Polar Systems Renewable Energy Mtg.

Design for Efficiency:

Empowering ‘Smaller’ Science in Antarctica

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Postulate

- Technology empowers science
- Not all Grantees are ‘tech-savvy’
- Not all Grantees have tech resources
- Instrumentation can make things possible

IF

we can get the message out, and make the hardware available

Field Camps: upgrading technology

PV power: electrically and environmentally clean

Network access: RJ45 jack to the outside world

Lake Hoare

Showcase solar PV system

No “feeling” of power limitation

Stable voltage

Lake Bonney (2 yrs. Ago)

. . . beautiful location, insane electrical situation

Electric heaters have to be plugged in and run outdoors,

to attempt to stabilize the generators

Davis Seal Camp (2 yrs. Ago)

Traditional Jamesway camp, diesel genset

Vibration & noise are problems

Desktop computers & monitors, 100-W bulbs

Load could be reduced to < 1000 W

Improving Energy Efficiency

DAVIS SEAL CAMP EXAMPLE

Electrical Load Items Tabulation :

Item	Present			Replacement			
	#	W	Total		#	W	Total
Minitower	6	200	1200	Use laptop as CPU	6	30	180
CRT Monitor	4	250	1000	Flat panel monitors	2	20	40
Flat Panel Monitor	2	20	40	Keep, attach to laptop	2	20	40
Laptop	6	30	180	Keep	6	30	180
Video monitors	4	250	1000	Flat panel monitors	4	20	80
Small consumer electronics	12	25	300	Keep	12	25	300
Communications eqpt.	3	25	75	Keep	3	25	75
Electric-motor tools	2			Battery-operated tools (chargers plugged in)	2	5	10
Lab equipment	4			Keep	4		
100 watt bulbs	10	100	1000	Windows			
Total			**4800**				**900**

Estimated continuous load of upgraded station: <**1000 Watts**

Environmental Impact

Diesel exhaust

is a Listed Air Toxic

We now have solar PV technology as a *proven replacement*

Environmental Impact: Emissions

LAKE HOARE EXAMPLE

	Solar PV System			Continuous Diesel		
	Time Fraction	ng	Relative Amount	Time Fraction	ng	Relative Amount
Background	85.7%	5.6	33%		5.6	4.2%
Other Local Sources	10.9%	5.5	32%		5.5	4.1%
Diesel Generator	**2.1%**	**2.5**	**14%**	**100%**	**120**	**90%**
Helicopter Landings	1.3%	3.8	21%		3.8	2.8%
TOTAL IMPACT		**12**			**130**	

Combustion emissions measurements at Lake Hoare, 2000/2001

Telescience and Remote Reporting

- Complement infrastructure of existing field camps and human deployment:
  - more data / less occupancy
  - less logistics, cost, risk, human impact
- Enable science under conditions that would be difficult, risky or costly for humans:
  - year-round installations
  - remote, unsupported locations

Personal Observations

- Many projects are small
- Low ratio of “Geeks” to “Beakers”
- Science is frequently labor-intensive
- Proportionally high support requirements
- Human limitations: cost, risk, support ..
- Many projects would *like* to do things that are inhospitable or impractical for humans

Overcoming ‘inhospitable, impractical ..’

Example : Watch seafloor for 3 months

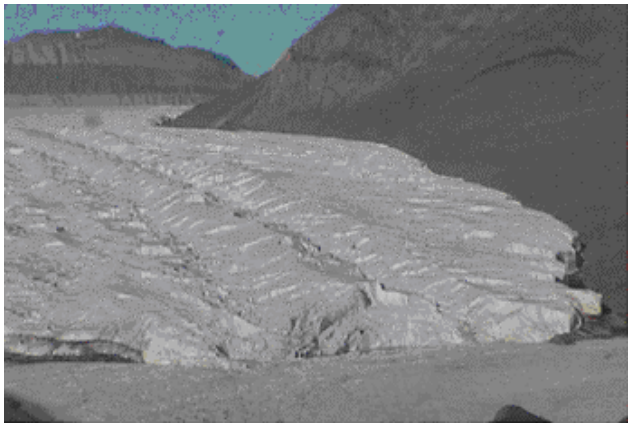
‘Romeo’

Steerable webcam: lithium batteries, fiber-optic cable

Live or time-lapse video close-ups

Overcoming ‘inhospitable, impractical ..’

Example : Watch glacier for 3 months



‘Big Taisu’

Steerable webcam: PV power, 802.11 link to network

Time-lapse image sequences

Overcoming ‘inhospitable, impractical ..’

Example : Watch penguins for 3 months (2004/5)

‘Big Taisu’

Steerable webcam: PV power,
802.11 link to network

Periodic tours of still
images for census;
live video & sequences

Overcoming ‘inhospitable, impractical ..’

Example : Report data every 12 hrs, to assist field party deployment decision

‘Mini Taisu’ data reporter:
lithium batteries, Iridium

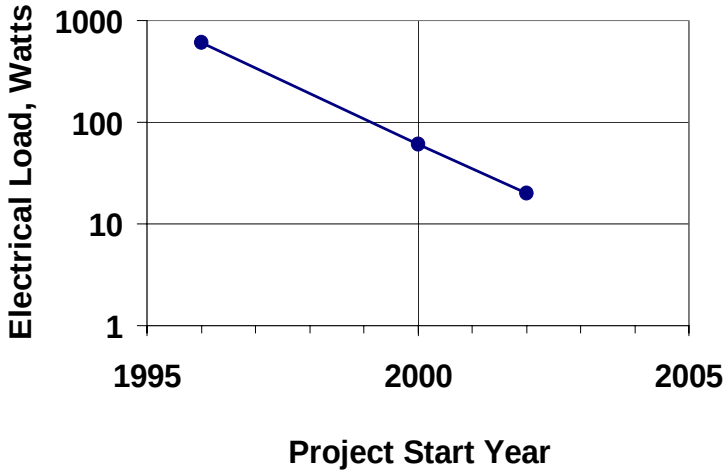
Out of the helo,
onto the ground,
on the air

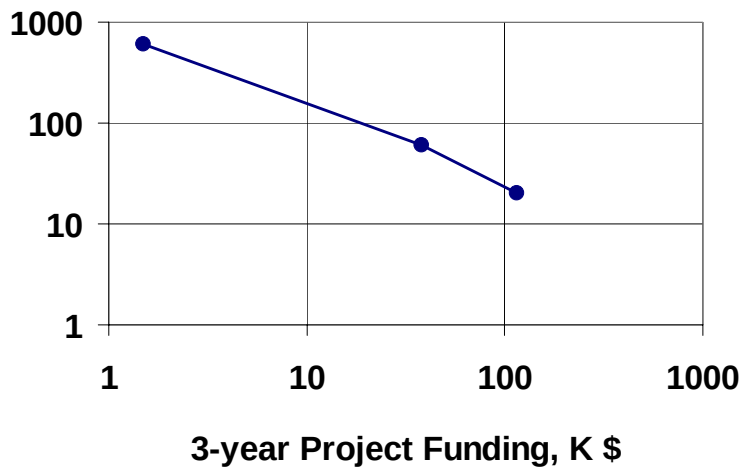
Engineering Requirements

- **Power** : supply, demand, reserve
- **Comms** : what does the end-user ***really*** need?
- **Data Acquisition & Storage : *ditto***
- **Portability** : weight, setup
- **Environment** : temperature, moisture, ..

Power: Grantee technology can improve ..

Electrical Power Requirement for Air Pollution Analyzer : USAP Project S-314





.. it just takes <u>motivation</u>, time, money, and engineering capabilities

Comms: Bandwidth *enables* **telescience**

- ‘Wow! – I didn’t know you could do that !’

  starts grantees thinking of new science

- Iridium data transmission
  - *Enables* **remote reporting from anywhere**
  - ‘How do I make it work ?’

Comms: Local *vs* satellite?

Bandwidth ; realtime *vs* batch ; 2-way or 1-way ; data transmission cost ; etc.

Challenges

- Make Grantees realize what's possible
- Make Grantees think about what they *could* achieve in their research, if only they had the gadget
- Offer tech consulting & resources
- Continuously work on *Infrastructure* and *Instrumentation* to make things possible

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