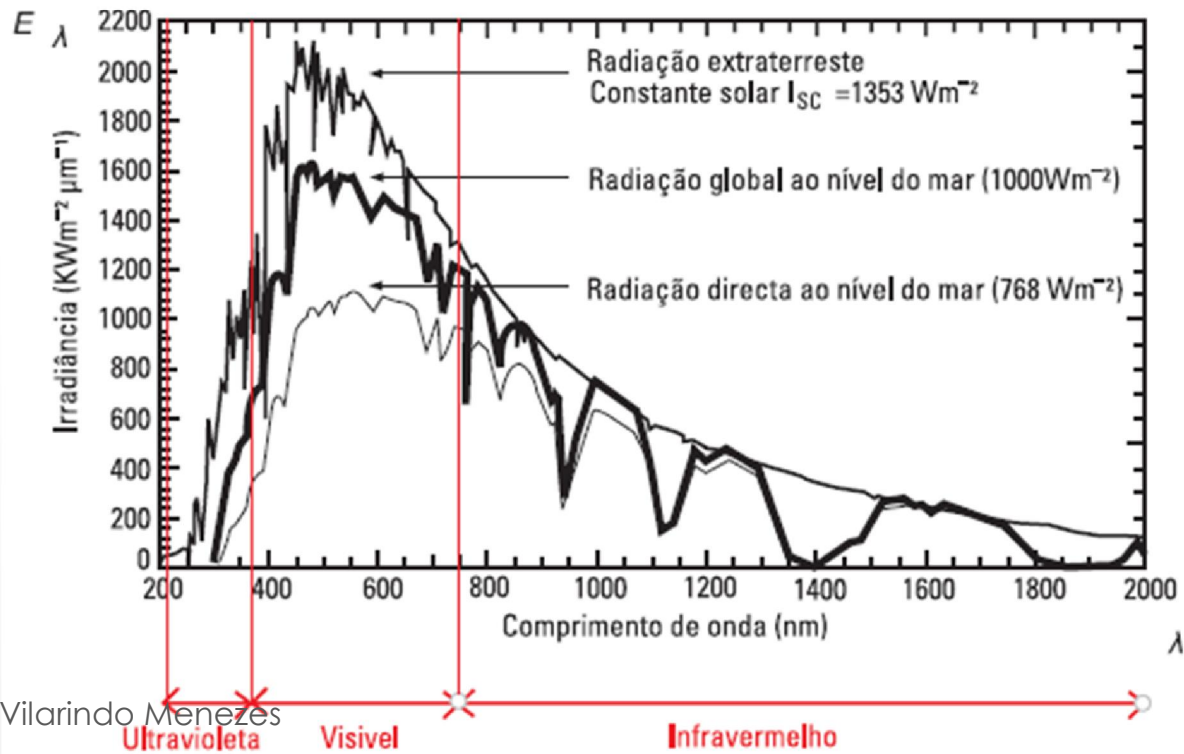
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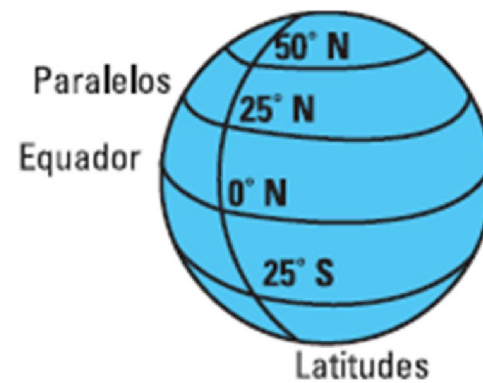
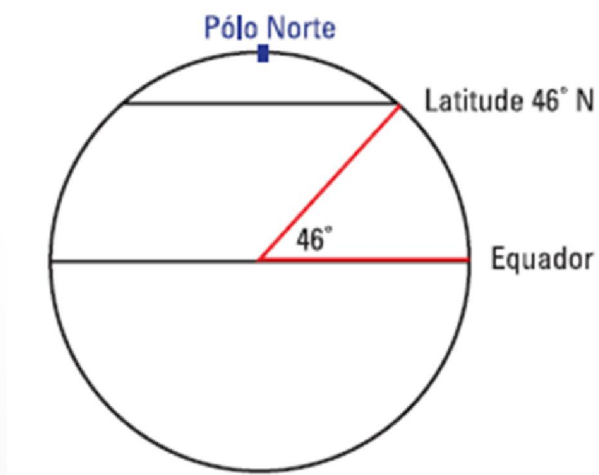
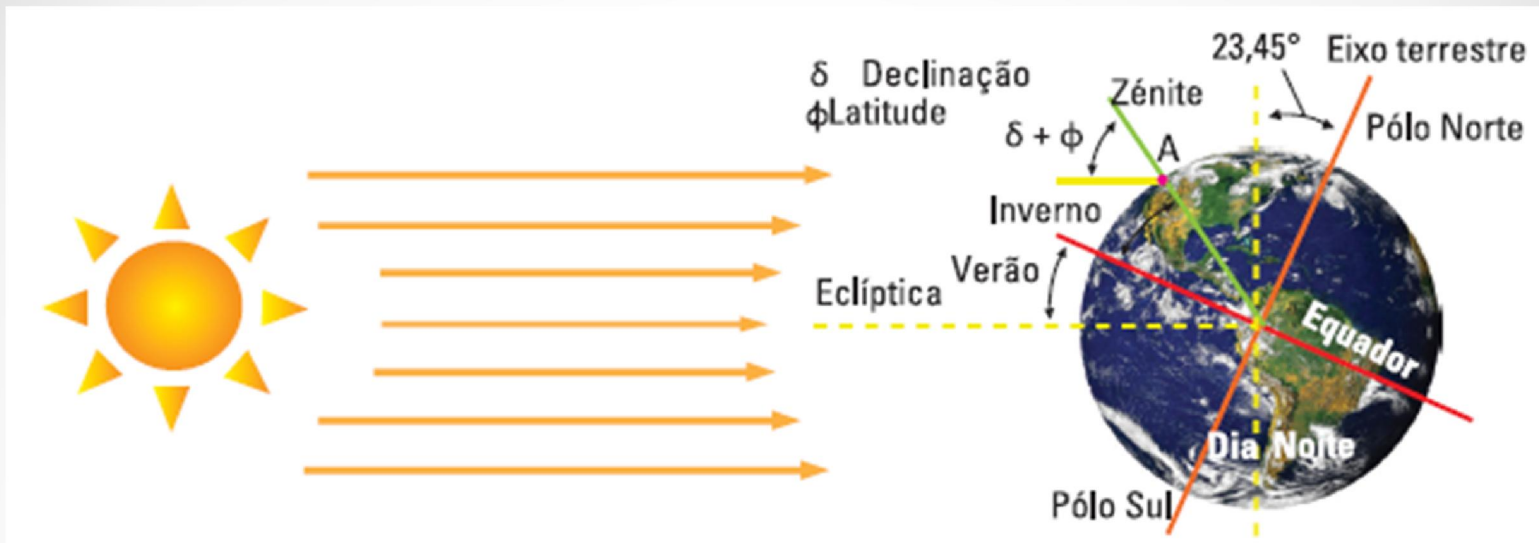
Irradiância varia entre 1350 e 1420 W/m<sup>2</sup>

Constante solar: **1367 W/m<sup>2</sup>**



Fonte: Weidmuller

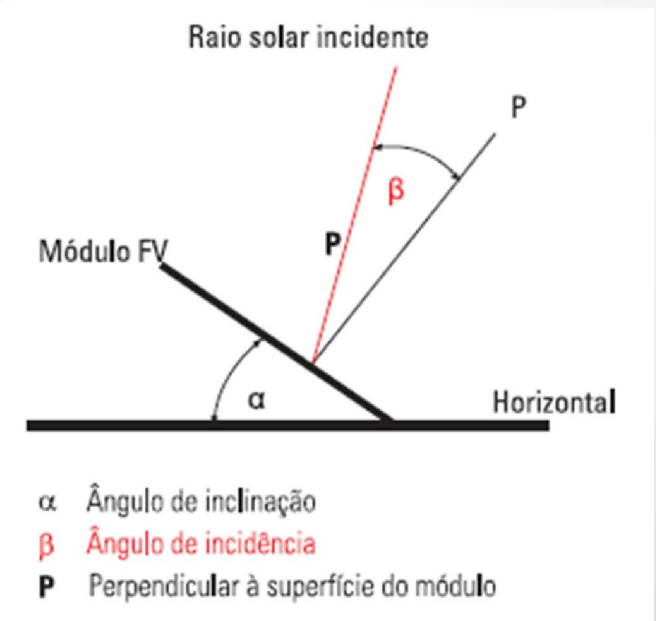
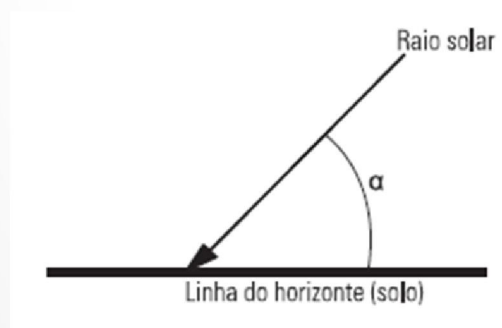
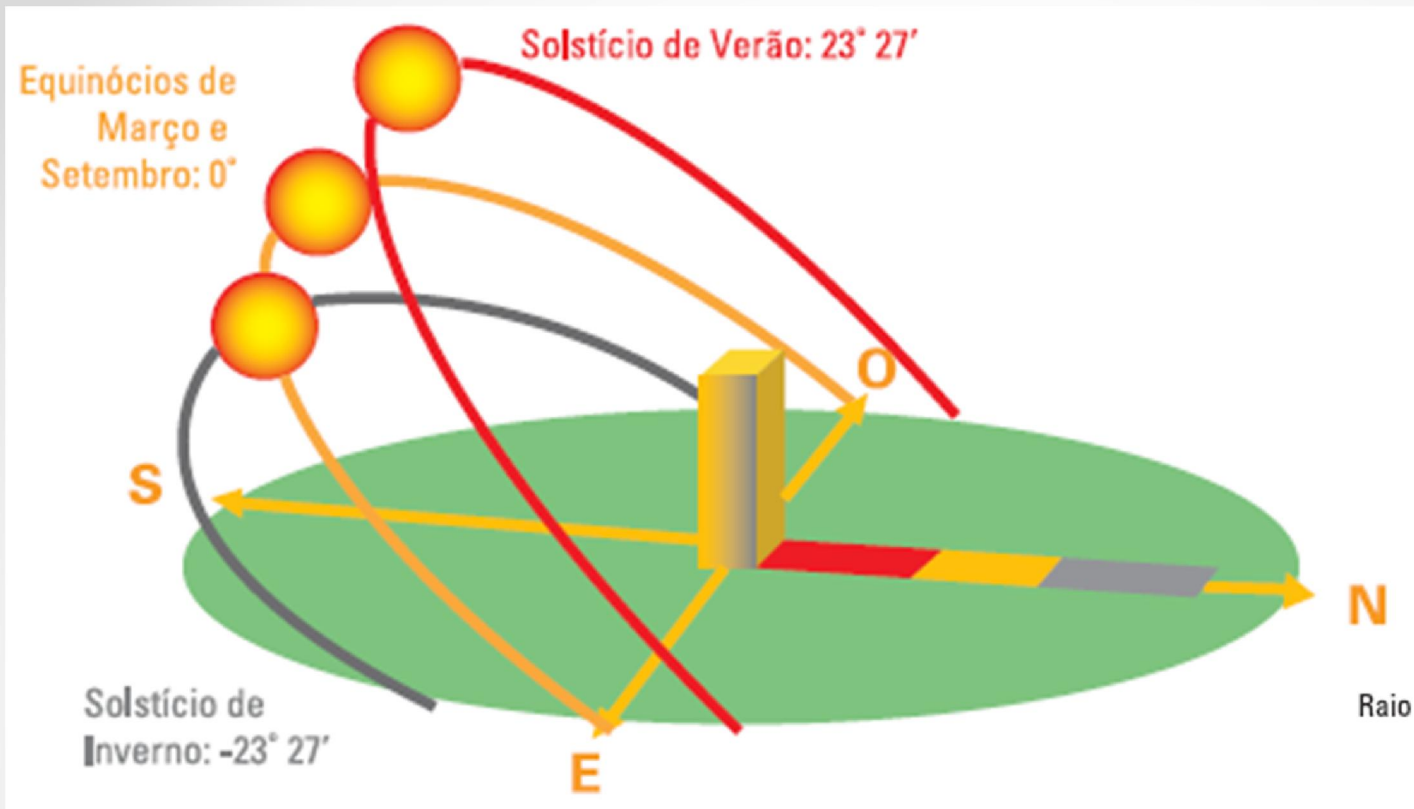
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Fonte: "Instalaciones Solares Fotovoltaicas", Miguel Moro Vallina, Paraninfo

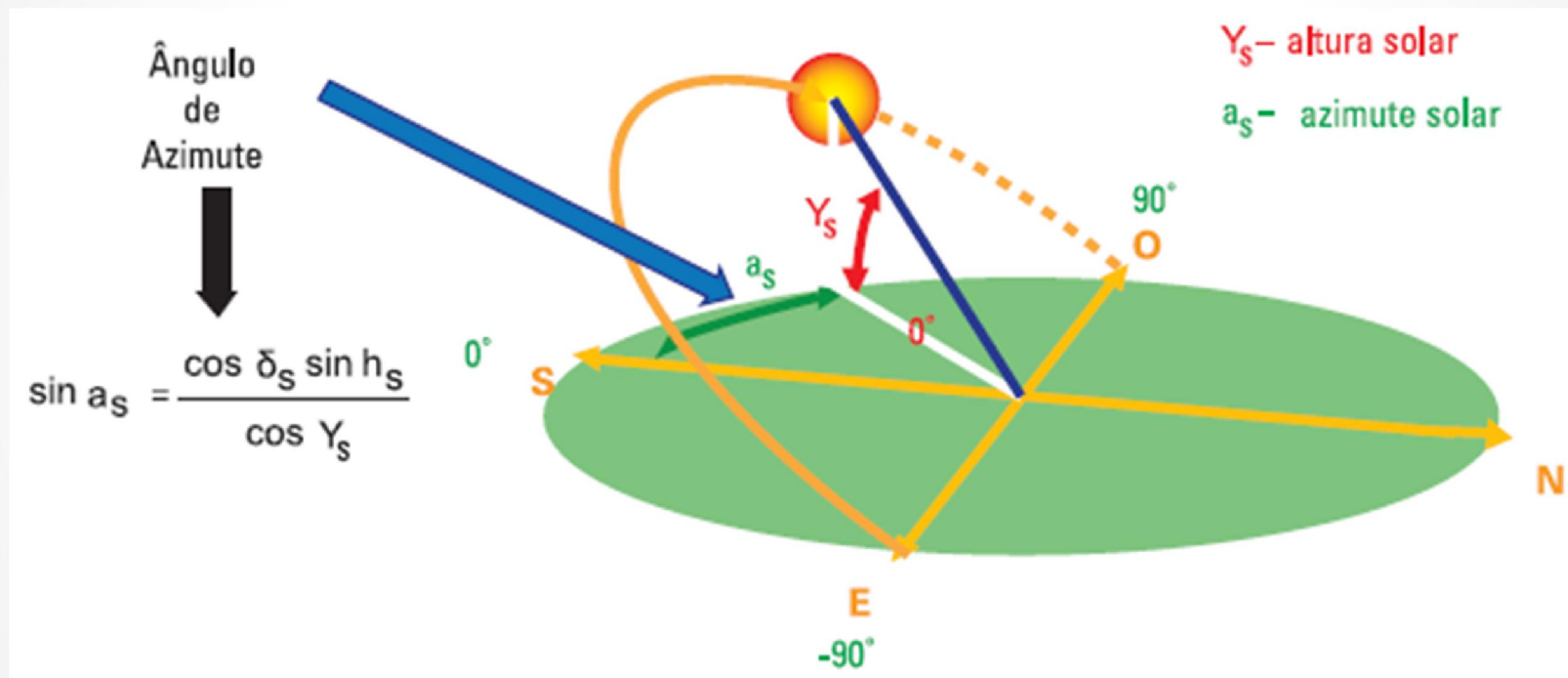
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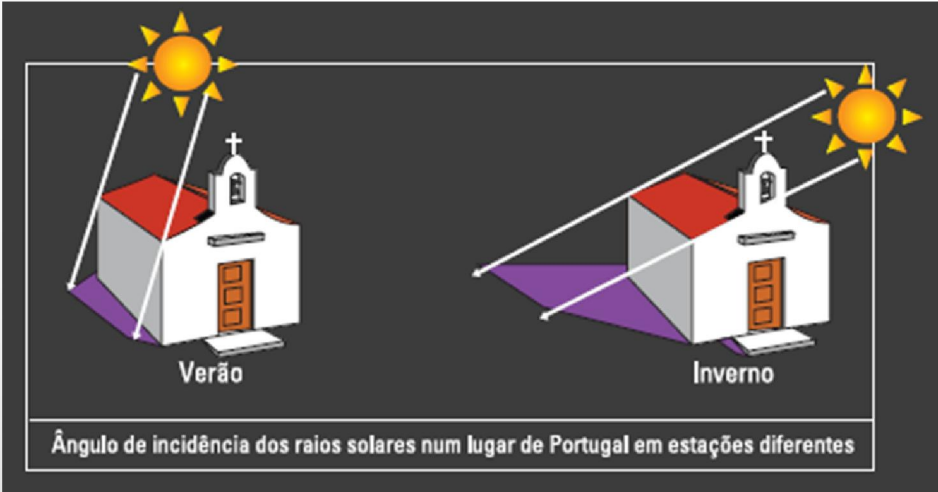
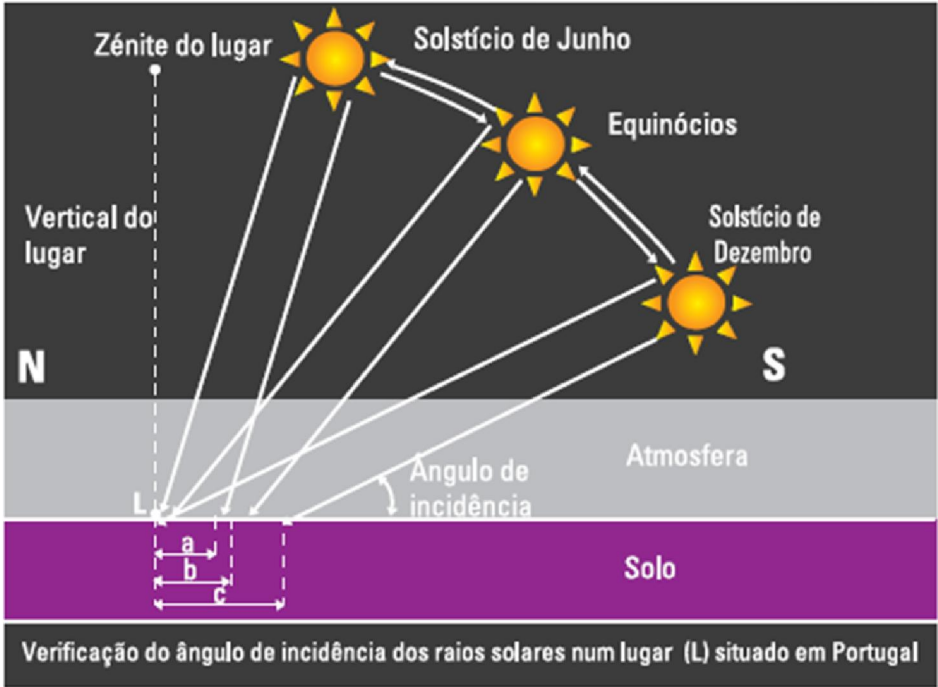
Fonte: <http://www.cienciaviva.pt/rede/energia/himalaya2005/home/guia2.pdf>

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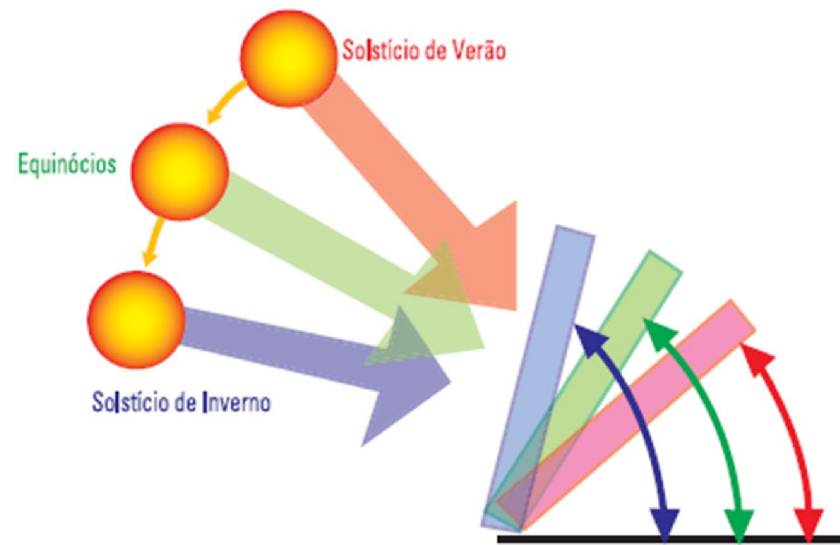
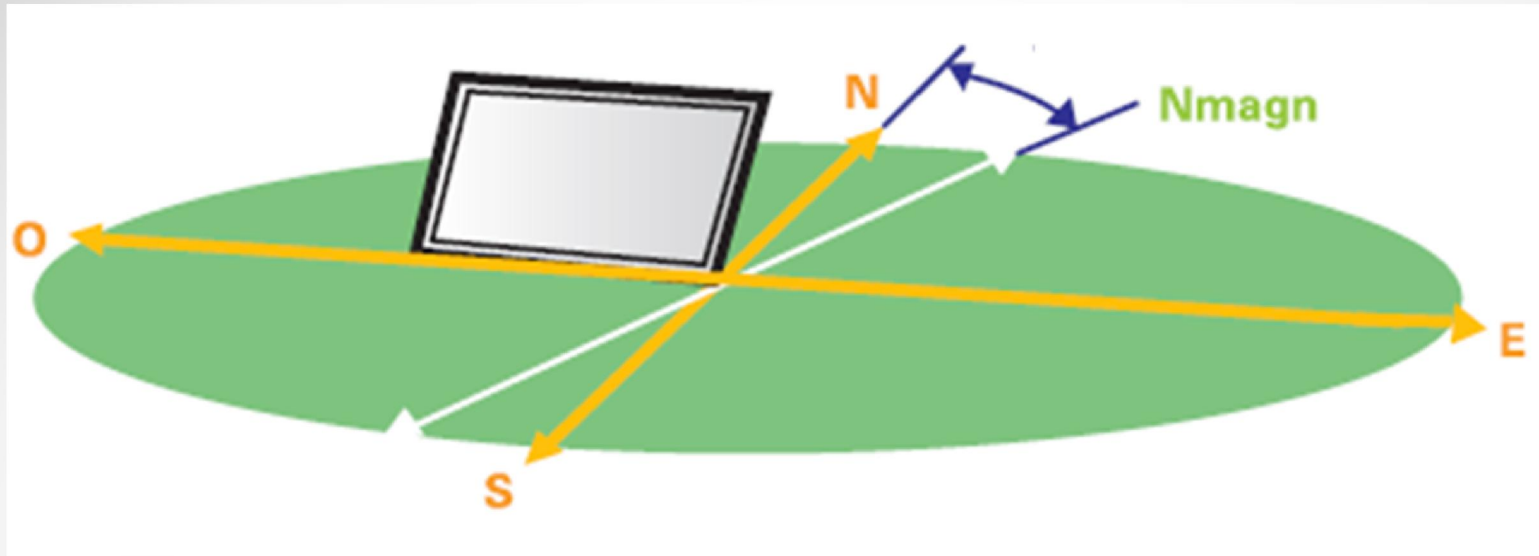


Fonte: <http://www.cienciaviva.pt/rede/energia/himalaya2005/home/guia2.pdf>

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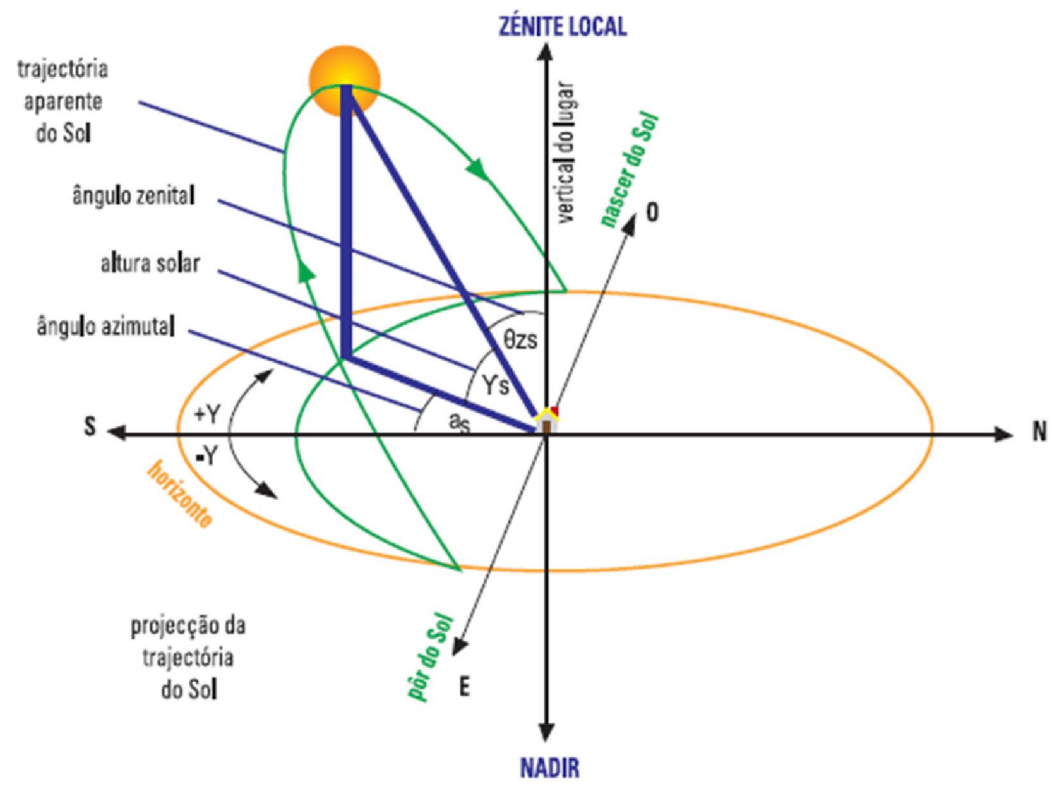






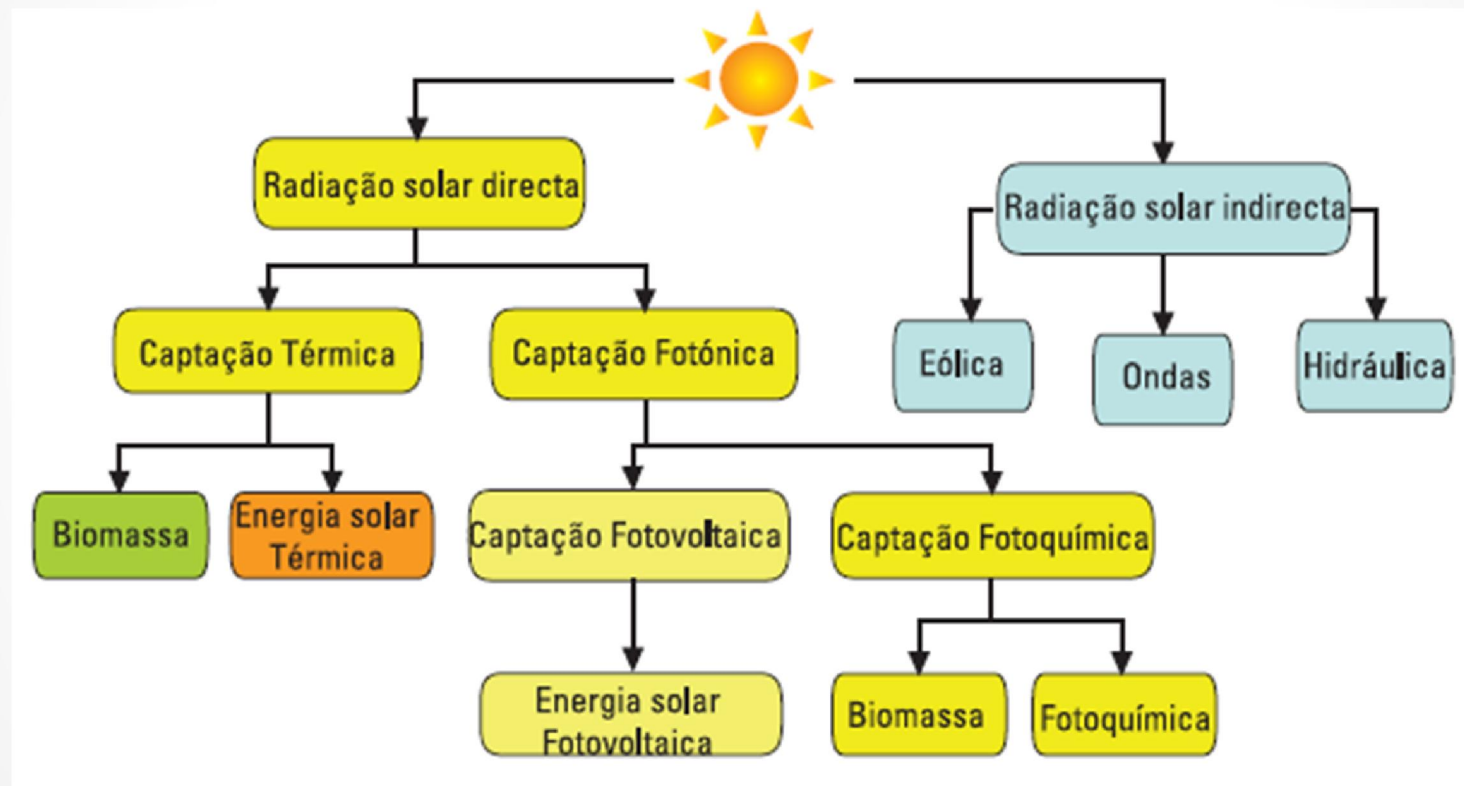
Fonte: <http://www.cienciaviva.pt/rede/energia/himalaya2005/home/guia2.pdf>

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Fonte: [http://www.google.pt/imgres?imgurl=http://www.ujaen.es/investigacion/solar/07cursosolar/home\\_main\\_frame/02\\_radiacion/01\\_basico/images/posi\\_sol.gif](http://www.google.pt/imgres?imgurl=http://www.ujaen.es/investigacion/solar/07cursosolar/home_main_frame/02_radiacion/01_basico/images/posi_sol.gif)

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Fonte: Weidmuller

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Piranômetro



Heliógrafo



Actinógrafo



Piroheliômetro

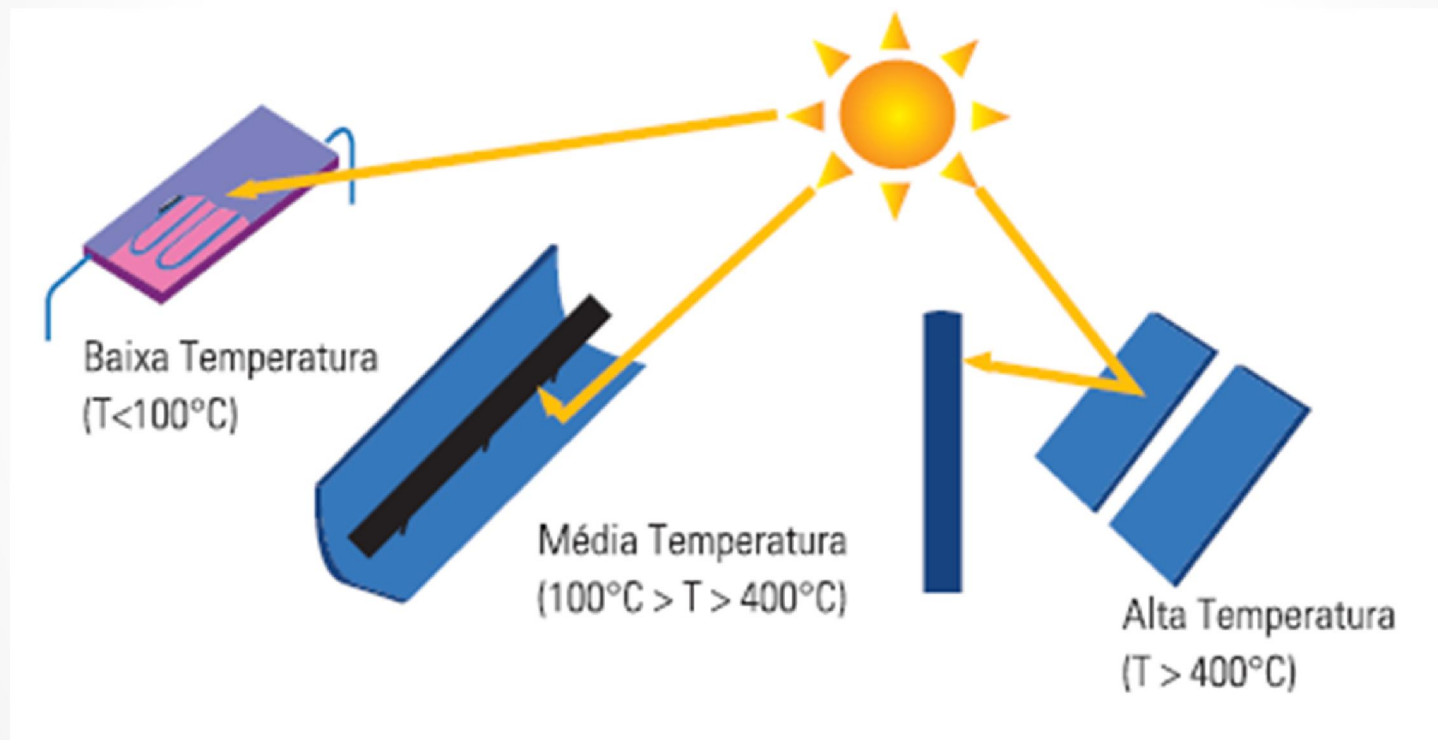
Fonte: [www.hukseflux.com/products/solarRadiation/lp02.html](http://www.hukseflux.com/products/solarRadiation/lp02.html)

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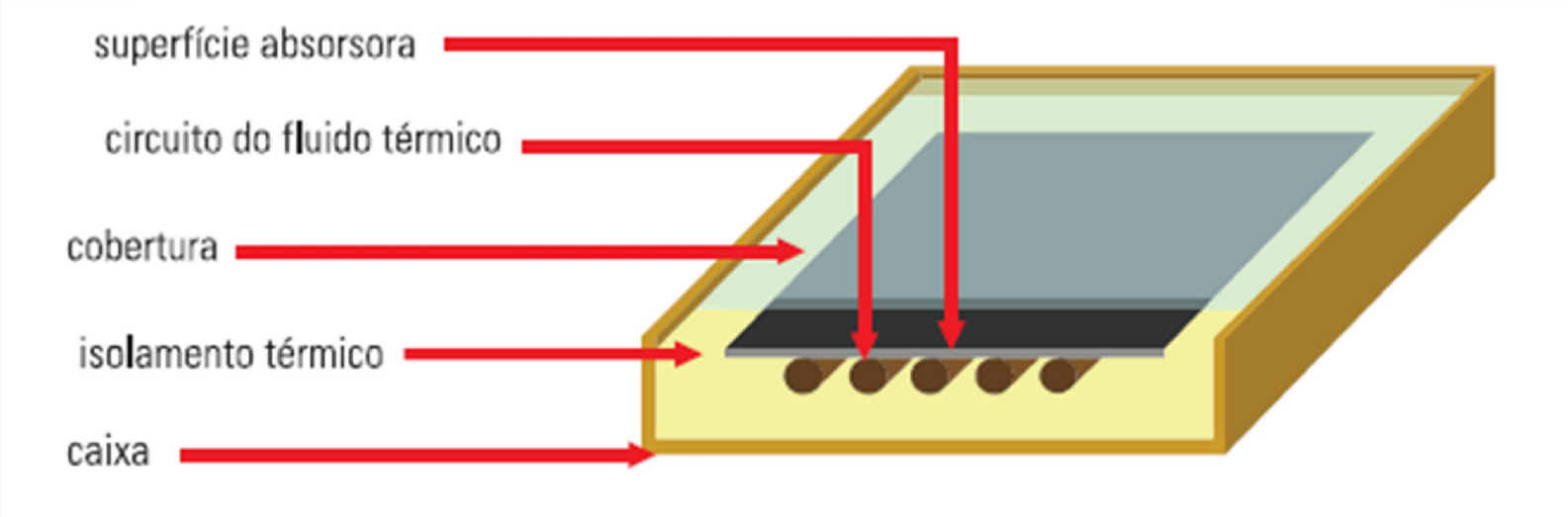
Fonte: "Guia 3 da Energia Solar", Padre Himalaya

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Fonte: Apresentações do INETI

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Fonte: "Guia 6 da Energia Solar", Padre Himalaya

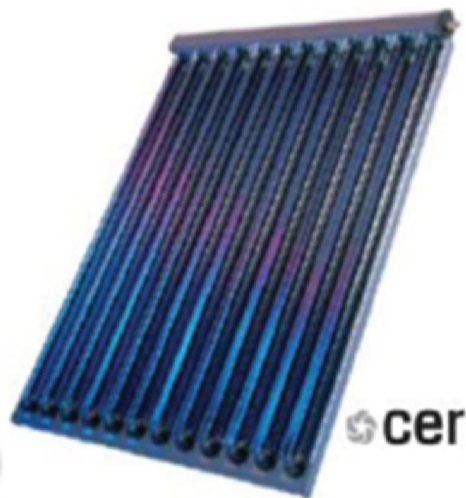
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Placa plana



- 50 a 70 °C;
- Possuem cobertura exterior, absorvedor, caixa e isolante;
- Residencial.

Tubos de vácuo



- Acima de 100 °C;
- Tubos de vidro à vácuo;
- Industrial.

Polipropileno



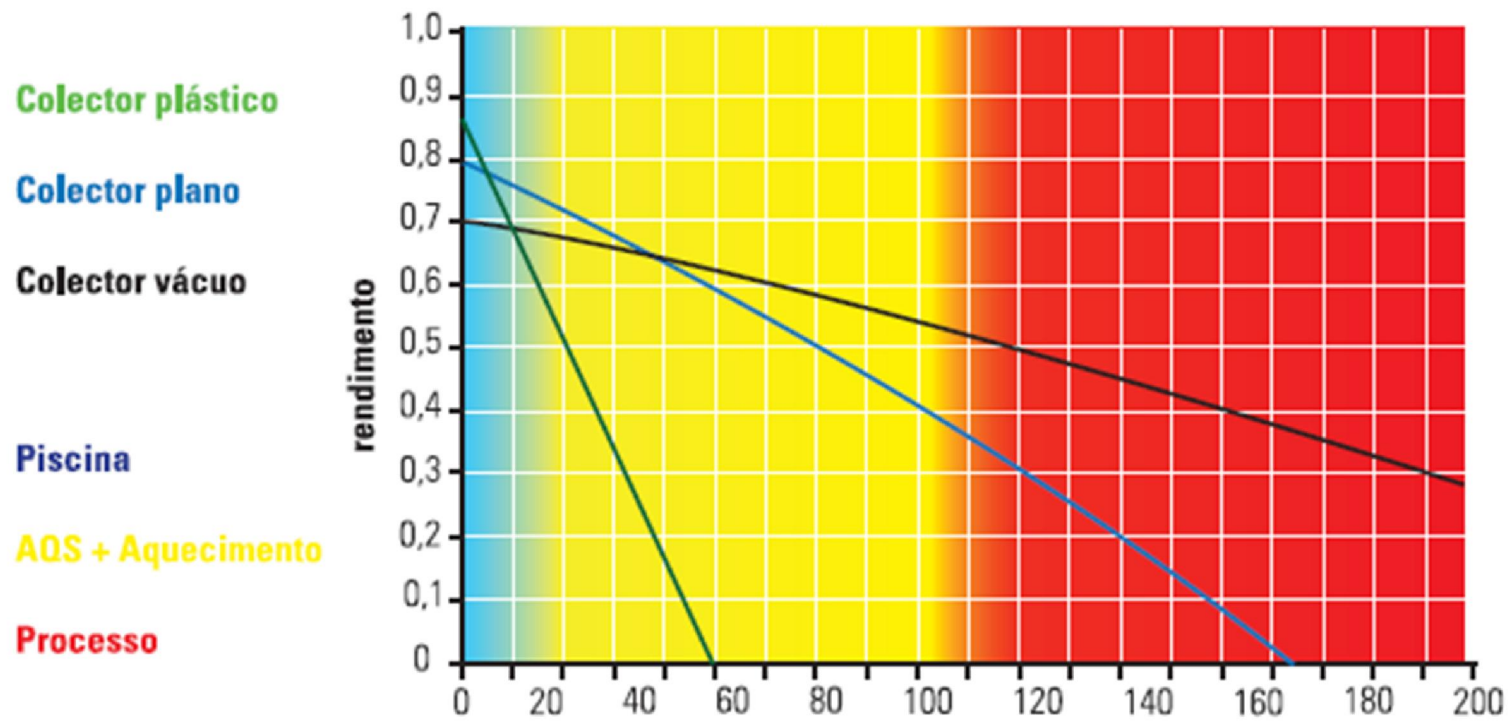
- 25 a 35 °C;
- Sem proteção, grandes perdas;
- Piscinas.

Fonte: Apresentações do INETI

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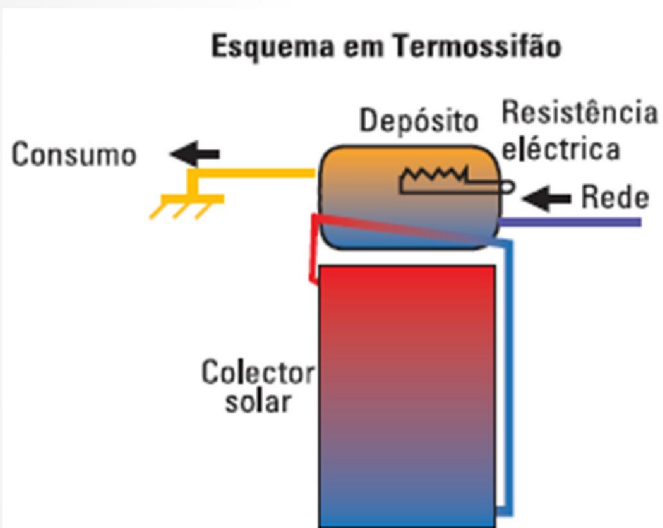


### Curva de rendimento - valores típicos

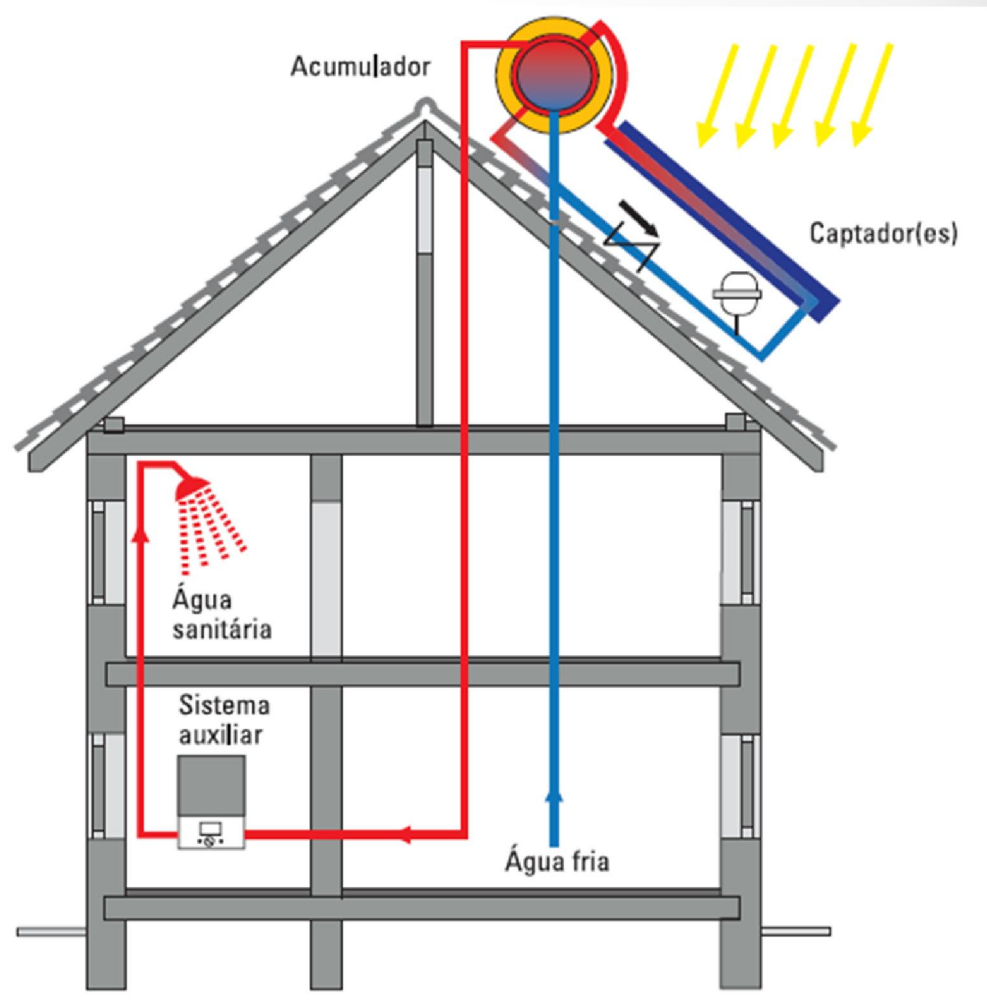


Fonte: ISQ

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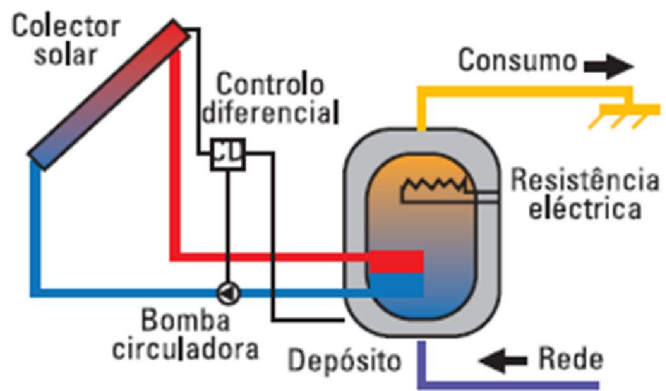


Fonte: <http://www.painelsolartermico.com/wp-content/uploads/2009/07/sistemas-solares-termicos.jpg>

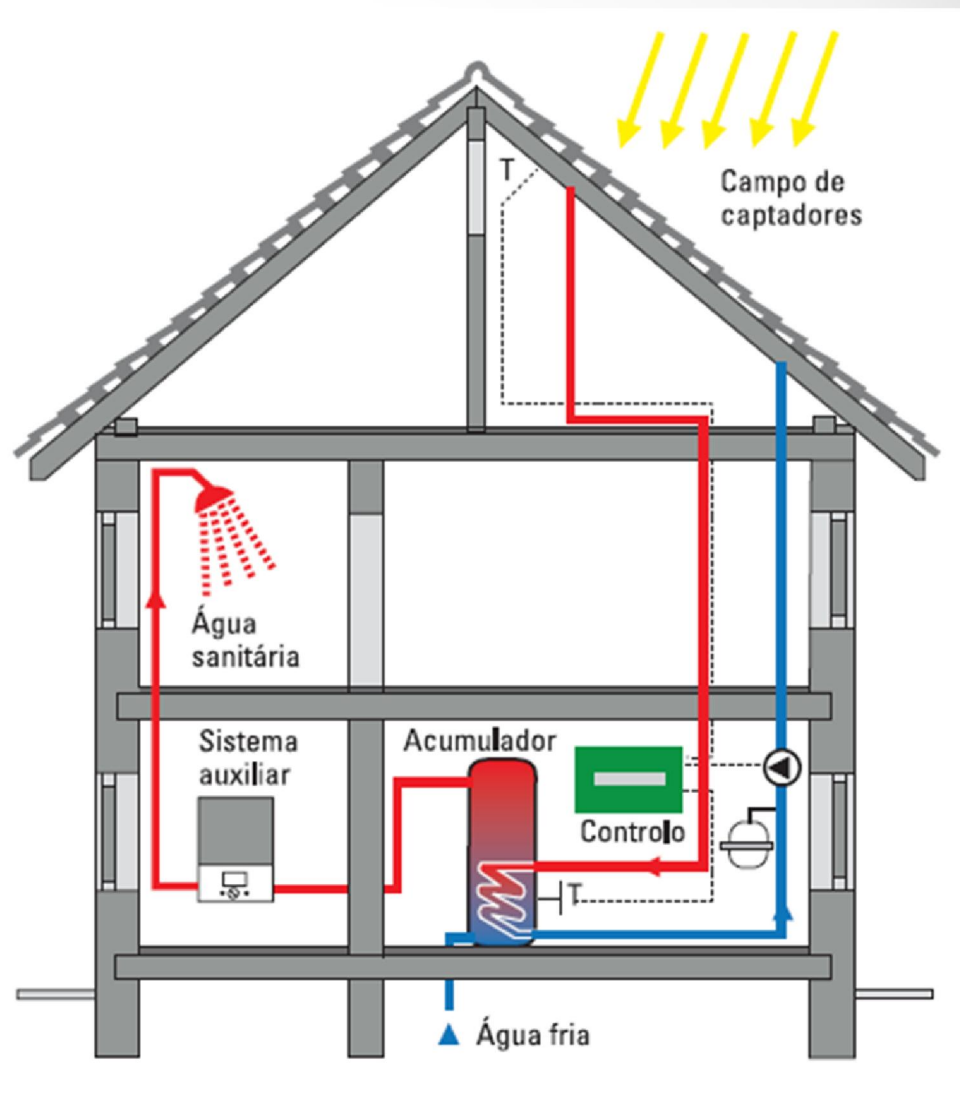


Fonte: Farinha Mendes & António Joyce, INETI

### Esquema em Circulação Forçada



Fonte: <http://www.painelsolartermico.com/wp-content/uploads/2009/07/sistemas-solares-termicos.jpg>



Fonte: Farinha Mendes & António Joyce, INETI