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Tipos de Energia Solar

A energia solar é a luz e o calor do Sol que é aproveitado usando uma gama de tecnologias em constante evolução, como o aquecimento solar, a energia fotovoltaica, energia solar térmica, arquitetura solar, plantas de energia de sal fundido e fotossíntese artificial.

É uma importante fonte de energia renovável e suas tecnologias são amplamente caracterizadas como solar passiva ou solar ativa dependendo de como elas capturam e distribuem a energia ou a convertem em energia elétrica. As técnicas solares ativas incluem o uso de sistemas fotovoltaicos, energia solar concentrada e aquecimento solar de água.

As técnicas solares passivas incluem a orientação de um edifício para o Sol, a escolha de materiais com propriedades térmicas favoráveis ou propriedades de dispersão da luz e a concepção de espaços que circulam naturalmente o ar.

Figura 1 – Planta – Fonte: Architetti Roma (www.architettiroma.it)

Figura 2 – Prédio Eficiente - Fonte: Cargo Collective (payload.cargocollective.com)

A grande magnitude da energia solar disponível torna uma fonte altamente atraente de eletricidade. O Programa de Desenvolvimento das Nações Unidas em sua Avaliação Energética Mundial de 2000 constatou que o potencial anual da energia solar era entre 1.575 e 49.837 exajoules (EJ). Isto é várias vezes maior do que o consumo total mundial de energia, que foi de 559,8 EJ em 2012.

A Terra recebe 174.000 terawatts (TW) de radiação solar entrante (insolação) na atmosfera superior. Aproximadamente 30% é refletido de volta ao espaço enquanto o resto é absorvido por nuvens, oceanos e massas terrestres. O espectro de luz solar na superfície da Terra é maioritariamente espalhado pelas faixas visíveis e próximo ao infravermelho com uma pequena parte no ultravioleta próximo. A maioria da população do mundo vive em áreas com níveis de insolação de 150-300watts/m², ou 3,5-7,0kWh/m² por dia.

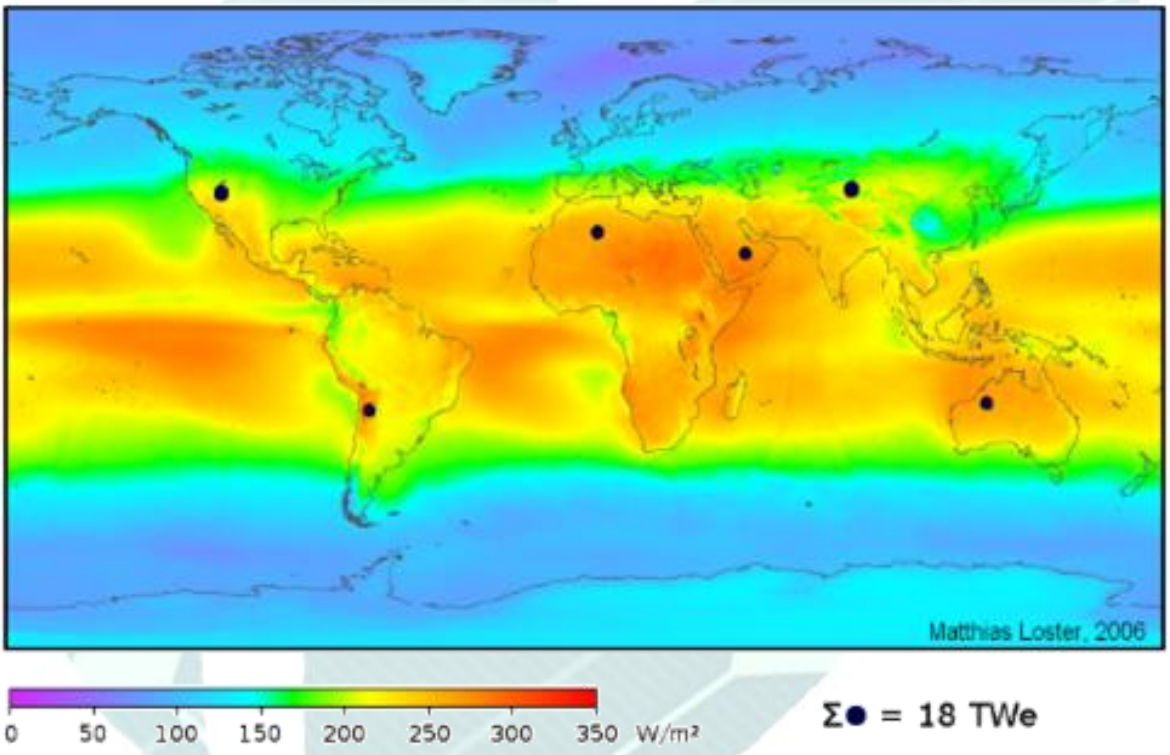

Figura 3 – Radiação Total – Fonte: Wikipédia (www.wikipedia.org)

A radiação solar é absorvida pela superfície terrestre da Terra, os oceanos (que cobrem cerca de 71% do globo) e a atmosfera. O ar quente que contém a água evaporada dos oceanos aumenta, causando a circulação atmosférica ou a convecção. Quando o ar atinge uma altitude elevada, onde a temperatura é baixa, o vapor de água se condensa em nuvens, que chovem sobre a superfície da Terra, completando o ciclo da água. O calor latente da condensação de água amplifica a convecção, produzindo fenômenos atmosféricos como vento, ciclones e anti-ciclones. A luz solar absorvida pelos oceanos e massas terrestres mantém a superfície a uma temperatura média de 14 °C.

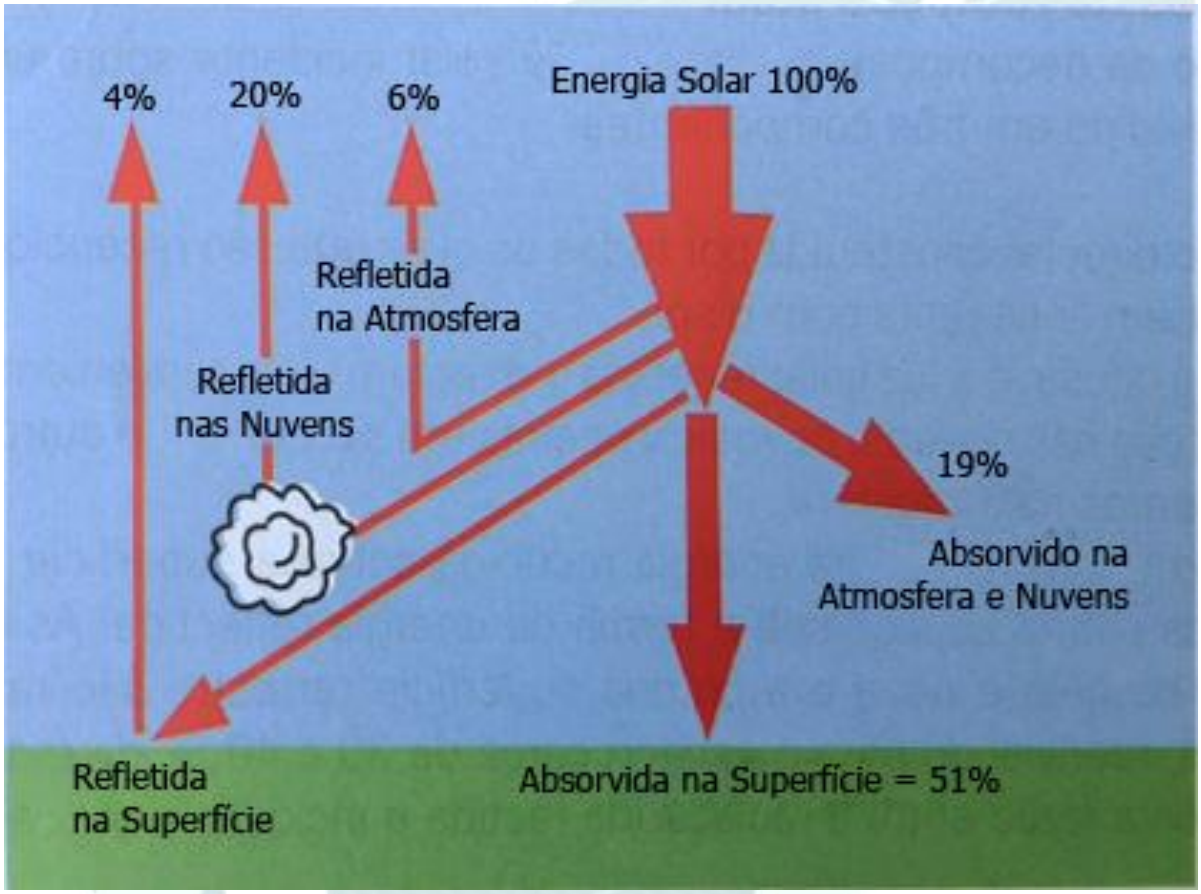

Figura 4 - Radiação distribuída na superfície da Terra - Fonte: FCSolar (www.fcsolar.eco.br)

A energia solar total absorvida pela atmosfera terrestre, oceanos e massas terrestres é de aproximadamente 3.850.000 exajoules (EJ) por ano. Em 2002, isto era mais energia em uma hora do que o mundo usa em um ano.

Energia Térmica

Figura 5 – Energia Térmica para aquecimento de água – Fonte: www.micronovasrl.com

Os sistemas de água quente solar usam a luz solar para aquecer a água. Em baixas latitudes geográficas (abaixo de 40 graus), 60 a 70% da água quente doméstica pode ser fornecida com sistemas de aquecimento solar até 60 °C. Os tipos mais comuns de aquecedores de água solares são coletores de vácuo (44%) e coletores de placas planas (34%) geralmente usados para água quente doméstica; E coletores plásticos não esmaltados (21%) utilizados principalmente para aquecer piscinas.

A partir de 2007, a capacidade instalada total de sistemas de água quente solar era de aproximadamente 154 gigawatt térmicos (GWth). A China é o líder mundial em sua implantação com 70GWth instalado a partir de 2006 e um objetivo de longo prazo de 210GWth até 2020. Israel e Chipre são os líderes per capita no uso de sistemas solares de água quente com mais de 90% das casas usando-os. Nos Estados Unidos, Canadá e Austrália, a piscina de aquecimento é a aplicação dominante de água quente solar com uma capacidade instalada de 18GWth a partir de 2005.

Energia Solar Concentrada

O sal fundido pode ser empregado como um método de armazenamento de energia térmica para reter a energia térmica coletada por uma torre solar ou cocho solar de uma usina de energia solar concentrada, de modo que ele pode ser usado para gerar eletricidade em mau tempo ou à noite.

Foi demonstrado no projeto **Solar Two de 1995-1999**. Prevê-se que o sistema tenha uma eficiência anual de 99%, uma referência à energia retida armazenando calor antes de transformá-lo em eletricidade, versus converter o calor diretamente em eletricidade. As misturas de sal fundido variam. A mistura mais utilizada contém nitrato de sódio, nitrato de potássio e nitrato de cálcio. É não-inflamável e não tóxico, e já foi usado nas indústrias químicas e de metais como um fluido do transporte de calor, assim que a experiência com tais sistemas existe em aplicações não-solares.

Figura 6 – Usina de Energia Solar Concentrada – Fonte: Inhabitat (www.inhabitat.com)

O sal funde a 131°C. Mantém-se líquido a 288°C num tanque de armazenamento "frio" isolado. O sal líquido é bombeado através dos painéis em um coletor solar onde o sol focalizado o aquece a 566°C. Em seguida, é enviado para um tanque de armazenamento quente. Isto é tão bem isolado que a energia térmica pode ser armazenada por até uma semana.

Figura 7– Usina de Energia Solar Concentrada – Fonte: Construction Review Online www.constructionreviewonline.com

Quando a eletricidade é necessária, o sal quente é bombeado para um gerador de vapor convencional para produzir vapor superaquecido para uma turbina/gerador como usado em qualquer usina convencional de carvão, óleo ou nuclear. Uma turbina de 100 megawatts precisaria de um tanque de cerca de 9,1 metros de altura e 24 metros de diâmetro para conduzi-lo por quatro horas neste projeto. Várias usinas parabólicas de calha na Espanha e o desenvolvedor de torre de energia solar **SolarReserve** usam esse conceito de armazenamento de energia térmica.

Energia Solar Fotovoltaica

Nas duas últimas décadas, a energia fotovoltaica (FV), também conhecida como PV solar, evoluiu de um nicho de mercado puro de aplicações de pequena escala para se tornar uma fonte de eletricidade generalizada. Uma célula solar é um dispositivo que converte luz diretamente em eletricidade usando o efeito fotoelétrico.

Como já vimos nas últimas unidades, a primeira célula solar foi construída por Charles Fritts em 1880. Em 1931, um engenheiro alemão, o **Dr. Bruno Lange**, desenvolveu uma célula fotográfica usando seleneto de prata no lugar de óxido de cobre. Embora o protótipo de células de selênio tenha convertido menos de 1% da luz incidente em eletricidade, **Ernst Werner von Siemens** e **James Clerk Maxwell** reconheceram a importância desta descoberta.

Após o trabalho de **Russell Ohl** nos anos 40, os pesquisadores **Gerald Pearson**, **Calvin Fuller** e **Daryl Chapin** criaram a célula solar de silício cristalino em 1954. Essas células solares iniciais custam 286USD/watt e atingem eficiências de 4,5-6%. Em 2012, as eficiências disponíveis excediam os 20%, e a eficiência máxima da conversão fotovoltaica era superior a 40%. Em 2017 já é normal encontrarmos módulos fotovoltaicos poli-cristalinos mais baratos com mais de 16% de eficiência.

Figura 8 – Satélite – Fonte: Nasa (www.nasa.org)

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