

Smart Prepayment Solutions for SSEG

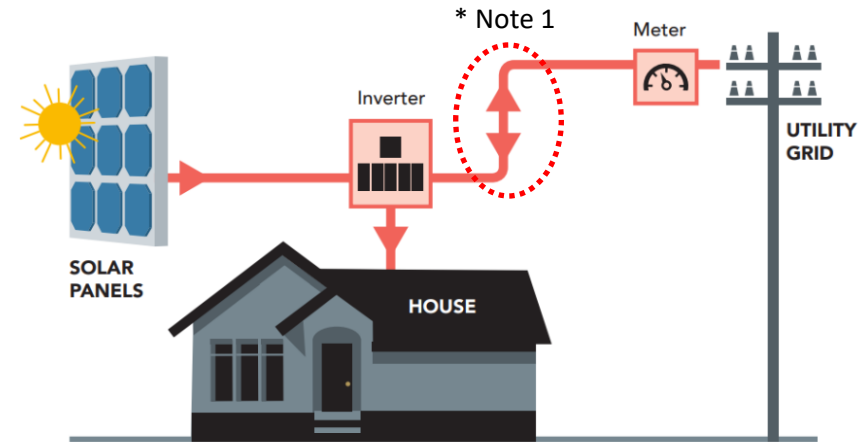
A presentation for virtual AMEU branch meetings
Dave Tarr

There was recent communication to the AMEU community about SSEG

- NERSA list of municipalities with approved small-scale-embedded-generation (“SSEG”) tariffs as of 2 September 2020
- Therefore the opportunity for shared learning and some discussion about Smart STS prepayment meters and their value to support SSEG

SSEG – Small Scale Embedded Generation

- Electrical generators that can connect and operate in parallel with the grid/network (by synchronizing with the grid), are referred to as embedded generators (EG)
- Embedded generators smaller than 1MVA (1000kVA) are defined as small scale embedded generators (SSEG)
- In South Africa solar PV is the main technology type used as an SSEG, but wind, biogas electricity, hydro power and diesel generators connected to the grid are also forms of embedded generators



Reference: <https://www.sseg.org.za/>
Website managed by Sustainable Energy Africa

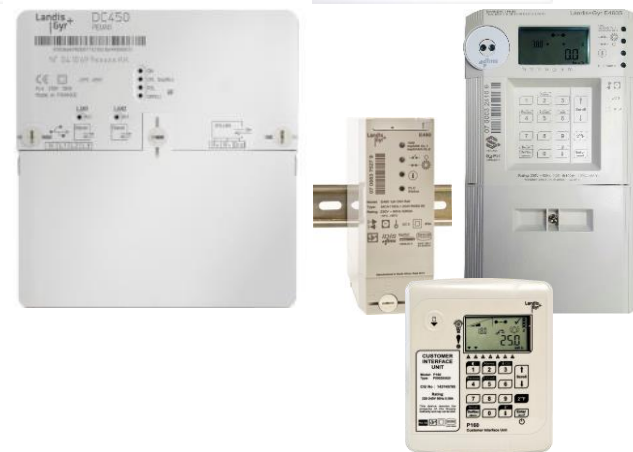
Note 1:

The ability of the meter to support bi-directional energy metering, is essential in the context of SSEG

What is AMI (aka Smart Metering)?

Advanced Metering Infrastructure (AMI)

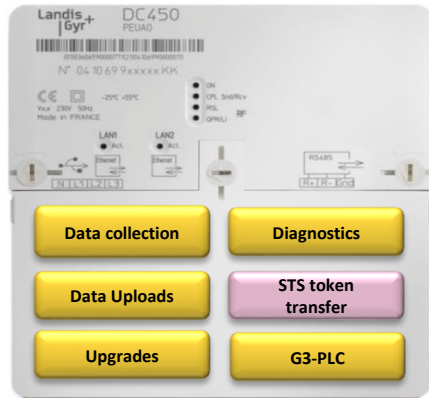
- AMI refers to an infrastructure which consists of systems and various components, including meters, customer interface units, data concentrators & appliance control devices
- An AMI architecture typically specifies interfaces between all systems and components in order to ensure communications between all parts
- An AMI system is capable of collecting & analysing meter data, instantaneous values, meter energy usage, a range of events, power quality profiles and **in the context of SSEG (e.g. import and export energy registers)**



Smart + STS Prepayment Functionality

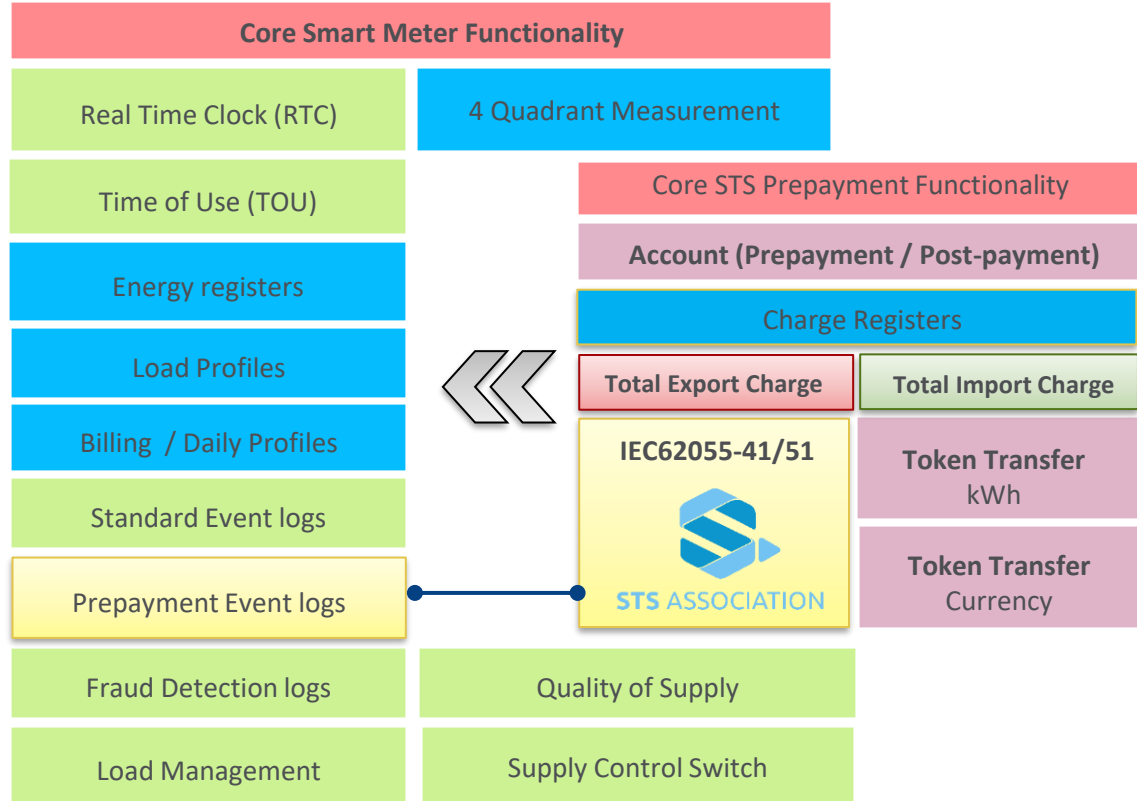
Smart + STS Prepayment Functionality

Data Concentrator / Network Gateway



1ph DIN-Rail Smart Prepayment meter

Local & Remote Communications



Charge Registers

Account

Active Account (0-0:19.0.0) Passive Account (0-1:19.0.0)

Account Mode (2) prepayment

Account Status (2) account active

Currency Unit (1) consumption [Whr]

Currency Name Whr

Currency Scale x1

Account

Active Account (0-0:19.0.0) Passive Account (0-1:19.0.0)

Account Mode (1) credit

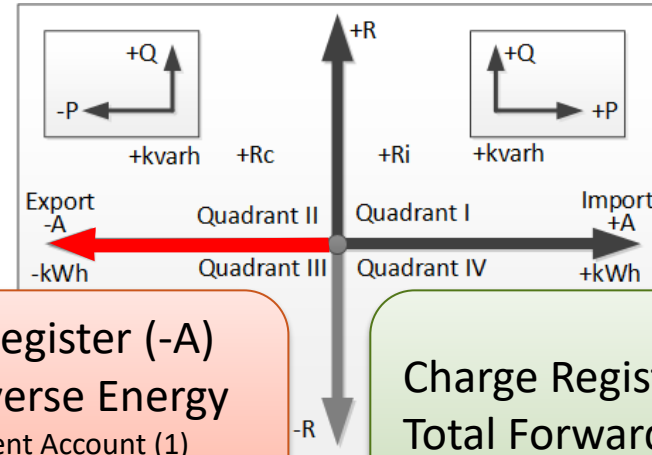
Account Status (2) account active

Currency Unit (1) consumption [Whr]

Currency Name Whr

Currency Scale x1

Mode: Prepayment Account



Charge Register (-A)

Total Reverse Energy

- Decrement Account (1)
- No Charge (0)
- Pay Back the Account (-1)

Charge Register (+A)

Total Forward Energy

- Decrement Account (1)

Charge Register - Consumption STS Prepayment

Active TOU | Passive TOU | Special Days | Emergency Settings

TOU ID **ACTIVE**

Season Table

	Season Name	Month	Day	Week Name
1	0	January	1	1

Week Table

	Week Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	1	1	1	1	1	1	1	1

Day Tables

Day ID **1**

	Start Time	Action
1	12:00 AM	execute rate script 1

Charge Register Total Reverse Energy (0-0:19.20.2)

Active Charge | Passive Charge

Commodity Reference 1-0:2.8.0 - Active energy export -A (QII+QIII)

Currency Unit (1) consumption [Whr]

Commodity Scale Wh x1

Price Scale Whr x0.01

Charge Table

	Charge	Unit	Index	Register
1	0	Whr/Wh	00	Active energy export -A (QII+QIII) rate 1
2				Active energy export -A (QII+QIII) rate 2
3	0	Whr/Wh	02	Active energy export -A (QII+QIII) rate 3
4	0	Whr/Wh	03	Active energy export -A (QII+QIII) rate 4

No charge for the applicable rate

Consumption (kWh) STS

- In this example, there are no charges applied to export energy
- This means that for export energy, the prepayment account (available credit) will neither be decremented nor incremented

Charge Register - Consumption STS Prepayment

Active TOU | Passive TOU | Special Days | Emergency Settings

TOU ID **ACTIVE**

Season Table

	Season Name	Month	Day	Week Name
1	0	January	1	1

Week Table

	Week Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	1	1	1	1	1	1	1	1

Day Tables

Day ID **1**

	Start Time	Action
1	12:00 AM	execute rate script 1

Charge Register Total Reverse Energy (0-0:19.20.2)

Active Charge | Passive Charge

Commodity Reference 1-0:2.8.0 - Active energy export (Whr/Wh)

Currency Unit (1) consumption [Whr]

Commodity Scale Wh x1

Price Scale Whr x0.01

Charge Table

	Charge	Unit	Index	Register
1	-1	Whr/Wh	00	Active energy export -A (QII+QIII) rate 1
2	0	Whr/Wh	01	Active energy export -A (QII+QIII) rate 2
3	0	Whr/Wh	02	Active energy export -A (QII+QIII) rate 3
4	0	Whr/Wh	03	Active energy export -A (QII+QIII) rate 4

Consumption (kWh) STS

- In this example, there is a charge applied to export energy (-1)
- This means that for export energy during rate 1 (the only available rate), the prepayment account (available credit) will be incremented by 1kWh for every 1kWh exported

Charge Register - Currency STS Prepayment

Active TOU | Passive TOU | Special Days | Emergency Settings

TOU ID **ACTIVE**

Season Table

	Season Name	Month	Day	Week Name
1	0	January	1	1

Week Table

	Week Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	1	1	1	1	1	1	1	1

Day Tables

Day ID **1**

	Start Time	Action
1	12:00 AM	execute rate script 1

Charge Register Total Reverse Energy (0-0:19.20.2)

Active Charge | Passive Charge

Commodity Reference 1-0:2.8.0 - Active energy rate 1

Currency Unit (2) monetary

Commodity Scale Wh x1000

Price Scale R x0.01

Charge Table

	Charge	Unit	Index	Register
1	-0.30	R/Wh	00	Active energy export -A (QII+QIII) rate 1
2	0	R/Wh	01	Active energy export -A (QII+QIII) rate 2
3	0	R/Wh	02	Active energy export -A (QII+QIII) rate 3
4	0	R/Wh	03	Active energy export -A (QII+QIII) rate 4

Currency (Monetary) STS

- In this example, there is a charge applied to export energy (-0.30)
- This means that for export energy during rate 1 (the only available rate), the prepayment account (available credit) will be incremented by R0.30 for every 1kWh exported

Charge Register Examples - with Time of Use

Week Table

	Week Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	1	1	1	1	1	1	1	1

Day Tables

Day ID 1

	Start Time	Action
1	12:00 AM	execute rate script 2
2	7:00 AM	execute rate script 1
3	10:00 AM	execute rate script 2
4	2:00 PM	execute rate script 3
5	6:00 PM	execute rate script 4
6	8:00 PM	execute rate script 2

Charge Register Total Reverse Energy (0-0:19.20.2)

Active Charge | Passive Charge

Commodity Reference 1-0:2.8.0 - Active energy export -A (QII+QIII)

Currency Unit (2) monetary

Commodity Scale Wh x1000

Price Scale R x0.01

Charge Table

	Charge	Unit	Index	Register
1	-1.80	R/Wh	00	Active energy export -A (QII+QIII) rate 1
2	0	R/Wh	01	Active energy export -A (QII+QIII) rate 2
3	0	R/Wh	02	Active energy export -A (QII+QIII) rate 3
4	-1.20	R/Wh	03	Active energy export -A (QII+QIII) rate 4

Currency STS with Time of Use

- In this example, there is a charge applied to export energy for rate 1 and rate 4 – but no charges for rate 2 and rate 3
- This means that for export energy during rate 1 and rate 4, the meter will pay back the account according to the charge, but for rate 2 and rate 3, there is no payback ..
- This could be used as an incentive for SSEG during peak times, but not offering an incentive for SSEG during off-peak times

Smart Meter Energy Registers

	OBIS	Value	Unit	Designation	Group
▶	1-0:1.8.1	5318.204	kWh	Active energy import +A (QI+QIV) rate 1	Energy
	1-0:1.8.2	0.000	kWh	Active energy import +A (QI+QIV) rate 2	Energy
	1-0:1.8.3	0.000	kWh	Active energy import +A (QI+QIV) rate 3	Energy
	1-0:1.8.4	0.000	kWh	Active energy import +A (QI+QIV) rate 4	Energy
	1-0:2.8.1	855.650	kWh	Active energy export -A (QII+QIII) rate 1	Energy
	1-0:2.8.2	0.000	kWh	Active energy export -A (QII+QIII) rate 2	Energy
	1-0:2.8.3	0.000	kWh	Active energy export -A (QII+QIII) rate 3	Energy
	1-0:2.8.4	0.000	kWh	Active energy export -A (QII+QIII) rate 4	Energy
	1-0:3.8.1	334.273	kvarh	Reactive energy import +R (QI+QII) rate 1	Energy
	1-0:3.8.2	0.000	kvarh	Reactive energy import +R (QI+QII) rate 2	Energy
	1-0:3.8.3	0.000	kvarh	Reactive energy import +R (QI+QII) rate 3	Energy
	1-0:3.8.4	0.000	kvarh	Reactive energy import +R (QI+QII) rate 4	Energy
	1-0:4.8.1	56.533	kvarh	Reactive energy export -R (QIII+QIV) rate 1	Energy
	1-0:4.8.2	0.000	kvarh	Reactive energy export -R (QIII+QIV) rate 2	Energy
	1-0:4.8.3	0.000	kvarh	Reactive energy export -R (QIII+QIV) rate 3	Energy
	1-0:4.8.4	0.000	kvarh	Reactive energy export -R (QIII+QIV) rate 4	Energy
	1-0:5.8.1	0.000	kvarh	Reactive energy +Ri (QI) rate 1	Energy
	1-0:5.8.2	0.000	kvarh	Reactive energy +Ri (QI) rate 2	Energy
	1-0:5.8.3	0.000	kvarh	Reactive energy +Ri (QI) rate 3	Energy
	1-0:5.8.4	0.000	kvarh	Reactive energy +Ri (QI) rate 4	Energy
	1-0:6.8.1	0.000	kvarh	Reactive energy +Rc (QII) rate 1	Energy
	1-0:6.8.2	0.000	kvarh	Reactive energy +Rc (QII) rate 2	Energy
	1-0:6.8.3	0.000	kvarh	Reactive energy +Rc (QII) rate 3	Energy
	1-0:6.8.4	0.000	kvarh	Reactive energy +Rc (QII) rate 4	Energy
	1-0:7.8.1	0.000	kvarh	Reactive energy -Ri (QIII) rate 1	Energy
	1-0:7.8.2	0.000	kvarh	Reactive energy -Ri (QIII) rate 2	Energy
	1-0:7.8.3	0.000	kvarh	Reactive energy -Ri (QIII) rate 3	Energy
	1-0:7.8.4	0.000	kvarh	Reactive energy -Ri (QIII) rate 4	Energy
	1-0:8.8.1	0.000	kvarh	Reactive energy -Rc (QIV) rate 1	Energy
	1-0:8.8.2	0.000	kvarh	Reactive energy -Rc (QIV) rate 2	Energy
	1-0:8.8.3	0.000	kvarh	Reactive energy -Rc (QIV) rate 3	Energy
	1-0:8.8.4	0.000	kvarh	Reactive energy -Rc (QIV) rate 4	Energy

	OBIS	Value	Unit	Designation	Group
▶	1-0:15.8.0	6173.945	kWh	Active energy A (QI+QII+QIII+QIV)	Energy
	1-0:2.8.0	855.741	kWh	Active energy export -A (QII+QIII)	Energy
	1-0:1.8.0	5318.204	kWh	Active energy import +A (QI+QIV)	Energy
	1-0:4.8.0	56.539	kvarh	Reactive energy export -R (QIII+QIV)	Energy
	1-0:3.8.0	334.273	kvarh	Reactive energy import +R (QI+QII)	Energy
	1-0:5.8.0	334.273	kvarh	Reactive energy +Ri (QI)	Energy
	1-0:6.8.0	0.000	kvarh	Reactive energy +Rc (QII)	Energy
	1-0:7.8.0	56.539	kvarh	Reactive energy -Ri (QIII)	Energy
	1-0:8.8.0	0.000	kvarh	Reactive energy -Rc (QIV)	Energy
	1-0:10.8.0	857.341	kVAh	Apparent energy export -VA (QII+QIII)	Energy
	1-0:9.8.0	5327.323	kVAh	Apparent energy import +VA (QI+QIV)	Energy
	1-0:16.8.0	4462.453	kWh	Active energy A (QI+QIV-QII-QIII)	Energy

Energy Registers

Four (4) quadrant measurement provides for :

Import [forward] energy (taken from network)

Export [reverse] energy (generated by alternative source OR a reverse connection)

Active and reactive energy registers

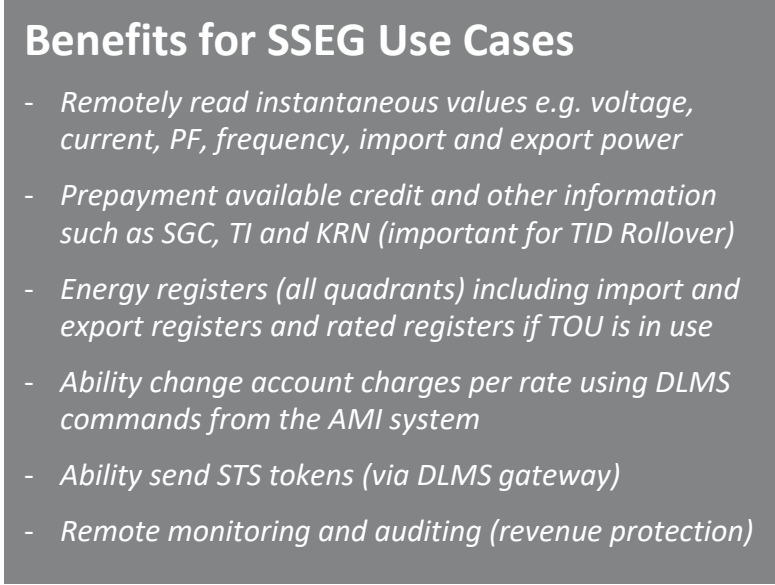
Rated energy registers (for each available TOU rate)

Typical smart prepayment meters

Bidirectional marking on the faceplate indicates the ability to register import and export energy

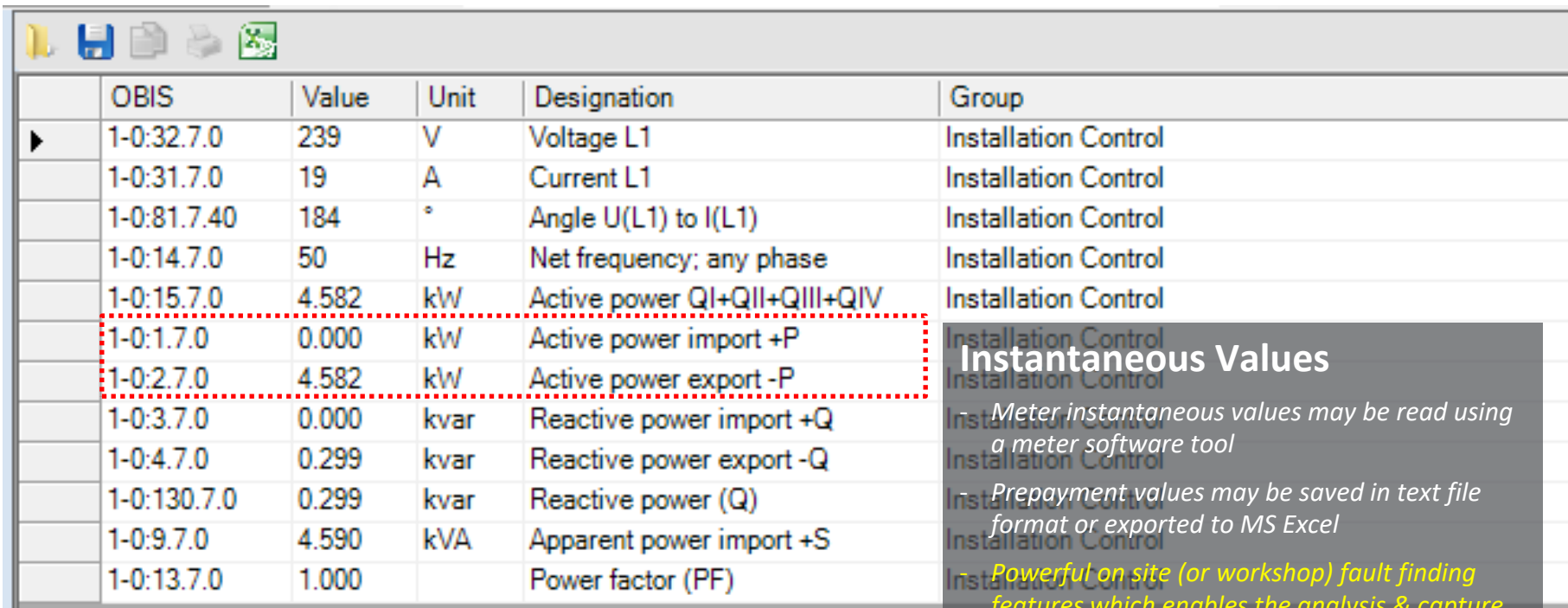


AMI System Benefits for SSEG



AMEU Branch Meeting | Dave Tarr | © Landis+Gyr | October 2, 2020 | PUBLIC

Reading Instantaneous Values - Locally



	OBIS	Value	Unit	Designation	Group
▶	1-0:32.7.0	239	V	Voltage L1	Installation Control
	1-0:31.7.0	19	A	Current L1	Installation Control
	1-0:81.7.40	184	°	Angle U(L1) to I(L1)	Installation Control
	1-0:14.7.0	50	Hz	Net frequency; any phase	Installation Control
	1-0:15.7.0	4.582	kW	Active power QI+QII+QIII+QIV	Installation Control
	1-0:1.7.0	0.000	kW	Active power import +P	Installation Control
	1-0:2.7.0	4.582	kW	Active power export -P	Installation Control
	1-0:3.7.0	0.000	kvar	Reactive power import +Q	Installation Control
	1-0:4.7.0	0.299	kvar	Reactive power export -Q	Installation Control
	1-0:130.7.0	0.299	kvar	Reactive power (Q)	Installation Control
	1-0:9.7.0	4.590	kVA	Apparent power import +S	Installation Control
	1-0:13.7.0	1.000		Power factor (PF)	Installation Control

Instantaneous Values

- Meter instantaneous values may be read using a meter software tool

- Prepayment values may be saved in text file format or exported to MS Excel

- Powerful on site (or workshop) fault finding features which enables the analysis & capture of instantaneous values on site

- Same values may be remotely read by the Smart Meter system

Reading Instantaneous Values - Remotely

Direct reading data

Data of unit 60024744 (E460 S G3)

Previewing data. Reading is still in progress.

Analog

Name	Reading time	Register value	Unit of meas.
Number of power cuts in any phase	2017-07-18 12:18:57	54	none (no quality)
Current L1	2017-07-18 12:18:58	19	A
Available credit	2017-07-18 12:18:58	539947	Wh
Active power A+	2017-07-18 12:18:59	0	W
Voltage L1	2017-07-18 12:18:59	239	V
Active power A-	2017-07-18 12:19:00	4558	W

Close

Instantaneous Values

- When meter is installed in an on-line mode, with Data Concentrator (or point to point) and Smart Meter System, then available instantaneous values may be accessed

remotely

-- Prepayment credit

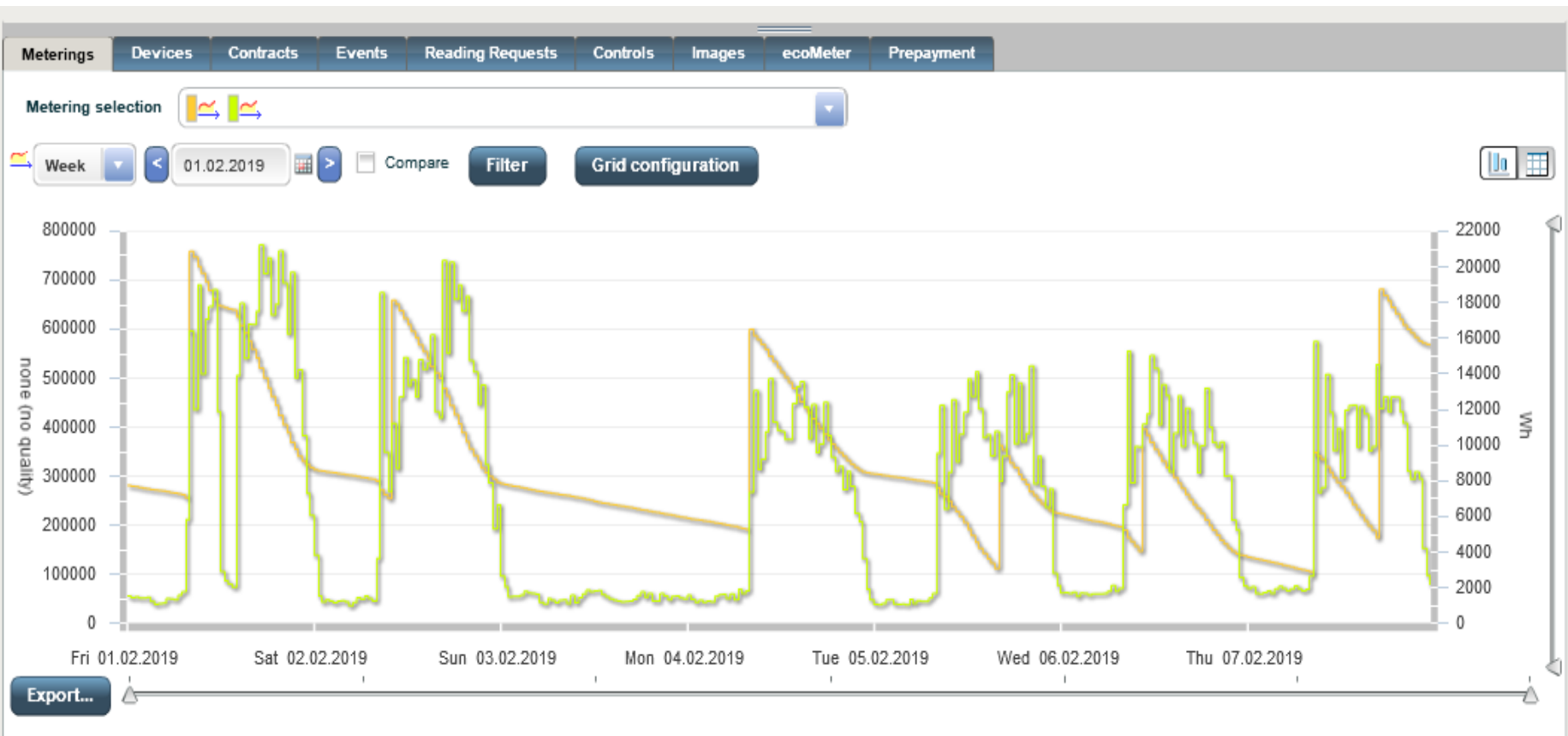
-- Power quality information

Voltage, current, PF, frequency, power etc.

- This is very powerful for remote auditing and fault finding features

- Reduces operating costs of the utility as this level of meter analysis and auditing can be done by Utility Engineers from the office

Profile Visualisation in AMI systems



Conclusion

The VALUE of the Smart Prepayment Solution

Smart STS prepayment meters offer powerful functionality to support SSEG

- DLMS gateway to support STS functionality
- Separate DLMS import and export energy registers (+A, -A)
- Separate DLMS import and export power registers (+P, -P)
- Customer interface & meter's display has direction indicators (+P, -P)
- Customer interface & meter's display can be configured to display SSEG registers (import and export energy and power)
- Smart prepayment meters also support DLMS net energy register (import minus export)
- Charge registers for import and export energy for the prepayment account
- When part of the AMI system
 - ability to remotely read all applicable registers, instantaneous values, monitor import and export generation and STS prepayment information
 - remotely disconnect and reconnect the meters supply control switch
 - remotely monitor and audit for improved revenue protection

Thank you for your attention



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