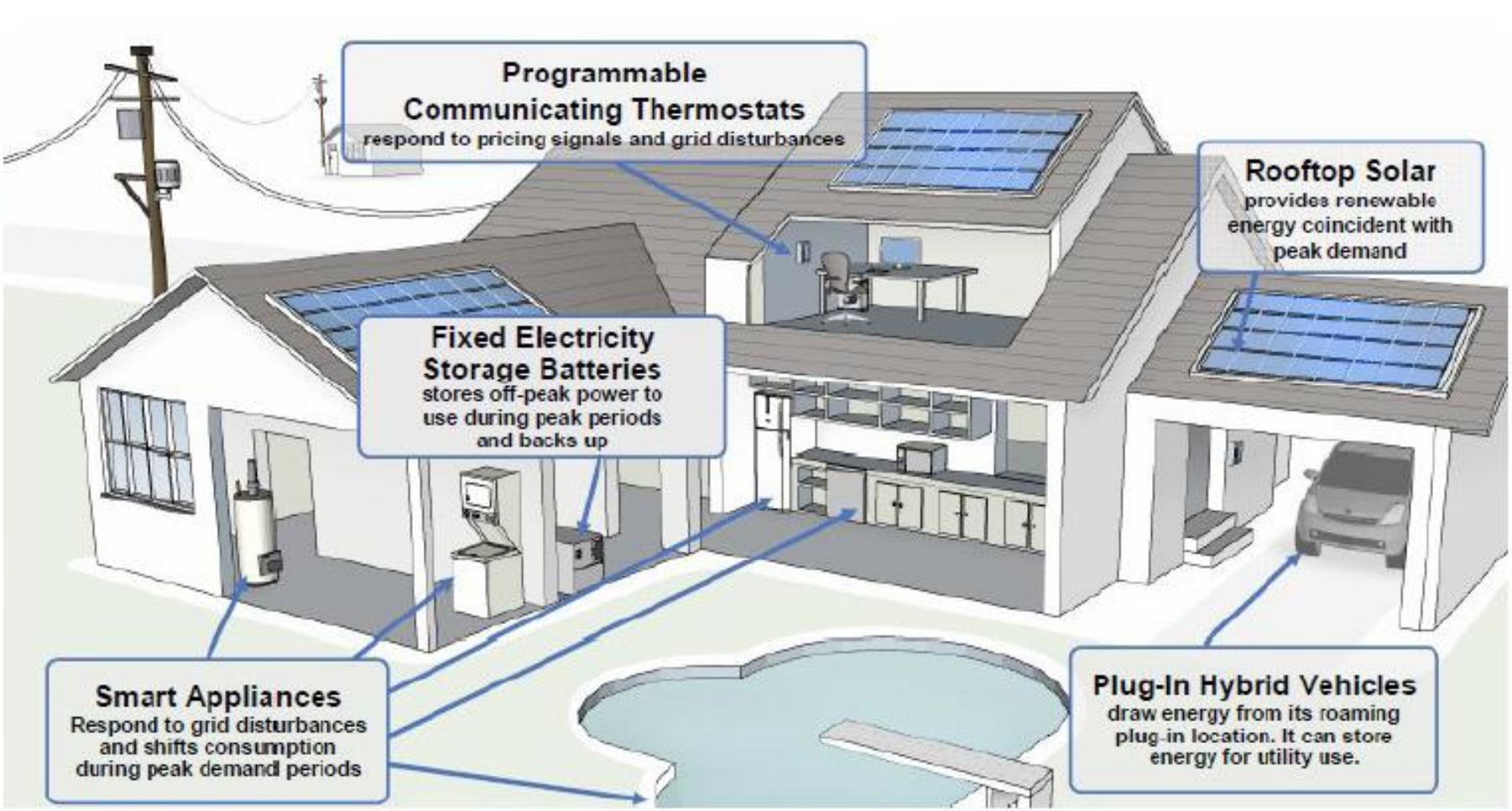
NWEMS

Bi-Directional Metering

August 21, 2019 | Matt Monroe PE, Landis+Gyr

Landis+Gyr
manage energy better

A vision of the home of the future



Source: wsj.com


CAUTION
CAUTION
CAUTION

Customer Generation

Backup Generator

Water Turbine

Battery Storage

Solar Panels

Wind Turbine

Utility Technical Challenges

Technical Challenges

- Intermittent generation
- Feeder capacity limits
- Voltage regulation
- Two-way load flow
- Inverter grid support

Source: Greentech Media

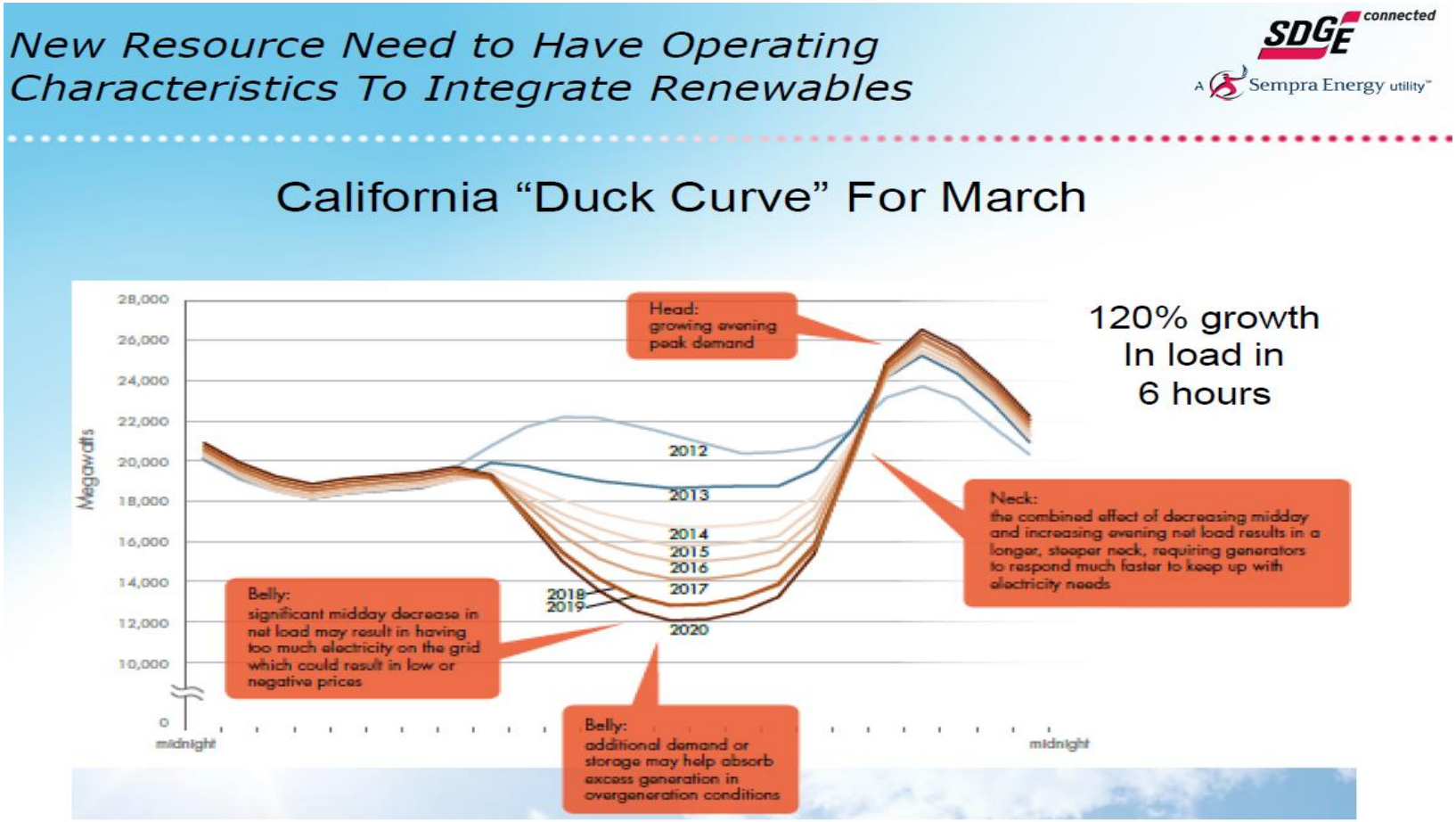
Technology is viable; no longer “cutting edge”

Critical mass of products and knowledge

Strong public and political support

Financial incentives

The PV Duck Curve



All new homes in California required to have PV in 2020

Production Metering

- *Net Metering* is at the Point of Service
  - "Net" combination (result) of Generation and Load together
- *Production Metering* is at the output of the Generator
  - Gross output of the system before any load

- Production Metering is not new…
  - What *is new* is that *utilities* are getting into Production Metering
  - New government incentives based on production, not just nameplate rating or cost
  - Utilities purchasing the "green tags" to meet generation portfolio requirements

Value of Solar to Utility

Value of Solar Assessment Components	
Value Component	**Basis**
Fuel Value	Avoided cost of fuel to meet electric loads as well as transmission and distribution losses, based on the solar production profile. This is inferred from ERCOT market price data and future natural gas prices.
Plant O&M Value	Avoided costs associated with natural gas plant operations and maintenance by meeting peak load through renewable sources.
Generation Capacity Value	Avoided capital costs of generation by meeting peak load through renewable sources, inferred from ERCOT market price data.
Transmission and Distribution Capacity Value	Savings in transmission costs resulting from the reduction in the peak load by renewable sources.
Environmental Compliance Value	Avoided cost to comply with environmental regulations and local policy objectives.

How it is applied

For each billing month the customer shall receive a non-refundable, non-transferable credit equal to the metered kilowatt-hour output of the customer's photovoltaic system multiplied by the current Value-of-Solar Rate plus any carry-over credit from the previous billing month. Credits are applicable to the customer's total charges for Residential Service in the customer's name on the same premise and account where the on-site solar photovoltaic system is interconnected. Any remaining amount of credit(s) shall be carried forward and applied to the customer's next electric service bill. In the event of service termination, any credit balance will be applied to the Power Supply Adjustment (PSA) to reduce net purchased power costs.

The Value-of-Solar Rate is a tariff rider that is set annually through the Austin Energy budget approval process. Effective January 1 of each calendar year, the rate calculation uses the Value-of-Solar assessment's monthly average of the prospective twelve-months and the shorter period of either: a) the prevailing assessments since October 1, 2012, or b) the previous 48 months.

Effective Dates	**Value-of-Solar Rates** ($/kWh)
October 1, 2012	$0.1280

Interconnection Technology

- Majority of Net Metered systems use an Inverter
  - Generation is DC
  - Inverter converts to AC
  - Micro or whole house
- Special type of inverter
  - Matches voltage and frequency
  - Provides some unique “grid-tie” functions
  - Anti-islanding

    UL-1741 Compliant Inverter

What is “Net Metering”?

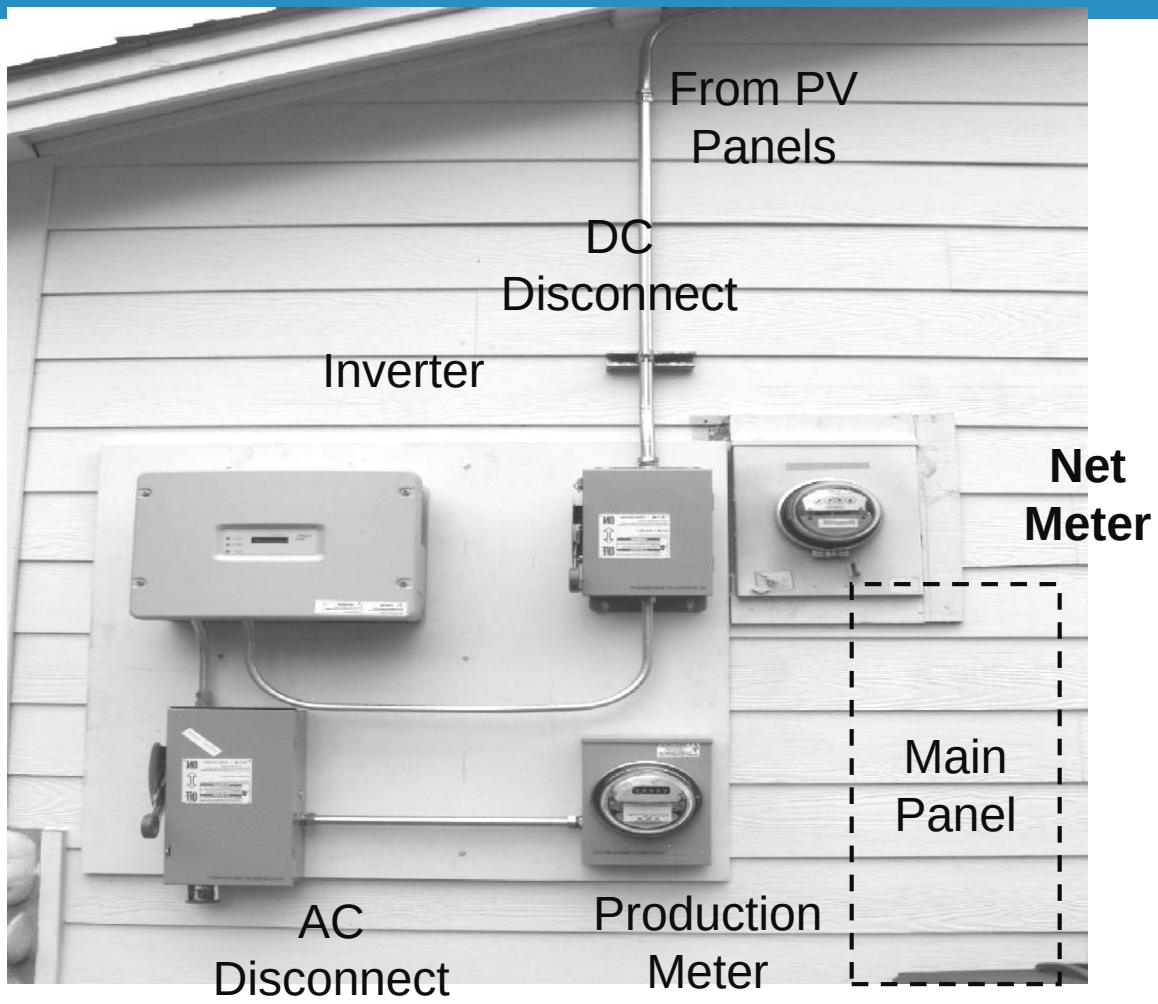
- It’s not just a “type of meter”
- Customer-owned small-scale generation
  - Parallels to the grid
  - May “run the meter backwards” at times
  - Examples:
    - Solar Photo-voltaic (PV)
    - Micro-hydro
    - Co-Generation
- Typically (but not necessarily) Green Power
- Typically (but not necessarily) Residential
- Purpose is to offset load

- Wind Turbines
- Anaerobic Digestion
- Other?

Why All the Fuss About NET Metering?

- NET metering means a customer can spin their meter backwards. The customer is allowed to **generate power** and feed energy back on to the power grid.
- NET metering means the utility **receives energy**, as well as delivers energy
- NET metering requires **special equipment**
- NET metering has **safety considerations**
- NET metering is a **special rate** at most utilities

Typical Residential Service



Net Metering Issues

- Issues with meters “running backwards”
  - Billing system compatibility? 99999 vs. -1 vs. delivered - received
  - Meter compatibility? Bidirectional or net
  - AMR/AMI compatibility? What value can be brought back remotely
  - Fraud detection? Upside down vs. PV (net, detent, security)
  - Does it meet the customer’s needs? (display values)
- Options
  - Normal “house” meter (basic e/m meter)
  - Separate detented meters wired for delivered and received
  - Meter with advanced capabilities (multi-function)

Other Net Metering Challenges

- Meter aggregation issues
  - "Joint" projects (multiple owners)
- Rate issues
  - Tiered rates?
  - Seasonal rates?
  - Time-of-use?
  - Demand Rates?
  - Load Profile Based Rates?
  - Load control or interruptible rates?

Production Metering Challenges

- Location (electrically)
- Safety
- Location (physically)
- Complexity
- Misperceptions and misinformation
- Cost to utility
- Cost to customers

Safety – A Utilities Perspective

A NET metering customer's electric generator is typically held to the same standard of care, as the utility is required to maintain. **The safety of the general public and the utility's personnel and equipment cannot be reduced or impaired as a result of the customer's generator interconnect.**

A NET metering customer's electrical generator must be:

1. Equipped with protective functions designed to **prevent the generator from being connected to a de-energized utility circuit.**

2. Equipped with the necessary protective functions designed to **prevent connection or parallel operation if the distribution service voltage and frequency are not of normal magnitude.**

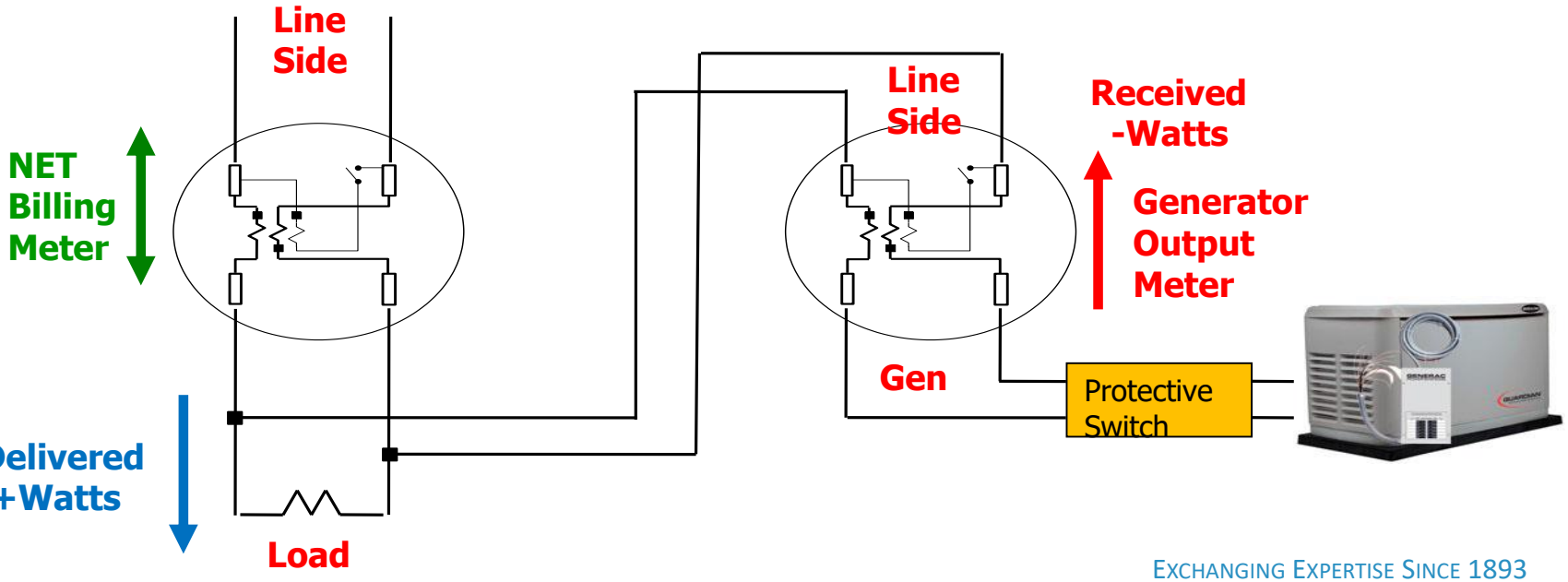
Utility Goal of a NET Metering Customer:

The quality, reliability and the availability of service to the Utility's other customers cannot be diminished or impaired as a result of the Interconnection.

UL-1741 compliance is key

Equipment Issues to Consider

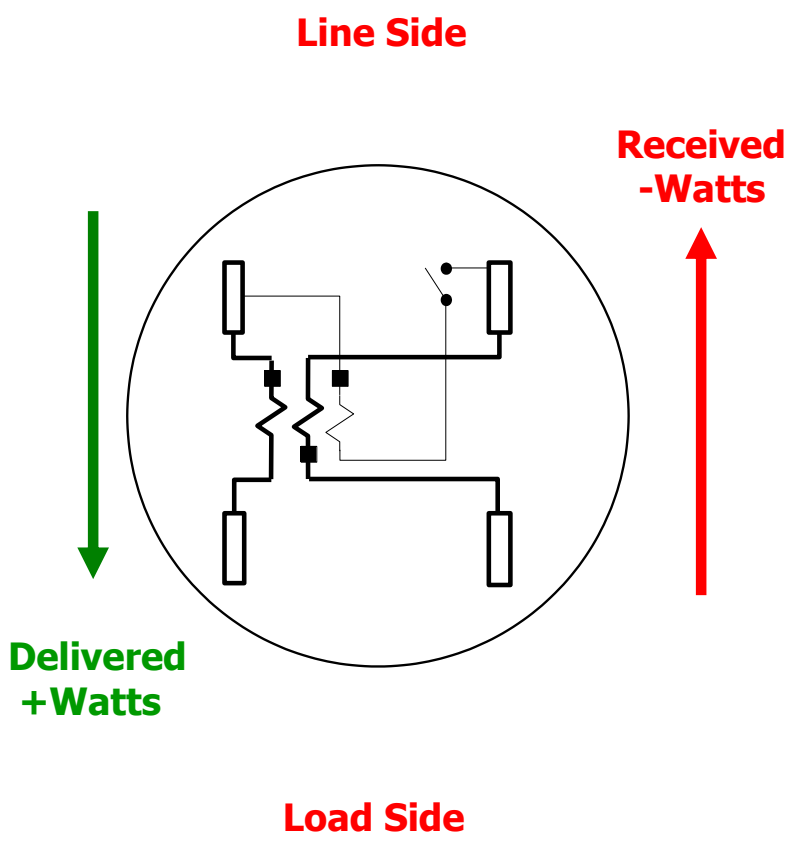
- Protect Switch between Generator and Utility Service that meets the requirements from the previous slide.
- Because 2 meters are used, it is good practice to wire the second meter with line voltage at top socket jaws for safety consistency. Many utilities train their field people that the top jaws are always “hot”.
- However, this practice causes the 2nd generator meter to run backwards
- Clearly label the **NET Billing Meter** and the **Generator Meter**.



NET Metering – Follow the Flow of Energy

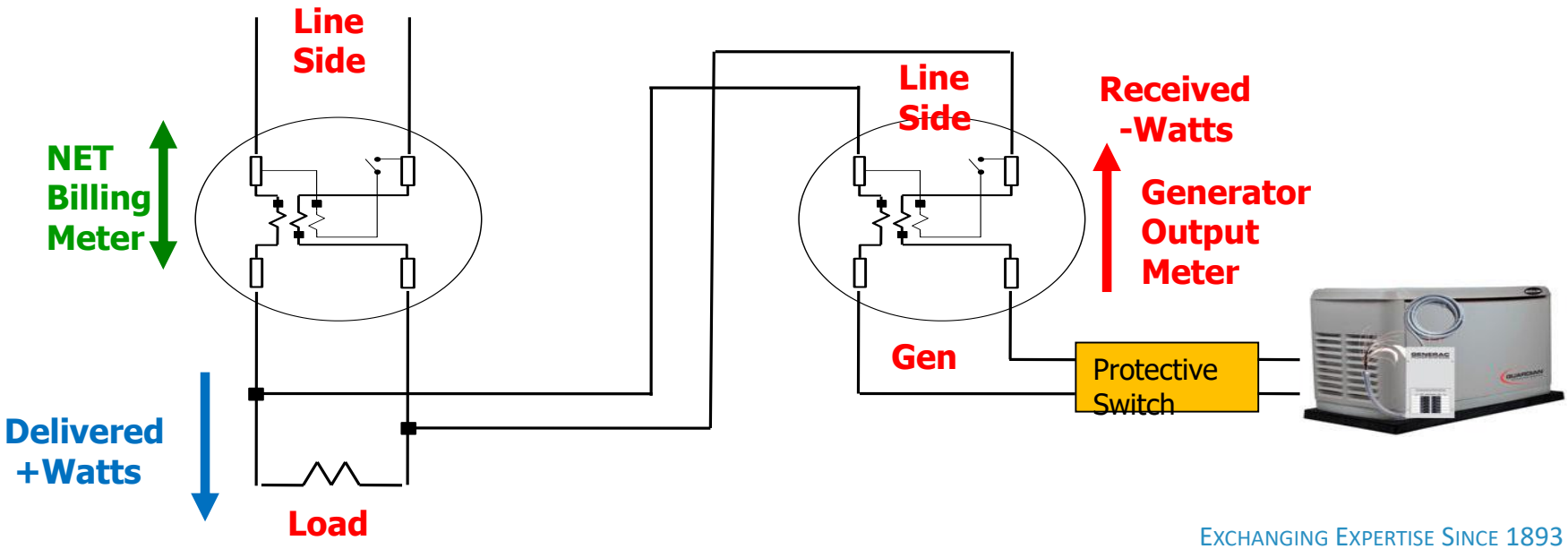
- Positive energy is energy ***delivered*** to a Household (load)
- Negative energy is energy ***received*** from the Household (generator)
- NET energy is the difference:

NET = delivered – received energy

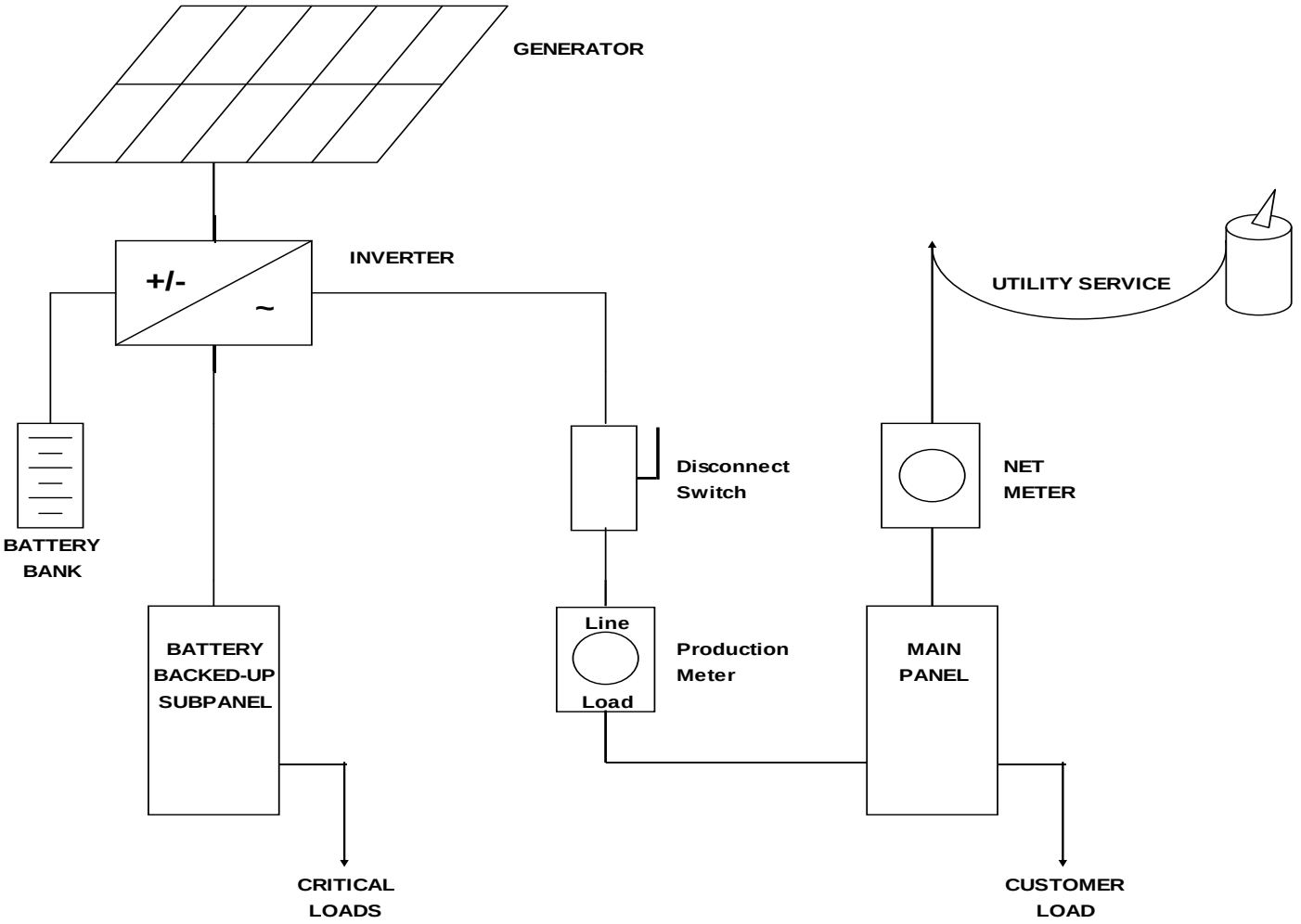


NET Metering – Special Equipment

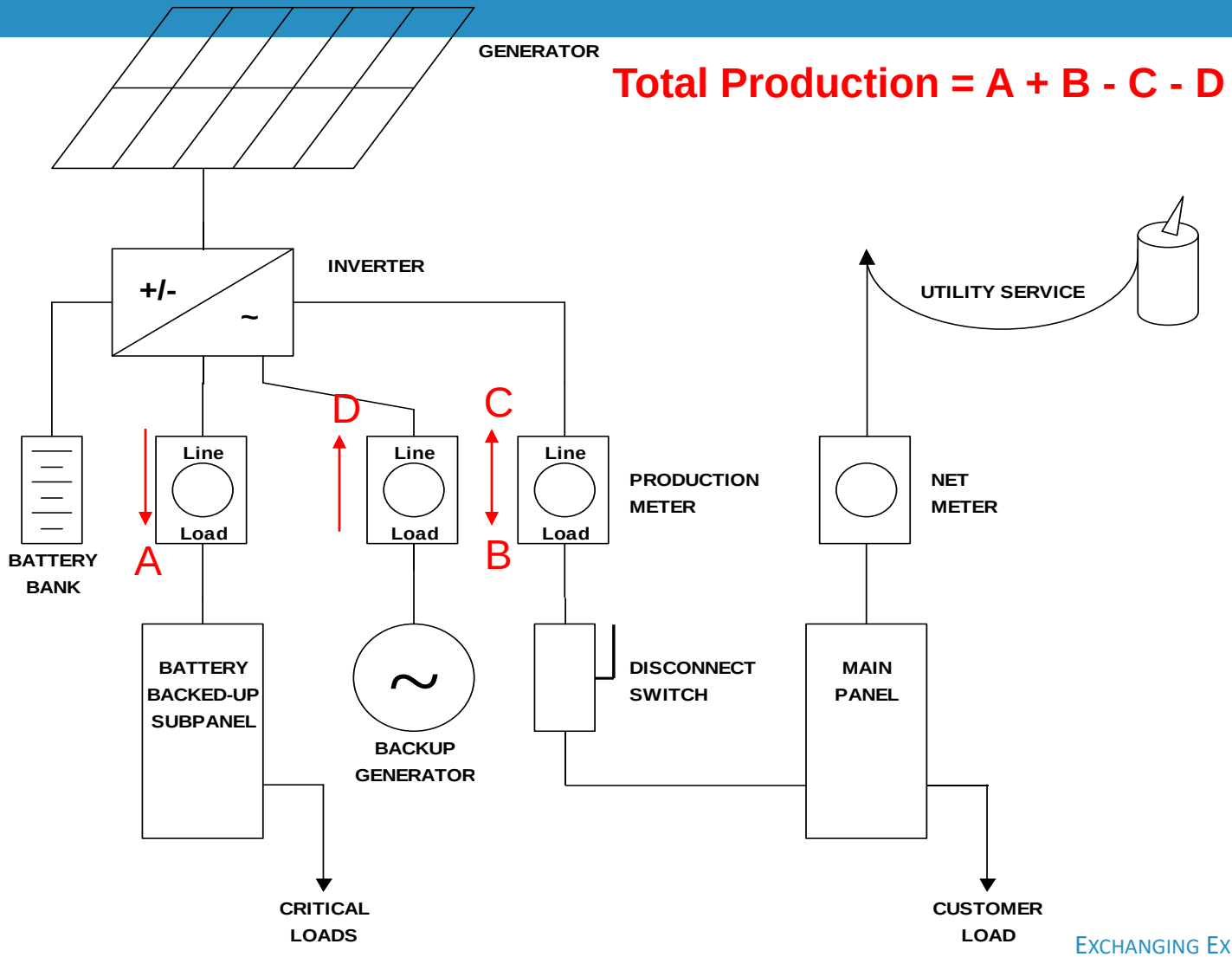
- A single watthour meter can only provide the NET power (delivered – received)
- A single watthour meter can NOT tell how much energy is generated by the customer's equipment
- To determine how much energy is generated, a second watthour meter must be connected between the generator and the service.



PV System with battery storage

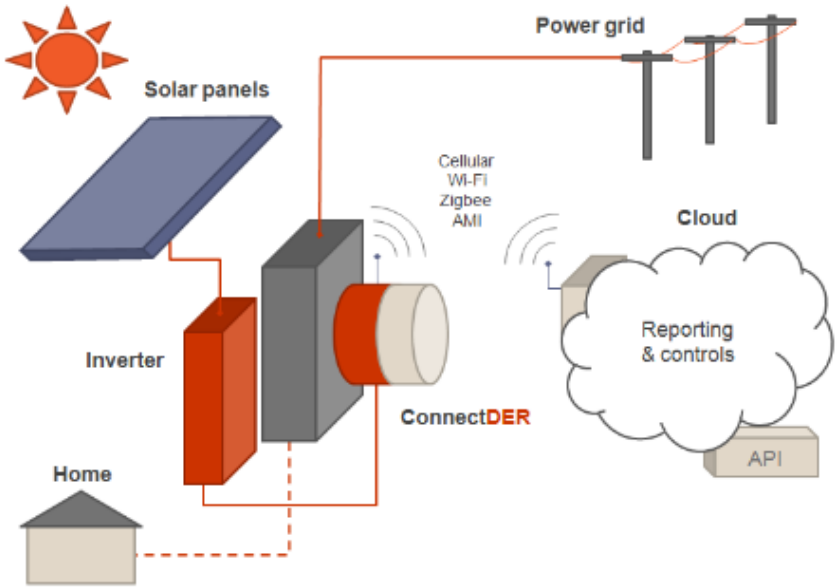


Battery + Generator + Critical Load



Simplified PV Connections

Smart ConnectDER



- All Simple ConnectDER™ features plus...
- Revenue grade metering on branch circuit (certified to ANSI C.12)
- Cellular, Wifi, Zigbee, or AMI communications options
- Cloud based fleet operations system
- Emergency remote disconnect on branch circuit
- Hardwired serial bus communications to inverter
- Hardwired TCP/IP over MODBUS communications to inverter

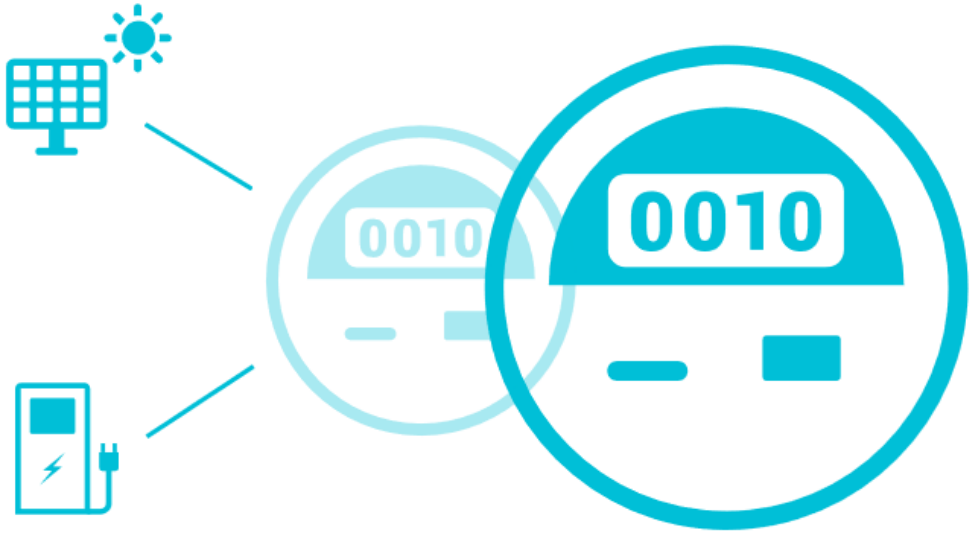
PRODUCT SPECIFICATION | MANUAL

Smart Inverter vs Meter Disconnect Solution

- **3-7 KW Rooftop solar program for residential customers**
- **Monitor load, voltage and VAR, disconnect as necessary via AMI network**
- **Utility leases rooftop – PV becomes part of Community solar**
- **PV connected to line side of Meter and is controlled by Utility**

Virtual Submetering for DER

Eliminates the need for dual meters in DER applications



Lower cost, quicker solar and electric vehicle integration with the ability to apply device specific rates.

NET Metering – Configuring the Meters

+ The Billing Meter can be configured to be:

  NET – i.e the “dials” count up/down for delivered/received energy.

  OR

  The billing meter displays BOTH Delivered and Received energy

+ The Generator Meter has to measure the generator output. It can be configured to measure:

  Received energy

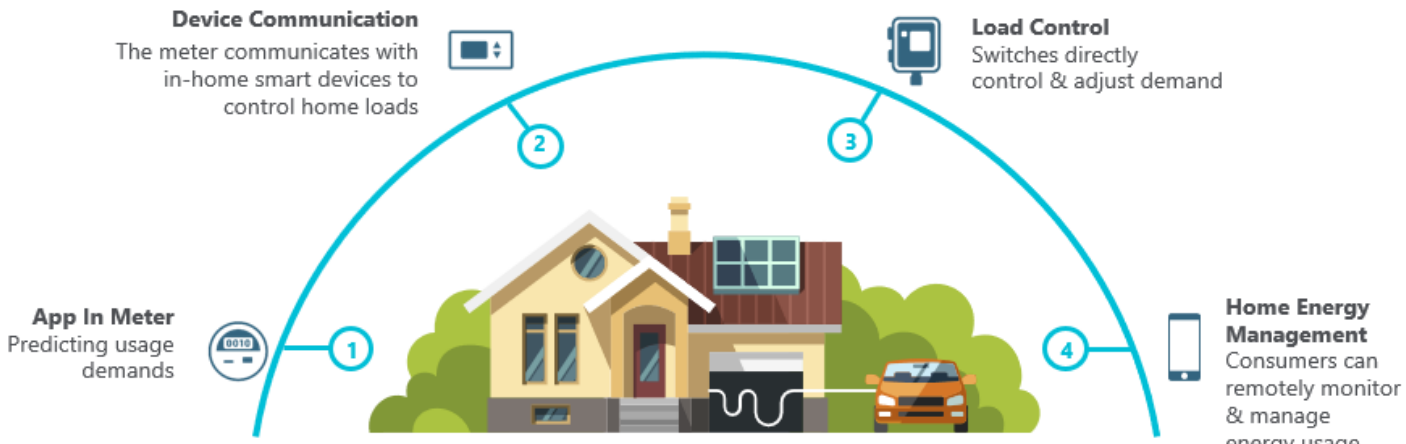
  OR

  Delivered energy on a meter configured for BOTTOM FEED

New rates and meter functionality based on DER

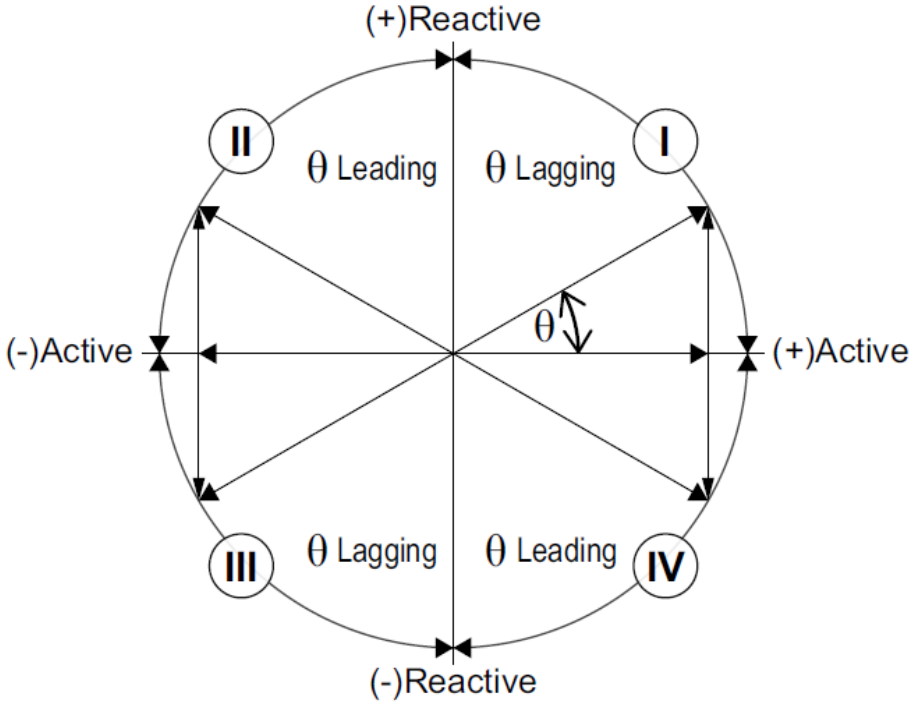
- Received Demand
- Residential TOU Energy and Demand
- Harmonic monitoring
- Residential reactive energy monitoring
- Production Limiting
- Grid Limiting
- Variable TOU switch point based on energy direction
  - Received TOU switch points vs Delivered TOU switch points

Managing Residential Demand via Advanced Meters



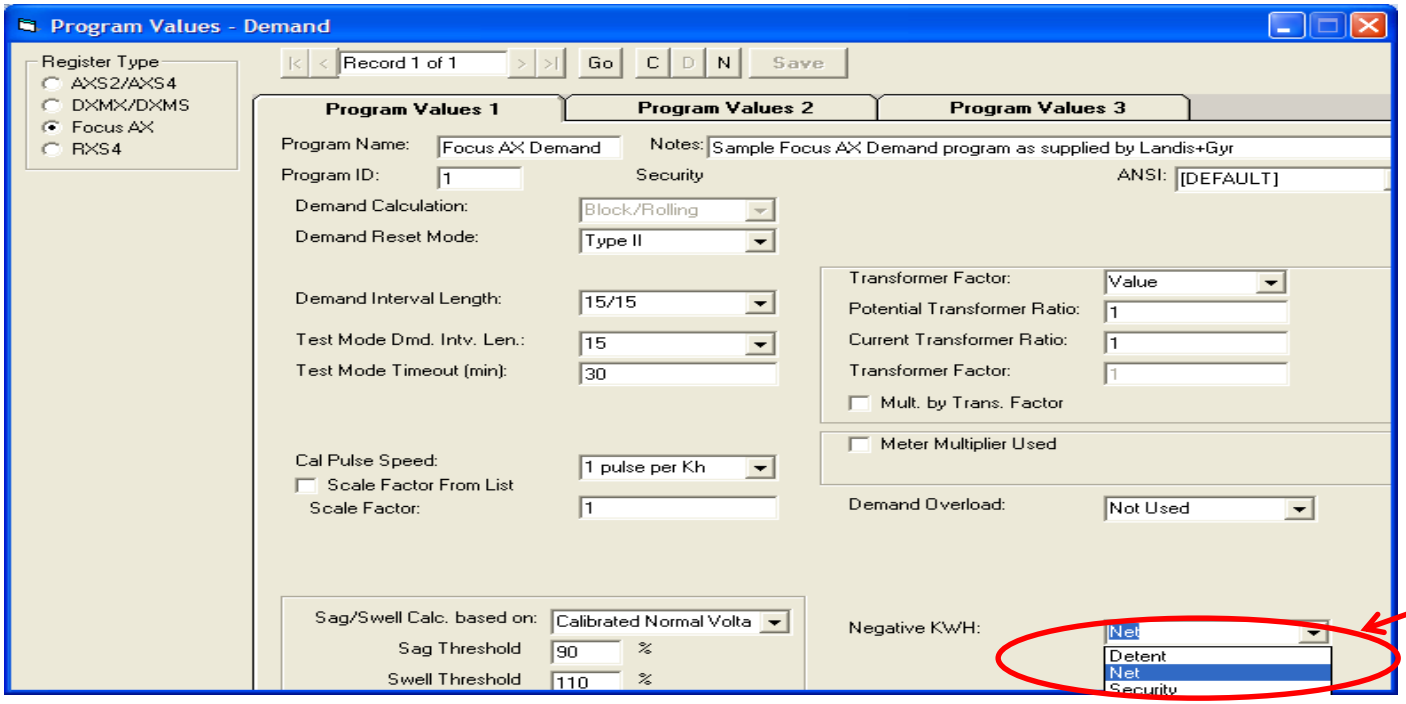
Provide consumer tools to manage and reduce demand charges through alerts and automated controls.

Reactive Measurement
with Reverse Power Flow



Quadrant I	Positive watts (delivered)	VAR (delivered) / (lagging power factor)
Quadrant II	Negative watts (received)	VAR (delivered) / (leading power factor)
Quadrant III	Negative watts (received)	VAR (received) / (lagging power factor)
Quadrant IV	Positive watts (delivered)	VAR (received) / (leading power factor)

NET Billing Meter – Configuring in software



NET Selection

"Total kWh" follows **NET** for Billing Meter, or **Detent** for Generator Meter.
Select "Bottom Feed" to configure the Generator Meter to run backwards.

NET Metering – What about Demand Rates?

Utilities don't credit generated demand peak back to a customer

Demand is always based on Delivered (or Received) Energy . The reasons are:

1. Demand has to do with the size of the distribution wires, breakers, transformer, and service. These still have to be a certain size even if the customer generates power.

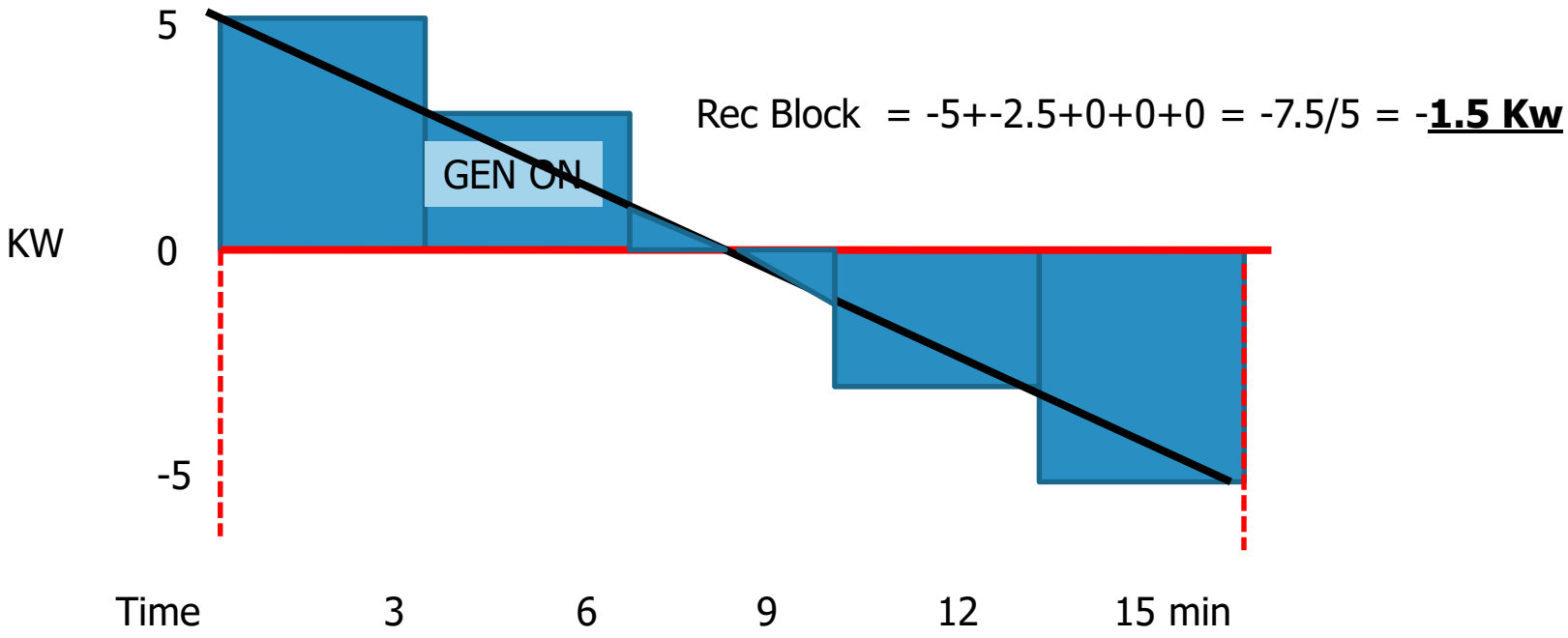
2. Demand peak charges have to do with the customer load varying. Loads aren't flat and predictable. A customer with a generator is typically the worst! Their load varies from Delivered to Received! The swing can be quite large!

Net Block Demand

NET Block = 5+2.5+0+-2.5+-5 = 0/5 = **0 Kw**

Del Block = 5+2.5+0+0+0 = 7.5/5 = **1.5 Kw**

Rec Block = -5+-2.5+0+0+0 = -7.5/5 = -**1.5 Kw**

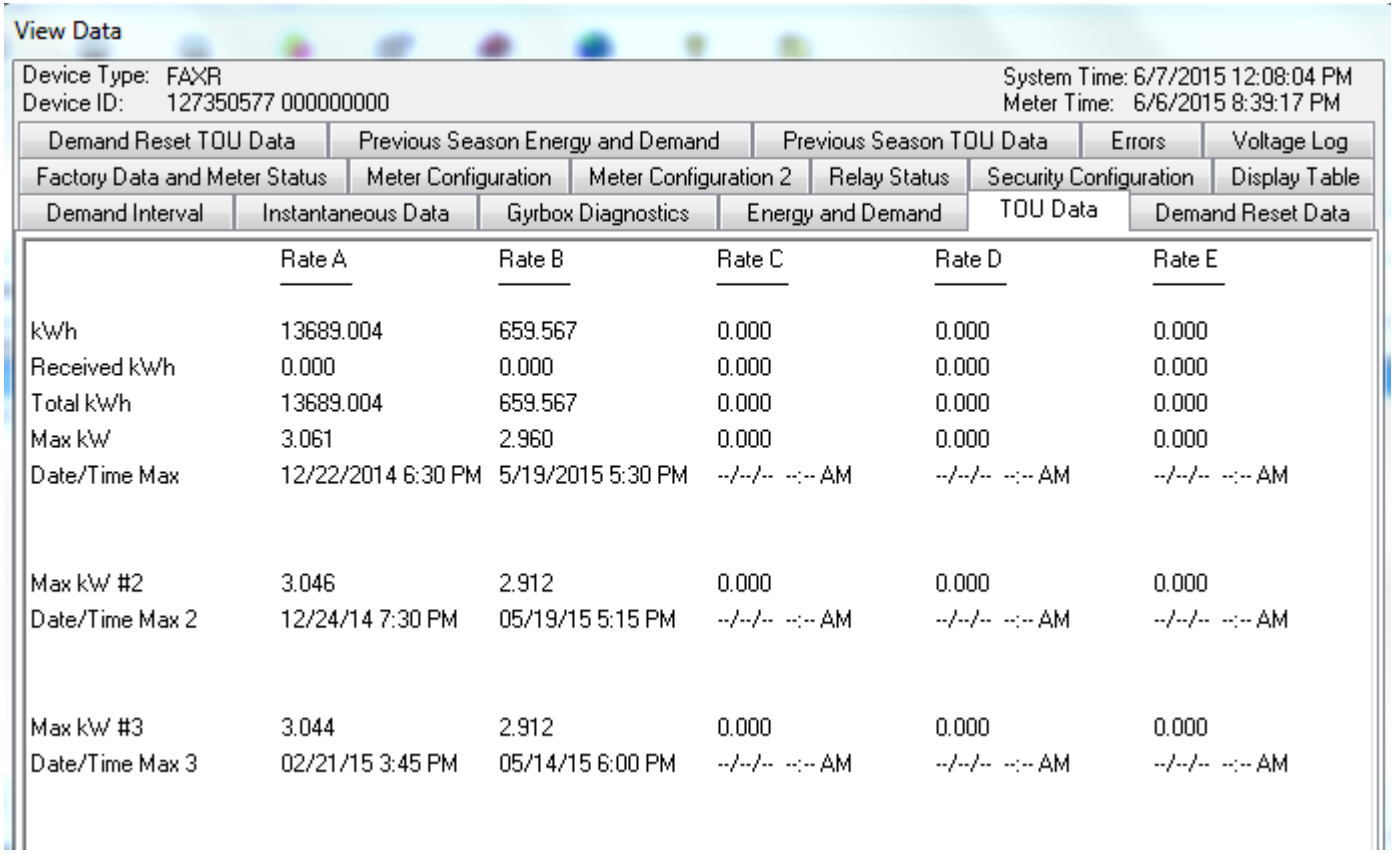


Example of Customer with 5kw load turning on 10 Kw of Generation. Shown in a 15 minute Block demand.

NET Metering – Use of Load Profile

- If a utility needs Received Demand, another option is to use a meter equipped with load profile.
- Configure the meter for 2 channels: +KWH and –KWH
- Most back office software will perform the “NET” of the 2 channels…i.e. NET = +kWh - -kWh

Net Time-of-Use Metering



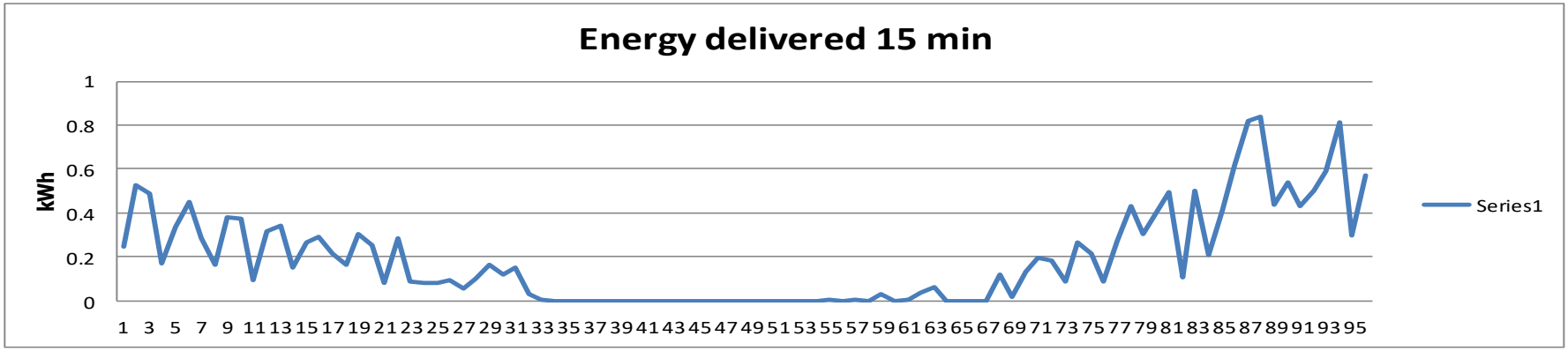
	Rate A	Rate B	Rate C	Rate D	Rate E
kWh	13689.004	659.567	0.000	0.000	0.000
Received kWh	0.000	0.000	0.000	0.000	0.000
Total kWh	13689.004	659.567	0.000	0.000	0.000
Max kW	3.061	2.960	0.000	0.000	0.000
Date/Time Max	12/22/2014 6:30 PM	5/19/2015 5:30 PM	--/--/-- --:-- AM	--/--/-- --:-- AM	--/--/-- --:-- AM
Max kW #2	3.046	2.912	0.000	0.000	0.000
Date/Time Max 2	12/24/14 7:30 PM	05/19/15 5:15 PM	--/--/-- --:-- AM	--/--/-- --:-- AM	--/--/-- --:-- AM
Max kW #3	3.044	2.912	0.000	0.000	0.000
Date/Time Max 3	02/21/15 3:45 PM	05/14/15 6:00 PM	--/--/-- --:-- AM	--/--/-- --:-- AM	--/--/-- --:-- AM

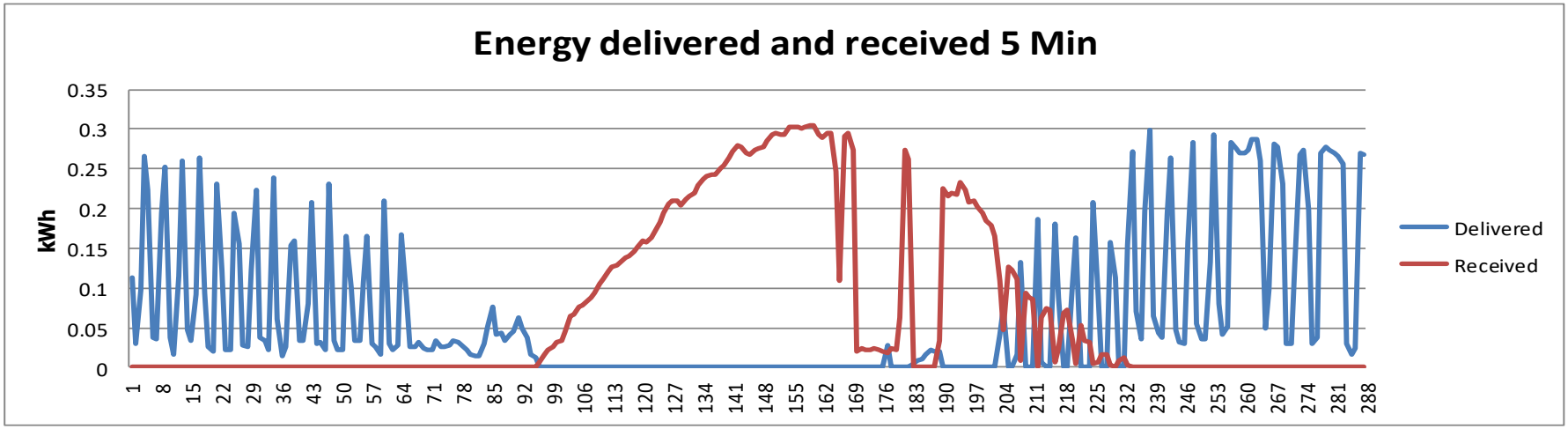
Net Metering in a solid-state AMI world

- How to detect tampering
  - Reverse Rotation
  - Load patterns
  - Tamper event
  - Tilt Switch (Insertion/Removal)
  - Voltage signature
- How to handle “Dials” reverse rollover from 00000
  - Signed kWh, Magnitude or 99999?
  - What can billing system handle?
  - What does AMI data deliver?
- Disconnectable PV
  - Inverter Control
  - Disconnect on PV meter

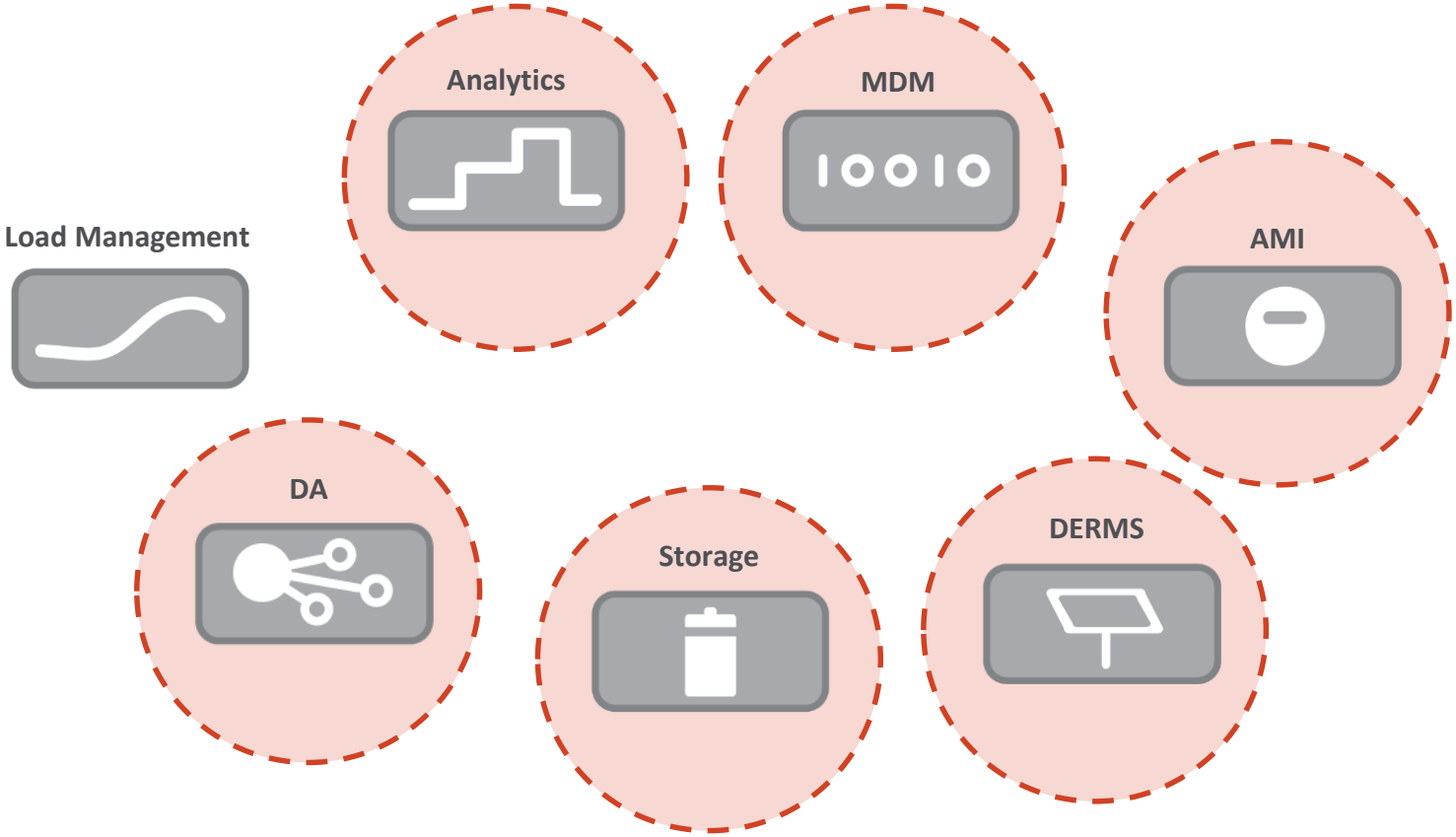
Dual socket Dual AMI Meter installation - with Photovoltaic metering

Interval Data Comparisons





Solutions and Systems for Renewables



Thank you

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manage energy better