5MS and GS Reconciliation support workshop #2

Monday 18th November, 2019

AEMO Offices:
Level 9, 99 Gawler Place, Adelaide
Level 10, 10 Eagle Street, Brisbane
Level 22, 530 Collins Street, Melbourne
Level 2, 20 Bond Street, Sydney

PLEASE NOTE THIS MEETING WILL BE RECORDED FOR THE PURPOSE OF PREPARING MINUTES

Today's Objective

- Explain how Participants can verify/reconcile the UFE and Trading Amounts on the AEMO Settlements Reports, by:
  - Explaining various UFE related terms, acronyms and concepts
  - Providing examples of how AEMO will calculate the relevant UFEF (UFE factor) values
  - Providing some initial mock-ups of the most relevant RM reports
  - Providing some initial mock-ups of the proposed changes to the Settlements Reports (SR)
  - Providing a high-level understanding of AEMO's proposed UFE enquiry management approach
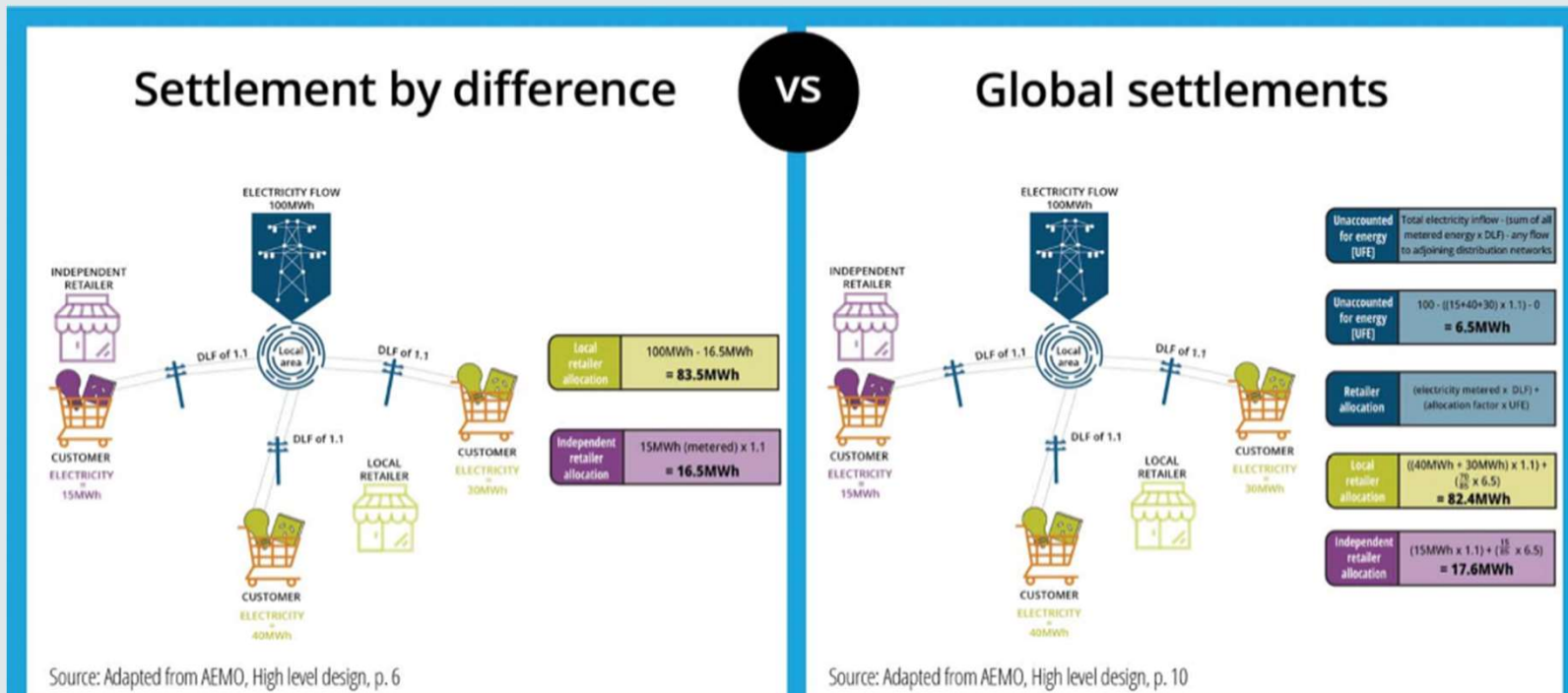
Agenda

NO	TIME	AGENDA ITEM	RESPONSIBLE
Preliminary matters			
1	2:00pm – 2:05pm	Welcome, introduction and apologies	Blaine Miner
Matters for noting			
2	2:05pm – 2:15pm	Introduction	Blaine Miner
3	2:15pm – 2:20pm	De-brief on actions since previous workshop	Blaine Miner
Matters for discussion			
4	2:20pm – 3:00pm	UFE - calculation • Worked examples of how AEMO <u>calculates</u> UFE • Mocked-up examples of RM reports	Paul Lyttle
BREAK 3:00pm – 3:10pm			
5	3:10pm – 3:55pm	UFE - allocation • Worked examples of how AEMO <u>allocates</u> UFE • Changes to invoices and settlement reports (including timings) • Mocked-up data interchange reports	Pierre Fromager
6	3:55pm – 4:05pm	Checkpoint	Blaine Miner
7	4:05pm – 4:20pm	UFE enquiry management	Dimi Botha
Other business			
8	4:20pm – 4:30pm	General questions & Appendices	Blaine Miner

Introduction

Blaine Miner

Settlements by Difference vs Global Settlements (1)

Settlement by difference VS **Global settlements**

Source: Adapted from AEMO, High level design, p. 6

Source: Adapted from AEMO, High level design, p. 10

Stylised calculation of settlement by difference
1. Establish total amount of electricity that flows into the distribution network
2. Sum the metered electricity for each independent retailer and adjust for distribution losses
3. Charge each respective independent retailer their distribution loss-adjusted metered consumption
4. The local retailer pays for the remainder of the electricity in the local area, including any UFE

UFE is made up of errors in the distributed loss factor (DLF), commercial losses (e.g. electricity theft, inaccurate meters, estimation errors for unmetered devices) and estimation errors from profiling meters

Stylised calculation of global settlements:
1. Establish total amount of electricity that flows into the distribution network
2. Sum the metered electricity for all retailers and adjust for distribution losses
3. Calculate UFE as the difference between DLF-adjusted metered energy and the total energy inflow into the distribution network
4. Apportion UFE to each retailer based on their proportion of total metered consumption
5. Charge each retailer their distribution loss-adjusted metered energy and their proportion of UFE

Settlements by Difference vs Global Settlements (2)
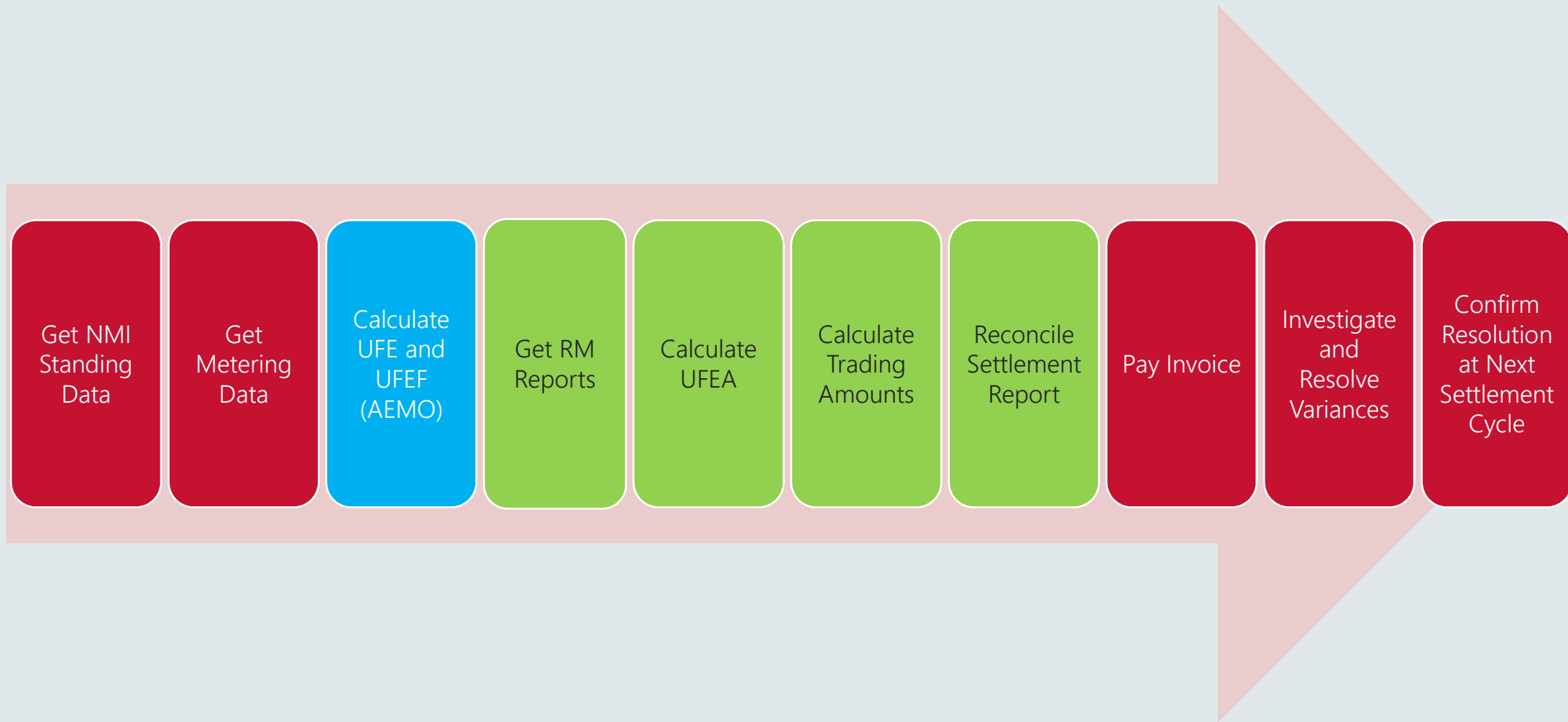
Reconciliation today:

- For LRs, a 'top down' check that the quantity at the TNI less quantity of 2nd tier NMIs x DLF equals quantity billed at the TNI.
  - The 'difference' is a 'balancing item' and is deemed to include all of the first-tier NMIs and any UFE, but this cannot be checked.
- For FRMPs, that the quantity of their NMIs x DLF equals the quantity billed at a TNI
- LRs and FRMPs receive TNI & NMI level quantities from AEMO to assist with reconciliation processes

Settlements by Difference vs Global Settlements (3)

Reconciliation in a GS environment:

- As no Retailer is financially liable for the boundary energy, reconciliations are now only performed by FRMPs
- The 'top down' is extended by deducting the quantities of not only market NMIs, but also the quantity of 1st tier and non-contestable unmetered NMIs, to calculate the residual UFE quantity in a Local Area
- Then, as there is no longer a 'balancing item' for LRs, the reconciliation process becomes a 'bottom up' process from NMI to TNI to Local Area; the UFE is allocated to all NMIs that have a net load
- This means a FRMP that wants to check the quantity billed at each TNI needs to sum the quantity for all its NMIs assigned to the TNI, being NMI metered quantity x DLF plus any UFE allocated
- FRMPs will need to calculate the UFE allocated to NMIs as this is not in the data provided by AEMO
- In summary, the reconciliation process is materially different under GS

High-Level Reconciliation Overview

Get NMI Standing Data → Get Metering Data → Calculate UFE and UFEF (AEMO) → Get RM Reports → Calculate UFEA → Calculate Trading Amounts → Reconcile Settlement Report → Pay Invoice → Investigate and Resolve Variances → Confirm Resolution at Next Settlement Cycle

De-brief on actions since previous workshop

Blaine Miner

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Change Request Update

CR#	Opportunity	Proposal	Status
CR18	Provisioning of what meter data version was used to support a Settlement Report/Invoice	To include the MDP version date/time in the applicable RM reports to enable participants to accurately validate the settlement statement.	Change request has been approved, and is being incorporated into AEMO's 5MS work program.
CR19	Continuation of 30-minute RM and settlement reports post 5MS commencement date	The creation 5 and 30min versions of the RM16, RM17, RM20, RM25, RM22 and RM43 reports.	Change request impact has been assessed, and feedback on potential benefit being sought through SWG and PCF.
CR20	Provisioning of 5min profiled metering data quantities associated to 15/30min interval and basic metering data (1st tier and 2nd tier).	AEMO to deliver profiled energy values to Participants	AEMO has decided not to approve this CR for inclusion into the 5MS work program. If participants wish to pursue this change it will need to be raised through the ERMC process.
CR21	Provisioning of Retail/NMI Standing data via data interchange	Retail/NMI Standing data provided via data interchange in a similar manner to Wholesale data	AEMO has decided not to approve this CR for inclusion into the 5MS work program. If participants wish to pursue this change it will need to be raised through the ERMC process.

How AEMO Calculates UFE and UFEF

Paul Lyttle

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

How AEMO Calculates UFEF

Get NMI Standing Data → Get Metering Data → Calculate UFE and UFEF (AEMO) → Get RM Reports → Calculate UFEA → Calculate Trading Amounts → Reconcile Settlement Report → Pay Invoice → Investigate and Resolve Variances → Confirm Resolution at Next Settlement Cycle
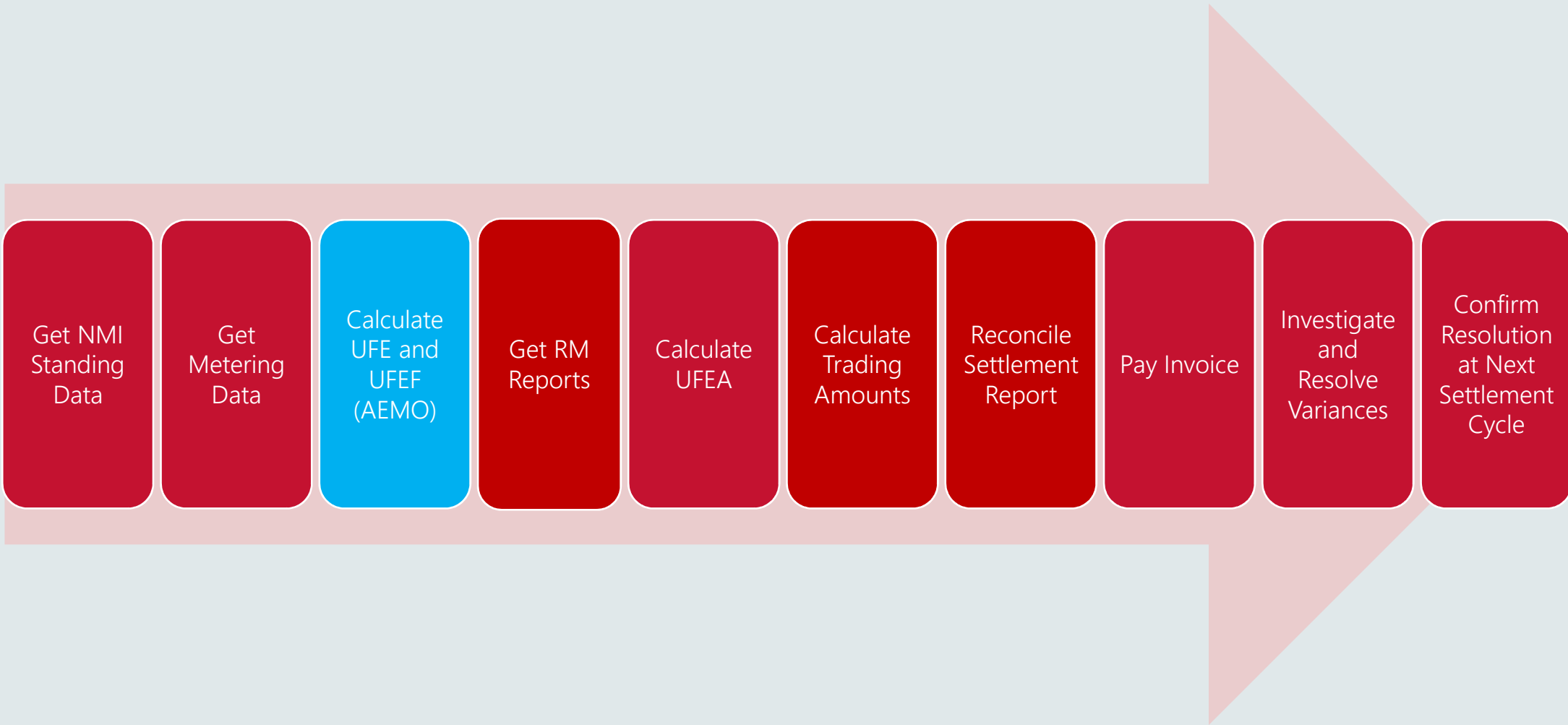
UFE Terms Relevant to this Agenda Item

Term	Description
Local Area	The *Local Area* (LA) is a collection of Transmission Node Identifier (TNI) codes through which *energy* flows into or out of a *distribution area*. Unmetered cross boundary NMIs are assigned to supply Local Areas using their TNI codes.
Net Energy	Net Energy (N) = Export/Load (E) – Import/Generation (B) Notes: • Metering data (in MDFF and MDMF files) adopts a signage convention that is the reverse of that in the NER. • Metering data uses a positive quantity for load and a negative quantity for generation. • I.e. For metering data provided to market participants and AEMO by MDPs, a positive Net Energy quantity at a NMI indicates a net outflow from the connection point while a negative Net Energy quantity indicates a net inflow. • This does not pose any issues for AEMO's systems as import and export values are recorded separately and are able to be interpreted appropriately.
Floored Load	Where the Net Energy is negative for a TI on a *distribution network connection point*, the ME- quantity is set to 0.

UFE Acronyms Relevant to this Agenda Item

Term	Description
TME	The amount of electrical energy flowing at each of the transmission network connection points in the local area i.e. sum of all TNI energy into and out of a local area
DDME	The amount of electrical energy flowing at each of the distribution network connection points in the local area which are connected to an adjacent local area i.e. sum of all Cross Boundary metered energy into and out of a local area
ADME	The aggregate of the amounts represented by (ME x DLF) for that trading interval for each connection point assigned to the transmission network connection point or virtual transmission node i.e. sum of all NMI energy flows within a local area adjusted by DLF
ME-	The ME- is the quantity of Net Load at a *distribution network connection point* for each trading interval as recorded on the meter.
ADMELA	The aggregate of the amounts represented by DME for that trading interval for each market connection point in that local area i.e. sum of all net NMI energy loads within a local area, net generation is set to 0 for the trading interval
UFE	The total unaccounted for *energy* for each *trading interval* i.e. residual energy associated to a local area after all metered energy has been allocated
UFEF	A factor to determine the allocation of UFE to each (or group of) *energy* loads at each *market connection point* (adjusted by DLF) for each *trading interval* i.e. factor that can be applied to applicable loads within the local area to determine its allocation of UFE

Creation of UFE Factor (UFEF)

Clause 3.15.5 (c) of the Rules provides the following formula for UFE allocation:

$$UFEA = UFE \times (DME / ADMELA)$$

- For a local area two values are used for all FRMPs

UFE = Unaccounted for energy for the local area
$ADMELA$ = Aggregated amount of DME for the local area

- Mathematically the formula can be translated to:

$$UFEA = (UFE / ADMELA) \times DME$$

- A constant (i.e. a factor) allows a value to be applied to any DME within the same local area and trading interval

$$UFEF = (UFE/ADMELA)$$

- Applying factor to formula:

$$UFEA = UFEF \times DME$$

Local Area 1 = EasyLand (*TI 1*)

    TNIs

        MPET = +100

        MPEB = +150   TME = +250

    Cross Boundary

        E2WNW2E1 = +62   DDME = +62

    NMIs *(DLF adjusted)*

        MPET ELCP0001 = +30

        MPET ELCP0002 = +20

        MPET ELCP0003 = +40

        MPEB ELCP0004 = +25

        MPEB ELCP0005 = +35

        MPEB ELCP0006 = +30   ADME = +180

        NMIs with Net Load   ADMELA = +180

Rules Clause 3.15.5(a)

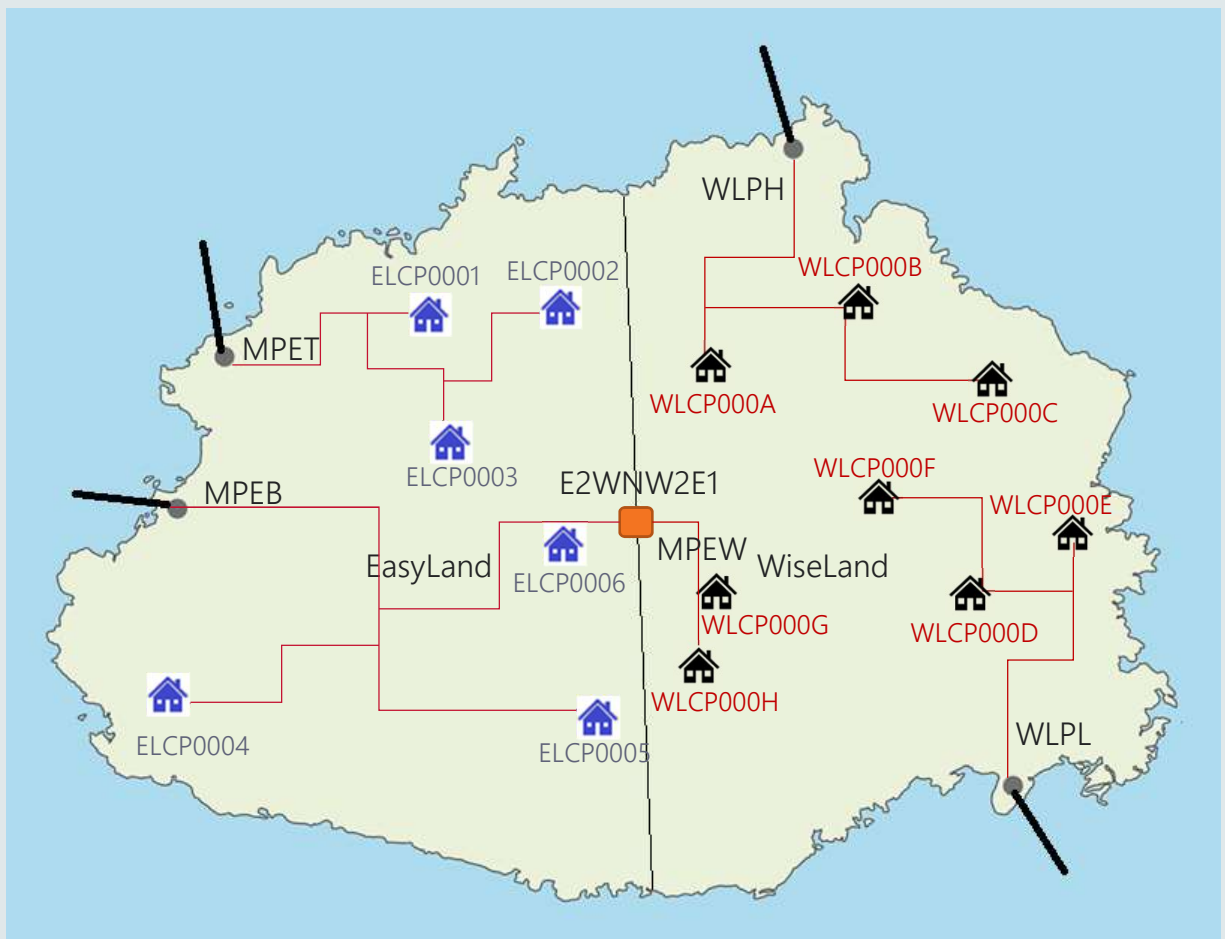   *UFE = TME – DDME – ADME*

    UFE = 250 – 62 – 180

    UFE = +8

    UFE Factor (UFEF) = UFE / ADMELA

    UFEF = 8 / 180

    UFEF = 0.04444444

    (Note: Decimal precision to be confirmed)

AEMO's Calculation of UFE and UFEF - EasyLand (TI 2)

Local Area 1 = EasyLand (*TI 2*)

    TNIs

        MPET = +110

        MPEB = +180   TME = +290

    Cross Boundary

        E2WNW2E1 = +58   DDME = +58

    NMIs *(DLF adjusted)*

        MPET ELCP0001 = +17

        MPET ELCP0002 = +37

        MPET ELCP0003 = +42

        MPEB ELCP0004 = +7

        MPEB ELCP0005 = +77

        MPEB ELCP0006 = +42   ADME = +222

    NMIs with Net Load   ADMELA = +222

Rules Clause 3.15.5(a)

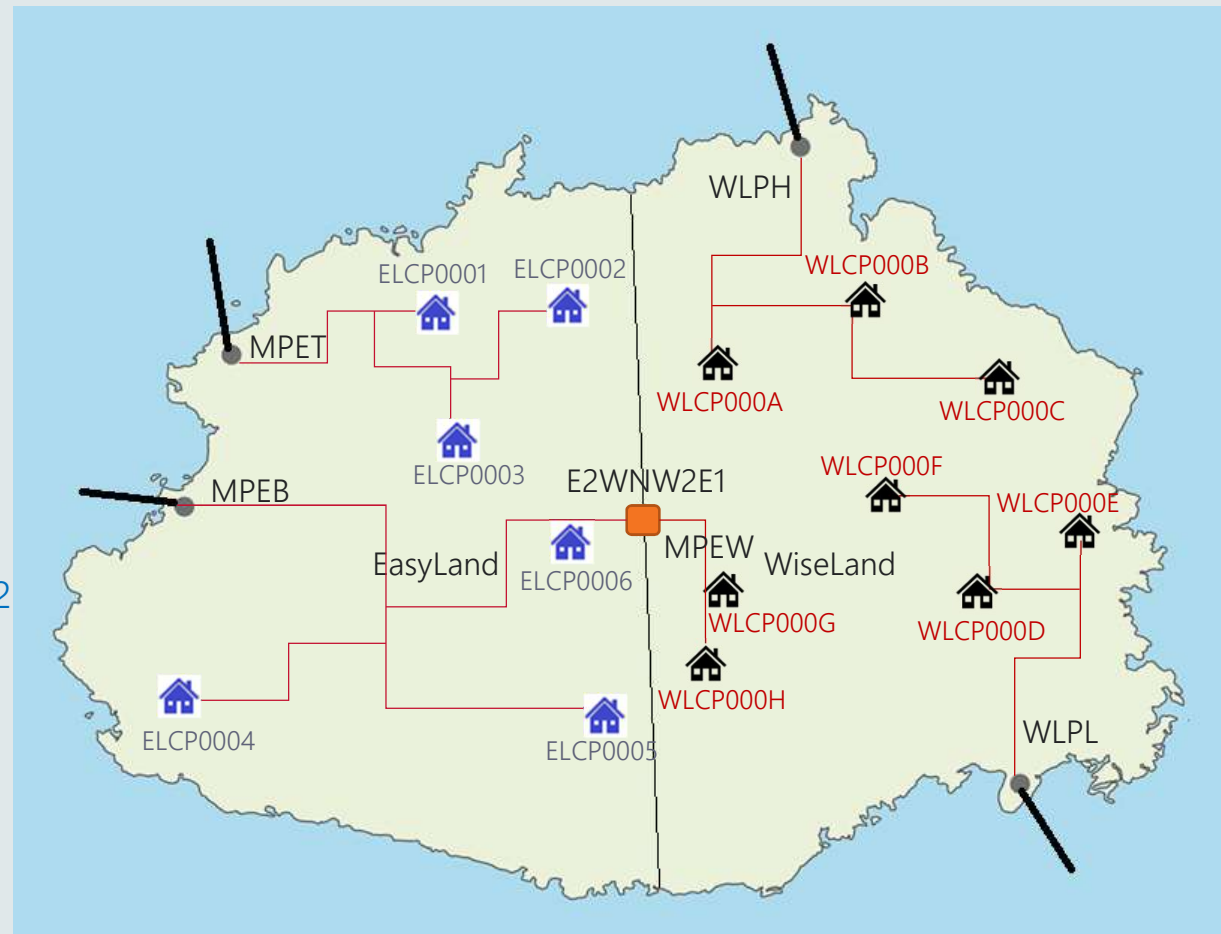   *UFE = TME − DDME − ADME*

    UFE = 290 − 58 − 222

    UFE = +10

    UFE Factor (UFEF) = UFE / ADMELA

    UFEF = 10 / 222

    UFEF = 0.04504505

    (Note: Decimal precision to be confirmed)

AEMO's Calculation of UFE and UFEF - WiseLand (TI 1)

Local Area 1 = WiseLand (*TI 1*)

    TNIs

        WLPH = +100

        WLPL = +100   TME = +200

    Cross Boundary

        E2WNW2E1 = -62   DDME = -62

    NMIs *(DLF adjusted)*

        WLPH WLCP000A = +10

        WLPH WLCP000B = +20

        WLPH WLCP000C = +40

        WLPL WLCP000D = +50

        WLPL WLCP000E = +15

        WLPL WLCP000F = +45

        MPEW WLCP000G = +10

        MPEW WLCP000H = +50   ADME = +240

        NMIs with Net Load   ADMELA = +240

Rules Clause 3.15.5(a)

    UFE = TME – DDME – ADME
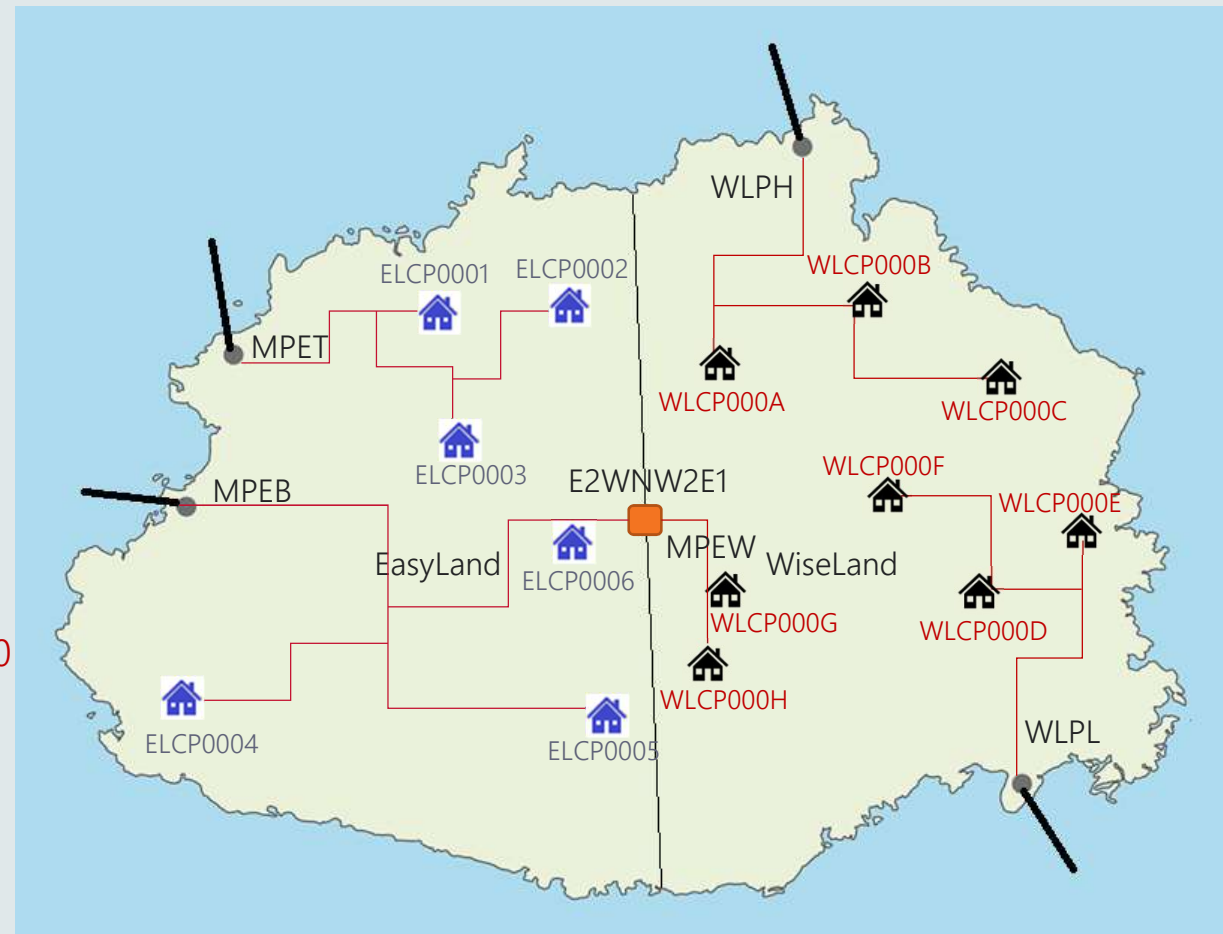
    UFE = 200 – (-62) – 240

    UFE = +22

    UFE Factor (UFEF) = UFE / ADMELA

    UFEF = 22 / 240

    UFEF = 0.09166667

    (Note: Decimal precision to be confirmed)

AEMO's Calculation of UFE and UFEF - WiseLand (TI 2)

Local Area 1 = WiseLand (*TI 2*)

    TNIs

        WLPH = +120

        WLPL = +130   TME = +250

    Cross Boundary

        E2WNW2E1 = -58   DDME = -58

    NMIs *(DLF adjusted)*

        WLPH WLCP000A = +47

        WLPH WLCP000B = +17

        WLPH WLCP000C = +37

        WLPL WLCP000D = +67

        WLPL WLCP000E = +57

        WLPL WLCP000F = +52

        MPEW WLCP000G = +52

        MPEW WLCP000H = -40   ADME = +289

        NMIs with Net Load   ADMELA = +329

Rules Clause 3.15.5(a)

    UFE = TME – DDME – ADME

    UFE = 250 – (-58) – 289

    UFE = +19

    UFE Factor (UFEF) = UFE / ADMELA

    UFEF = 19 / 329

    UFEF = 0.05775076

    (Note: Decimal precision to be confirmed)
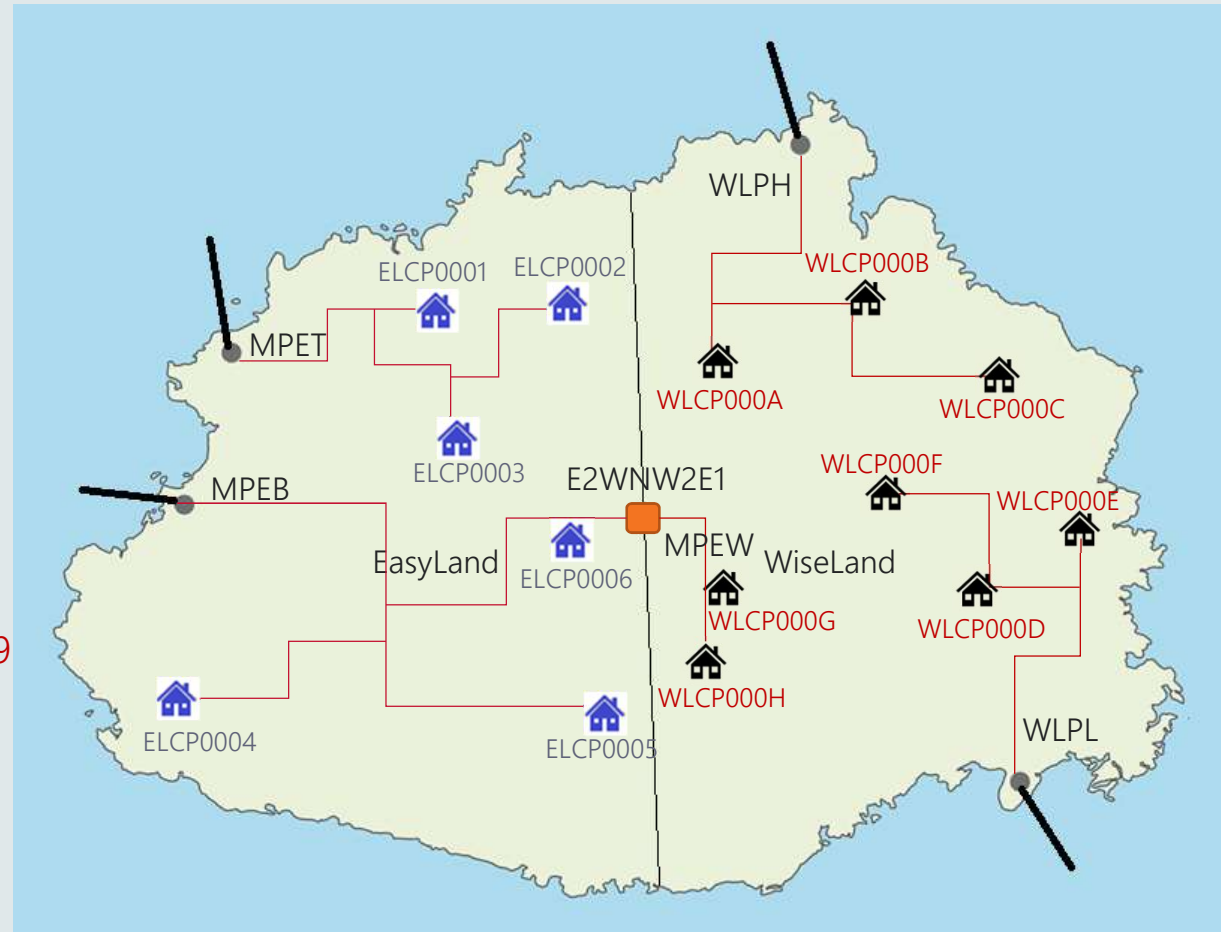
Mocked-up examples of RM reports

Paul Lyttle

Mocked-up examples of RM reports

Get NMI Standing Data → Get Metering Data → Calculate UFE and UFEF (AEMO) → Get RM Reports → Calculate UFEA → Calculate Trading Amounts → Reconcile Settlement Report → Pay Invoice → Investigate and Resolve Variances → Confirm Resolution at Next Settlement Cycle

RM43 Report Example

RM43 UFE Factor Value by Local Area:

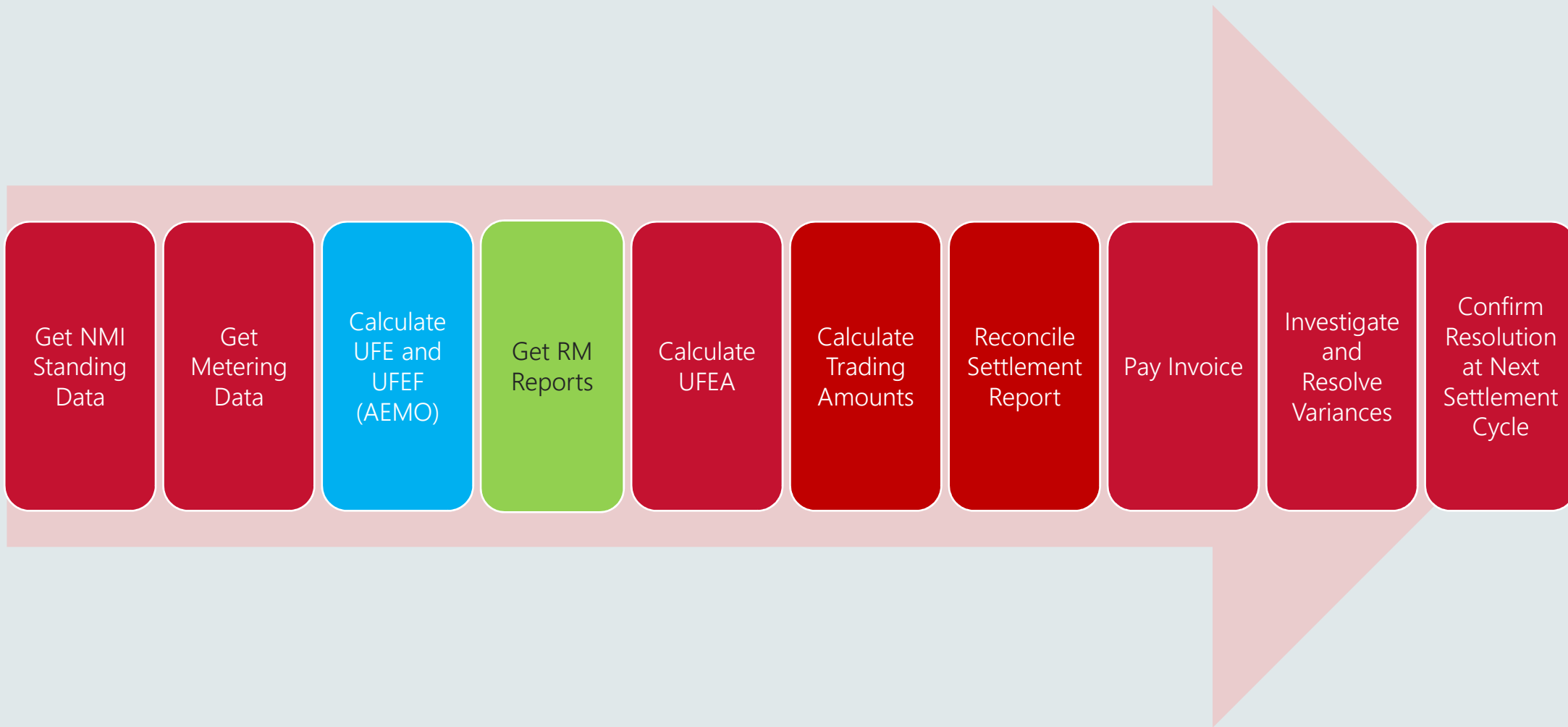|	
EasyLand (*TI 1*)	UFEF = 0.04444444
EasyLand (*TI 2*)	UFEF = 0.04504505
WiseLand (*TI 1*)	UFEF = 0.09166667
WiseLand (*TI 2*)	UFEF = 0.05775076

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RM46 UFE Validation Report

- Purpose to provide values to support the calculation of UFE and UFEF.
- New report to Identify each Local Area for each TI

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RM46 UFE Factor Value by Local Area

EasyLand	(TI 1)	(TI 2)
TME	250	290
DDME	62	58
ADME	180	222
UFE	8	10
ADMELA	180	222
UFEF	0.04444444	0.04504505

WiseLand	(TI 1)	(TI 2)
TME	200	250
DDME	-62	-58
ADME	240	289
UFE	22	19
ADMELA	240	329
UFEF	0.09166667	0.05775076

How to calculate UFEA - Example 1

The RM17 is a:

- NMI level settlement data report

- Providing interval data

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Calculation of UFEA (ELCP0001 ti1)

$UFEA = \text{Net Energy } t_i \times \text{UFEF } t_i$

$= 30 \times 0.04444444$

$= 1.33333$

The RM43 is a:

- UFE Factor report

- Providing a UFE factor for each time interval

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How to calculate UFEA - Example 2

The RM17 is a:

- NMI level settlement data report

- Providing interval data

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Calculation of UFEA (WLCP000H ti1)

UFEA = Net Energy t_i x UFEF t_i

     = 30 x 0.09166667

     = 2.7500001

Calculation of UFEA (WLCP000H ti2)

UFEA = Net Energy t_i x UFEF t_i

     = 0 x 0.05775076

     = 0

Net Energy for period is "Floored" to 0 therefore no UFE is allocated

The RM43 is a:

- UFE Factor report

- Providing a UFE factor for each time interval

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9876, F, EASYLAND, 2019/10/04, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 2
9876, F, EASYLAND, 2019/10/05, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 3
9876, F, EASYLAND, 2019/10/06, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 4
9876, F, EASYLAND, 2019/10/07, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 5
9876, F, EASYLAND, 2019/10/08, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 6
9876, F, EASYLAND, 2019/10/09, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 7
9876, F, WISELAND, 2019/10/03, 2019/10/20, 0.09166667, 0.05775076, , , , , 8
9876, F, WISELAND, 2019/10/04, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 9
9876, F, WISELAND, 2019/10/05, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 10
9876, F, WISELAND, 2019/10/06, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 11
9876, F, WISELAND, 2019/10/07, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 12
9876, F, WISELAND, 2019/10/08, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 13
9876, F, WISELAND, 2019/10/09, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 14
</csv data>
```

Using the UFEF with one or many NMIs

UFE Factors Value for EASYLAND

Applying UFEF to a single NMI Load

TNI	NMI	TI 1	TI 2
MPET	ELCP0001	+30	+17
	UFEF	0.04444444	0.04504505
	UFEA	1.33333	0.73577

Applying UFEF to a FRMP's Load

TNI	NMI	TI 1	TI 2
MPET	ELCP0001	+30	+17
MPET	ELCP0003	+40	+42
MPEB	ELCP0004	+25	+7
MPEB	ELCP0005	+35	+77
	Total	+130	+148
	UFEF	0.04444444	0.04504505
	UFEA	5.77777	6.66667

UFE Factors Value for WISELAND

Applying UFEF to a single NMI Load

TNI	NMI	TI 1	TI 2
WLPH	WLCP000C	+40	+37
	UFEF	0.09166667	0.05775076
	UFEA	3.66666	2.13677

Applying UFEF to a FRMP's Load

TNI	NMI	TI 1	TI 2
WLPH	WLCP000C	+40	+37
WLPL	WLCP000E	+15	+57
WLPL	WLCP000F	+45	+52
MPEW	WLCP000H	+50	0 *
	Total	+150	+146
	UFEF	0.09166667	0.05775076
	UFEA	13.75	8.43161

WLCP000H has a Net Energy inflow (Generation) of -40
(UFE is only allocated where there is load (in a TI),
therefore WLCP000H is 'Floored' to 0 KWh)

RM16 – Level 1 Settlement Reconciliation
RM27 – Level 2 Settlement Reconciliation

The **RM16**:

- Is an aggregated TNI settlement data report
- Provides interval data for each FRMP, LR & MDP combination

<csv data>
```
TNI,DataType,FRMP,LR,MDP,CreationDT,SettlementDate,Period001,Period002,....,SeqNo
WLPH,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/03,70,101, , , , , ,1
WLPH,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/04,0nnnn,0nnnn, , , , , ,2
WLPH,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/05,0nnnn,0nnnn, , , , , ,3
WLPH,I,FRMP1,, , , , , ,7
WLPL,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/03,110,176, , , , , ,8
WLPL,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/04,0nnnn,0nnnn, , , , , ,9
WLPL,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/05,0nnnn,0nnnn, , , , , ,10
WLPL,I,FRMP1,, , , , , ,14
MPEW,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/03,60,12, , , , , ,15
MPEW,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/04,0nnnn,0nnnn, , , , , ,16
MPEW,I,FRMP1,LR1,MDP123,2019/10/20,2019/10/05,0nnnn,0nnnn, , , , , ,17
MPEW,I,FRMP1,, , , , , ,21
```
</csv data>

The **RM27**:

- Is a NMI Level daily settlement data report
- Provides total daily NMI data

<csv data>
```
TNI,LR,MDP,SettlementDate,NMI,DataType,MSATS_Est,Total_Energy,SeqNo
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N,47,1
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N,n0000,2
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N, n0000,3
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N, n0000,4
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N, n0000,5
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N, n0000,6
MPET,LR1,MDP123,2019/10/03, ELCP0001,I,N, n0000,7
```
</csv data>

Notes:

- RM16 and RM27 are used to reconcile Energy Sales and Purchases, however, they are unable to be used to calculate UFEA. This is because the data contained in these reports are aggregated to <u>daily</u> and <u>participant combination levels</u> respectively, which is not the necessary level of granularity to reconcile UFEA.
- RM17 and RM43 reports are to be used for UFEA purposes.

Settlements - UFE allocation

Pierre Fromager

Settlements - UFE allocation

Get NMI Standing Data → Get Metering Data → Calculate UFE and UFEF (AEMO) → Get RM Reports → Calculate UFEA → Calculate Trading Amounts → Reconcile Settlement Report → Pay Invoice → Investigate and Resolve Variances → Confirm Resolution at Next Settlement Cycle
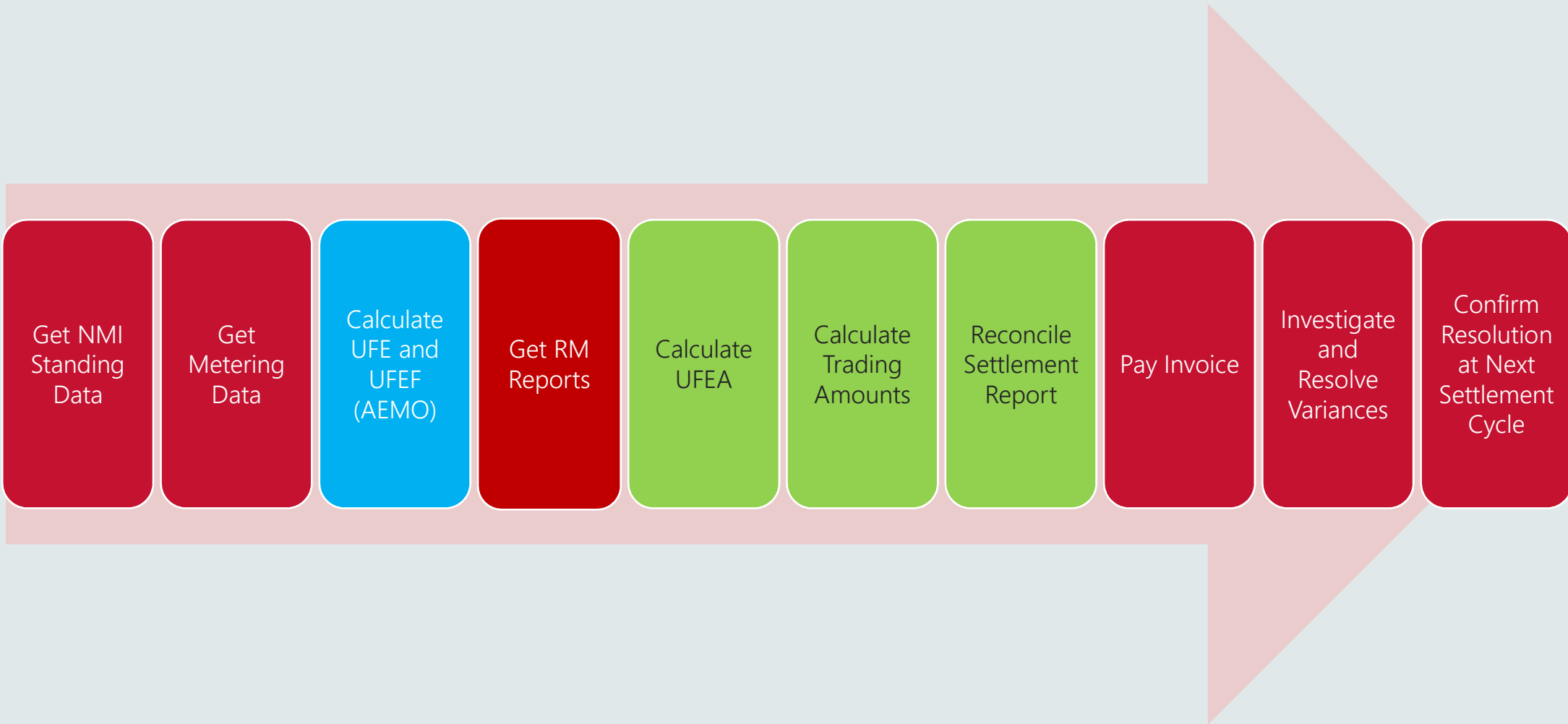
Introduction

- How Settlements
    - Receives and applies aggregated values from Metering
    - Calculates DME and ADMELA
    - Allocates UFEA
- Review of AGE (adjusted gross energy) and TA (trading amount)
- Embedded networks
- Reporting of ADME and UFEA
- Data Model tables
- Review invoices and statements

Aggregation

- Let AFE be 'accounted-for 'energy', adjusted by DLFs.

- Metering gathers import, export and net export data from each NMI and applies the DLF.

- It then aggregates these AFE quantities to a unique combination of Participant, TNI (or transmission connected generators and customers), NMI Classification and trading interval.

$$AFE = import - export$$

Warning

- **Metering Reports** (from MDPs and AEMO) reflect the direction of flow relative to the meter:
    - Negative (generation) to the meter
    - Positive (consumption) from the meter
    - Net Energy = consumption - generation (i.e. Net Energy)

- **Settlements** view the flow of energy <u>from</u> the grid
    - Positive (generation) to the grid
    - Negative (consumption) from the grid.
    - AFE = generation - consumption (i.e. Net Energy x -1)

Calculating DME and ADMELA

Scenario	Import (G)	Export (C)	Net (AFE)	Export Net
NMI 1 (Net consumption customer)	5	7	-2	2
NMI 2 (Net generation customer)	6	5	1	0
NMI 3 (Embedded Generator)	5	0	5	0
NMI 4 (Consumption customer)	0	12	-12	12

- DME = Export Net
  - e.g. the DME for NMI 4 above is -12

- ADMELA = sum of DME for the local area
  - i.e. assuming that these four NMIs represent the local area, the ADMELA would be -14 (-2+0+0-12)

Allocating UFE

- Metering also provides UFE for a local area, so Settlements can calculate UFEA:

$$UFEA = UFE \times \frac{DME}{ADMELA}$$

In Wiseland TI 2, for WLPH WLCP000A, UFEA = -19 * -47 / -329 = - 2.71428571

Resulting values

The Rules provide the following formulas

Metering Quantity

$$AGE = (ME \times DLF) + UFEA$$

i.e.

$$AGE = AFE + UFEA$$

Settlement Value

$$TA = AGE * TLF * RRP$$

Embedded Networks

- Continue to use 'settlement by difference':
  - The parent NMI's AFE is adjusted by the total of the AFE of all child NMIs in the network.
- The UFE allocation is then applied to resulting adjusted amounts.

- UFE = 21 − (10 + 10) = 1
- AGE for Papa =
  - DME = 10 - 1 − 1.5 = 7.5
  - UFEA = (7.5/21) x 1 = 0.35714
  - AGE = 7.5 + 0.35714 = 7.85714
- AGE for BigNRG =
  - 10 + 1.5 + 0.54762 = 12.04762
- AGE for MENRG =
  - 1 + 0.04762 = 1.04762

FRMP: GloPool
LR: Pool-NSW
21

WSYD

FRMP: BigNRG
LR: GloPool
10

Shopping Centre

FRMP: Papa
LR: GloPool
10

Embedded
Network

FRMP: MENRG
LR: Papa
1

FRMP: BigNRG
LR: Papa
1.5
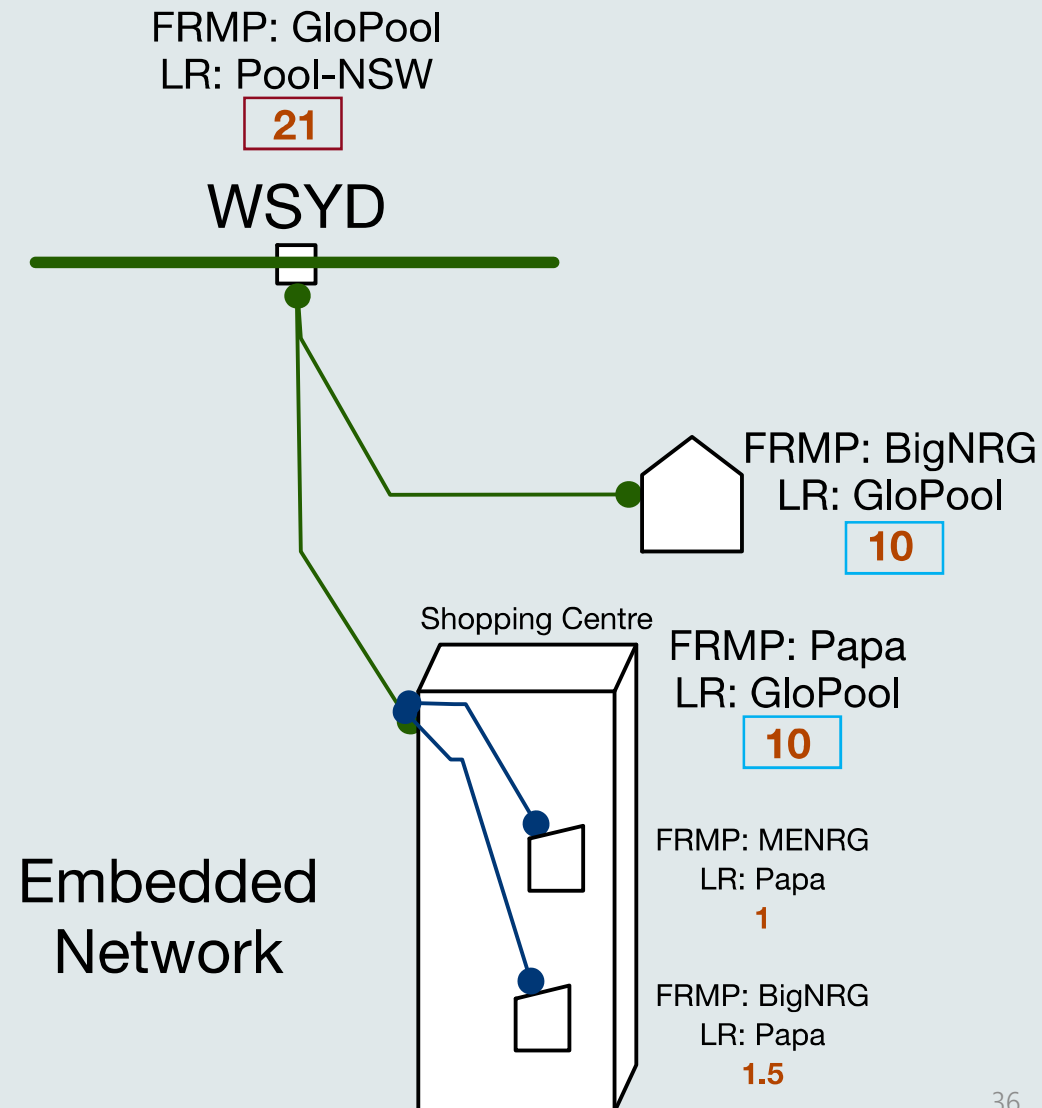
Review of AGE and TA

```
Energy Transactions
                                    Aggregate            Trading             UFE
                                 Energy (MWh)        Amount ($)    Allocated (MWh)
                              _____   _____   _____
Total Sales                      9,999,999.99    $9,999,999.99
Total Purchases                  9,999,999.99    $9,999,999.99          9,999.99
                              _____   _____   _____
Nett Sales (Purchases)           9,999,999.99    $9,999,999.99          9,999.99
```

- Total Sales: AGE and TA for 'Generator' or 'SGA' category.

- Total Purchases: AGE and TA for 'Customer' category,

- UFEA is provided as information only.
    - Prior to 6/2/22, AGE does not include UFEA
    - From 6/2/22, AGE does include UFEA – Report is not changed, just the value.

SR – Base energy summary

Until 5 Feb 2022

```
Energy Transactions
                            Aggregate         Trading            UFE
                         Energy (MWh)    Amount ($)    Allocated (MWh)

                         _____    _____    _____
Total Sales                      250    $25,000,00
Total Purchases                  289    $28,900.00               19

                         _____    _____    _____
Nett Sales (Purchases)          (39)    ($3,900.00)            (19)
```

From 6 Feb 2022, UFEA is added to Total Purchases.

```
Energy Transactions
                            Aggregate         Trading            UFE
                         Energy (MWh)    Amount ($)    Allocated (MWh)

                         _____    _____    _____
Total Sales                      250    $25,000,00
Total Purchases                  308    $30,800.00               19

                         _____    _____    _____
Nett Sales (Purchases)          (58)    ($5,800.00)            (19)
```

SR – Base energy detail

```
Sales (Purchases) by Transmission Connection Point
_____

Transmission                    Aggregate      Trading  Load Wtd Avg.      DME     UFEA
Node           Description    Energy (MWh)  Amount ($)  Price ($/MWh)     (MWh)    (MWh)
_____  _____   _____  _____  _____   _____  _____
AAAA1          Temporary          9,999.99   $9,999.99      $9,999.99   9,999.99 9,999.99
BBBB2          Temporary          9,999.99   $9,999.99      $9,999.99   9,999.99 9,999.99
CCCC3          Temporary          9,999.99   $9,999.99      $9,999.99   9,999.99 9,999.99
```

- This section of the SR report is changing with the addition of the DME and the UFEA for each transmission node.

- DME: total DME for this participant and transmission node, across this billing period.
- UFEA: total UFEA for this participant and transmission node, across this billing period.

Reporting – SR – Base energy detail

```
Sales (Purchases) by Transmission Connection Point
_____

Transmission               Aggregate      Trading   Load Wtd Avg.       DME    UFEA
Node          Description  Energy (MWh)  Amount ($)  Price ($/MWh)      (MWh)   (MWh)
_____  _____  _____  _____  _____   _____  _____
WLPH          Temporary       (101.00)  ($10,100.00)     $100.00    (101.00)    (5.83)
WLPL          Temporary       (176.00)  ($17,600.00)     $100.00    (176.00)   (10.17)
MPEW          Temporary        (12.00)   ($1,200.00)     $100.00     (52.00)    (3.00)
```

Note: Based on WiseLand (TI 2) Example

Data Model Tables: SETTLEMENT_DATA

SETCPDATA

Field Name	Data Type	Description
AFE	NUMBER (18,8)	Adjusted Gross Energy for this Market Customer FRMP and TNI in the trading interval, excluding any UFEA component.
DME	NUMBER (18,8)	Sum of "ME-" for all NMI's at this Market Customer FRMP and TNI in the trading interval.
UFEA	NUMBER (18,8)	Share of UFE allocated to this FRMP and TNI in the trading interval
AGE	NUMBER (18,8)	Adjusted Gross Energy for this Market Customer FRMP and TNI in the trading interval. This will include the UFEA value once financial settlement of UFE commences on 6th Feb 2022.

SETLOCALAREATNI

Field Name	Data Type	Description
SETTLEMENT DATE	DATE	Settlement date of the settlement run
SETTLEMENT RUN NO	INTEGER	Settlement run number of the settlement run
LOCAL AREA ID	STRING (30)	Unique identifier for the local area
TNI	STRING (30)	Unique identifier for a TNI constituent to the local area as-at the settlement run
LAST CHANGED	DATETIME	Last changed date for the record

SETLOCALAREAENERGY

Field Name	Data Type	Description
SETTLEMENT DATE	DATE	Settlement date of the settlement run
SETTLEMENT RUN NO	INTEGER	Settlement run number of the settlement run
LOCAL AREA ID	STRING (30)	Unique identifier for the local area
PERIOD ID	INTEGER	Period identifier
UFE	NUMBER (18,8)	Total unaccounted-for energy for the local area in this trading interval, in MWh
DDME	NUMBER (18,8)	DDME component of UFE for the local area in this trading interval, in MWh.
TME	NUMBER (18,8)	TME component of UFE for the local area in this trading interval, in MWh.
ADME	NUMBER (18,8)	ADME component of UFE for the local area in this trading interval, in MWh.
ADMELA	NUMBER (18,8)	The sum of all DME amounts for each Market Customer FRMP and TNI in the local area, in this trading interval.
LAST CHANGED	DATETIME	Last changed date for the record

FRMP Reconciliation

FRMPs can reconcile the AEMO settlement data in SETCPDATA using data they can access and applying the following process.

- MDFF $(E-B)_{NMI}$ = Net Energy$_{NMI}$
  Sum Net Energy$_{NMI}$ to TNI = AFE$_{TNI}$

- AFE$+_{NMI}$ x DLF = DME$_{NMI}$
  Sum DME$_{NMI}$ to TNI = DME$_{TNI}$

- DME$_{NMI}$ x UFEF$_{LA}$ = UFEA$_{NMI}$
  Sum UFEA$_{NMI}$ to TNI = UFEA$_{TNI}$

- AFE$_{NMI}$ x UFEA$_{NMI}$ = AGE$_{NMI}$
  Sum AGE$_{NMI}$ to TNI = AGE$_{TNI}$

SETCPDATA

Field Name	Data Type	Description
AFE	NUMBER (18,8)	Adjusted Gross Energy for this Market Customer FRMP and TNI in the trading interval, excluding any UFEA component.
DME	NUMBER (18,8)	Sum of "ME-" for all NMI's at this Market Customer FRMP and TNI in the trading interval.
UFEA	NUMBER (18,8)	Share of UFE allocated to this FRMP and TNI in the trading interval
AGE	NUMBER (18,8)	Adjusted Gross Energy for this Market Customer FRMP and TNI in the trading interval. This will include the UFEA value once financial settlement of UFE commences on 6th Feb 2022.

Data Model Tables – BILLING_RUN

Gen: Billing_Run: Billing Gen Data   CP: Billing_Run: Billing CP Data

Field	Provenance (DB/ DM)
AGE	Sales: Sum (Gen. Aggregate Energy) Purchases: Sum (CP. Aggregate Energy) + Sum (Gen. Purchased Energy)
TA	Sales: Sum (Gen. Sales) Purchases: Sum (CP. Purchases) + Sum (Gen. Purchases)
UFEA	Sum (CP. UFEA)
Total	Sum of each column: AGE, TA, UFEA.
TNI	Gen. Connection Point ID *and* CP. Connection Point ID
DME	Sum (CP. DME)

Invoicing – Base energy detail

Supplies made by AEMO

Taxable supplies

Description	GST Exclusive ($)
Energy 24,234 MWh	-6,858.39
Ancillary Service	-557,113.73

For context, the invoice shows the energy quantity and value. This is the AGE and the TA. This is not changing, except in look and feel and the layout of GST values.

Note: UFE will not be published as a dollar value in the tax invoice, although participants can 'derive' a notional dollar value for it.

- Supplies made by AEMO - Energy: purchased energy either by customer or generator, with associated trading amount.

- Supplies made to AEMO - Energy: sold energy by generator, with associated trading amount.
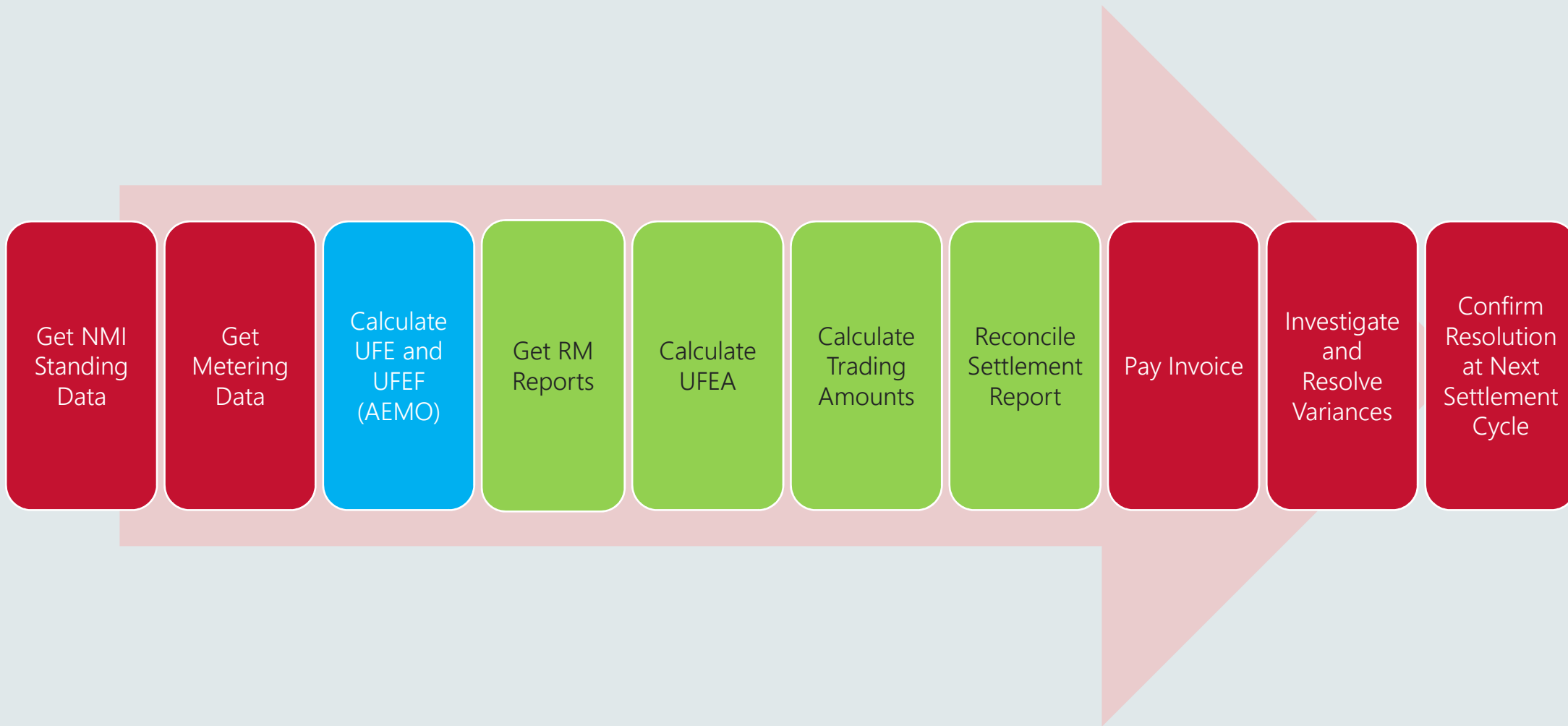
Invoicing – Summary

- All energy values are aggregated to one energy value in the summary.

Description	$
Energy	834,067.84
Ancillary Services	189,190.74

Checkpoint

Blaine Miner

High-Level Reconciliation Overview

Get NMI Standing Data → Get Metering Data → Calculate UFE and UFEF (AEMO) → Get RM Reports → Calculate UFEA → Calculate Trading Amounts → Reconcile Settlement Report → Pay Invoice → Investigate and Resolve Variances → Confirm Resolution at Next Settlement Cycle

Calculate UFEA (NMI/TNI Level)

Based on calculation of UFE and UFEF – Wiseland TI 2

Local Area 1 = WiseLand (*TI 2*)

TNIs   WLPH = **+120**

      WLPL = +130   TME = +250

Cross Boundary

     E2WNW2E1 = -58   DDME = -58

NMIs *(DLF adjusted)*

   WLPH WLCP000A = +47
   WLPH WLCP000B = +17
   WLPH WLCP000C = +37
   WLPL WLCP000D = +67
   WLPL WLCP000E = +57
   WLPL WLCP000F = +52
   MPEW WLCP000G = +52
   MPEW WLCP000H = -40   ADME = +289

NMIs with Net Load   ADMELA = +329

   UFE = 250 – (-58) – 289
   UFE = **+19**

UFE Factor (UFEF) = UFE / ADMELA

   UFEF = 19 / 329
   UFEF = 0.05775076
   (Note: Decimal precision to be confirmed)

The RM17:

<csv data>
SettlementDate,NMI,Suffix,CreationDT,Period001,Period002,Period..., StatusFlags,SeqNo
2019/10/03, WLCP000A,N1,2019/10/20,**47**,, , , , ,AA.....,1
2019/10/04, WLCP000A,N1,2019/10/20,n0000,n0000, , , , ,AA.....,2
2019/10/04, WLCP000A,N1,2019/10/20,n0000,n0000, , , , ,AA.....,3
2019/10/04, WLCP000A,N1,2019/10/20,n0000,n0000, , , , ,AA.....,4
2019/10/04, WLCP000A,N1,2019/10/20,n0000,n0000, , , , ,AA.....,5
2019/10/04, WLCP000A,N1,2019/10/20,n0000,n0000, , , , ,AA.....,6
2019/10/04, WLCP000A,N1,2019/10/20,n0000,n0000, , , , ,AA.....,7
</csv data>

The RM43:

<csv data>
CASEID, SETTLMENTTYPE, LOCALAREA, SETTLMENTDATE, CREATIONDATE, PERIOD001, PERIOD002, PERIOD..., SEQ
9876, F, EASYLAND, 2019/10/03, 2019/10/20, 0.04444444, 0.04504505, , , , , 1
9876, F, EASYLAND, 2019/10/04, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 2
9876, F, EASYLAND, 2019/10/05, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 3
9876, F, EASYLAND, 2019/10/06, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 4
9876, F, EASYLAND, 2019/10/07, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 5
9876, F, EASYLAND, 2019/10/08, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 6
9876, F, EASYLAND, 2019/10/09, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 7
9876, F, WISELAND, 2019/10/03, 2019/10/20, 0.0916666, **0.05775076**, , , , , 8
9876, F, WISELAND, 2019/10/04, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 9
9876, F, WISELAND, 2019/10/05, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 10
9876, F, WISELAND, 2019/10/06, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 11
9876, F, WISELAND, 2019/10/07, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 12
9876, F, WISELAND, 2019/10/08, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 13
9876, F, WISELAND, 2019/10/09, 2019/10/20, 0.0nnnn, 0.0nnnn, , , , , 14
</csv data>

Reconcile Settlement Report Values

```
Sales (Purchases) by Transmission Connection Point
_____
```

Transmission Node	Description	Aggregate Energy (MWh)	Trading Amount ($)	Load Wtd Avg. Price ($/MWh)	DME (MWh)	UFEA (MWh)
WLPH	Temporary	(101.00)	($10,100.00)	$100.00	(101.00)	(5.83)
WLPL	Temporary	(176.00)	($17,600.00)	$100.00	(176.00)	(10.17)
MPEW	Temporary	(12.00)	($1,200.00)	$100.00	(52.00)	(3.00)

Local Area 1 = WiseLand (*TI 2*)

TNIs   WLPH = **+120**
        WLPL = +130   TME = +250

Cross Boundary

        E2WNW2E1 = -58   DDME = -58

NMIs *(DLF adjusted)*

        WLPH WLCP000A = +47
        WLPH WLCP000B = +17
        WLPH WLCP000C = +37
        WLPL WLCP000D = +67
        WLPL WLCP000E = +57
        WLPL WLCP000F = +52
        MPEW WLCP000G = +52
        MPEW WLCP000H = -40   ADME = +289
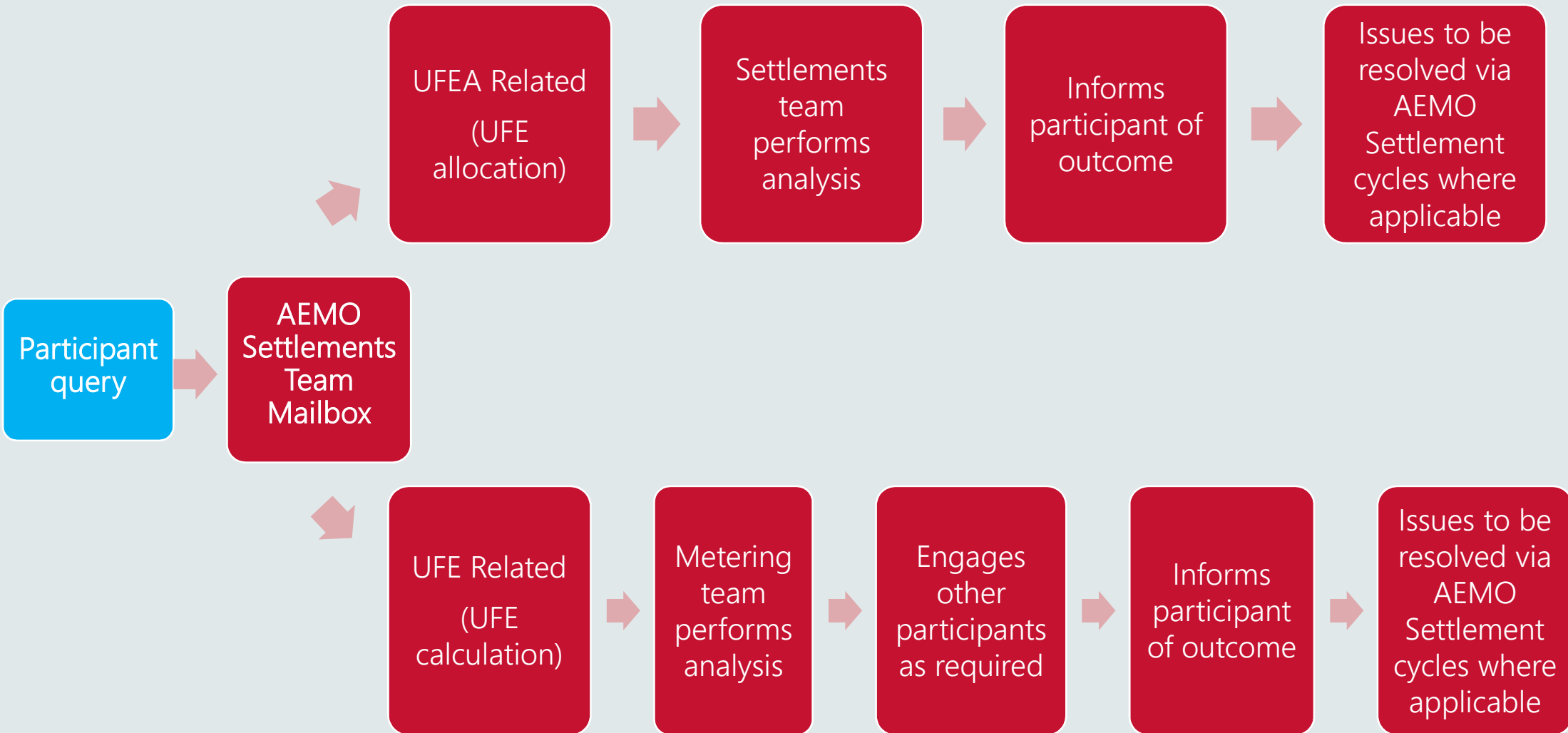   NMIs with Net Load   ADMELA = +329

UFE = 250 − (-58) − 289
UFE = +19

UFE enquiry management

Dimi Botha

Internal AEMO Approach

Participant query → AEMO Settlements Team Mailbox

Top flow (UFEA Related):
UFEA Related (UFE allocation) → Settlements team performs analysis → Informs participant of outcome → Issues to be resolved via AEMO Settlement cycles where applicable

Bottom flow (UFE Related):
UFE Related (UFE calculation) → Metering team performs analysis → Engages other participants as required → Informs participant of outcome → Issues to be resolved via AEMO Settlement cycles where applicable

General questions

Blaine Miner

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Appendix:

A. Detailed formulas
B. Acronyms and terms

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

A. Detailed Formulas

Aggregation - AFE

PID: participant ID

wcp: wholesale connection point (TNI or NMI)

IE: Import energy, adjusted by DLF

EE: Export energy, adjusted by DLF

Energy Category (EC):

- Customer
- Generator
- SGA
- Interconnector

$$es: pid, wcp, ec, ti$$

$$AFE_{es} = IE_{es} - EE_{es}$$

Aggregation - DME

$\forall$: "For all", "for each"
$\in$: "is an element of"
EEN: Export Energy Net

$$ec = 'Customer'$$

$$DME_{es} = \sum EEN_{es}$$

$$\forall\, pid \in PID$$
$$\forall\, ec \in EC$$
$$\forall\, wcp \in WCP_{la}$$

$$ADMELA_{la,ti} = \sum DME_{es}$$

Allocated UFE

$$UFEA_{es} = UFE_{la,ti} \times \frac{DME_{es}}{ADMELA_{la,ti}}$$

$$es: pid, wcp, ec, ti$$

Resulting values

d: Settlement day
r: Region to which the TCP or TNI belongs

$$d: ti \in d$$
$$r: wcp \in r$$

$$AGE_{es} = AFE_{es} \times UFEA_{es}$$

$$TA_{es} = AGE_{es} \times TLF_{wcp,d} \times RRP_{r,ti}$$

$$es: pid, wcp, ec, ti$$

B. Acronyms and Terms

Acronyms and Terms

AGE	*Adjusted gross energy*, which is the quantity (in MWh) that is used to calculate a FRMPs TA
AFE	*Accounted-for energy*
DLF	*Distribution loss factor*
FRMP	*Financially responsible market participant*
NMI	*National metering identifier*, which is used to identify a *specific connection point*
quantity	In this presentation, applies to electrical flows and has a unit of measure of MWh (unlike 'values', which are understood to be financial values)
RRP	*Regional reference price*
TA	*Trading amount*, which is payable by (or to) a FRMP *Equals:* AGE x TLF x RRP
TI	*Trading interval*, a 30 minute period ending on the hour (EST) or on the half hour and, where identified by a time, means the 30 minute period ending at that time.
TLF	*Transmission loss factor*
TNI	*Transmission node identifier*, which is used to identify a *transmission network connection point* (that is sometimes referred to as 'a wholesale connection point')

'UFE-specific' Acronyms (1)

From rule 3.15.5(a)	
TME	'transmission metered energy', is the quantity of *energy* flowing at a TNI for a TI. It is positive where the flow is towards to a TNI (i.e. generation) and negative where the flow is away from a TNI (i.e. load) Equals: the sum of metered energy (or ME) flowing into and out of a LA at a TNI
ME	'metered energy', is the quantity of flow at a NMI. It is positive where the flow is towards to the TNI (i.e. generation) and negative where the flow is away from the TNI (i.e. load) [rule 3.15.4(b)]
DDME	'distributor to distributor metered energy', is the quantity flowing from one LA to an adjacent LA, at a NMI, for a TI. It is negative where the flow is towards the adjacent *distribution network* and positive if it s in the other direction. Equals: the sum of all ME that crosses the boundary (i.e. flows into and out of) a LA
ADME	'adjusted distribution metered energy', is the aggregated quantity of all flows at a *market connection point* (or NMI with a FRMP) for a TI, adjusted by a NMI-specific DLF Equals: sum of ME x DLF for all NMIs in a LA
UFE	'unaccounted-for energy' quantity, is the difference between the metered flows into and out of a LA, for a TI Equals: sum of ME at TNIs for a LA (TME) plus/minus flows from/to another LA (DDME) minus load, or flows out of the LA (ADME)

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'UFE-specific' Acronyms (2)

From rule 3.15.5(c)	
ME-	The ME- quantity is the Net Energy quantity for a distribution network connection point for a TI **but** only when it is negative (i.e. has load). So, ME- is subject to the 'Floored Load' and is zero for (a) GENERATR or NREG NMI classification codes and (b) NMIs where local generation (e.g. from solar panels) exceeds the load.
DME	'distribution metered energy' quantity, is the sum of single and bi-directional flows at a NMI, and is subject to the Floored Load Equals: ME- x DLF
ADMELA	'adjusted distribution metered energy for a LA' quantity, is the sum of DMEs for a LA, for a TI and is subject to the Floored Load Equals: sum of all DMEs, for a LA
UFEA	'unaccounted for *energy* – allocated', is the quantity of UFE allocated to an individual NMI. Equals: UFE x (DME / ADMELA) , where DME = ME x DLF
Used to calculate UFEA	
UFEF	'unaccounted for energy factor', is used to allocate the UFE for a LA to one or many loads at NMIs that have FRMPs (i.e. *market connection points*), for a TI. It is the ratio of UFE to the total load for a LA (adjusted by DLF) and is not rounded. Equals: UFE / ADMELA

Thank you for your attendance and participation ☺