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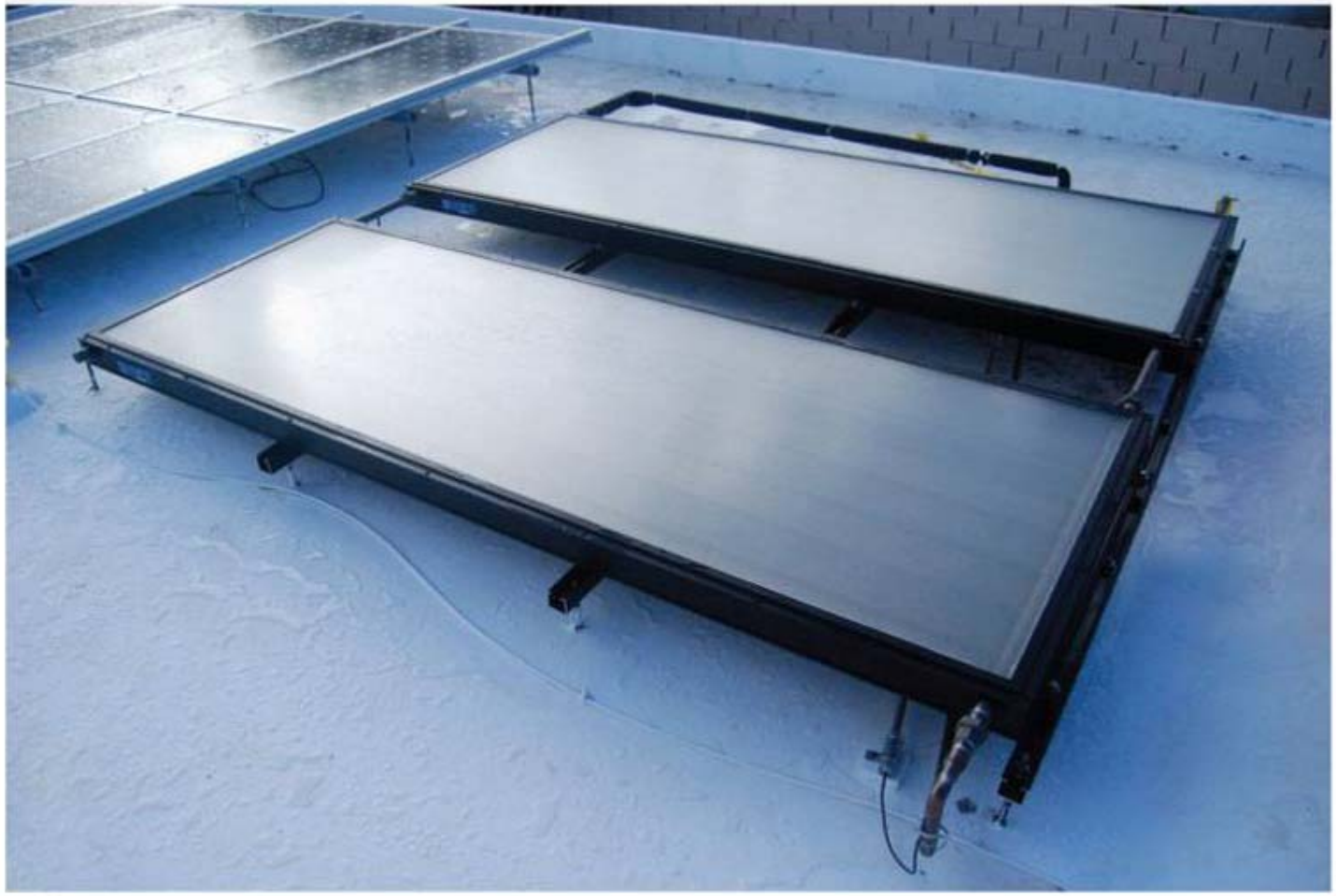

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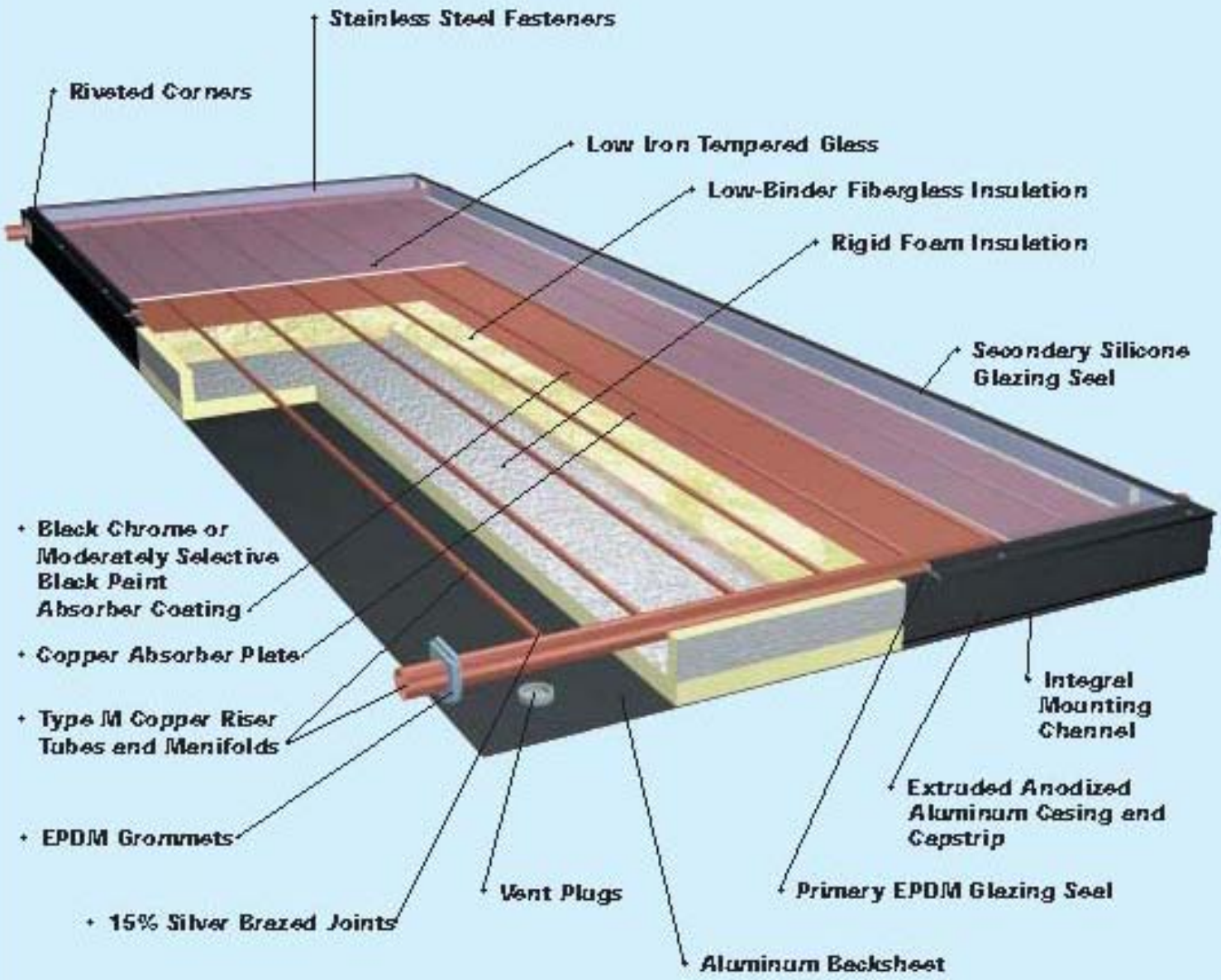
IN SOLAR WATER HEATING TECHNOLOGY



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Project: Solar Panel - Mr. Hagen Residence		
Comments: Solar Panel -	Job No. : Designed by LNB	Sheet No.: Date: Feb. 23, :
Subject: Design of Strut and Anchor	Reviewed by : CPA	

. Based on Technical specs: Sunmodule SW155/165/175 mono
Solar panel to be installed at Roof of Mr. Hagen's Two storey Residence

length =	63.39	inches
width =	31.89	inches
weight =	33.00	lbs
weight/sqft. =	2.35	psf

. Lateral Loads/Wind Load

Assume panel to hold the wind design velocity
Wind Velocity, V = 175 mph
two locations = Flat and slopping roof (96 hor: 14 vert)

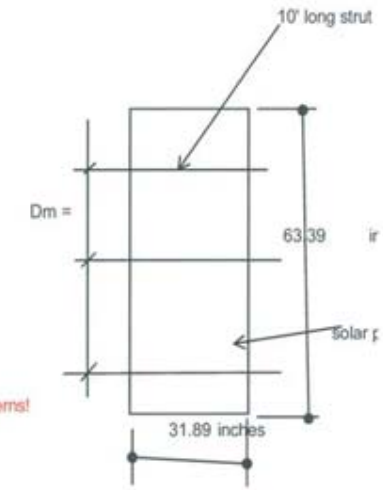
Per UBC Code :
WL = Ce Cq qs I

where :
Ce = 1.39 Exposure D at two storey height
Cq = 1.30 For unenclosed structures with slope < 58.3%

slopping roof (96 hor: 14 vert) slope = 14.50% < 58.3%
lopping roof (180 hor: 20 vert) slope = 6.34% < 58.3%

qs = 0.00256 V^2
78.65 psf
I = 1.0

.:
WL = (1.39) (1.30) (78.65) (1.0)
WL = 142.11 psf



. Load Combination

Net Working Load = DL - WL = 2.35 - 142.11
-139.76 UPLIFT

let Ult Load 1= 0.9DL - 1.3WL = 0.9(2.35) - 1.3(142.11)
-182.63 UPLIFT governs!

let Ult Load 2= 1.2DL - 1.3WL = 1.2(2.35) - 1.3(142.11)
-181.92 UPLIFT

Project: Solar Panel - Mr. Hagen Residence		
Comments: Solar Panel -	Job No. : Designed by LNB	Sheet No.: of Date: Feb. 23, 2009
Subject: Design of Strut and Anchor	Reviewed by : CPA	

D. Design of Strut spacing holding Solar Panel -use working Load
Trial spacing= 24 inches; also called D_m
From technical specs of Solar Panel:

$F_L = D_m \times P_m$; lbs/ft should not exceed 300lb/ft in any application
where : P_m = -139.761 psf pressure the module is exposed, in psf
D_m = 24 inches; height of module being racked, in feet, strut spacing

$F_L = \frac{(-139.761)(24)}{12}$

F_L = -279.522 lbs/ft > 300 lbs/ft .: ok
use 24" on center strut spacing

However; Technical Specs doesnot mentioned if Working Load or Ultimate load to use for design of Strut Spacing
Code says, the most stringent Load should be used if specs is silent.

Trial spacing= 24 inches; also called D_m
therefore, use Ultimate load P_m = -182.629 psf pressure the module is exposed, in psf
D_m = 24 inches; height of module being racked, in feet, strut spacing

$F_L = \frac{(-182.629)(24)}{12}$

F_L = -365.259 lbs/ft > 300 lbs/ft .: not ok
DCR : 1.218 **21.8%** overstressed, and more than 10% therefore not acceptable.

Trial spacing= 20 inches; also called D_m
therefore, use Ultimate load P_m = -182.629 psf pressure the module is exposed, in psf
D_m = 20 inches; height of module being racked, in feet,strut spacing

$F_L = \frac{(-182.629)(20)}{12}$ not ok but acceptable

F_L = -304.382 lbs/ft > 300 lbs/ft .: use 20" on center strut spacing
DCR : 1.015 **1.5%** overstressed, but less than 10% therefore tolerable.

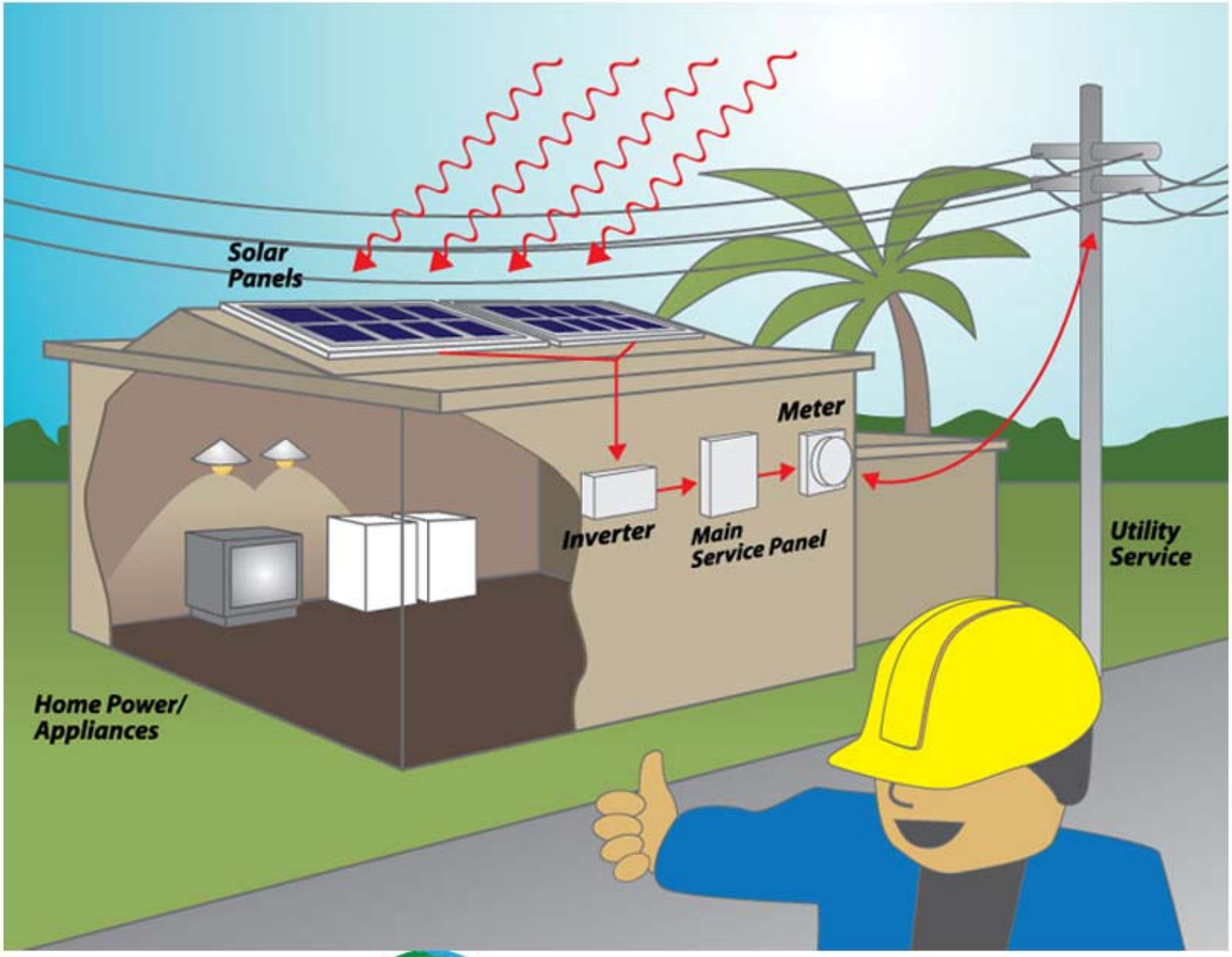
E. Design of Anchor Bolt for Strut Holding Solar Panel using 20" spacing - use Ultimate Load
From technical specs of Solar Panel:
P_m = -182.629 psf **Governing Net Ultimate pressure** the module is exposed, in psf
use D_m = 20 inch designed strut spacing using ultimate load

$F_f = F_L \times D_f$; psf
where : F_L = -3652.6 lbs/ft Linear Load, not exceeding 300lbs/ft
D_f = 10 ft strut free spun, length of strut

F_f = 3652.6 x 10'
F_f = -36525.9 lbs

Try 22 inches SSTL Anchor Bolt spacing
n = 10 x 12/20"
n = 5.450 pcs. use n = 6

Check Tension
Governing Ultimate Uplift Force per Bolt
Uplift Force per Bolt = $\frac{-182.63}{12} \frac{20.00}{6} 10.00$ = **-507.30** lbs
Technical specs load factor x 2.0
-1014.6 lbs
Factor without inspection x 1.5
-1521.9 lbs > 3630 lbs
.: use 3/8" SSTL Bolt @ 22" spacing with 3-3/8" embedment with 20 inches strut spacing



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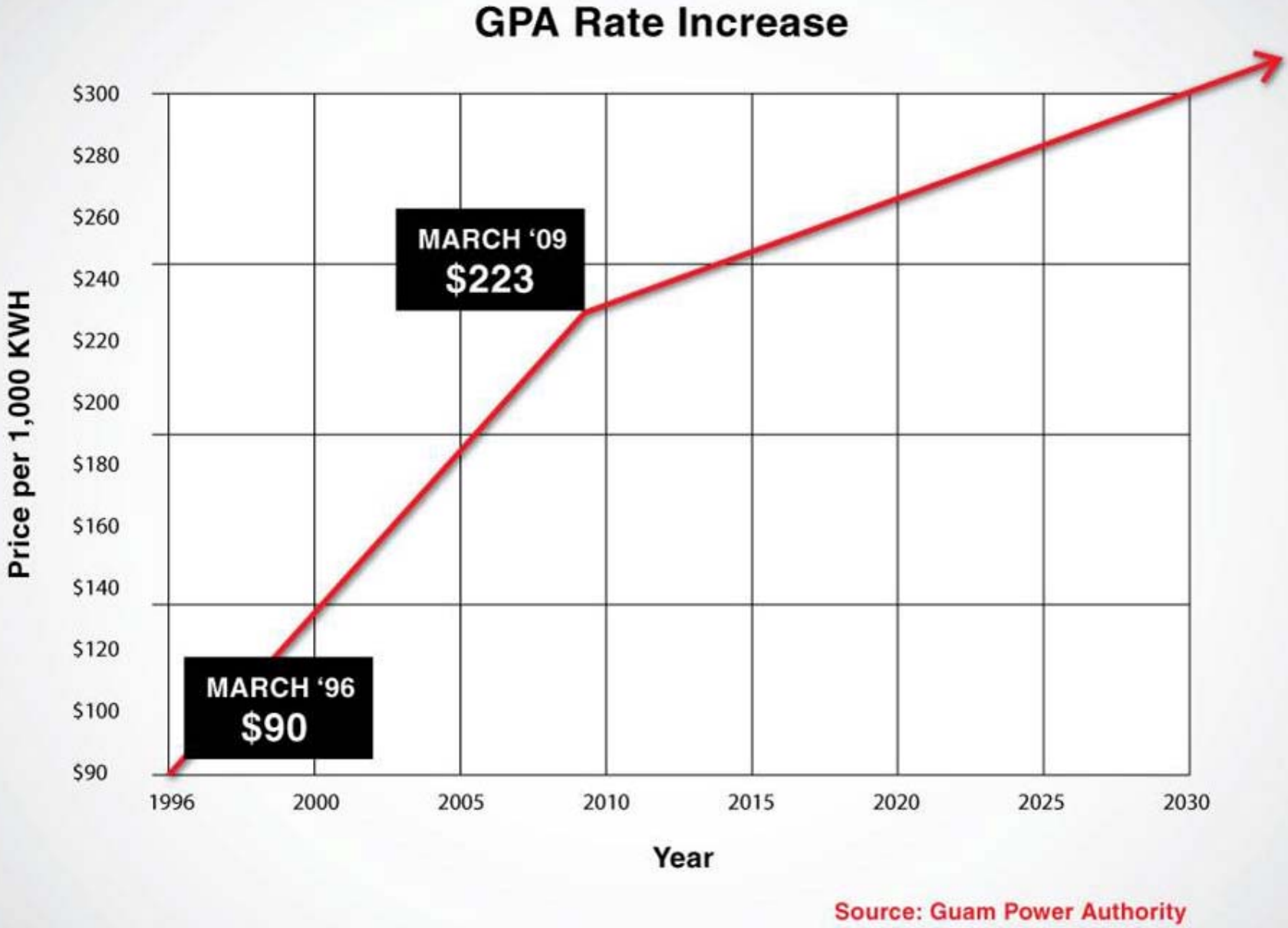
GPA Rate Increase
Price per 1,000 KWH
$300
$280
$260
$240
$220
$200
$180
$160
$140
$120
$100
$90
MARCH '09
$223
MARCH '96
$90
1996
2000
2005
2010
2015
2020
2025
2030
Year
Source: Guam Power Authority

TURN YOUR METER BACKWARDS

Pacific Solar & Photovoltaics

Scott Hagen
632-4002 / 688-3080
s.hagen@guampestcontrol.com

William Hagen
632-4002
bill_hagen@hotmail.com

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