Making the most of solar energy in Antarctica

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SOLAR POTENTIAL FOR AUSTRALIAN ANTARCTIC BASES

Despite the high latitude and extreme weather in Antarctica, the sun shines for extended periods through summer. Harnessing this solar energy in an effective way presents solar power as a viable supplement to traditional Antarctic power systems, particularly for stand-alone summer installations and field work operations.

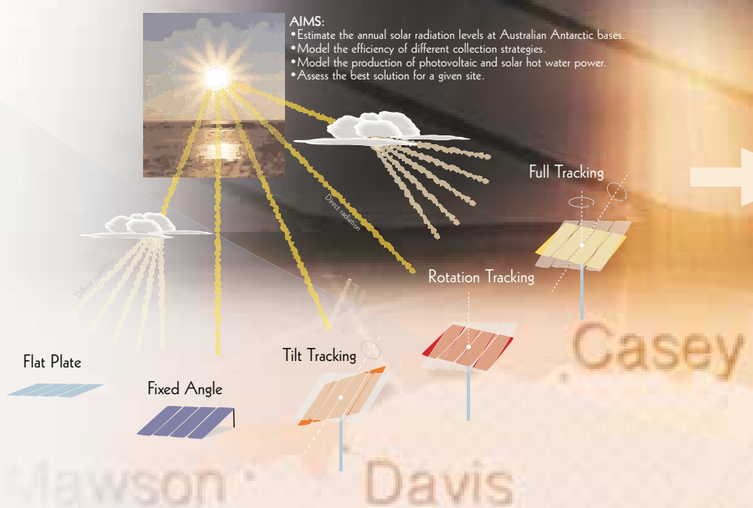
A PILOT SOLAR HOT WATER MONITORING SYSTEM

was installed at Davis station in the 1998-99 summer season. On-site Radiation levels were recorded in conjunction with operational Photovoltaic and Solar Hot Water Power data.

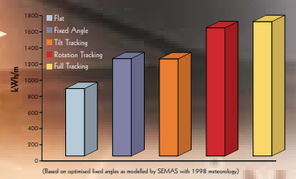
A COMPUTATIONAL ASSESSMENT SCHEME

(SEMAS - Solar Estimation, Modelling and Assessment Scheme) was developed to process the operational and meteorological data collected from Davis.

AIMS:
- Estimate the annual solar radiation levels at Australian Antarctic bases.
- Model the efficiency of different collection strategies.
- Model the production of photovoltaic and solar hot water power.
- Assess the best solution for a given site.

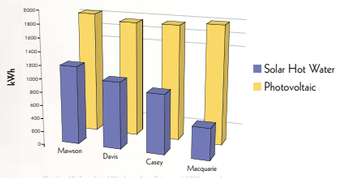


ANNUAL SOLAR RADIATION LEVELS FOR ALL COLLECTION SYSTEMS AT DAVIS STATION



(Based on optimised fixed angles as modelled by SEMAS with 1998 meteorology)

SOLAR POWER FOR AUSTRALIAN ANTARCTIC STATIONS



(Based on 12m² panelling, 13% photovoltaic efficiency and 1998 meteorology. Solar hot water estimates are preliminary and conservative in nature.)

CONCLUSIONS

- When the sun is shining in Antarctica, solar power can be collected and converted into useful power.
- Solar power can effectively supplement the traditional fuel systems, and provide up to 100% of the power necessary for stand-alone summer installations and field bases.
- Fixed collection systems, set to an annually optimised angle, are the best design choice for maximizing the total solar energy collected against cost.

WHICH SOLAR ENERGY COLLECTION SYSTEM?

	Fixed	Tracking
Collected Radiation (per m²)		✔
Operational Ability[1]	✔	
Cost[2] (per m²)	✔	

1. Fixed systems are less susceptible to high winds, freezing conditions and can be readily installed on existing surfaces (i.e. roofs)
2. The simplicity of fixed systems equates to significant savings on purchase, installation and maintenance.

- Analysis indicates that although tracking systems offer greater radiation capture per unit area, the gain is not sufficient to validate the higher purchase, installation and maintenance cost associated with such systems per unit area.
- Examining the fixed system option further, analysis was completed to seasonally optimise the orientation throughout the year. Although a seasonally adjusted system does maximize collected energy, the gains are not significant enough relative to an annually fixed system optimised to a specific location to justify the additional overheads.

WHICH SOLAR POWER SYSTEM?

	Photovoltaic	Solar Hot Water
Power Output[1]	✔	
Operating Ability[2]	✔	
Purchase Cost[3]		✔
Installation / Maintenance[3]	✔	✔

1. Photovoltaic systems offer greater power per m², but are an order of magnitude more expensive to purchase per m².
2. Photovoltaic systems convert all available radiation. Solar Hot Water Systems have minimum operational requirements, directly related to the available radiation and local meteorology. Hence, PV performs better in cloudier environments.
3. The major component of Installation and Maintenance Costs for both systems is related to the high cost of remote area access.

- The design choice between using PV or SHW is application dependent. Future development of SEMAS will enable operators to quickly assess the most cost-effective means of delivering power using either system.

Solar power in Antarctica

2002 Install a mixture of PV and SHW power systems at Australian Bases

2001 Monitoring and Collecting Data, Further Development of SEMAS

2000

1999 Installation of Pilot Solar Hot Water System at Davis Station

1998 Development of Solar Estimation, Modeling and Assessment Scheme (SEMAS)

1997

1996 Collect and assess data

1995

1994 Install Basic Monitoring Systems at Stations

1993 Conception

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