

Presenter: **Andy Baker, PE, Owner & Project Manager**
YourCleanEnergy LLC of Anchorage, AK

AASB Conference – ANC AK – Oct 18, 2017

Success With Solar Energy In Alaska



This powerpoint copyright 2017 YourCleanEnergy LLC

YourCleanEnergy^{LLC} - Mission

- **History:** Providing clean energy consulting (financial evaluation & design) services to commercial and municipal clients in Alaska since 2006.
- Specialize in sea water heat pump evaluation & design.
- Successful clean energy projects are ones that are:

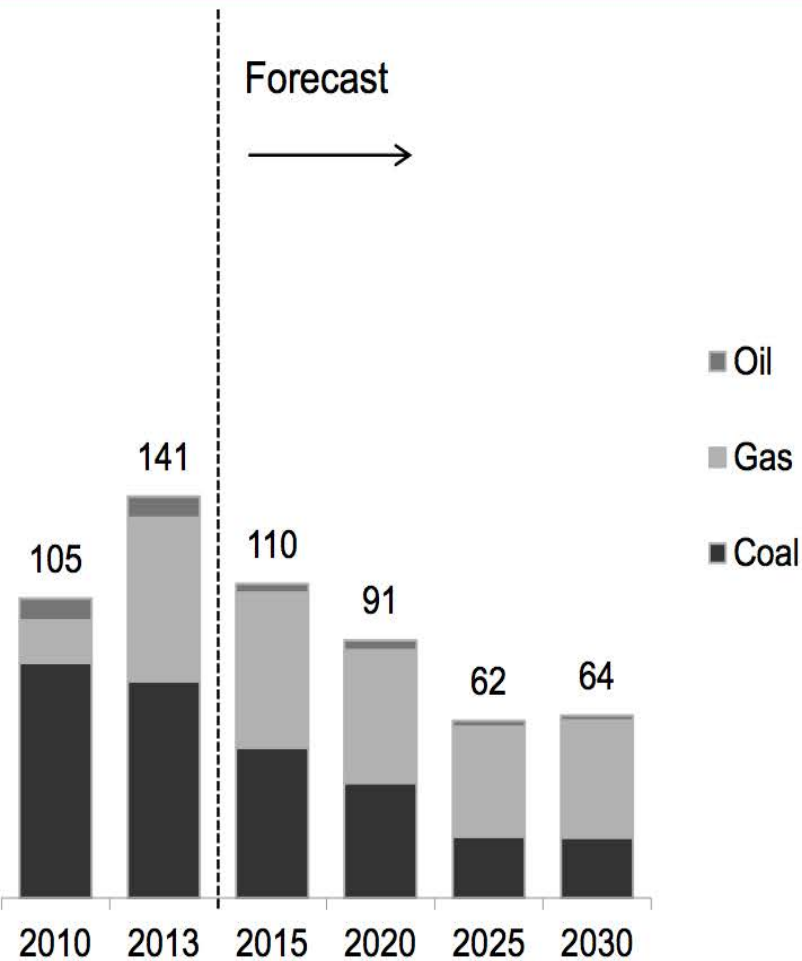
• **Affordable Reliable Safe**

Your Clean Energy

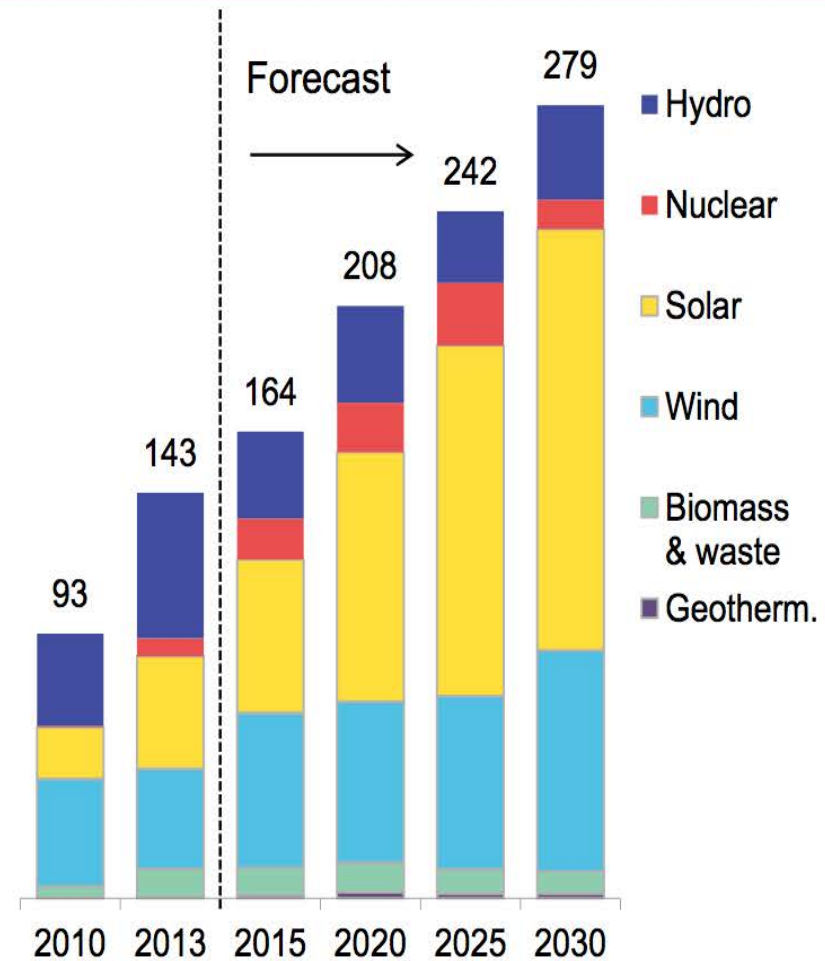


Celebrate the power of nature...™

FOSSIL FUEL



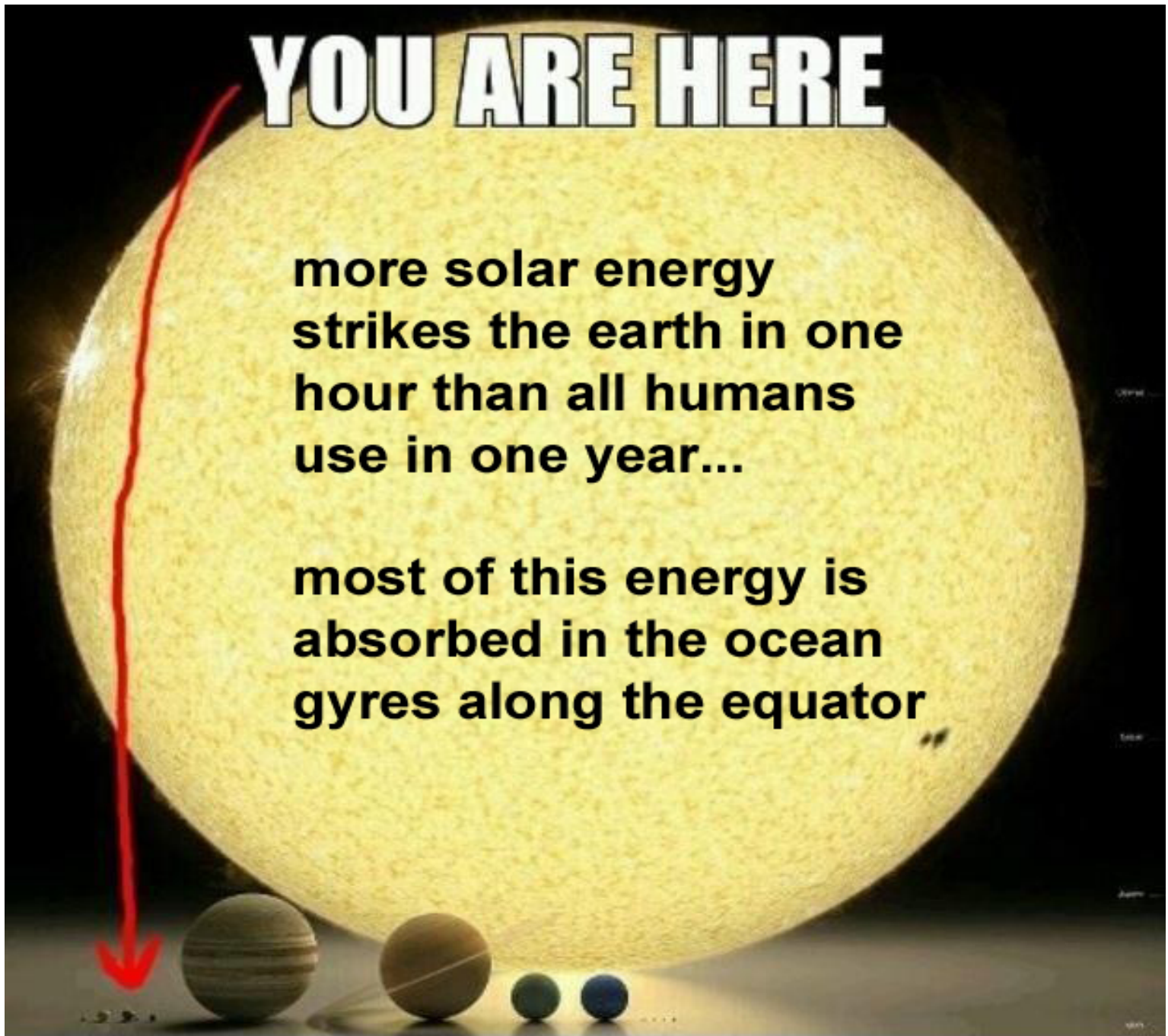
CLEAN ENERGY



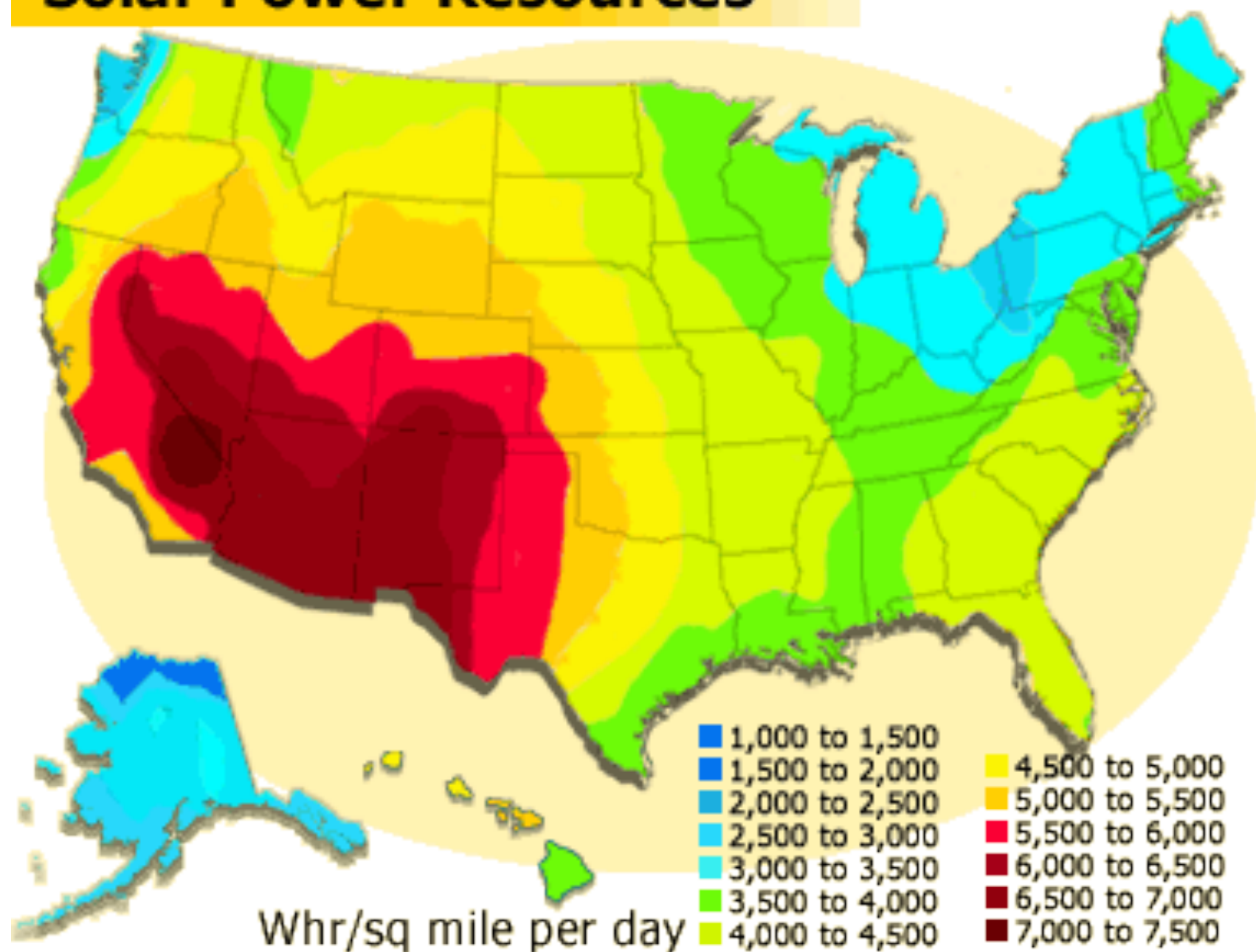
YOU ARE HERE

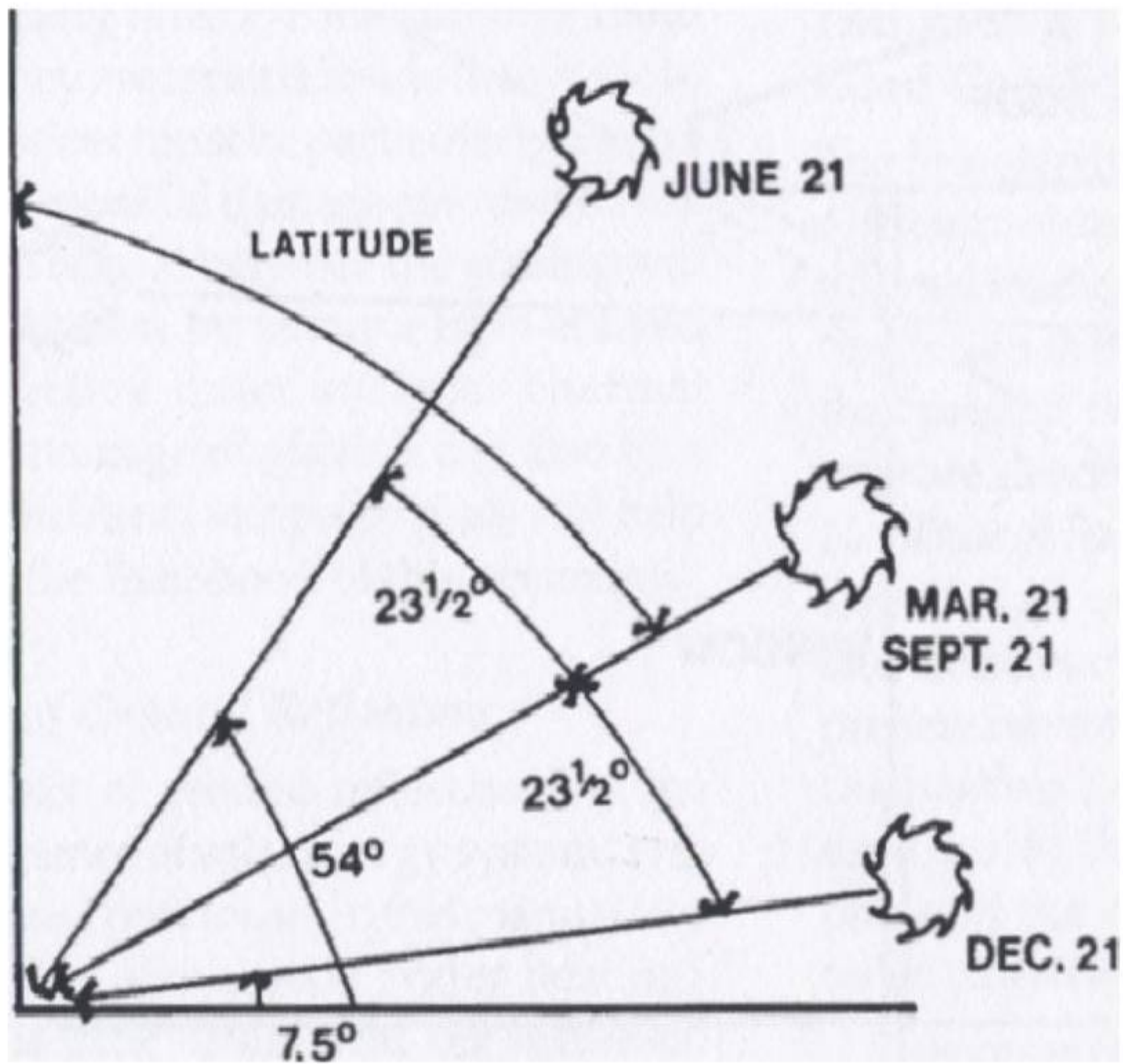
**more solar energy
strikes the earth in one
hour than all humans
use in one year...**

**most of this energy is
absorbed in the ocean
gyres along the equator**



Solar Power Resources





FLAT PLATE COLLECTORS WORK IN ANCHORAGE

Heliodyne GOBI 406 solar hot water collectors installed on 9/14/08

South facing, 62 degree tilt, anchored by lag screws into rafters, snow will shed completely off roof



System Design by Andy Baker, PE

YourCleanEnergy LLC, Anchorage, AK
www.yourcleanenergy.us

Seth Downs Triplex

Heliodyne solar hot water panels installed on tri-plex, 821 Edwards Street, Anchorage 9/14/08

System design by Andy Baker of YourCleanEnergy LLC Owner: Seth Downs 50% of annual Domestic Hot Water for six persons



Seth Downs Tri-plex January 4, 2009

2:40pm Outside air temp = -8 deg F
thickness of snow on collectors = 12 inches+

snow pile at bottom edge of roof is supporting snow column on collector face above, preventing reliable self-cleaning from mid-December thru early January.

Manual snow cleaning may be required for three weeks before and after winter solstice (December 21) to achieve useful heat gain.

street light
pole shadow



photo by Andy Baker

www.yourcleanenergy.us



Solar Thermal Panels Dominate Skyline In Eagle River, AK...

Coronado Park Senior Village
Cook Inlet Housing Authority

photo by Andy Baker March 22, 2014

Largest Solar Thermal Array In Alaska = 56 Flat Plate 4' x 10' Collectors
Heliodyne GOBI 410's + Custom Designed Aluminum Racking
Coronado Park Senior Village - Eagle River, Alaska
Owner: Cook Inlet Housing Authority
Architect: KPB Architects, Anchorage
Solar Thermal Design: YourCleanEnergy LLC
Mechanical Design: RSA Engineers, Anchorage
Structural Design: Reid Middleton, Anchorage
Mechanical Contractor: Klebs Mechanical
Tech Support: SunWaterSolar, CA
Bldg General Contractor: Neeser

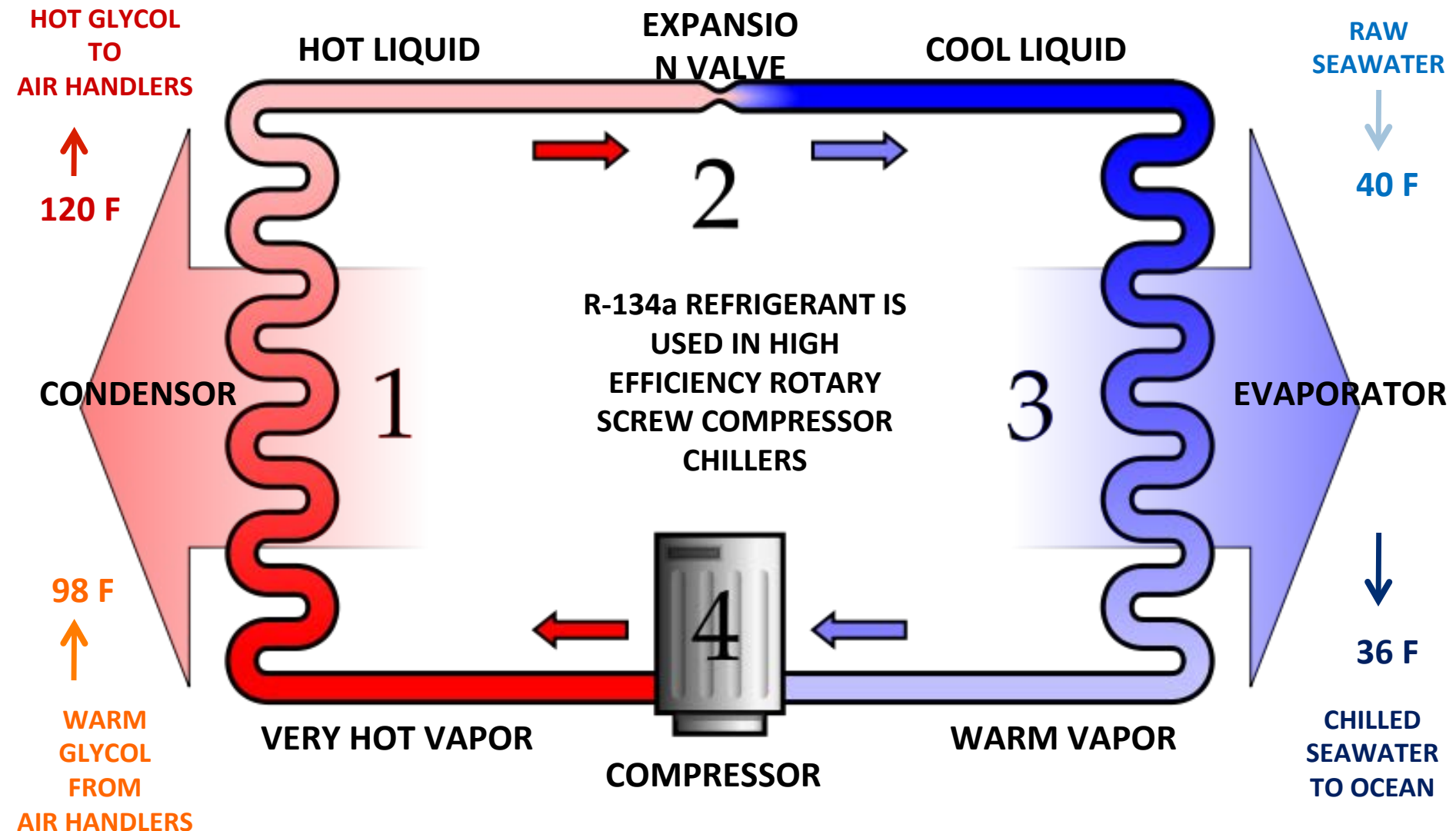
Photo by Klebs March 22, 2014



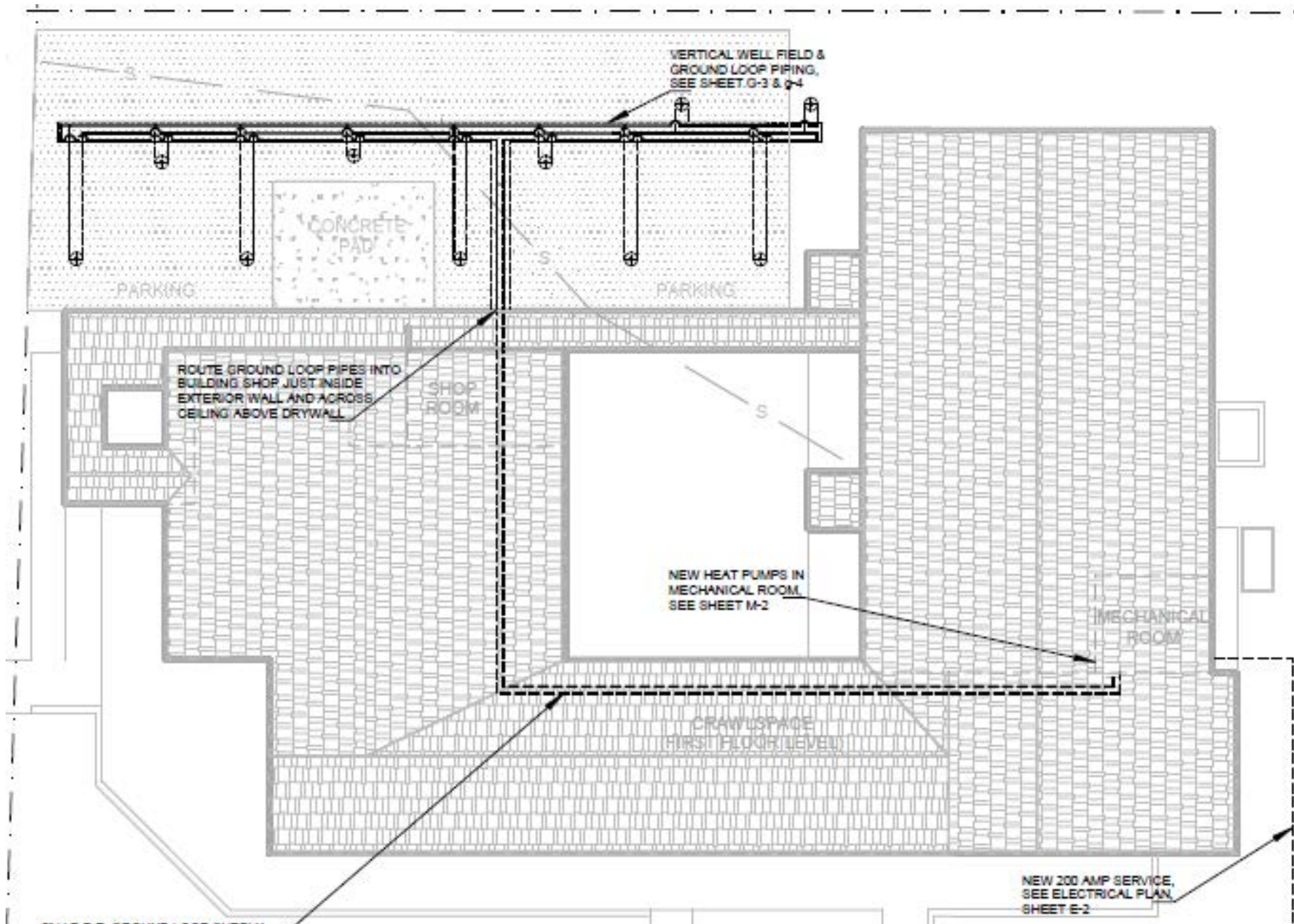
Heat Pump Package Also Available In Compact Cabinet: 1 Ton – 20 Tons



Technology Fundamentals



SELDOVIA SENIOR HOUSING – 17,000 SQ FT – ELIMINATE OIL BOILER



Small Drill Rig Can Make 6" Diameter x 300 Ft Deep Borehole



11/5/2014

Vertical Loop U-Bend Coils: Pre-Made and Leak Tested



11/5/2014

COLD GROUND
SOURCE WATER
@ 40F IS PUMPED
FROM VERTICAL
GROUND LOOPS

FLOW METER
AND TEMP
SENSORS ARE
INSTALLED TO
MEASURE COP

HOT HYDRONIC
HEATING WATER
@ 140F IS
PUMPED FROM
LOAD SIDE OF
HEAT PUMPS TO
BUFFER TANK

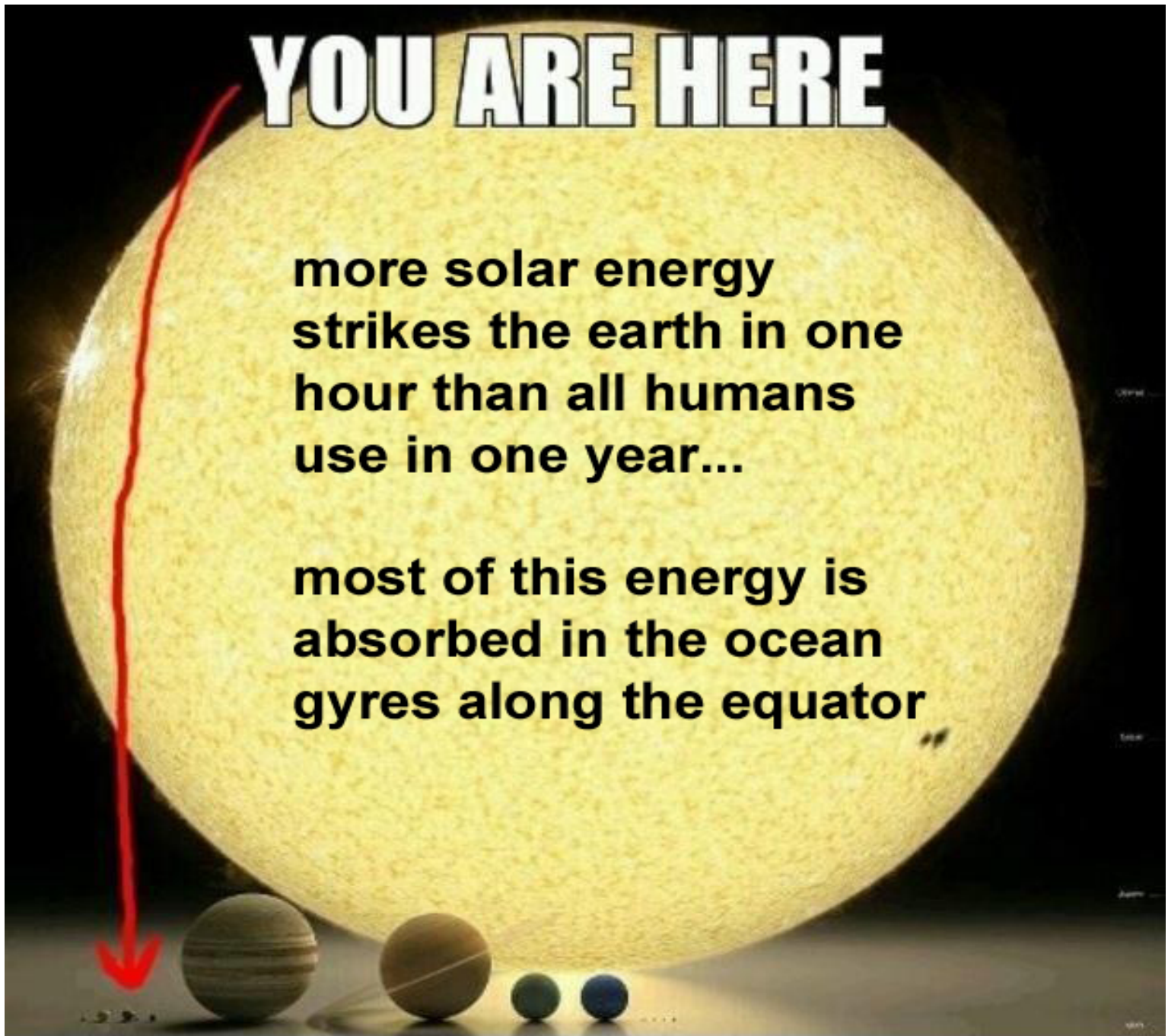
WATER FURNACE
SERIES 5 MODEL
7 TON CAPACITY
84,000 BTU/HOUR

GROUND SOURCE HP's
SELDOVIA HOUSE

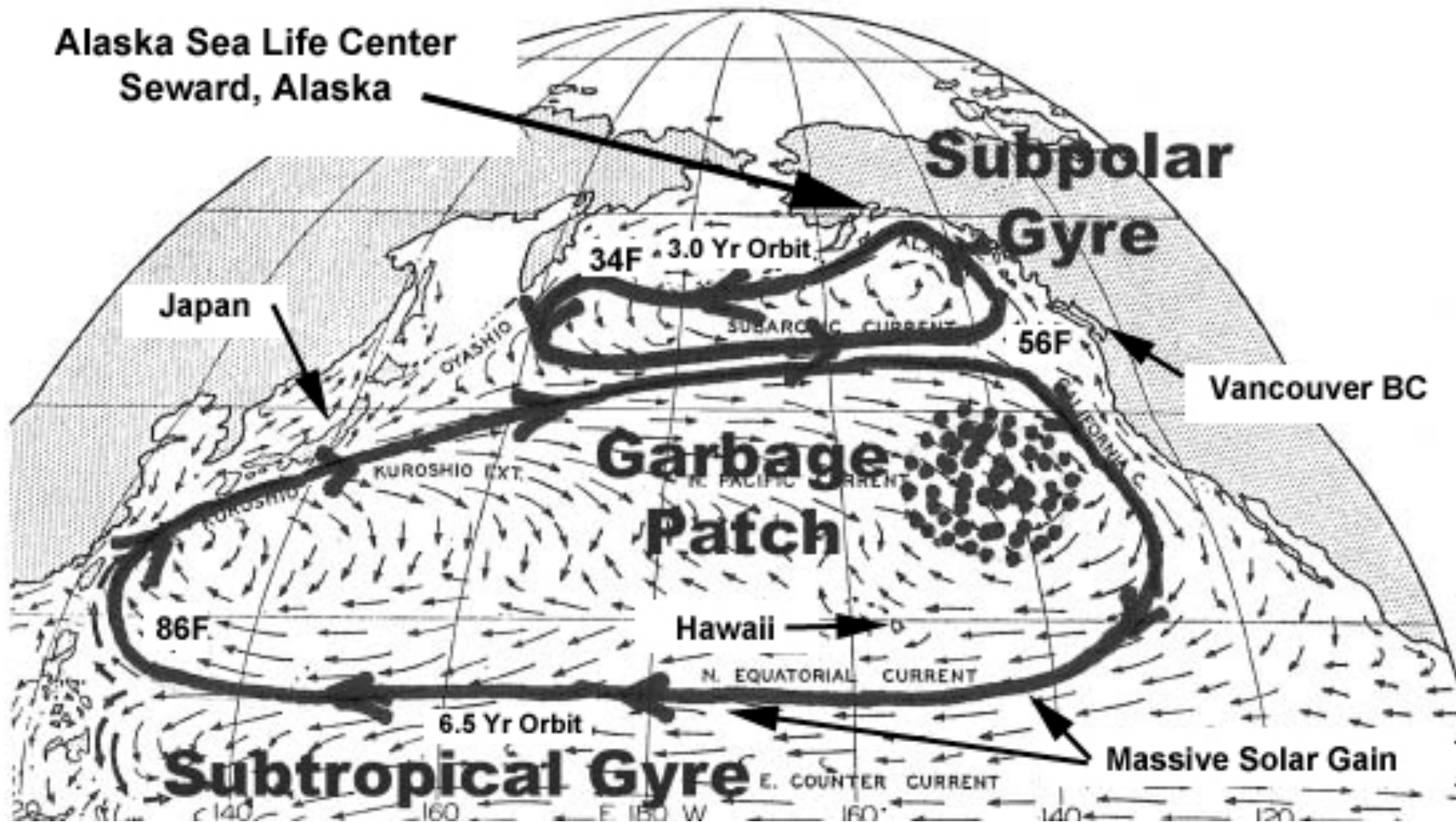
YOU ARE HERE

**more solar energy
strikes the earth in one
hour than all humans
use in one year...**

**most of this energy is
absorbed in the ocean
gyres along the equator**



Seward Gets Massive Ocean Heat From The Equator!!!





Alaska SeaLife Center®
windows to the sea

Alaska SeaLife Center



Rez Bay = Utility Grade Heat Source



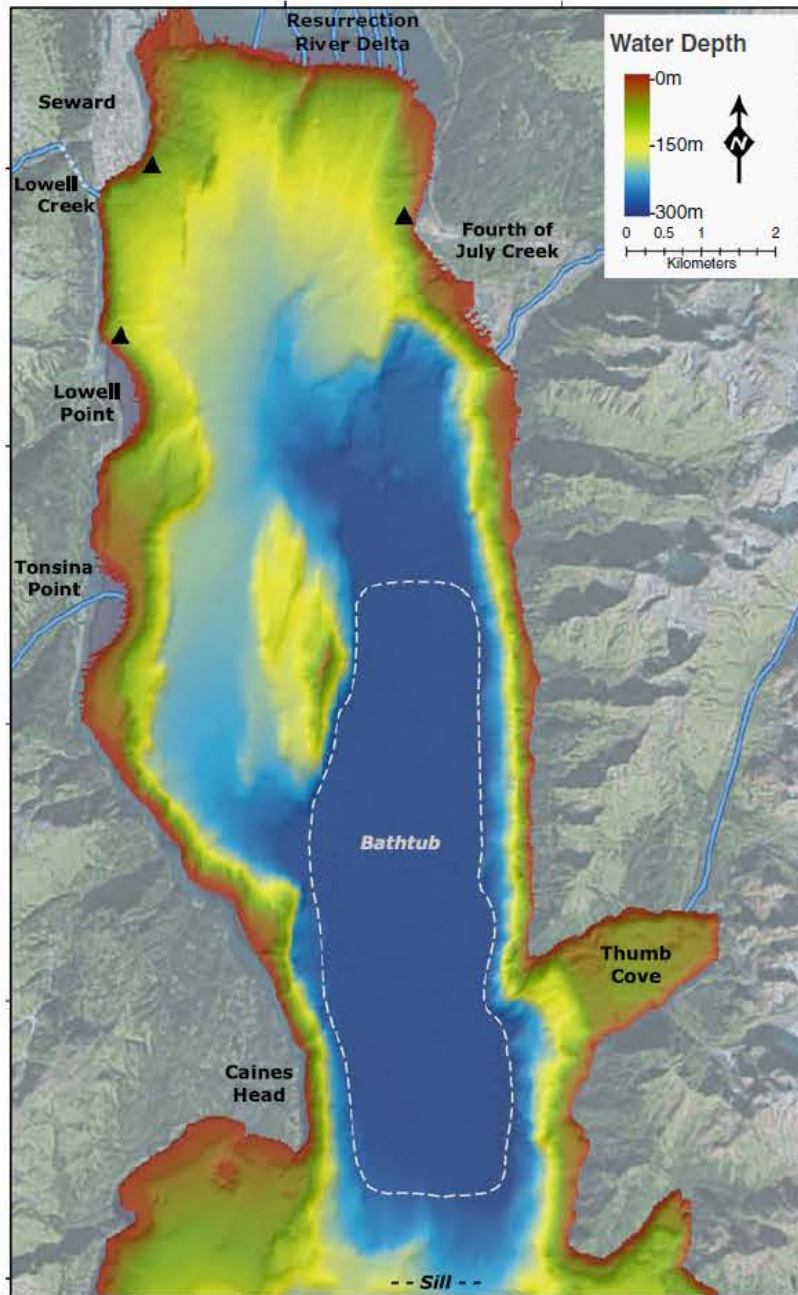
Resurrection Bay Steaming

November 18, 2009

Sea Water Temp = 50F

Outside Air Temp = 22F

photo by Ian Dutton



Resurrection Bay is very deep body of water – 900+ ft in large bathtub area

Bay is facing due south, warmed by Alaska Coastal Current, receives tremendous solar gain thru summer

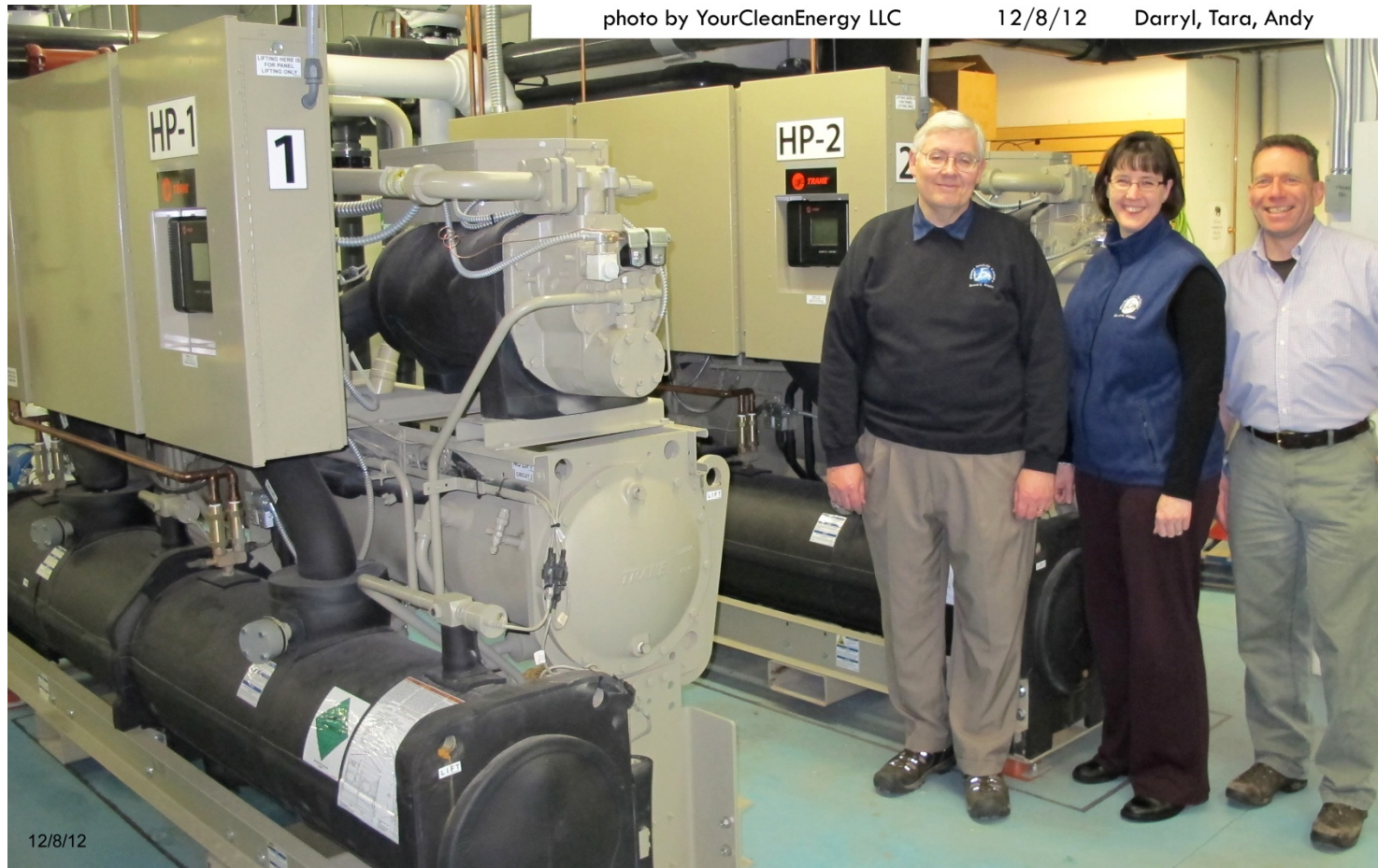
Bay receives solar heat all the way from the equator; tides are mild; some cooling from glaciers and rivers that drain into Bay

Actual Installation – Sea Water HX



Transfers Heat From Sea Water Into a Glycol Loop That Then Passes Through Heat Pumps

Actual Installation – Heat Pumps



Two 90-Ton Heat Pumps – One or Two Heat Pump Operation

Smaller Heat Pump Is Dedicated To Domestic Hot Water Tank



Packaged Trans-Critical CO2 Heat Pump

Source Glycol In

30F to 56F



Chilled Glycol Out

22F to 48F



Heated Water Out



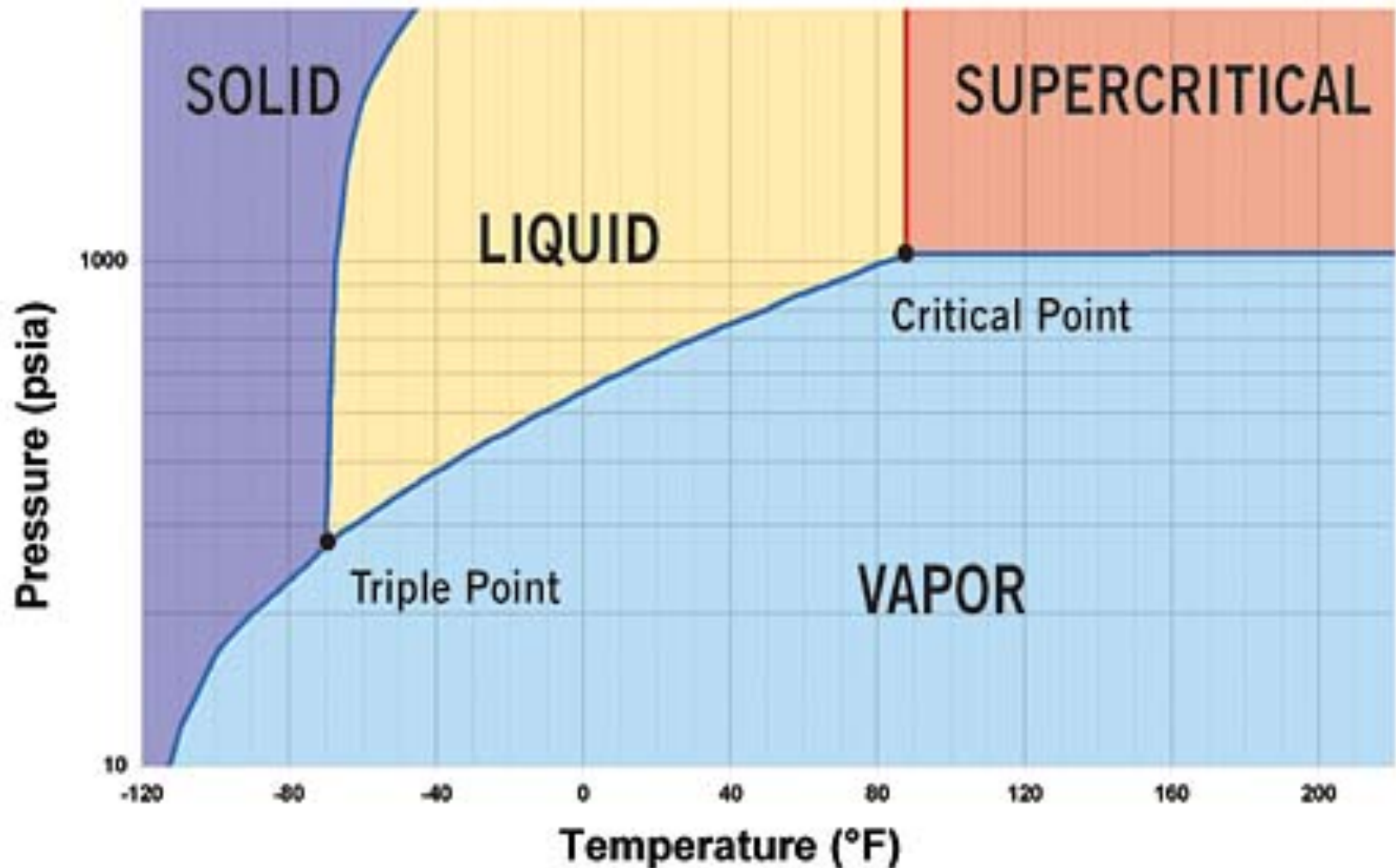
149F to 194F

Boiler Loop Return

90F to 130F

Packaged Units First Installed in USA in 2010, Capacity Limit 20 Tons

CO₂ Is Natural Refrigerant – R744



Phase Diagram For CO₂. Critical Point is 1,067 PSIA and 88 degrees F.

Taking The Trans-Critical Escalator Up

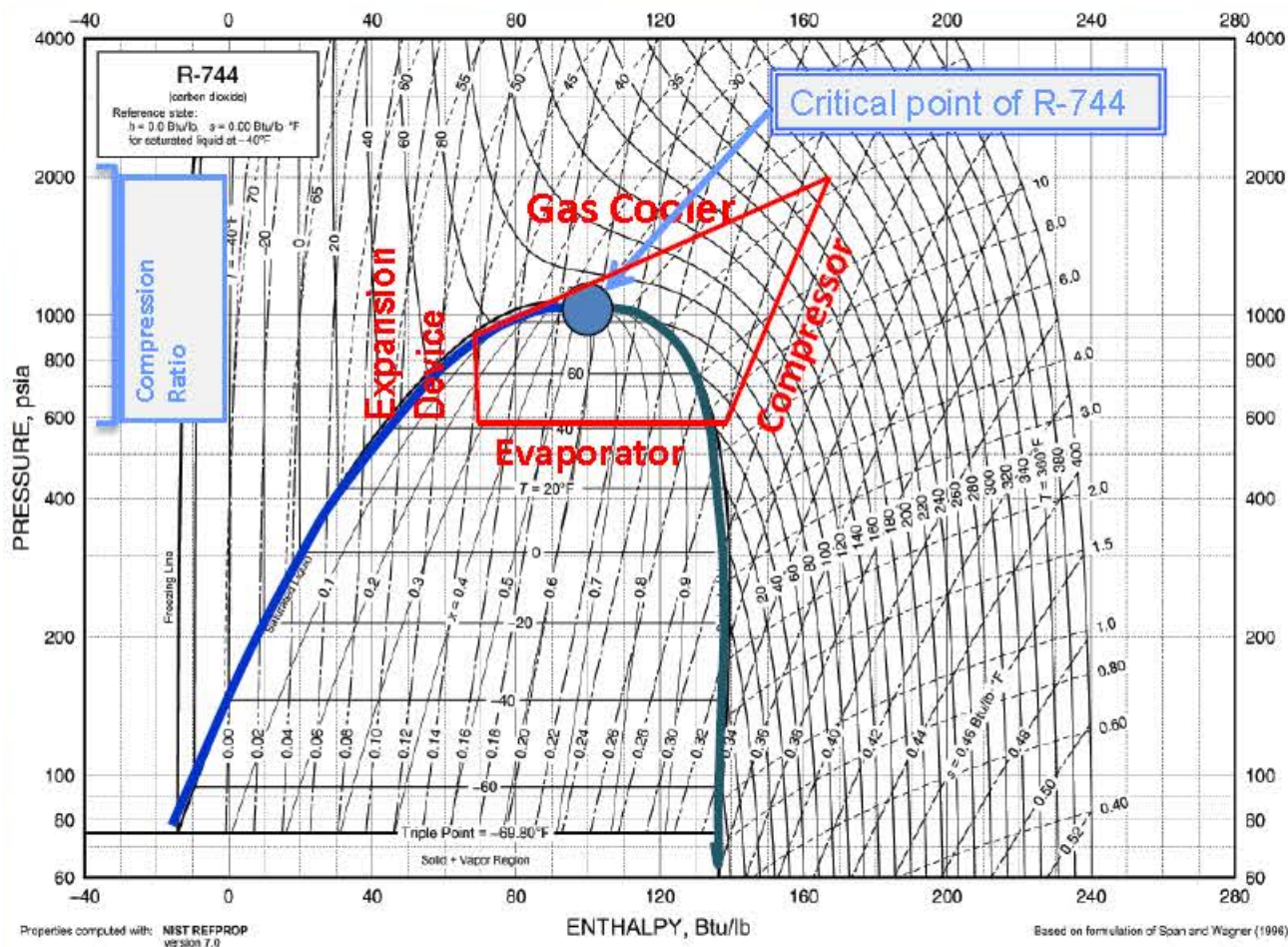


Fig. 18 Pressure-Enthalpy Diagram for Refrigerant 744 (Carbon Dioxide)

30.38

- ☐ Heat rejection occurs above critical point of refrigerant
- ☐ No condensation of CO₂ in the Trans-critical cycle
- ☐ Gas cooler temperature decreases throughout entire heat rejection process
- ☐ High temperature difference across gas cooler achieved for hot water heating purposes

2009 ASHRAE Handbook—Fundamentals

Compression & Gas Cooling Occur Above And Below Critical Point



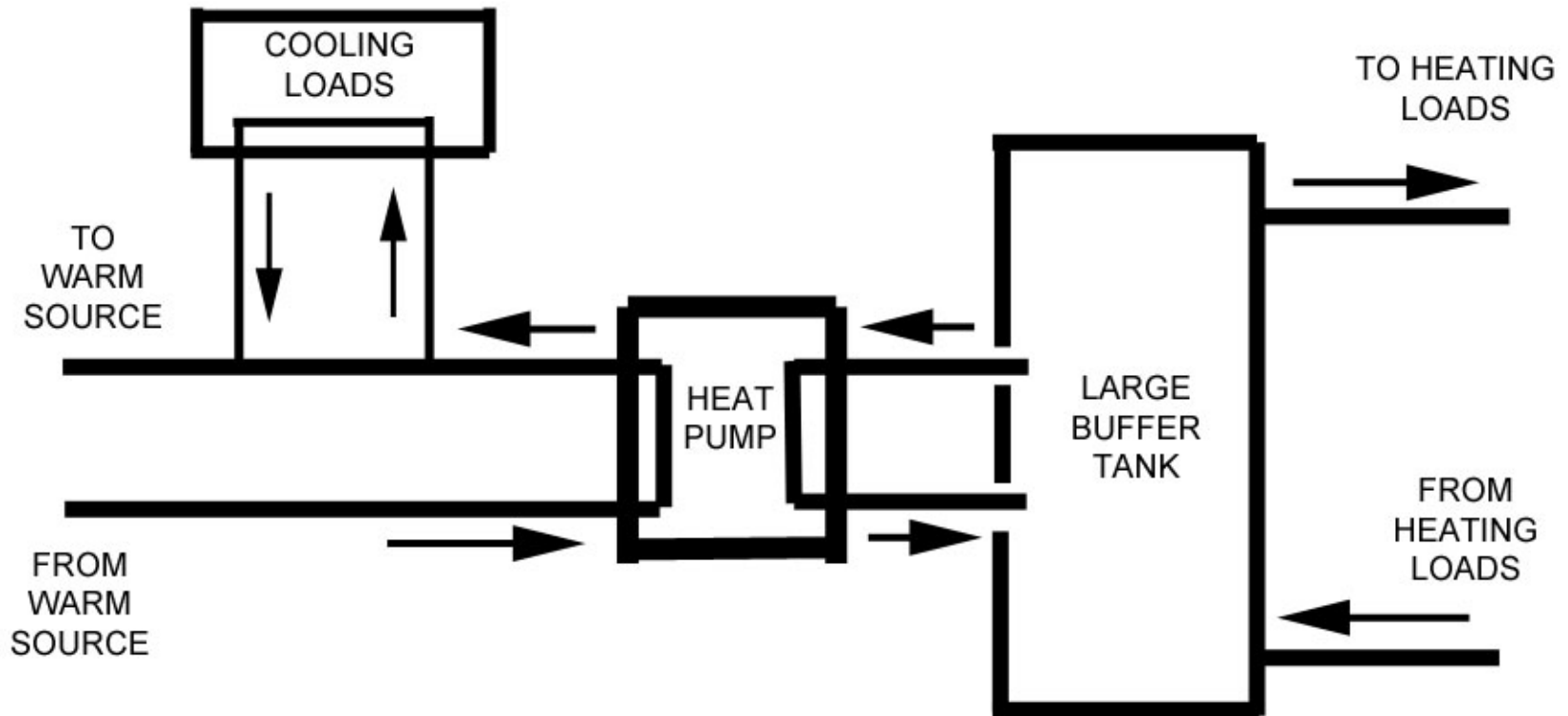
3/24/16

Successful Integration Of CO2 Heat Pumps = Heating Costs Cut In Half



photo by Andy Baker
YourCleanEnergy LLC
Jan 21 2016

Heat Pumps Allow Cooling & Heating



IDEAL HEAT PUMP SCHEMATIC

Net Metering Law In Alaska - 2010

- **History:** In 2009, six solar advocates battled with the five major utilities on the Railbelt to negotiate a regulation - law passed with 4 out of 5 votes - this got done without going thru the state legislature – no real push back from utilities
- **25 KW system size limit per customer**
- **Monthly billing with excess power sold at avoided cost**
- **Total capacity limited to 1.5% of peak load**
- **Interconnection agreement based on IREC standards – utility provides bi-directional meter – customer meets all codes and provides disconnects and placards at street level**
- **While it is far behind many other states, this simple policy has enabled the growth of PV across the railbelt by creating a stable price for distributed grid tied power**

Your Clean Energy



Celebrate the power of nature...™

SOLAR PV MODULES WITH MICRO-INVERTERS

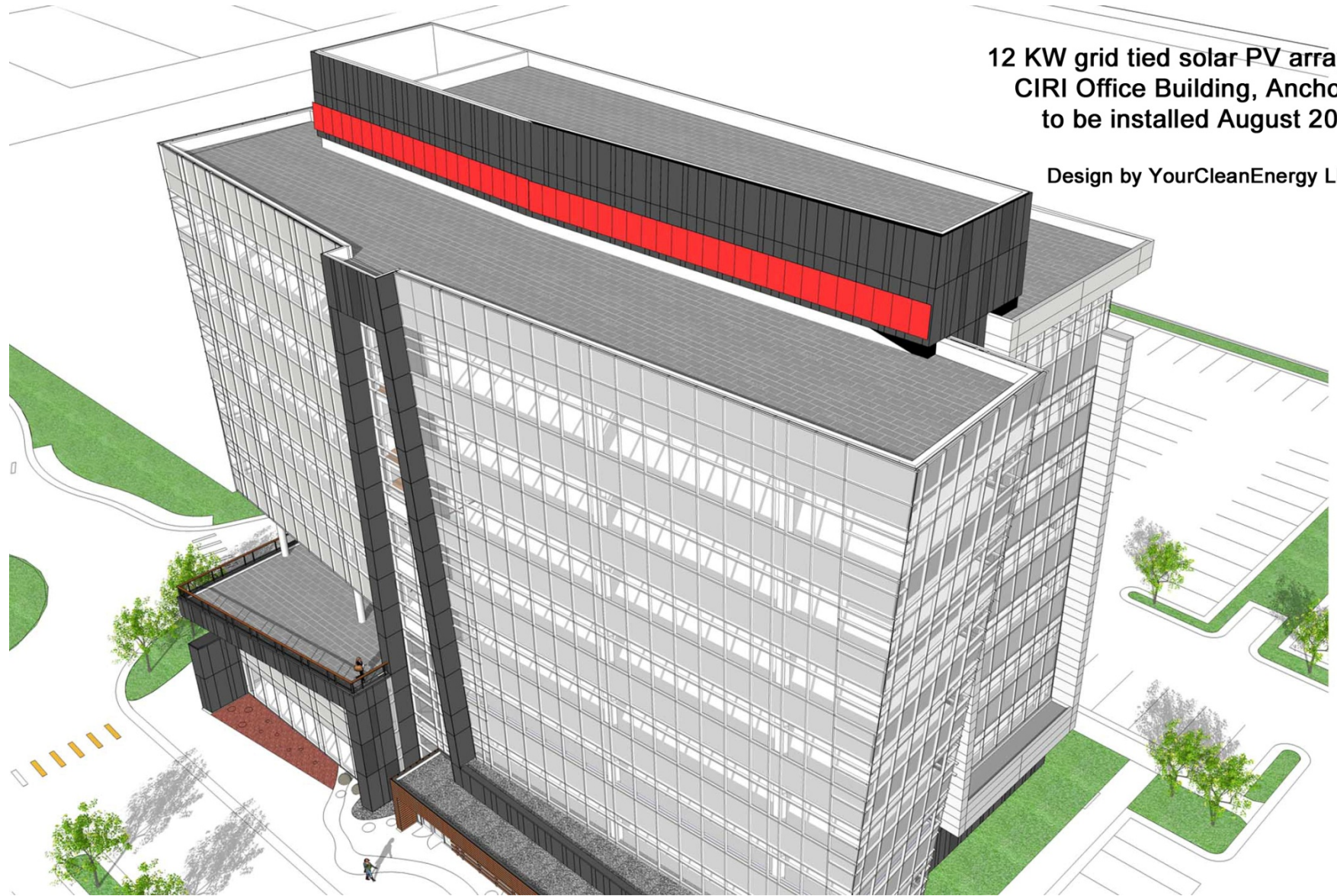
FLUSH MOUNTED TO EXISTING METAL ROOF

RESIDENTIAL STORAGE SHOP - LAZY MOUNTAIN, PALMER, ALASKA



**12 KW grid tied solar PV array - new
CIRI Office Building, Anchorage
to be installed August 2015**

Design by YourCleanEnergy LLC



SOLAR PV MODULES WITH MICRO-INVERTERS

RACK MOUNTED TO EXISTING FLAT ROOF

ANCHORAGE, ALASKA



12 KW GRID TIED SOLAR PV
CIRI OFFICE BLDG ROOF

725 E FIREWEED - ANCHORAGE
PHOTO BY JASON MOORE

SOLAR PV MODULES WITH MICRO-INVERTERS FLUSH MOUNTED TO EXISTING METAL ROOF

808 H STREET, ANCHORAGE, ALASKA



SOLAR PV MODULES WITH MICRO-INVERTERS FLUSH MOUNTED TO EXISTING METAL ROOF

RESIDENTIAL FAMILY HOUSE - BEAR VALLEY, ANCHORAGE, ALASKA



Seth Downs Residence
Site #4 on the 2017
Anchorage Solar Tour

2017 SOLAR DECATHLON - DENVER

SWISS NEIGHBOR HUB



2017 SOLAR DECATHLON - DENVER

SWISS NEIGHBOR HUB



2017 SOLAR DECATHLON - DENVER

SWISS NEIGHBOR HUB

10/12/17



2017 SOLAR DECATHLON – DENVER

MISSOURI S&T HOUSE

Missouri S & T

10/12/17



2017 SOLAR DECATHLON – DENVER

UNIV OF MARYLAND HOUSE



2017 SOLAR DECATHLON – DENVER

U OF MARYLAND HOUSE



2017 DENVER PERFORMING ARTS CENTER

ARCH CONNECTING TWO BOXES – SOLAR PV

Denver Performing Arts Center

10/8/13

