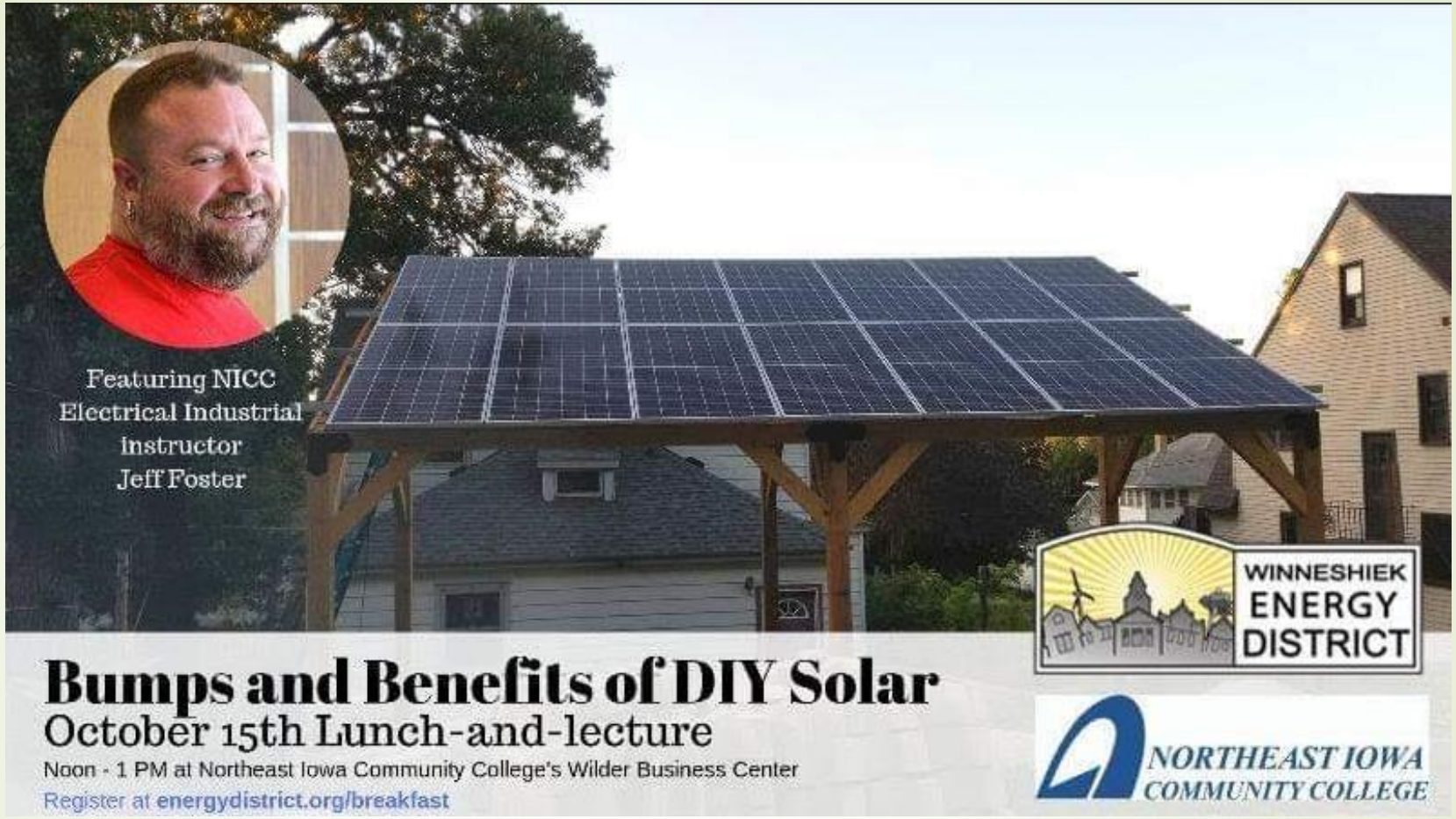

Featuring NICC
Electrical Industrial
Instructor
Jeff Foster
WINNESHIEK
ENERGY
DISTRICT
Bumps and Benefits of DIY Solar
October 15th Lunch-and-lecture
Noon - 1 PM at Northeast Iowa Community College's Wilder Business Center
Register at energydistrict.org/breakfast
NORTHEAST IOWA
COMMUNITY COLLEGE

Jeff Foster

# First question : How much solar should I get?

- How much solar do I need?
- How much can I afford ?
- How much space do I have ?
- How much will the utility let me have?

# Step 1:Getting current bill from your utility. 18.114 MWh. Ouch!



109 RURAL AVE, DECORAH, IA, 52101
Residential Electric Service
Rate Code: I400
Meter Number: 065419006

| Bill Date (Month/Day/Year) | Electricity (kWh) | Dollars |
|---|---|---|
| 03/27/19 | 1287.000000 | $177.55 |
| 03/01/19 | 1732.000000 | $231.89 |
| 01/31/19 | 1684.000000 | $232.24 |
| 12/27/18 | 1314.000000 | $178.60 |
| 11/27/18 | 1158.000000 | $170.26 |
| 10/29/18 | 1267.000000 | $187.91 |
| 09/27/18 | 1221.000000 | $198.80 |
| 08/30/18 | 1659.000000 | $296.44 |
| 07/27/18 | 1552.000000 | $274.57 |
| 06/27/18 | 1317.000000 | $204.41 |
| 05/29/18 | 1417.000000 | $203.84 |
| 04/26/18 | 1229.000000 | $181.82 |
| 03/27/18 | 1277.000000 | $183.93 |

# Utility resources.

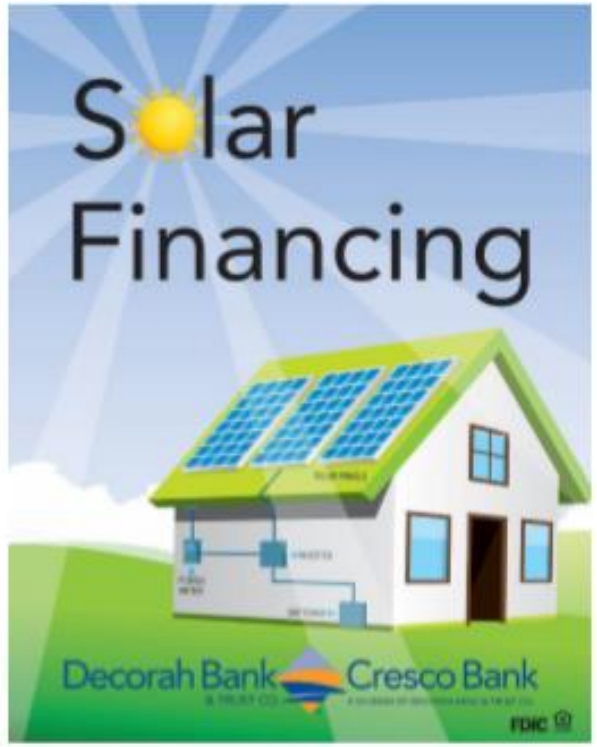
- https://www.alliantenergy.com/InnovativeEnergySolutions/SustainableEnergyChoices/CustomerInterconnection

Average price for solar installed is from 2.60 – 3.40 per watt.

## Solar Financing

**Ready to start rolling back your utility meter?**

- By installing solar in 2019, you can still claim the 30% Federal Tax Credit.
- Your immediate reduction in electricity spending is usually enough to cover the solar loan payment!
- Up to 100% financing is available.
- Take up to 10 years to pay off the loan.
- Decorah Bank has financed over 100 solar projects providing more than $7 million in financing to date!




**Ask one of our energy loan specialists for complete details.**

Family & Employee-Owned

Decorah Bank & TRUST CO.

Cresco Bank
A DIVISION OF DECORAH BANK & TRUST CO.

202 E. Water St., Decorah, IA 52101
563.382.9661 ◆ DecorahBank.com

126 Second Ave. SE, Cresco, IA 52136
563.547.2244 ◆ CrescoBank.com

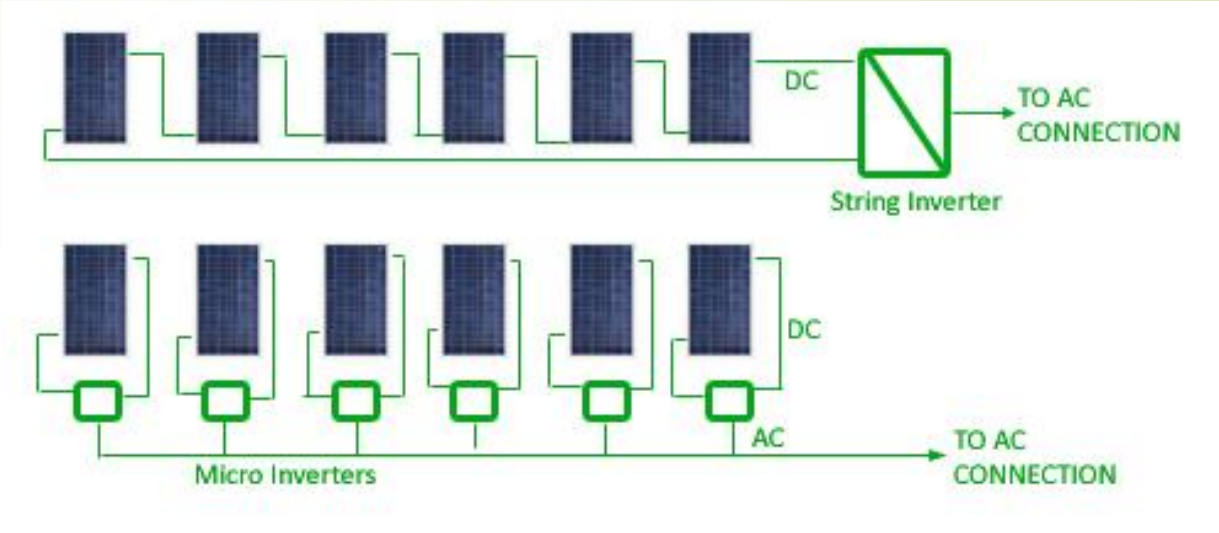
FDIC

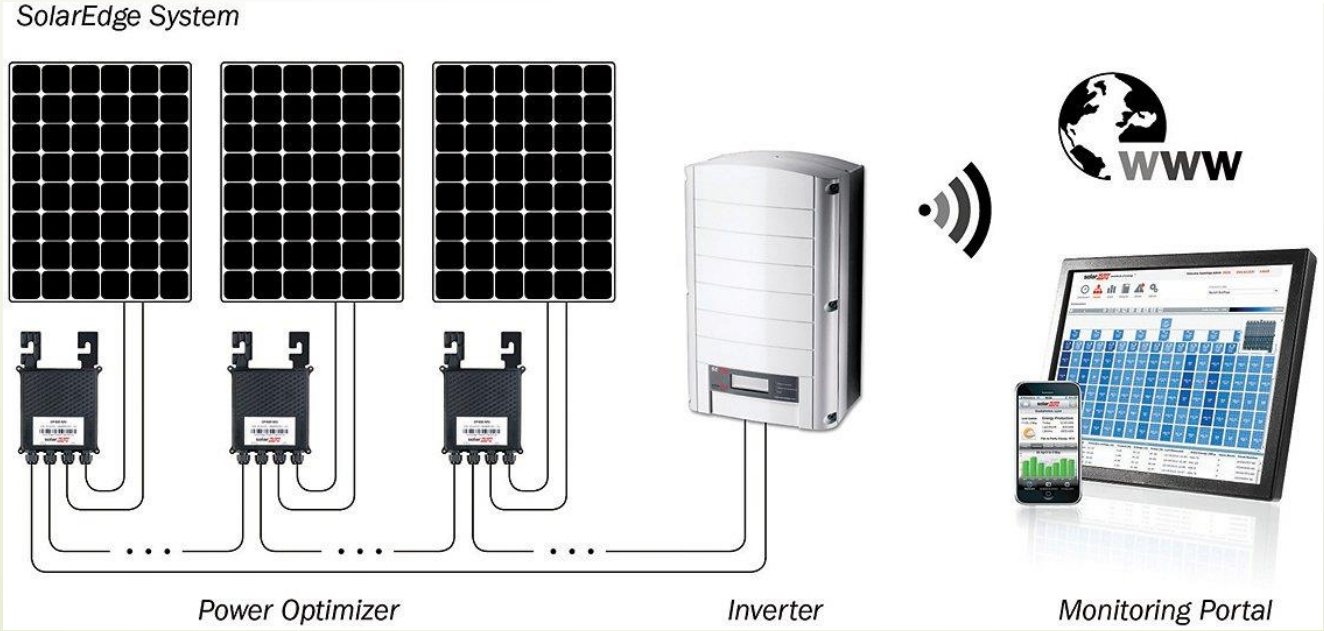
# What type of grid tied system do I want ?

String inverter:  more affordable,  less efficient, must include rapid shut down.

Microinverter: More expensive, more efficient, better communications.

Power optimizer: Best of both worlds.



# Solar edge sizing app.

- https://www.solaredge.com/us/products/installer-tools/designer#/

# Beginning an interconnection agreement with your utility.

- https://www.alliantenergy.com/InnovativeEnergySolutions/SustainableEnergyChoices/CustomerInterconnection

# DIY home owner Electrical permit rules.

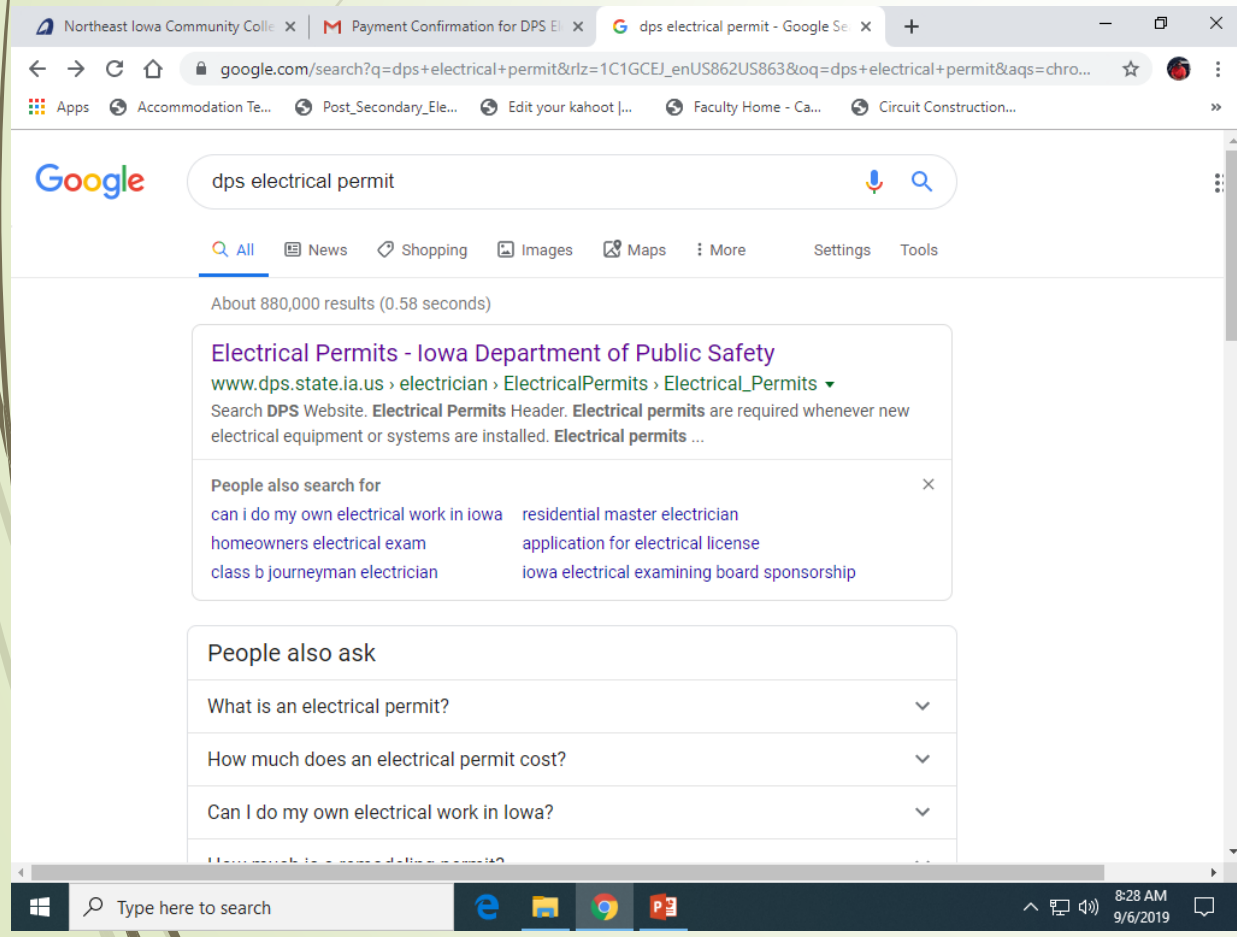
- Chapter 103 of the Iowa Code allows for homeowners and farmers to do electrical work on their property without the requirement of an electrical license. They merely apply for the Electrical Permit and schedule an Electrical Inspection as their wiring project proceeds. If they have any questions concerning their particular installation, we urge that they contact the Electrical Inspector Supervisor or view the Interactive Map of County and State Inspectors for assistance.

- Their exemption includes any accessory buildings on the property that do not exceed 3000 square feet but does not extend to investment property, business property, rental property, vacation homes, etc. A new home must be wired by an electrical contractor.

# Farmer DIY electrical permit rules.

- The exemption for the farmer is basically the same as that for the homeowner except that it extends to all agricultural properties that he/she may own and is not limited to 3000 square feet. Any new home or any existing residence other than the primary residence must be wired by an electrical contractor.

# Obtaining a home owner electrical permit. http://www.dps.state.ia.us/fm/electrician/inspection/inspections_index.shtml




journeyman or master electrician or by a licensed apprentice electrician under the direct supervision of a licensed journeyman or master electrician

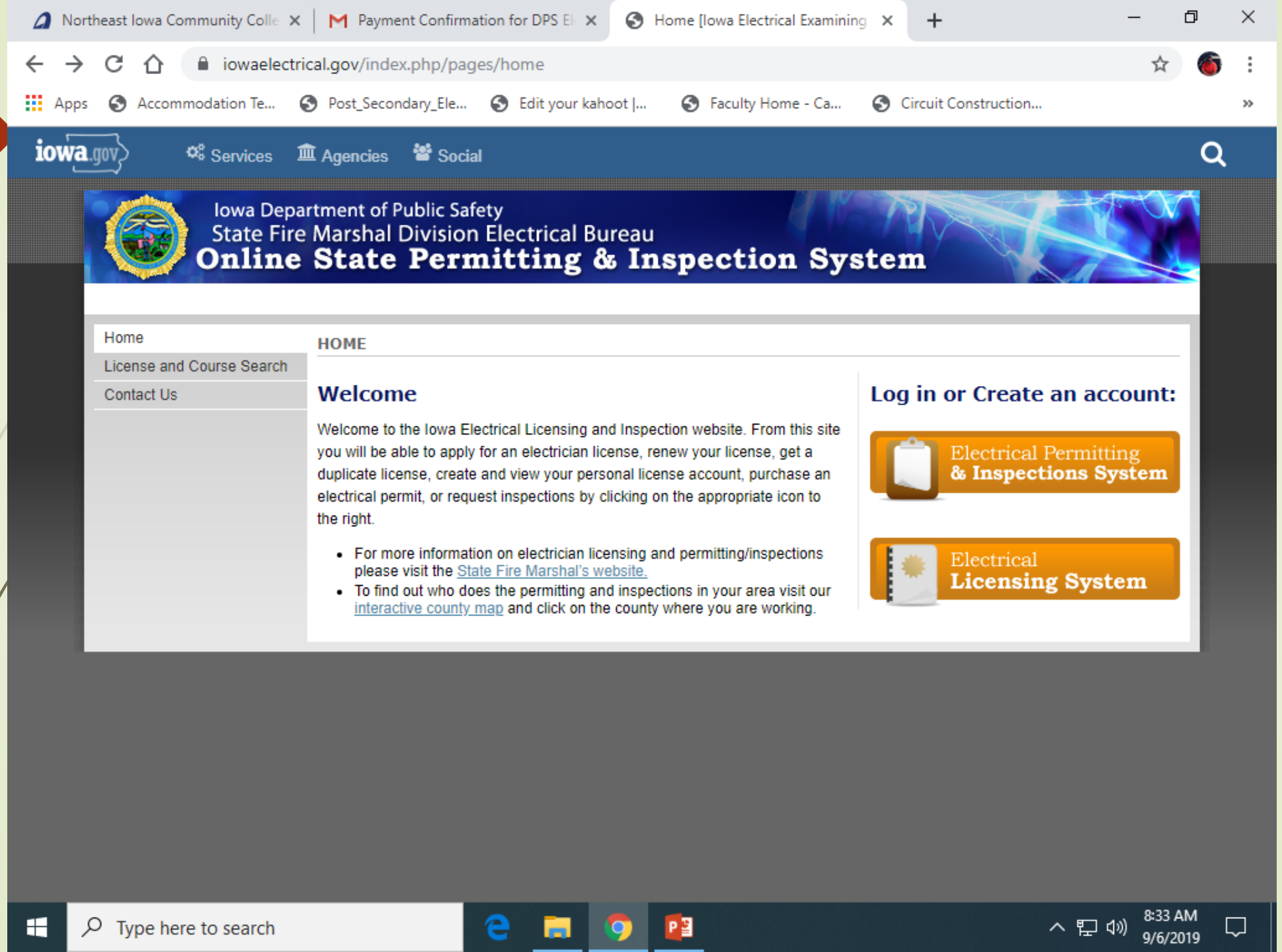
2. The installation does not involve work within a new or existing switch board or panelboard.

3. The installation does not involve any electrical line-to-ground circuit of more than 30 amperes.

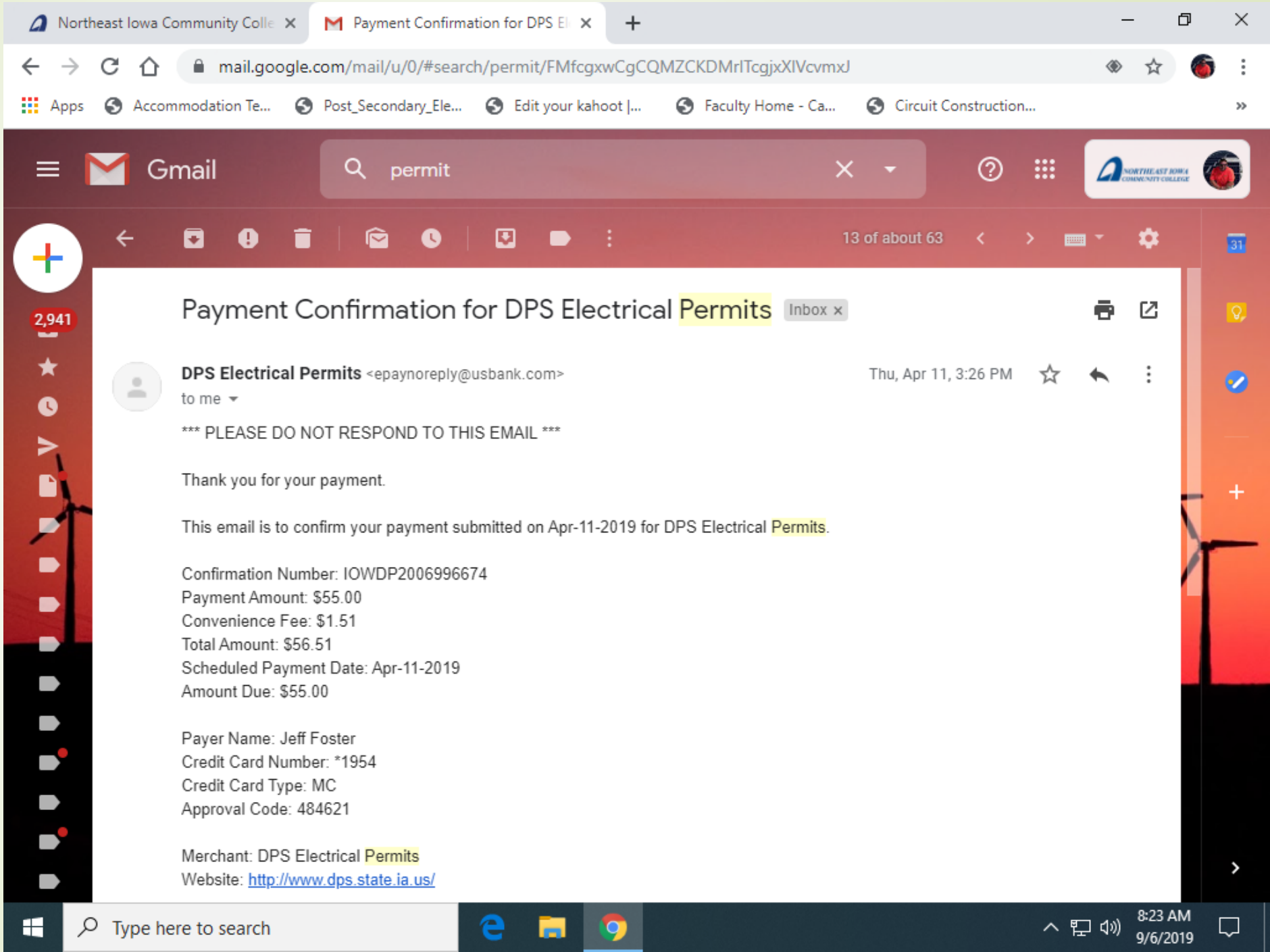
4. The installation does not involve any electrical line-to-ground circuit of more than 277 volts single phase.

Electrical permit is usually done by an electrical contractor performing the installation. There are some exceptions to Iowa Chapter 103 that allow the Homeowner/Farmer to perform the electrical installation but the other requirements for electrical permits and inspections still apply.

The application for electrical permit is usually done online at iowaelectrical.gov which uses a secured program to accept payment by credit card. This format is available 24 hours a day and the payment and submittal are instantaneous. For those without internet access or who prefer paper forms the Manual Permit Application can be filled out and submitted by mail with an accompanying check or money order. Naturally, this option is slowed by using the postal service. Contact your area electrical inspector using the Inspector Map and they can


Northeast Iowa Community Colle
Payment Confirmation for DPS El
Home [Iowa Electrical Examining
iowaelectrical.gov/index.php/pages/home
Apps
Accommodation Te...
Post_Secondary_Ele...
Edit your kahoot |...
Faculty Home - Ca...
Circuit Construction...
iowa.gov
Services
Agencies
Social
Iowa Department of Public Safety
State Fire Marshal Division Electrical Bureau
Online State Permitting & Inspection System
Home
License and Course Search
Contact Us
HOME
Welcome
Welcome to the Iowa Electrical Licensing and Inspection website. From this site you will be able to apply for an electrician license, renew your license, get a duplicate license, create and view your personal license account, purchase an electrical permit, or request inspections by clicking on the appropriate icon to the right.
For more information on electrician licensing and permitting/inspections please visit the State Fire Marshal's website.
To find out who does the permitting and inspections in your area visit our interactive county map and click on the county where you are working.
Log in or Create an account:
Electrical Permitting & Inspections System
Electrical Licensing System
Type here to search
8:33 AM
9/6/2019

# Permit


Northeast Iowa Community Colle
Payment Confirmation for DPS El
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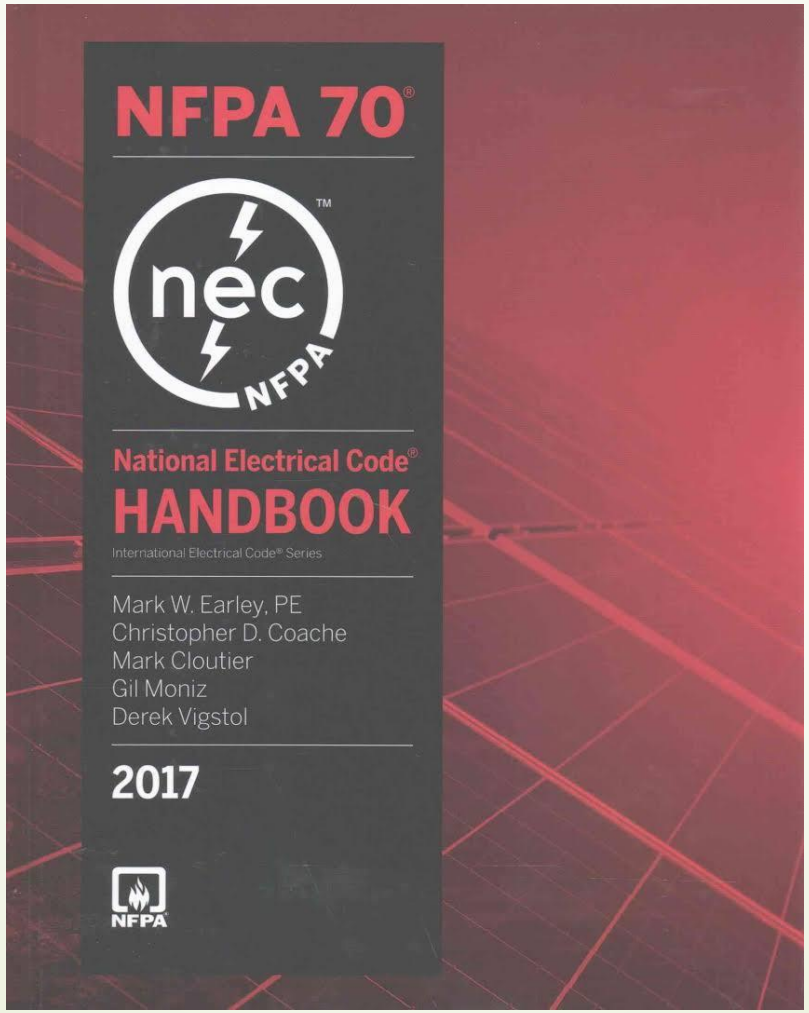
Apps
Accommodation Te...
Post_Secondary_Ele...
Edit your kahoot |...
Faculty Home - Ca...
Circuit Construction...
Gmail
permit
13 of about 63
2,941
Payment Confirmation for DPS Electrical Permits
Inbox ×
DPS Electrical Permits <epaynoreply@usbank.com>
to me
Thu, Apr 11, 3:26 PM
*** PLEASE DO NOT RESPOND TO THIS EMAIL ***
Thank you for your payment.
This email is to confirm your payment submitted on Apr-11-2019 for DPS Electrical Permits.
Confirmation Number: IOWDP2006996674
Payment Amount: $55.00
Convenience Fee: $1.51
Total Amount: $56.51
Scheduled Payment Date: Apr-11-2019
Amount Due: $55.00
Payer Name: Jeff Foster
Credit Card Number: *1954
Credit Card Type: MC
Approval Code: 484621
Merchant: DPS Electrical Permits
Website: http://www.dps.state.ia.us/
Type here to search
8:23 AM
9/6/2019

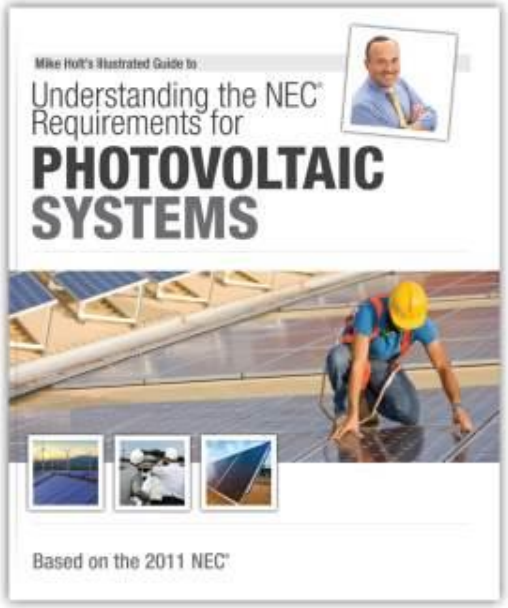
# Get to know NEC Book. Article 690 deals with PV systems .



# WELCOME TO

## Mike Holt's Illustrated Guide to Understanding the NEC® Requirements for PHOTOVOLTAIC SYSTEMS

part 2 of 2




www.MikeHolt.com | 888.NEC.CODE

# The NEC handbook is good for code beginners because the blue print give you explanations for the rules .

Because the smaller cables permitted by 690.31(D) are not normally marked with standard *Code*-recognized markings (e.g., USE-2), the PV module-manufacturer or installer should verify that these cables are listed and labeled for PV use, thereby indicating that they have the necessary sunlight and moisture resistance and are suitable for exposed, outdoor use.

In accordance with 200.6(A), grounded conductors that are smaller than 6 AWG and used in PV source circuits are permitted to be marked at the time of installation with a white marking at all terminations.

**(E) Direct-Current Photovoltaic Source and Output Circuits Inside a Building.** Where dc photovoltaic source or output circuits from a building-integrated or other photovoltaic system are run inside a building or structure, they shall be contained in metal raceways, Type MC metal-clad cable that complies with 250.118(10), or metal enclosures from the point of penetration of the surface of the building or structure to the first readily accessible disconnecting means. The disconnecting means shall comply with 690.14(A), (B), and (D). The wiring methods shall comply with the additional installation requirements in (1) through (4)

The use of metallic raceways, Type MC metal-clad cable, or metal enclosures inside a building provides additional physi-

within 25 cm (10 in.) of the roof decking or sheathing except where directly below the roof surface covered by PV modules and associated equipment. Circuits shall be run perpendicular to the roof penetration point to supports a minimum of 25 cm (10 in.) below the roof decking.

Informational Note: The 25 cm (10 in.) requirement is to prevent accidental damage from saws used by fire fighters for roof ventilation during a structure fire.

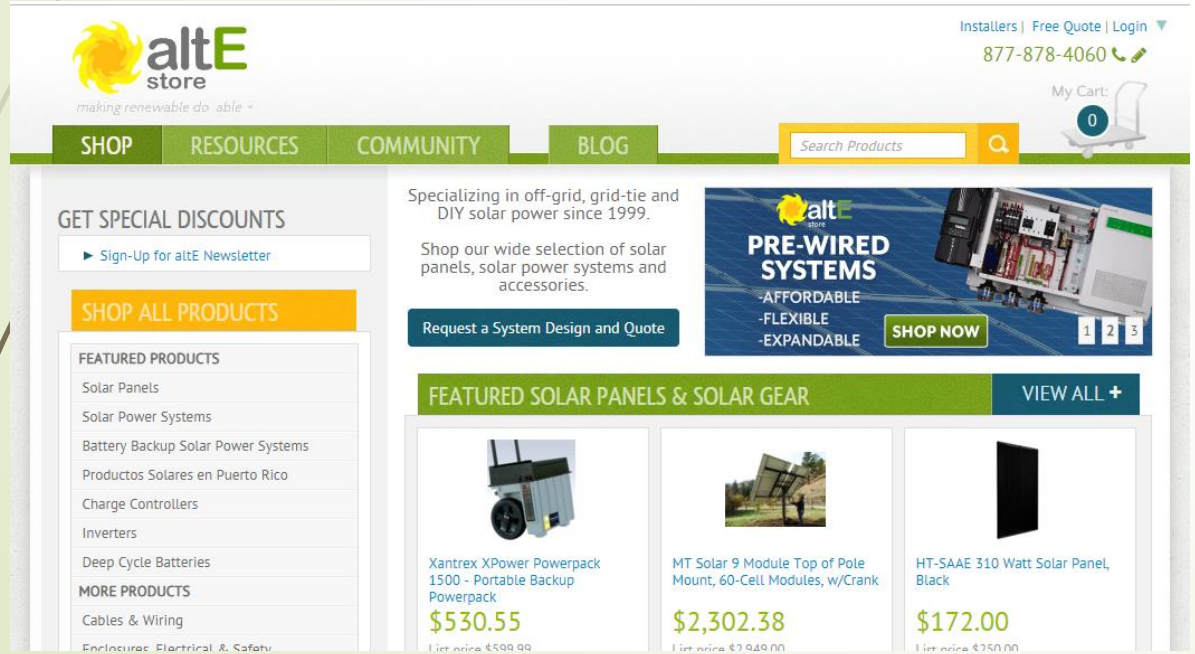
**(2) Flexible Wiring Methods.** Where flexible metal conduit (FMC) smaller than metric designator 21 (trade size ¾) or Type MC cable smaller than 25 mm (1 in.) in diameter containing PV power circuit conductors is installed across ceilings or floor joists, the raceway or cable shall be protected by substantial guard strips that are at least as high as the raceway or cable. Where run exposed, other than within 1.8 m (6 ft) of their connection to equipment, these wiring methods shall closely follow the building surface or be protected from physical damage by an approved means.

**(3) Marking or Labeling Required.** The following wiring methods and enclosures that contain PV power source conductors shall be marked with the wording "Photovoltaic Power Source" by means of permanently affixed labels or other approved permanent marking:

(1) Exposed raceways, cable trays, and other wiring methods
(2) Covers or enclosures of pull boxes and junction boxes
(3) Conduit bodies in which any of the available conduit

# Where to get solar equipment?

https://www.altestore.com/store/





**Nate Dooley**

- **Technical Sales Representative**
- Making Renewable Do-able™
- 330 Codman Hill Road, Boxborough, MA 01719
- www.altEstore.com
- 
- Tel: +1.877.878.4060 x211 or +1.978.562.5858 x211
- Text: +1.857.270.5029
- Fax:  +1.978.263.7081

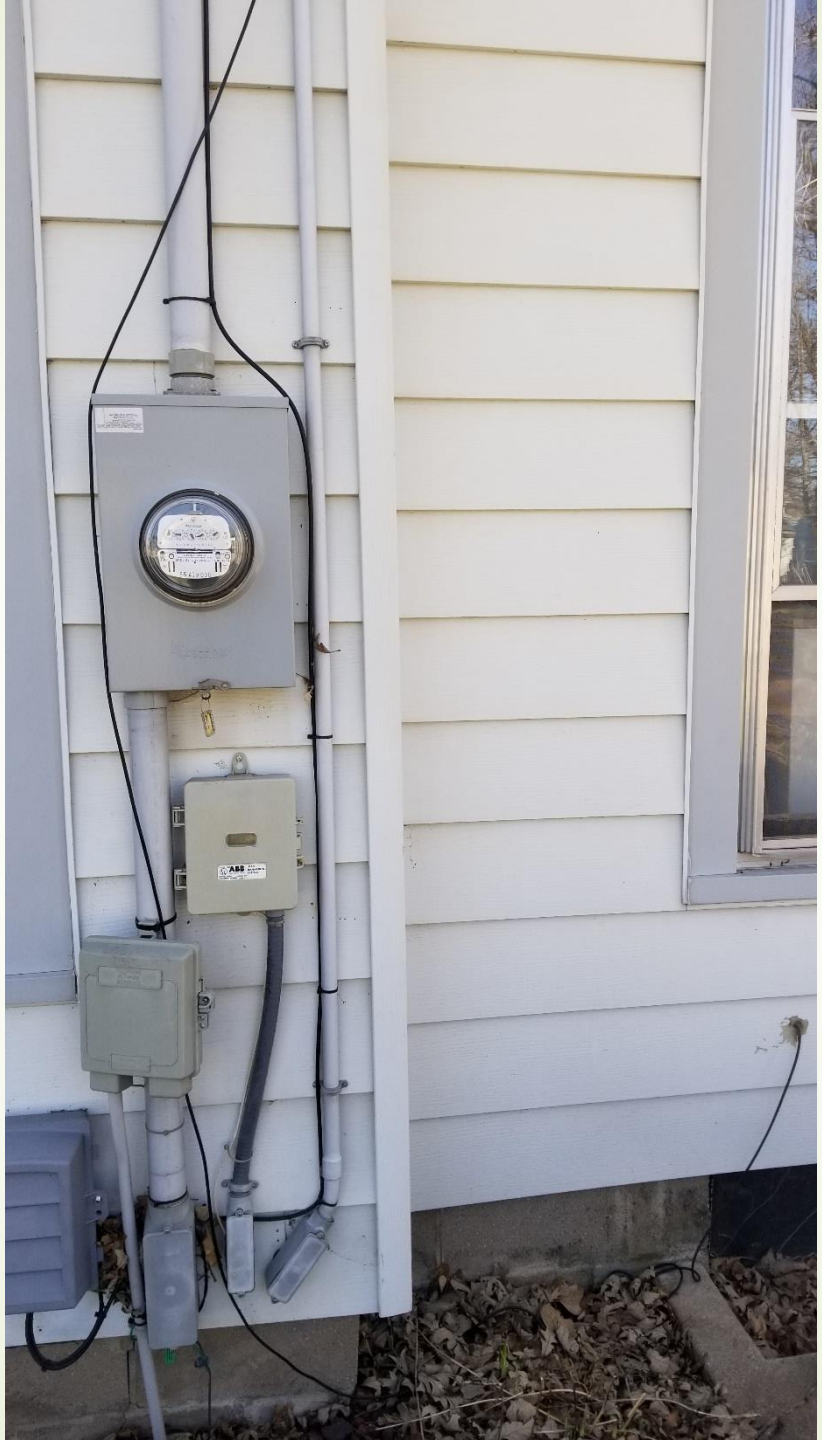
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 26 | DISCCHKWIRE | Discount for check, cash, wire | 1 | | $-145.00 | EA | | $-145.00 |
| 27 | | | | | | | | |
| 28 | WIRE-TRANSFER | Wire Transfer Fee | 1 | | $0.00 | EA | | $0.00 |
| 29 | | *Bank Wire Instructions*<br>*Company Name: Alternative Energy Store, Inc*<br><br>*Address*<br>** Citizens Bank*<br>** Telephone 800-922-9999 or outside of USA, +1-877-360-2472*<br>** Address:*<br>** 28 State Street*<br>** Boston, MA 02109*<br><br>** Account #: 1333472134*<br>** Routing # (for domestic wires): 011500120*<br>** SWIFT (IBAN) Code (for international wires): CTZIUS33* | | | | | | |
| 30 | | | | | | | | |
| 31 | SH | SHIPPING & HANDLING | 1 | | $460.58 | EA | | $460.58 |

"Good Faith Price Match"
We are proud to offer you the service and technical expertise you need , and work very hard to earn your business. In addition, if you find that our sales quote does not meet your budgetary needs, we would appreciate an opportunity to re-evaluate it for you. Please include a competitive quote in your reply and we are happy to get back to you within one business day with our response.

NOTE: 1) The prices on this quote are valid for only 7 days. 2) It is the responsibility of the installer and the person requesting this quote to verify that the listed components on this quote will work for the actual installation conditions. Neither altE nor any of its employees has visited the site or personally assessed actual renewable energy system design requirements, and neither altE nor any of its employees is liable or responsible for the listed components, design, installation, energy production, code compliance, and all other matters related to the system.

**Tax Details**
EXMPT $0.000

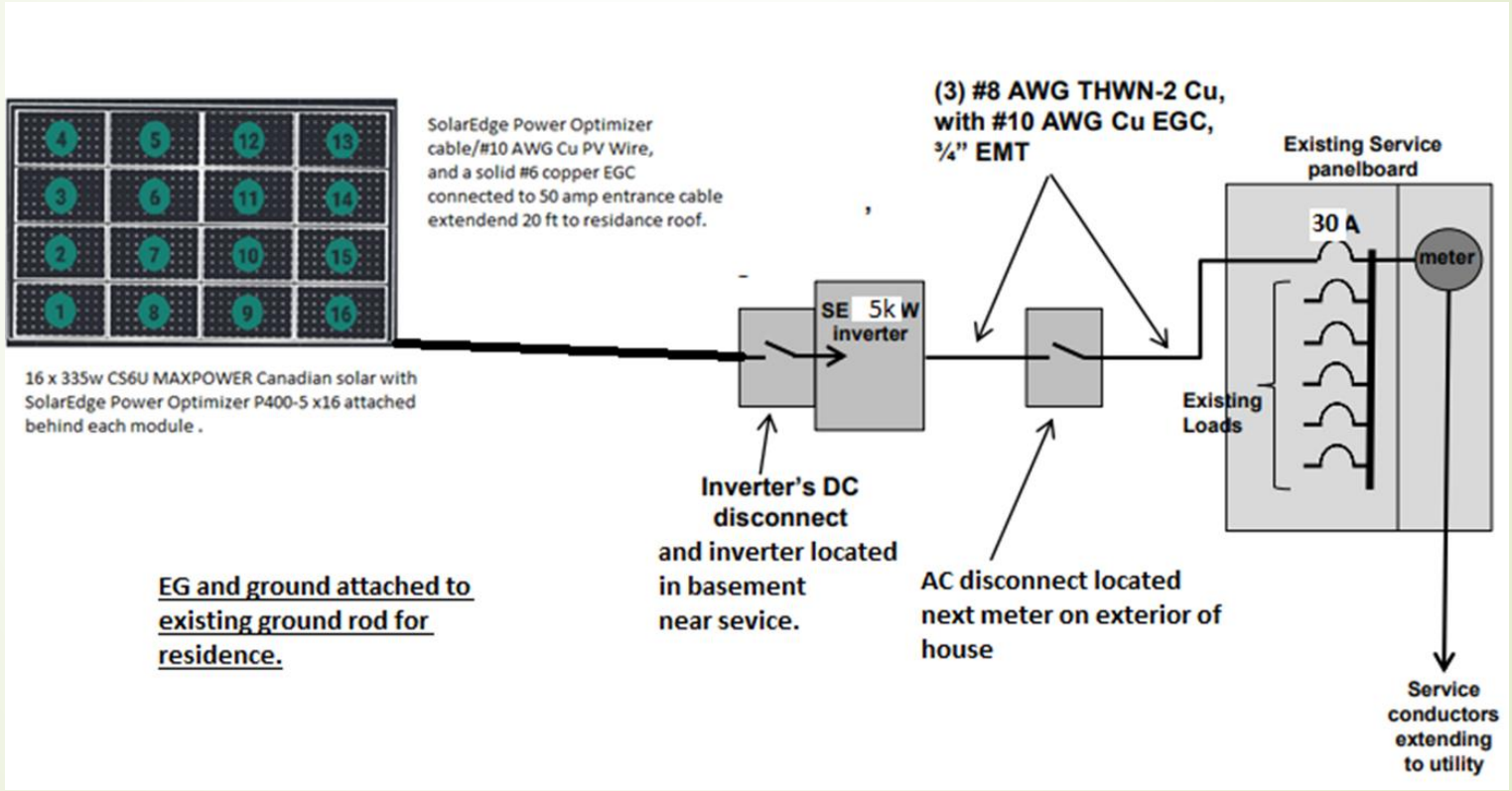
| | |
|---|---|
| **Taxable** | $0.00 |
| **Total Tax** | $0.00 |
| **Exempt** | $7,256.99 |
| **Total** | $7,256.99 |
| **Balance** | $7,256.99 |



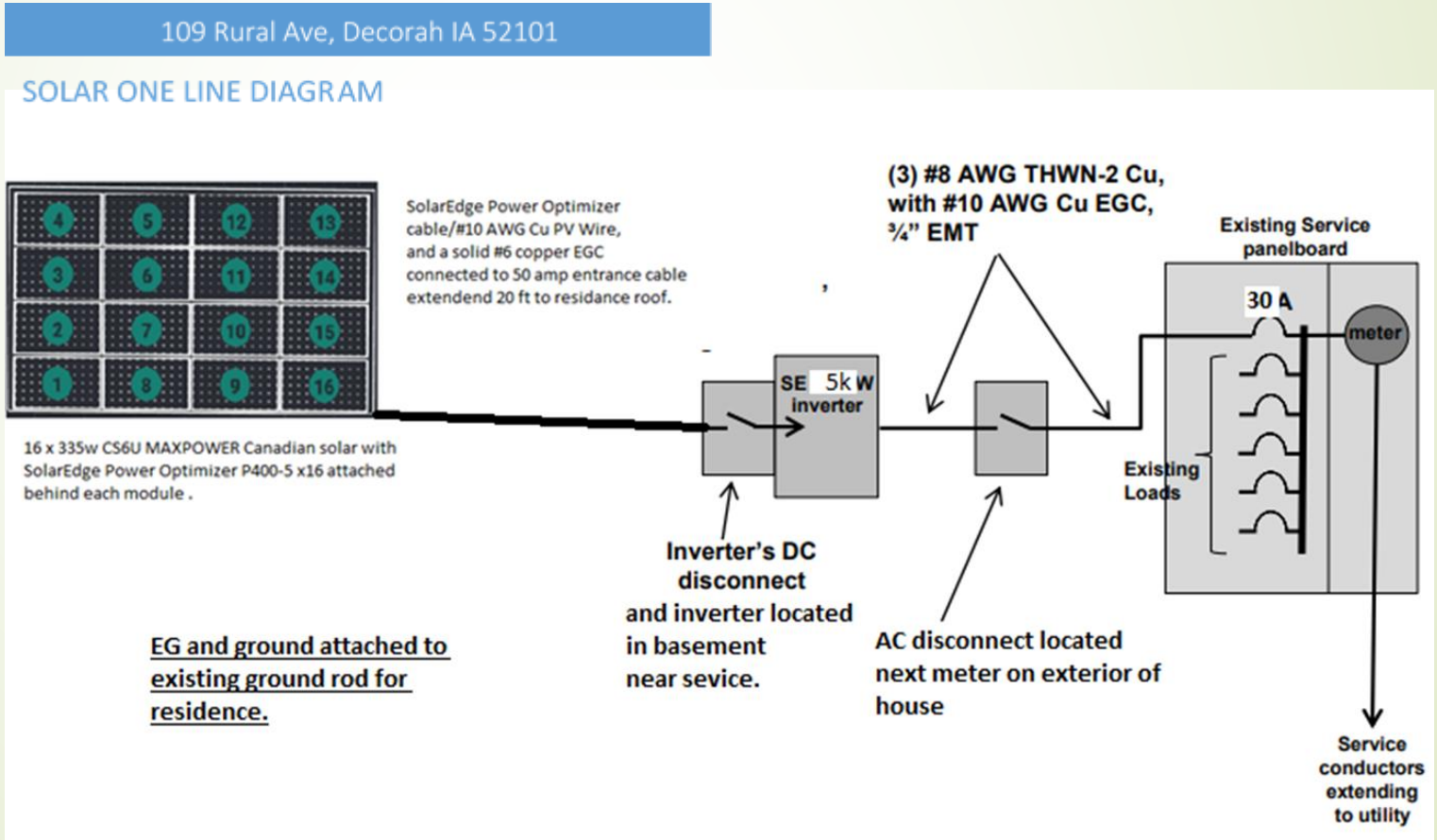
109 rural ave Decorah IA 52101

AC disconnect next to meter at rear West side of house.

# One line diagram Alliant did not accept.



# This One line Was accepted. This along with pictorial drawing should be sent to the AHJ also.



Measure at least twice! Precut all 6x6 with shoulders at 24 degree pitch for the beams takes careful measuring and cutting.


rpod

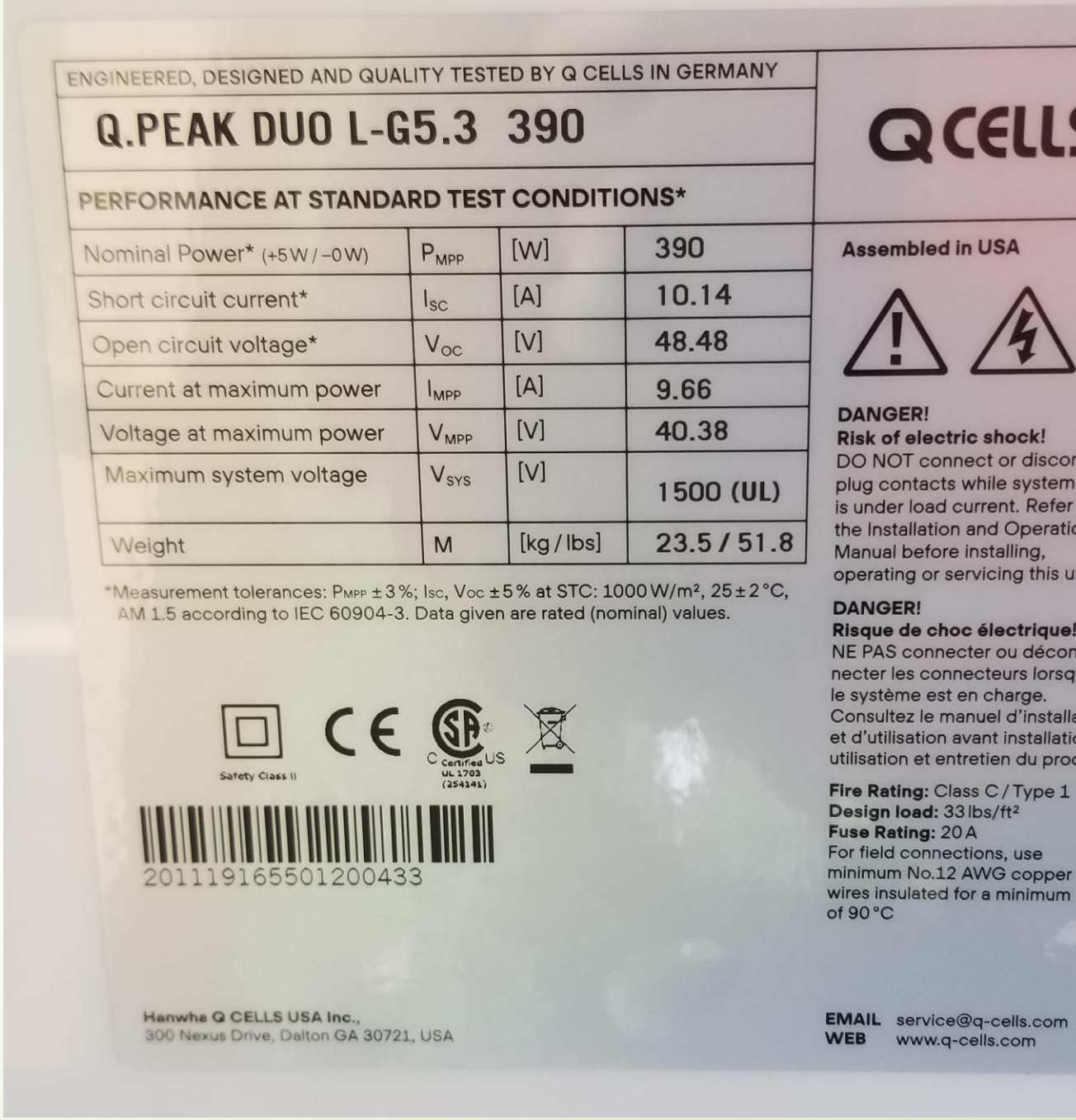

r-pod

# A little bit about the Mods.

390 WATTs

VOC 48.8 volts dc

ISC 10.14 amps



# First panel takes the longest.

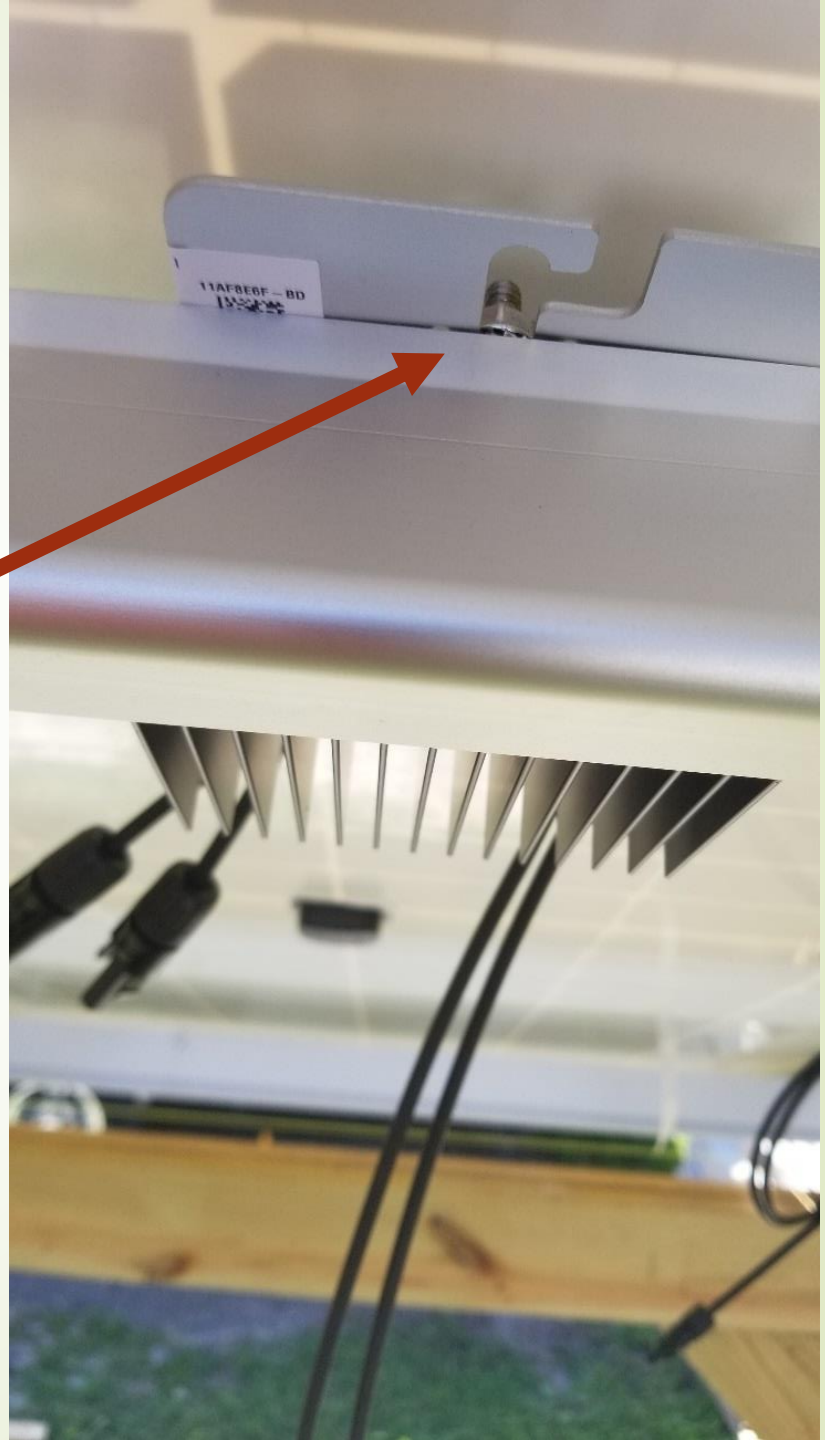
Two self tapping stainless screws tapped on back of solar module to rest on first rail. Two small beam clamps on back would also work.

This allows for easier adjustments to square first module before tightening down end clamps.

# First mod needs to be perfectly square or the whole system walks.

# Grounding

Equipment grounding is vital! Every thing must be grounded. Grounding washer between power optimizer and rail to ensure the anodization is bitten through and an grounding bond is made.



# Solar edge P505 power optimizer


# Optimizer scan sticker

Collect each sticker from each optimizer and place it on paper in order. These will be scanned and entered to an app. With a created mock of my system. I will be able to monitor what each module, optimizer and the inverter is doing and producing from my phone. Also this will alert me of any issues.

Dave is measuring center of where modules will be and mounting the power optimizer that will stay under the module and allow for all module connected in series.


BIL-JAX


rpod


BILJAX


BILJAX

# Wire management

UV resistant is important. Stainless wire clips are available. Zip ties are the right price though.

Nothing must touch or rub!

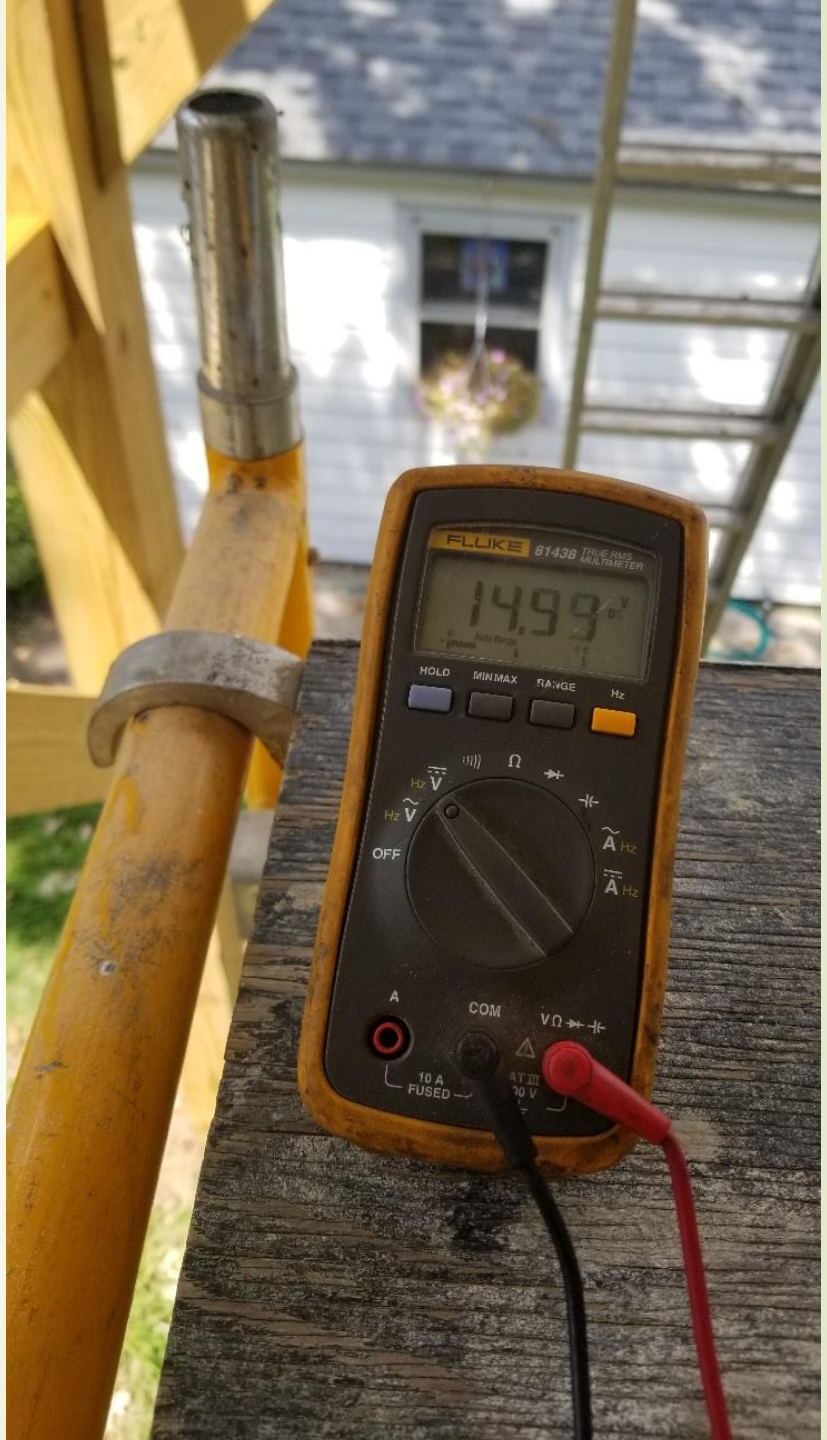
# Cool morning Modules

# Hot noon modules.

# Working properly.

As each module is connected to the optimizer the output for each is pair volt. This is because the system cannot produce the full voltage output unless it senses the utility voltage through the inverter. So if the power is down it will stop producing or exporting electricity at the power optimizer under the module. This is code.

So the fourteen modules all connected to their optimizers and the optimizers are connected in series they will show 14 ish volts. This is not dangerous voltage and proves they are connected correctly.



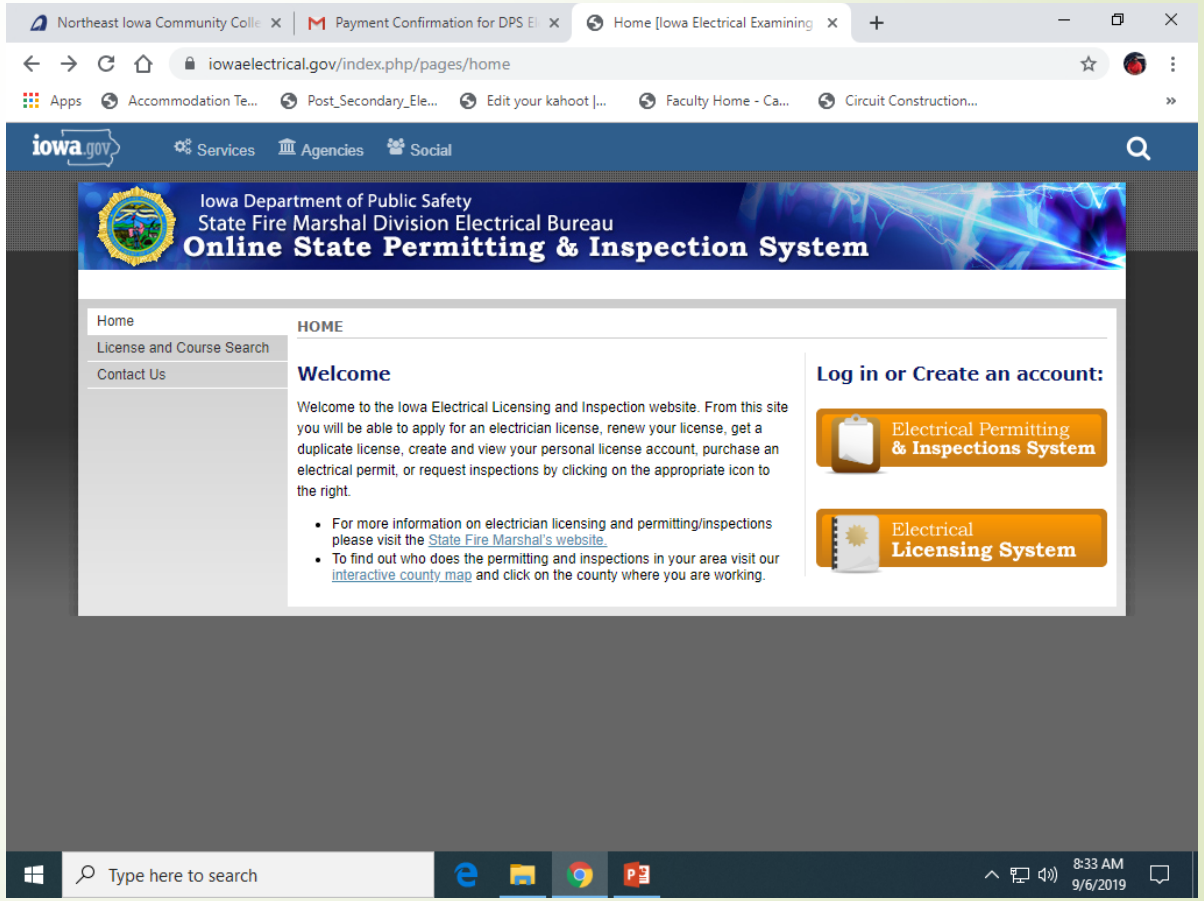

BILJAX
BILJAX
Haulette

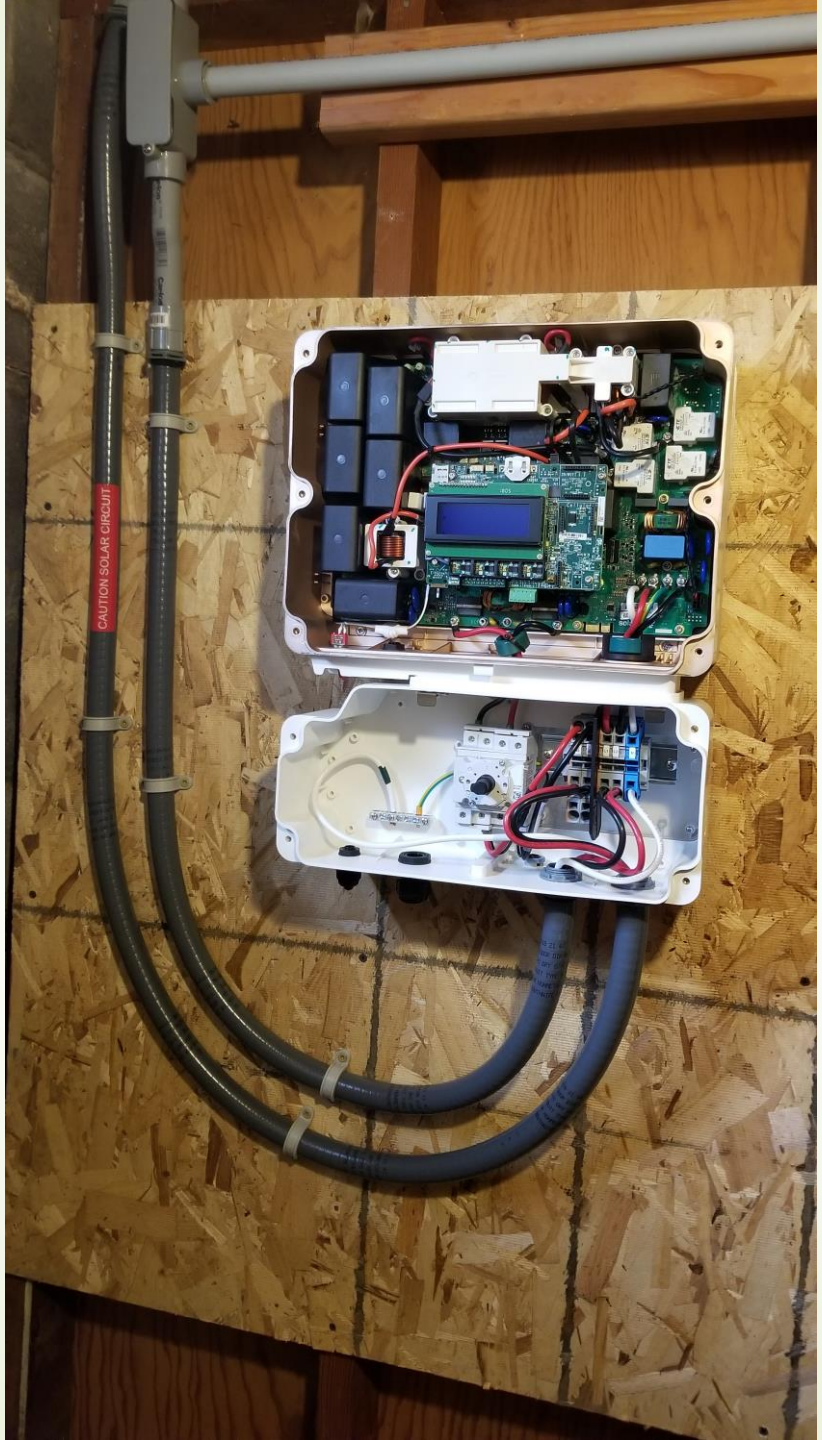

BILJAX

Equipment ground.
Non reversable
crimps.


solar
HD

Might be a good time for a rough in inspection? Ask questions, take notes. Set it up on line through the Iowa Department of Public Safety.




CAUTION SOLAR CIRCUIT

# AC Disconnect.

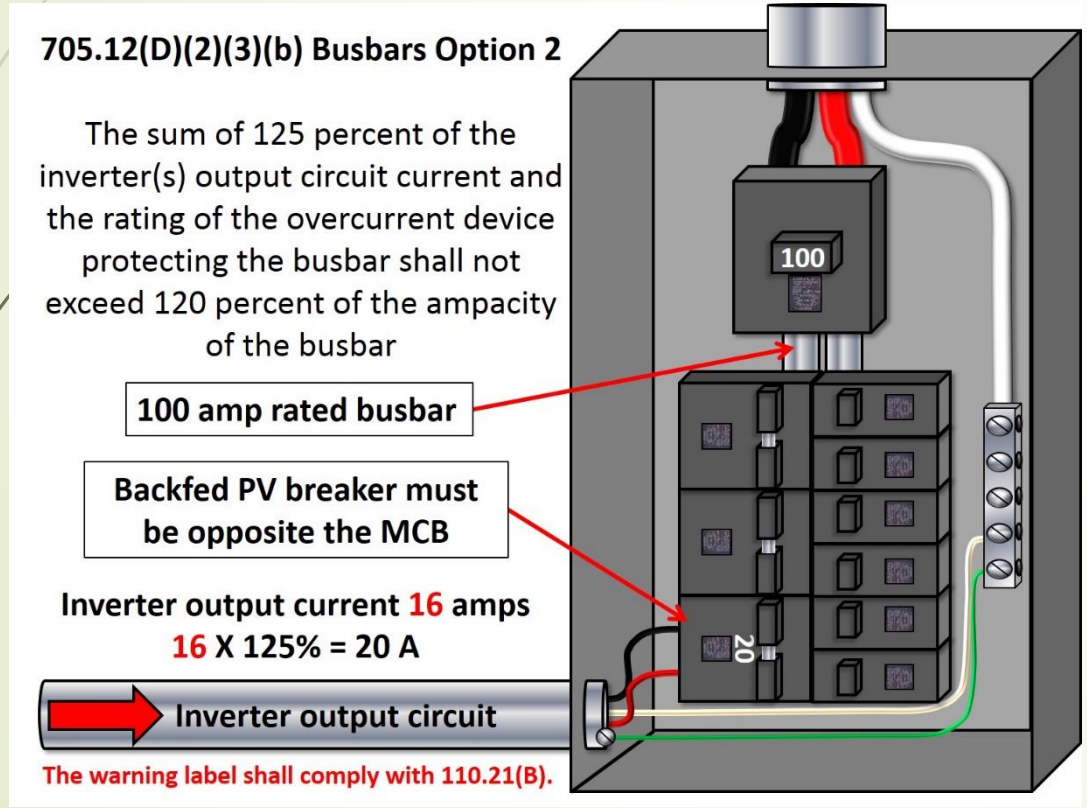
- Must be located within 4 ft of meter.
- Solar edge is considered to be a rapid shut down system.
- Rapid shutdown shuts down to safe voltages within 10 ft of modules.

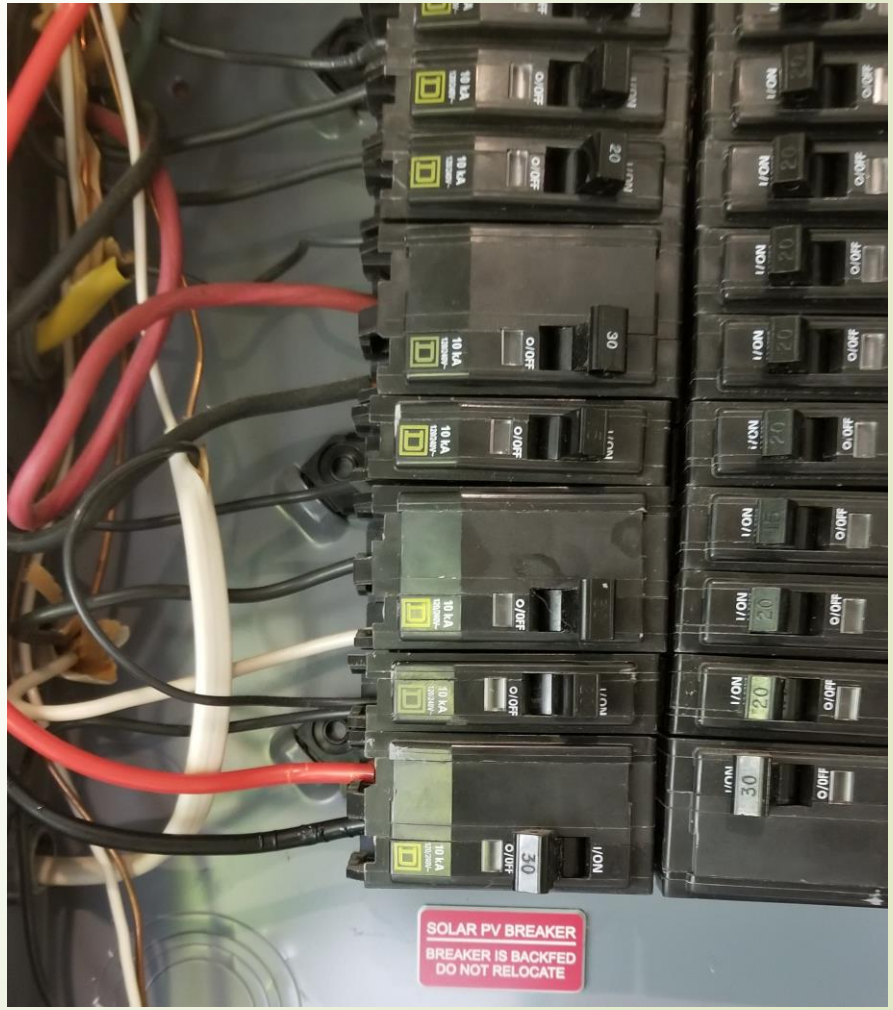
# Combiner box. One string.

# Polaris lugs $$

Polarity is very important!

# Back fed Breaker. 120% rule.



# Solar Labels Poster

http://wpc.ac62.edgecastcdn.net/00AC62/documents/datasheets/NEC2017_Solar_Label_Poster.pdf

# When system is complete the next step for me is to work on Efficiencies

- Replace electric water heater with energy star tankless gas water heater.
- Replace electric clothes drier with energy star gas dryer.
- Make sure all lights are LED.
- Replace old windows.
- Install switches to turn off entire rooms electricity. (electronics constantly use electricity even when not in use)
- One day, small off grid battery base to run freezer.

# Questions?


- Jeff Foster
- jfostersolar@gmail.com
- foster@nicc.edu