CH 8 ACTIVE SOLAR

1. P.V. (PHOTOVOLTAICS) 8.1 to 8.17

- GENERATE ELECTRICITY
  - USEFUL FOR NOT JUST HEATING
  - GOOD FOR "THIRD-WORLD" COUNTRIES (IN AFRICA, S.AMERICA, ETC.) WHERE LITTLE OR NO POWER GRID

PV PHYSICS ("SOLAR CELLS")

- "PHOTOELECTRIC EFFECT" - ELECTRONS KNOCKED OFF ATOMS IN A CRYSTALINE STRUCTURE

USE SEMI CONDUCTOR MATERIAL "DOPED" TO CREATE A PN JUNCTION (A DIODE)

- N-TYPE MATERIAL = DOPED SILICON TO MAKE DONOR ATOMS (GIVE UP ELECTRONS)
- P-TYPE MATERIAL = DOPED SILICON TO MAKE ACCEPTOR ATOMS (WANT ELECTRONS)

MUCH POSSIBILITIES IN ELECTRICAL ENGINEERING
- E.G. IBM MULTI-LAYER SOLAR CELLS

\[ P = I \times V \]
- POWER (PRODUCED)
- CURRENT
- VOLTAGE

IF CELLS IN SERIES
- TWICE THE VOLTAGE GENERATED
IF CELLS IN PARALLEL
- TWICE THE CURRENT GENERATED
**PV SYSTEMS:**

- **A Stand-alone (e.g., Third-world):**
  - PV → DC INVERTER → AC (for appliances)
  - Battery
  - DC APPLIANCES (try to have many)

- **B Grid-connected:**
  - PV → DC INVERTER → AC to GRID (sell power back to utility company)
  - AC APPLIANCES

- **Combined:**
  - PV systems best

- **A.1.4:**
  - Use hot air under PV for passive solar

- **A.1.5:**
  - Building integrated BIPV

- **A.1.23:**
  - Wind or fuel cells as back-up (fuel saving)
  - Minimize this

- **A.1.1:**
  - PV during peak (day) demand

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- **A.1.23:**
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- **Building materials cladded with PV**
  - Roof shingles
  - Part of shading canopies
  - Siding
  - Glazing (semiconductor, etc.)

- **Balance controller**
H₂O ② SWIMMING POOL HEATER.

- Not expensive!
- Just space into existing filtration loop
- Collector just plastic mat
- All indoor pools should do this

H₂O ③ "DOMESTIC" (i.e., "PORTABLE" = DRINKABLE) H₂O

HEAT EXCHANGER

Collector

 JUST DISTILLER

HEAT TRANSFER

Cold Supply

Collector: Just big flat black metal plate with pipes on top

Insulation underneath

* Very efficient!
Active tracking (rotating) to follow sun
More efficient, but need to do careful cost/benefit analysis

Air

Hot-air collectors
- Like thermosiphon in ch 7
  But pump it (blow it)

- Can use hot air directly
- Leaks cause no damage
- Use mass of building to store heat
- Air won't freeze

- Air's heat capacity is low
- Leaky ducts
- Bulky ducts

Google img: 'Japanese hot air roof collector'
**NOTE:**

- All collector orientation $= \sin(\text{latitude})$
- All collector sizing constantly changing with new technologies
- Active tracking may not yet be worth cost & maintenance to do

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But this could change as energy/unit area of cells improves