

Complex Billing Concepts

Oracle's commitment to modern utilities' AMI related billing needs

Name

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Oracle Energy & Water

March 13, 2023 1PM

San Diego Trivia!

What is the name of the local professional baseball team?



It was the Franciscan Friars -- Father Junípero Serra and Don Caspar de Portolá -- who founded the first Spanish colony in southern California. "Padre," of course, is Spanish for "Father" or "Friar" and **the name stems directly from the priests who established the first Spanish Missions in California in 1769.**

Our Mission

To provide the best meter solutions to address the world's energy and water challenges.



Accurate Billing and Settlement per market rules

- Market Trends
- Best Utility Practice
- A solution that will grow and evolve with industry trends

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The Agenda

1. Complex Billing
→ What does it mean?

2. Oracle's E&W commitment to addressing evolution of billing

3. Key use cases introduced with AMI and leveraging product features and concepts

What is Complex Billing?

- **Meter and Management of Meter Data is complex**
 - Typically, multi-accounts, multi-premise, multi-meter/multi-channels per meter, bi-directional metering, etc. with complex relationships
 - Totalization, Aggregation, Balancing, Imbalance, Netting,
- **Charge calculation is complex**
 - Multi-Layers of Service Agreements may exist.
 - Contract Options, renewals, cancellations
- **Invoice presentation is complex**
 - Multi-page invoice and/or statement
 - Almost always requires ALL interval data to be sent to customer.
 - Some require a specific MS-Excel spreadsheet to be submitted as invoice
- **Billing process is complex**
 - Accrual
 - True-up / Re-statement
 - Prior-period adjustments
 - Adjustments to Adjustments

Quick question...

OPEN YOUR ORACLE EVENTS APP

- *Navigate to our session*
- *Click on polls*
- *Select poll to vote*

OPEN & SHARE RESULTS >> [HERE](#)

When rolling out a new rate tariff/ program, what is your biggest hurdle in supporting new customer rate initiatives today?

- A. Ensuring ability of metering solution to provide bill determinants to CIS
- B. Ensuring CIS and Rating engine has capability to support new tariff calculations
- C. Presentation of Customer Invoice
- D. Customer Engagement/ Rate Adoption



Oracle's E&W commitment to addressing evolution of billing

Oracle E&W Products with Complex Billing Capabilities

On-Premise

CC&B

Customer Care & Billing

- The Rating Side of Complex Billing
- Requires an MDM
- Requires pre-calculated “complex” Billing Determinants

MDM/AMS

Meter Data Management/ Advanced Metering System

- AMS is same as MDM but adds ability to manage interval measurement
- Allows complex interval billing determinant calculations
- Requires integration to a Rating system, i.e., CC&B

C2M +AMS

Customer to Meter

- MDM & CC&B in a single instance
- All capabilities of CC&B and MDM
- Includes the following capabilities:
 - Customer Operations
 - Service Orders
 - Revenue Management
 - Device Management
 - Meter Data Management
 - Head-End Integration (note: specific AMI Vendor adapters are extra cost)

CCS + AMS

Customer Cloud Service

- Cloud version of C2M
- Includes the following:
 - BI Publisher for invoicing
 - Includes all currently supported AMI Vendor adapters
 - OUAV – Oracle Utilities Analytics Visualization

MSCS

Meter Solution Cloud Service

- Exact capabilities of MDM+AMS
- Includes the following:
 - Includes all currently supported AMI Vendor adapters
 - OUAV – Oracle Utilities Analytics Visualization

SaaS

BCS

Billing Cloud Service

- Standalone Complex Billing Solution
- All Features of CCS minus:
 - Credit & Collections
 - Service Orders
 - Device Management

End to end usage to invoice process

Business users can design, build, and maintain without coding

Step 1: Cleanse Usage

- Measurement data is loaded
- Validation, Editing, and Estimation is performed
- Additional values are derived (gallons to thousand gallons)

Step 2: Apply Usage Rules

- Calculate bill determinants
 - Totalize usage
 - Usage Variance calculations
 - Request approval
- Check if threshold was exceeded

Step 3: Calculate Charges

- Leverage out of the box calculation rule types: flat charges, service quantities, stepped service quantities, minimums, maximums, apply to, perform math
- Apply prices
- Perform GL mapping

Step 4: Generate Bill

- Invoice extract is created for printing / email / posting to the web
- Support for both XML extract and/or a flat file

METER

CASH

Standard Configuration

Advanced pre-built bill determinants and rating calculations

STANDARD PRECONFIGURED RULES		
Usage Rules 	Vector and Service Quantity Math	Rating Rules 
<ul style="list-style-type: none">Defines the calculation of Billing Determinants for use by the Rating<ul style="list-style-type: none">Residential, commercial, and industrial billing supportSimple Scalar/Register ReadsSimple Interval TotalizationInterval Time-of-UseSupport for unmetered itemsCurtailmentsDemand Response<ul style="list-style-type: none">Critical Peak Periods (CPP)Peak Time Rebate (PTR)Peak Values (Coincident / Non-Coincident)Interval Curves (Real or Derived)Validation against a ToleranceRule to call other Usage GroupsEligibility Criteria	<ul style="list-style-type: none">Library of functions: Math, Trigonometric, etc.Math Expressions (SQRT (X^2 + Y^2))Conditional Expressions (IF X > Y THEN X+Y ELSE X*Y)Combination of abovePowerful user-interface allows customers to write complex formulas	<ul style="list-style-type: none">Defines the pricing for products offered to the market.<ul style="list-style-type: none">Tariff / Contract BillingUnlimited number of charge linesProration is handled automaticallyConsumption values may be further manipulated, if needed.Testing and checking rates:<ul style="list-style-type: none">What-if AnalysisValidating Billing Queries from customersCalculating quotes for salesSummary Billing for many servicesCancel/RebillBillable charges for 3rd party calculations

Key use cases introduced with AMI and leveraging product features and concepts

Charlie is responsible for rates



Charlie
“Billing and Rating
Analyst”

1. Transition from Register to Interval or TOU based billing



2. Demand Response/
Event base pricing e.g. Peak
Time Rebate



3. Net Energy Metering
and Community Solar
Programs



4. Complex Pricing and
Contracts



1. Transition from Register to Interval based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

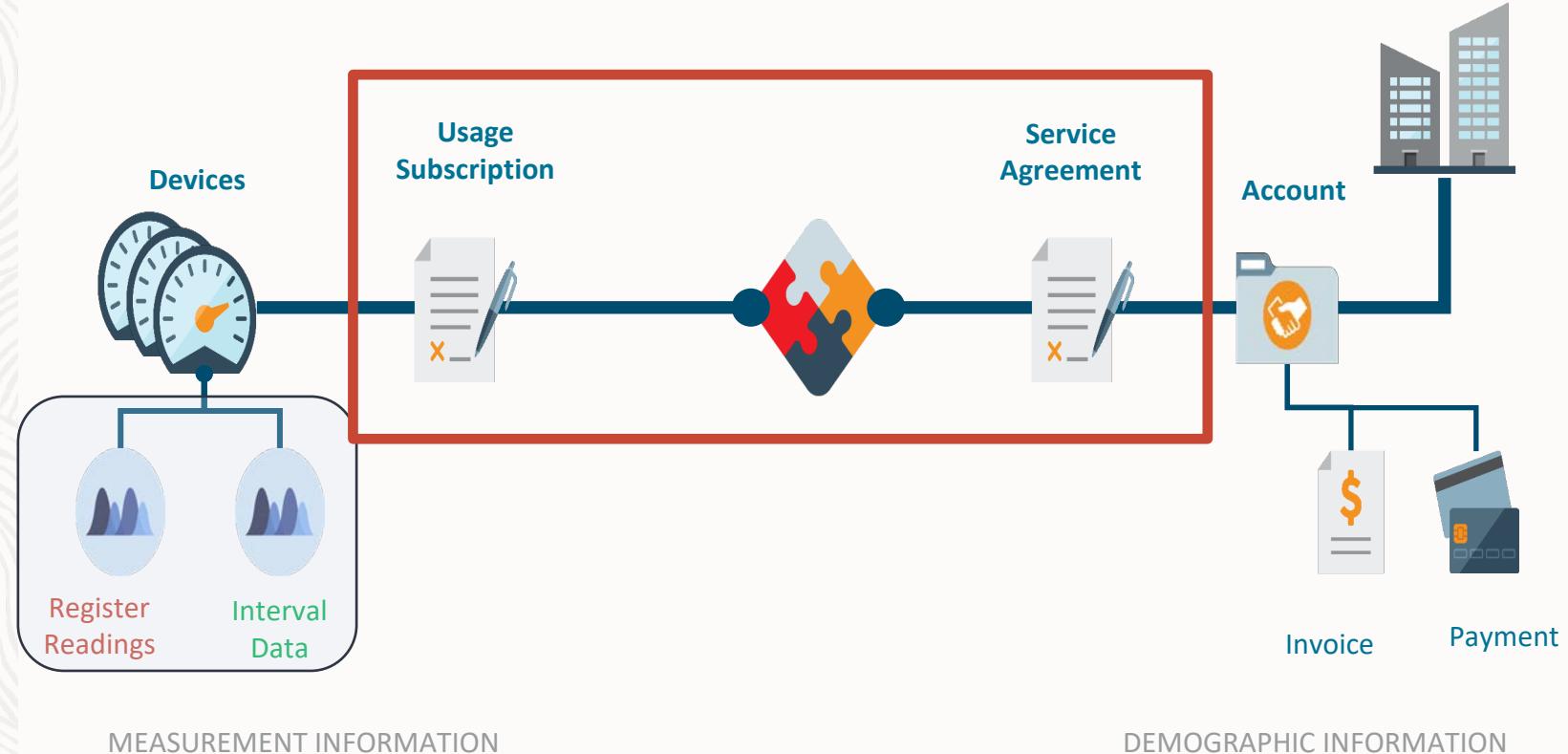
3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Standard Data Model

Standard data model allows for register and interval data billing

Customer



1. Transition from Register to Interval based billing

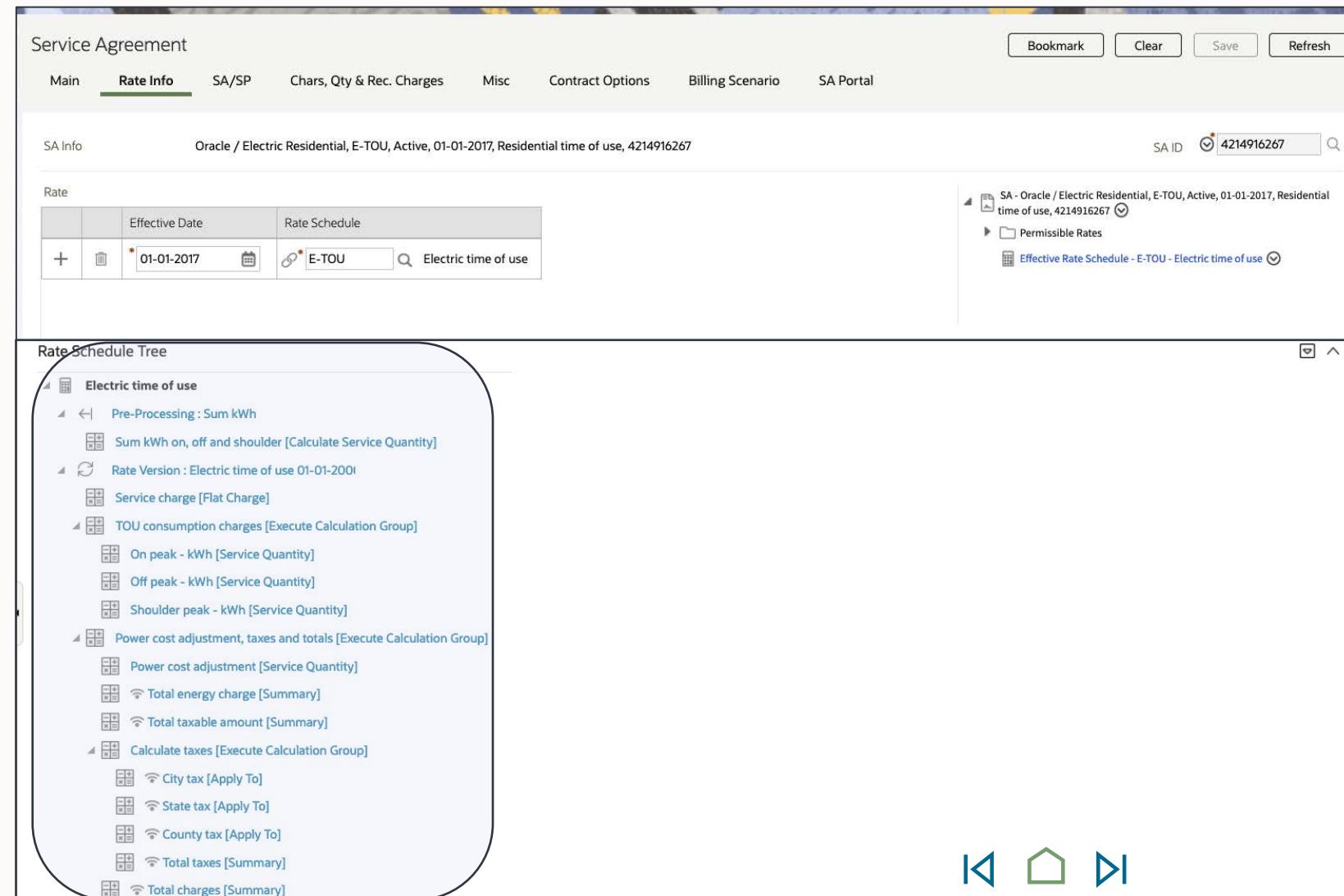
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Service Agreement- Rate Schedule

Rate Schedule defines rules required for billing calculations...



Service Agreement

Main Rate Info SA/SP Chars, Qty & Rec. Charges Misc Contract Options Billing Scenario SA Portal

SA Info Oracle / Electric Residential, E-TOU, Active, 01-01-2017, Residential time of use, 4214916267 SA ID 4214916267

Rate

	Effective Date	Rate Schedule
+	01-01-2017	E-TOU

Rate Schedule Tree

- Electric time of use
 - Pre-Processing : Sum kWh
 - Sum kWh on, off and shoulder [Calculate Service Quantity]
 - Rate Version : Electric time of use 01-01-2001
 - Service charge [Flat Charge]
 - TOU consumption charges [Execute Calculation Group]
 - On peak - kWh [Service Quantity]
 - Off peak - kWh [Service Quantity]
 - Shoulder peak - kWh [Service Quantity]
 - Power cost adjustment, taxes and totals [Execute Calculation Group]
 - Power cost adjustment [Service Quantity]
 - Total energy charge [Summary]
 - Total taxable amount [Summary]
 - Calculate taxes [Execute Calculation Group]
 - City tax [Apply To]
 - State tax [Apply To]
 - County tax [Apply To]
 - Total taxes [Summary]
 - Total charges [Summary]

1. Transition from Register to Interval based billing

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Rate Schedule

....but also validates appropriate device configuration

Rate Schedule: Electric time of use

Main

Rate Schedule

Rate Schedule	E-TOU ⓘ
Description	Electric time of use
Service Type	Electric
Frequency	Monthly
Currency Code	United States Dollars
Allow Estimates	Yes
Allow RV Proration	Yes
RV Selection Date	

Pre-Processing Calculation Groups ⓘ [Add Calculation Group](#)

Sequence	Description	Calculation Group	Rule Cross Reference
10	Sum kWh on, off and shoulder	Sum kWh	Add/Remove Links

Rate Version Calculation Groups ⓘ [Add Calculation Group](#)

Effective Date	Description On Bill	Calculation Group	Rule Cross Reference
01-01-2000	Electric time of use %D	Electric time of use	Add/Remove Links

Post-Processing Calculation Groups ⓘ [Add Calculation Group](#)

Sequence	Description	Calculation Group	Rule Cross Reference

Record Actions ⓘ

[Edit](#) [Delete](#) [Duplicate](#)

Record Information

Valid Device Configuration Types ⓘ

Device Configuration Type

- Electric Manual Read - kWh TOU - Scalar
- Electric Auto Read - kWh - 60 min intervals

[Go to CCB Rate Schedule Extendable Lookup](#)

Bill Messages ⓘ

Bill Message	Start Date	End Date
Earth Day	03-12-2017	04-12-2017

1. Transition from Register to Interval based billing

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Rate Schedule – Usage Subscription

Provide a relationship link to how the usage should be calculated in supporting the Rate Schedule

Usage Subscription: Keller,James / Electric - Residential / 01-01-2017 0:00:00 PST / Active

Main Log

Usage Subscription

Main

Information	Keller,James / Electric - Residential / 01-01-2017 0:00:00 PST / Active
Usage Subscription Type	Electric - Residential
Division	California
Access Group	
Status	Active
Start Date/Time	01-01-2017 0:00:00 PST
End Date/Time	
Usage Recipient	Customer to Meter
Usage Approval	Not Required
External ID	4214916267
Main Contact	Keller,James
Time Zone	US Pacific Time

Processing Information

Most Recent Usage Transaction Date/Time	03-01-2017 0:00:00 PST
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Service Points

Service Point	Start Date/Time	Override Start Date/Time	Stop Date/Time	Override Stop Date/Time	Usage	Use Percent
375 Harrison St. #101, San Francisco, CA, 94107 / Electric Residential / Electric / ER-SM-902 / Active	01-01-2017 0:00:00 PST				Add	100

Record Actions

Record Information

Factor Overrides

Factor	Start Date/Time	End Date/Time	Value
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Usage Calculation Groups

Effective Date/Time	Expiration Date/Time	Calculation Group
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Fallback Usage Calculation Groups

Effective Date	Calculation Group
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Rate History

Effective Date	Rate
01-01-2017	E-TOU

Measuring Components

Relationship Type	Measuring Component
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1. Transition from Register to Interval based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

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Rate Schedule – Extendable Look-up Configuration

Provide a relationship link to how the usage should be calculated in supporting the Rate Schedule

Extendable Lookup Value

Main	
Rate	E-TOU
Description	Electric time of use
Override Description	
Detailed Description	
Default Usage Calculation Group	
Calculation Group	Electric - Time of Use

Record Actions: Edit, Delete, Duplicate

Record Information

Override

Device Configuration Type	Calculation Group
Electric Auto Read - kWh - 60 min intervals	Electric - TOU (on/off/sh) & Demand with register reads

Established default usage calculation e.g. requires standard scalar/ register reads to support billing

Applies override usage calculation based on change or type of device configuration

1. Transition from Register to Interval based billing

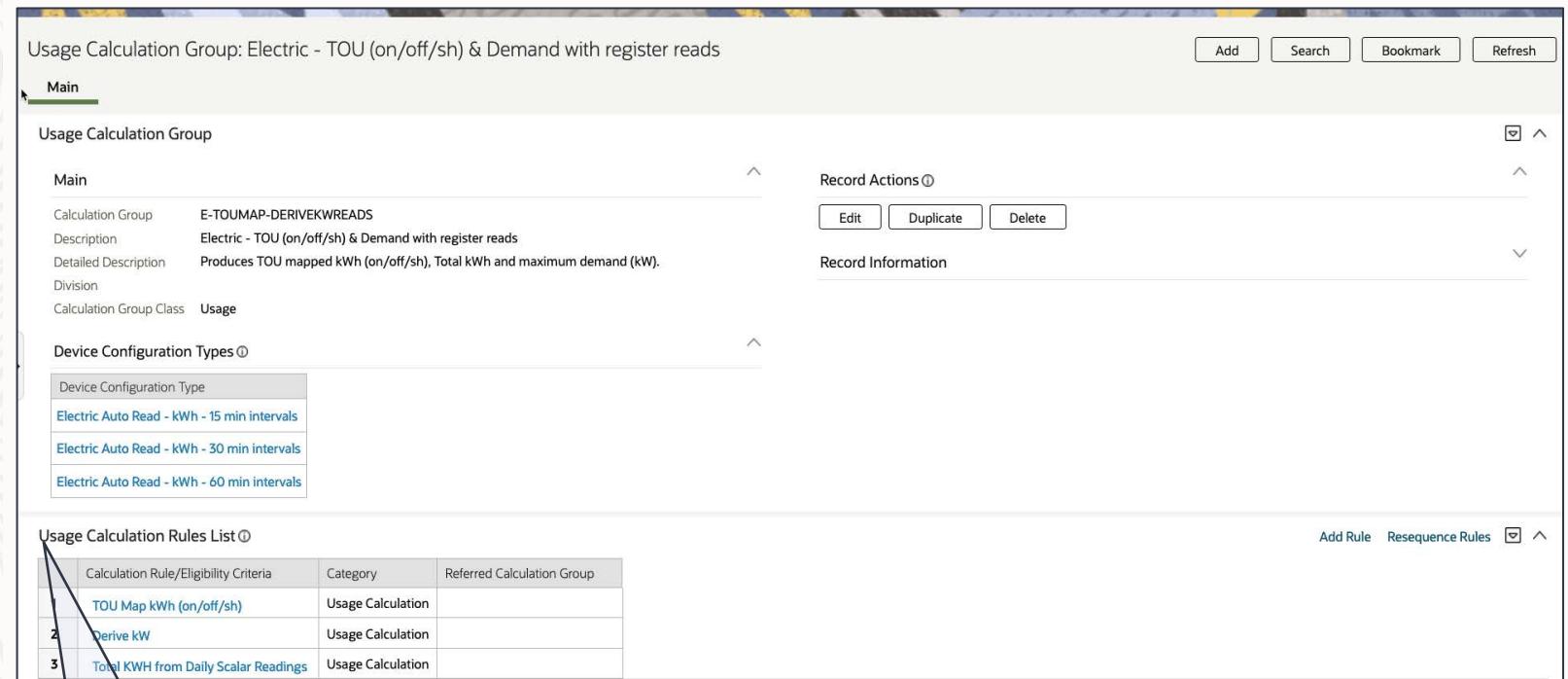
2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Calculation Group- Rules

Provide list of usage calculation rule(s) that will output the desired results for billing



Usage Calculation Group: Electric - TOU (on/off/sh) & Demand with register reads

Main

Usage Calculation Group

Main

Calculation Group: E-TOUMAP-DERIVEKREADS
Description: Electric - TOU (on/off/sh) & Demand with register reads
Detailed Description: Produces TOU mapped kWh (on/off/sh), Total kWh and maximum demand (kW).
Division:
Calculation Group Class: Usage

Record Actions: Edit, Duplicate, Delete

Record Information

Device Configuration Types

Device Configuration Type: Electric Auto Read - kWh - 15 min intervals, Electric Auto Read - kWh - 30 min intervals, Electric Auto Read - kWh - 60 min intervals

Usage Calculation Rules List

Calculation Rule/Eligibility Criteria	Category	Referred Calculation Group
TOU Map kWh (on/off/sh)	Usage Calculation	
Derive kW	Usage Calculation	
Total KWH from Daily Scalar Readings	Usage Calculation	

Add Rule Resequence Rules

Established default usage calculation e.g. requires standard scalar/ register reads to support billing

1. Transition from Register to Interval based billing

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Rate Schedule – Extendable Look-up Configuration

Provide a relationship link to how the usage should be calculated in supporting the Rate Schedule

Extendable Lookup Value

Main

Rate: E-TOU
Description: Electric time of use
Override Description
Detailed Description

Default Usage Calculation Group

Calculation Group: Electric - Time of Use

Record Actions: Edit, Delete, Duplicate

Record Information

Override

Device Configuration Type	Calculation Group
Electric Auto Read - kWh - 60 min intervals	Electric - TOU (on/off/sh) & Demand with register reads

Established default usage calculation e.g. requires standard scalar/ register reads to support billing

Applies override usage calculation based on change or type of device configuration

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Usage Calculation Results

Usage Calculation Rules Service Quantity (SQ) results can be used for more than just billing and rating. SQs are also used for interim calculation and informational purposes

Usage Request: Oracle / Electric Residential, Bill Determinants Processed, 02-01-2017 - 03-01-2017

Main Log

Service Point Usage Periods

Sequence	UOM	TOU	SQI	Quantity	Estimation	SQ Highlight
1	Kilowatt-Hours	Shoulder Peak		81.632162	Not Estimated	
2	Kilowatt-Hours	On-Peak		141.113896	Not Estimated	
3	Kilowatt-Hours			520.700000		
4	Kilowatt-Hours	Off-Peak		297.927327	Not Estimated	

Service Quantity Results for future rate and customer awareness

Usage Read Details

Final UOM	Final TOU	Final SQI	Quantity	Service Point	Seq	UOM	TOU	SQI	Start Reading	End Reading	Measured Quantity	Constant	How To Use	How To Use (SP)	Use Percent	Measures Peak Qty	Start Read Date/
Kilowatt-Hours			520.700000	2846798342	1	Kilowatt-Hours			549.990000	1,070.690000	520.700000	1.000000	Additive	Add	100		02-01-2017 0:00:

Meter Reading Details

Service Point

Premise

Market

Sequence	Badge Number	Serial Number	From Date/Time	To Date/Time
1	ER-SM-902	ER-SM-902	02-01-2017 0:00:00	03-01-2017 0:00:00

1. Transition from Register to Interval based billing

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Rate Schedule Execution- Bill Calculation Results

Service Quantity (SQ) are summarized scalar results values so rating isn't impacted with usage calculation determining how to summarize the information

Calculation Lines <small>①</small>					
Description on Bill	Calc Amount	RC Seq / Calc Rule	Print	In Summary	
Header 1, 02-01-2017 to 02-28-2017, Electric time of use (01-01-2000)	\$57.81				
Service charge	\$15.00	Service charge	Y	Y	
141.11 kWh at \$0.134 per kWh peak usage	\$18.91	On peak - kWh	Y	Y	
297.93 kWh at \$0.03029 per kWh off peak usage	\$9.02	Off peak - kWh	Y	Y	
81.63 kWh at \$0.06783 per kWh shoulder peak usage	\$5.54	Shoulder peak - kWh	Y	Y	
PCA 520.67 kWh at \$0.00547 per kWh	\$2.85	Power cost adjustment	Y	Y	
Energy total	\$36.32	Total energy charge	Y	Y	
Total taxable amount	\$51.32	Total taxable amount	N	Y	
City sales tax 11.5%	\$0.00	City tax	N	Y	
State sales tax 7.5%	\$6.36	State tax	Y	Y	
County sales tax 0.25%	\$0.13	County tax	Y	Y	
Tax total	\$6.49	Total taxes	N	Y	
Total charges	\$57.81	Total charges	Y	N	

Application of Rate Calculation against Usage related Service Quantity

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

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Dynamic Event Option

Dynamic options specify and override on how usage is normally calculated such as a Critical Peak or Curtailment period

Dynamic Option Type

Main

Dynamic Option Type List

No Filters Defined

	Dynamic Option Type	Description	Class	Edit	Duplicate	Delete
1	CPP	Critical Peak Period	Usage Event			
2	FIXED	Interruption: Fixed	Usage Event			
3	INTERRUPT	Standard Interruption	Usage Event			
4	NDP	Natural Disaster Period	Usage Event			
5	SMARTDAY	Smart Day Events	Usage Event			
6	VARIABLE	Interruption: Variable	Usage Event			

Dynamic Option Type

Main

Record Actions

Dynamic Option Type: CPP

Description: Critical Peak Period

Dynamic Option Business Object: [Dynamic Option](#)

Time Zone: US Pacific Time

Dynamic Option Class: Usage Event

Record Actions: Edit, Delete, Duplicate

Record Information

1. Transition from Register to Interval or TOU based billing

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Dynamic Option Time of Use (TOU) Map

Dynamic options reference a Dynamic TOU Map that allows for identification of dynamic option down to required interval resolution

TOU Map: Critical Peak Period - 15 min (TOU Override Use Only)

Main Log

TOU Map

Main ⓘ

Information Critical Peak Period - 15 min (TOU Override Use Only)
TOU Map Data exists for period 01-01-2019 0:15:00 PST to 01-01-2025 0:00:00 PST

TOU Map Type Critical Peak Period - 15 min

Status Active

Override TOU Map Template

TOU Map Data List ⓘ

Filters: TOU Map 227148861272

	Date/Time	TOU	Edit
1	01-01-2025 0:00:00 PST	Critical Peak	edit
2	12-31-2024 23:45:00 PST	Critical Peak	edit
3	12-31-2024 23:30:00 PST	Critical Peak	edit
4	12-31-2024 23:15:00 PST	Critical Peak	edit
5	12-31-2024 23:00:00 PST	Critical Peak	edit
6	12-31-2024 22:45:00 PST	Critical Peak	edit
7	12-31-2024 22:30:00 PST	Critical Peak	edit
8	12-31-2024 22:15:00 PST	Critical Peak	edit

TOU identifier assigned to Dynamic Option period



1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Calculation Group- Rules

Provide list of usage calculation rule(s) that will output the desired results for billing based on required Dynamic Event Option

Usage Calculation Group: Electric - Residential Peak-Time Rebate

Main

Usage Calculation Group

Main

Calculation Group	E-RES-PTR
Description	Electric - Residential Peak-Time Rebate
Detailed Description	
Division	
Calculation Group Class	Usage

Device Configuration Types ⓘ

Device Configuration Type
Electric Auto Read - kWh - 60 min intervals

Usage Calculation Rules List ⓘ

	Calculation Rule/Eligibility Criteria	Category	Referred Calculation Group
1	Get kWh Consumption	Usage Calculation	
2	Peak-Time Rebate Quantity Calculation	Usage Calculation	

Usage Rule to incorporate Dynamic Event Option

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

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4. Complex Pricing and Contracts

Usage Rule reference to Dynamic Option Event

Usage rule are allowed to reference Dynamic Option Event to apply appropriate Service Quantity Identifier for Billing

Usage Calculation Rule

Main

Calculation Group	Electric - Residential Peak-Time Rebate
Calculation Rule	PTR-QTY-CALC
Sequence	20
Description	Peak-Time Rebate Quantity Calculation
Detailed Description	Usage Calculation
Calculation Rule Category	
Input Values	
Dynamic Option ID	Critical Peak Period / Active
TOU Map	Year-Round 2-Bucket with Critical Peak - 60 min
UOM	Kilowatt-Hours
SQI	
Time Of Use Calculate Function	Sum
TOU Code for Peak	On-Peak
TOU Code for Critical Peak	Critical Peak
Qualifying Days	10
Peak Days	5
Include Weekend	No
Include Holidays	No
Include Critical Peak Days	No
SQI Code for kWh Conserved	Conserved

Record Information

Resulting Service Quantity

UOM	Kilowatt-Hours
TOU	
SQI	Net Conserved

Add Search Bookmark Refresh

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

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Usage Calculation Results

Provide list of usage calculation rule(s) that will output the desired results for billing

Usage Transaction: Sent / 01-01-2019 2:00:00 PST - 02-03-2019 2:00:00 PST / Electric - Residential Peak-Time Rebate														Add	Search	Bookmark	Refresh														
Main		Log																													
Usage Period 																															
Period 01-01-2019 2:00:00 PST-02-03-2019 2:00:00 PST																															
Usage Type Frequently Read																															
Service Quantities																															
UoM	TOU	SQL	Quantity	Data Quality Assessment	SQL Type	Service Point	Measuring Component	TOU Map	Factor	Characteristic Type	Characteristic Value	Calculation Group	Calculation Rule	Source Measurement Quality List	SQL Highlight Date/Time																
Kilowatt-Hours			1,334.309614		Other							Electric - Residential Peak-Time Rebate	GET-KWH-CONS	Source Measurement Quality		SQ Highlight Date/Time															
Kilowatt-Hours		Conserved	4.810000		Measuring Component	775 Howard St, San Francisco, CA, 94103 / Electric Residential / Electric / ER-PTR-01 / Active 	FR-PTR-01 / 1 / Electric Interval kWh - 60 min 					Electric - Residential Peak-Time Rebate	PTR-QTY-CALC	Source Measurement Quality		SQ Highlight Date/Time															
Kilowatt-Hours		Net Conserved	4.810000		Measuring Component	775 Howard St, San Francisco, CA, 94103 / Electric Residential / Electric / ER-PTR-01 / Active 	ER-PTR-01 / 1 / Electric Interval kWh - 60 min 					Electric - Residential Peak-Time Rebate	PTR-QTY-CALC	Source Measurement Quality		SQ Highlight Date/Time															

Usage Rule SQL results as Dynamic Event Option period is identified

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

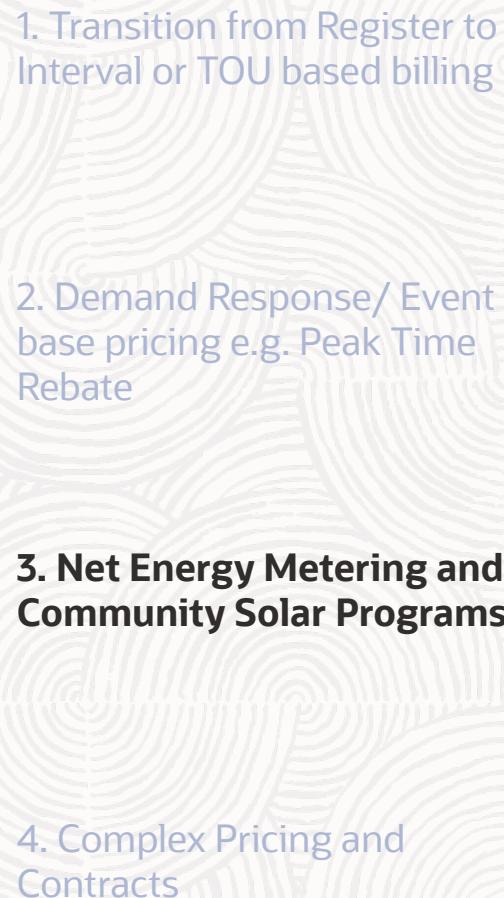
3. Net Energy Metering and Community Solar Programs

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Rate Schedule Execution- Bill Calculation Results

Usage Calculation Rules Service Quantity (SQ) results are then passed to rating calculations (SQ rule- Quantity times Bill Factor)

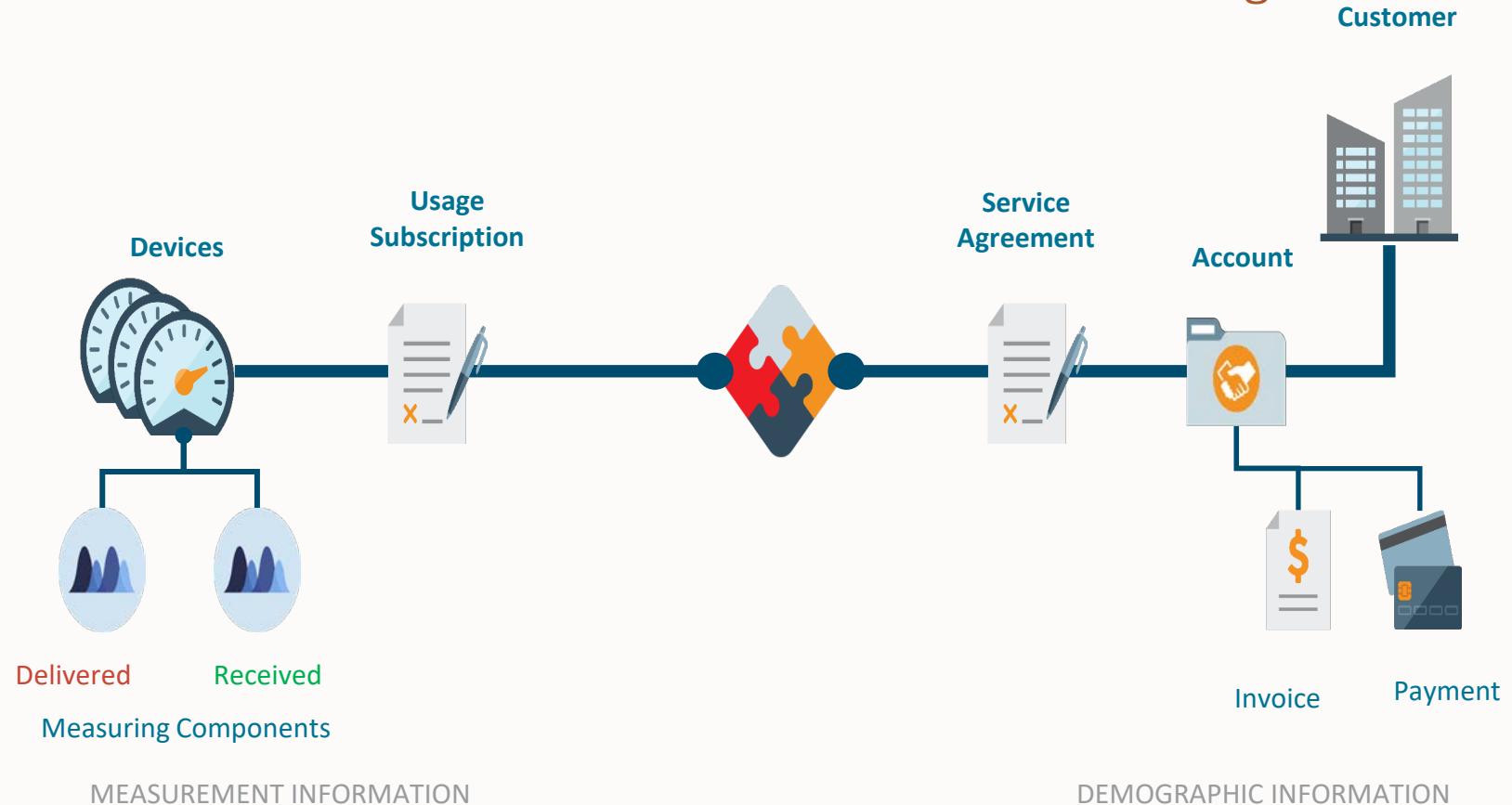
Bill Seg Info		Oracle / Electric Residential, Frozen, Period: 01-01-2019 - 02-02-2019, \$66.80, 2004487423					Bill Segment ID <input type="text" value="200878337099"/> <input type="button" value="Search"/>				
Bill Seg Hdr		1 of 1									
Sequence	Start Date	01-01-2019	End Date	02-02-2019	Amount	\$66.80					
Desc on Bill	Electric residential rate	Rate Version	Electric - Residential Peak Time Rebate 01-01-2019								
Sequence	Description on Bill	Calculated Amount	Print	Appears in Summary	Unit of Measure	Time of Use	SQL				
1	Service and Facility Charge	\$6.75	<input checked="" type="checkbox"/>	<input type="checkbox"/>							
2	Non-Summer Energy Charge: 1,334.31 kWh at \$0.04604 per kWh	\$61.43	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours						
3	Peak Time Rebate: 4.81 kWh at -\$0.28776 per kWh	-\$1.38	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours				Net Conserved		

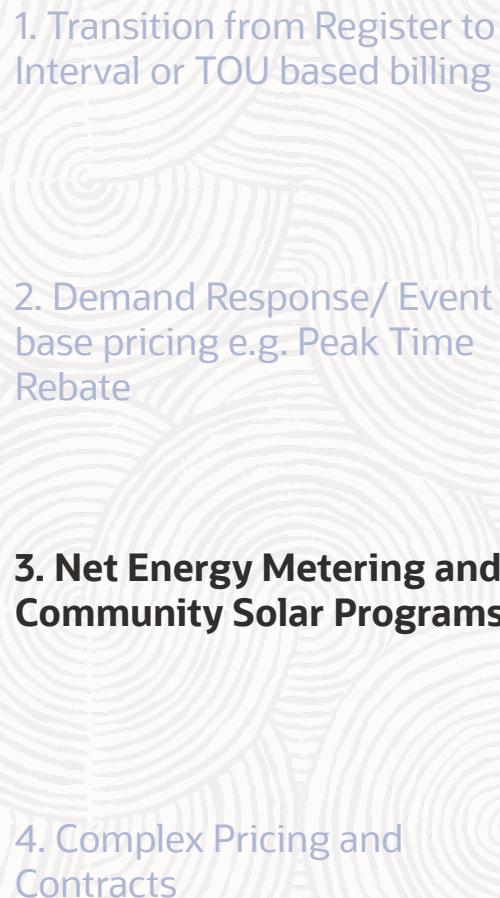


1. Transition from Register to Interval or TOU based billing
2. Demand Response/ Event base pricing e.g. Peak Time Rebate
- 3. Net Energy Metering and Community Solar Programs**
4. Complex Pricing and Contracts

Standard Data Model

Standard data model allows for individual Net Metering

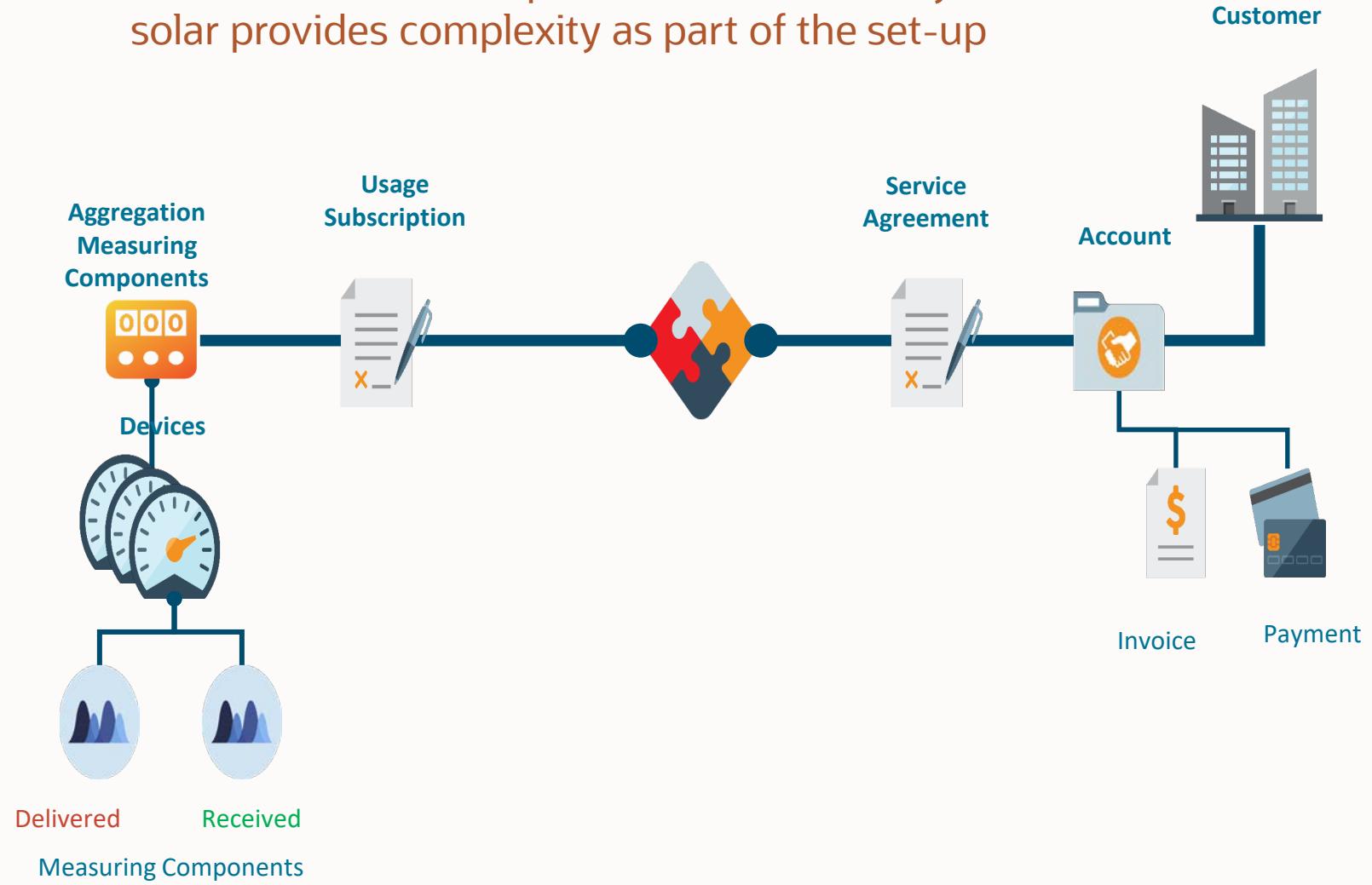




1. Transition from Register to Interval or TOU based billing
2. Demand Response/ Event base pricing e.g. Peak Time Rebate
- 3. Net Energy Metering and Community Solar Programs**
4. Complex Pricing and Contracts

Standard Data Model

Introduction of concepts such as community and shared solar provides complexity as part of the set-up



1. Transition from Register to Interval or TOU based billing

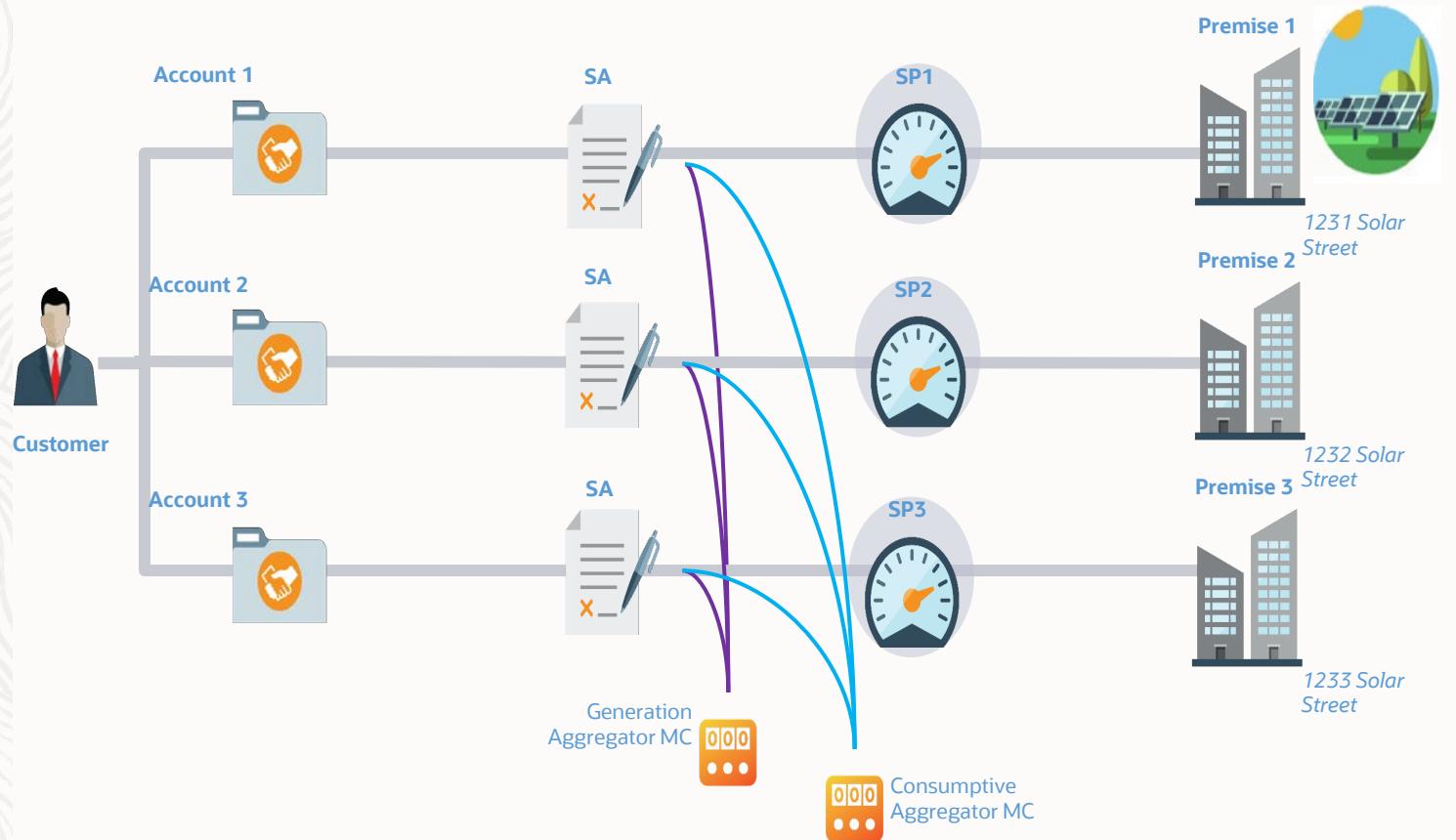
2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Complex Solar Arrangement and Set-up

Introduction of concepts such as community and shared solar provides complexity as part of the set-up



1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Dynamic Aggregation

Use of dynamic aggregation will allow to such as community and shared solar provides complexity as part of the set-up

Total and Trends View

Main

Measuring Component

Main

Information Aggregate by Solar Generation Source SP Id 352482330205

Measuring Component Type Solar NEM Generator Aggregator

Status Active

Solar Generation Source 1 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active

Consumption Aggregated Through Date/Time 04-01-2020 12:00AM

Record Actions

Edit Delete Aggregate Deactivate

Record Information

Next Aggregation Horizon

Add Search Bookmark Refresh

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Dynamic Aggregation

Use of dynamic aggregation will allow to monitor periodic load of community and shared generation and load as required

Total and Trends View

Main

Measuring Component

Main

Information Aggregate by Solar Generation Source SP Id 352482330205

Measuring Component Type Solar NEM Generator Aggregator

Status Active

Solar Generation Source 1 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active

Consumption Aggregated Through Date/Time 04-01-2020 12:00AM

Record Actions

Edit Delete Aggregate Deactivate

Record Information

Next Aggregation Horizon

Solar Aggregation Overview

	Type	Information	Calculation Group	
1	Solar Generation Source	Aggregate by Solar Generation Source SP Id 352482330205		Reload
2	Service Point - MDM	6 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active	Shared Generation Usage Calc Group 360	
3	Service Point - MDM	5 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active	Shared Generation Usage Calc Group 360	
4	Service Point - MDM	1 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active	Shared Generating Usage Calc Group 360	
5	Service Point - MDM	4 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active	Shared Generation Usage Calc Group 360	
6	Service Point - MDM	3 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active	Shared Generation Usage Calc Group 360	
7	Service Point - MDM	2 NEM Street, San Francisco, CA, 94111 / Electric Residential / Active	Shared Generation Usage Calc Group 360	

1. Transition from Register to Interval or TOU based billing

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3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Subscription – Aggregation MCs

Provide a relationship link to aggregation MCs to be used as part of usage calculation process

Usage Subscription: SOLAR,COMMUNITY / Home Phone (415) 010-1010 / Electric - Residential / 06-28-2019 12:00AM PDT / Active

Main Log

Usage Subscription

Main

Information: SOLAR,COMMUNITY / Home Phone (415) 010-1010 / Electric - Residential / 06-28-2019 12:00AM PDT / Active

Usage Subscription Type: Electric - Residential

Division

Access Group

Status: Active

Start Date/Time: 06-28-2019 12:00AM PDT

End Date/Time

Usage Recipient: Customer to Meter

Usage Approval: Not Required

External ID: 6876159346

Main Contact: SOLAR,COMMUNITY / Home Phone (415) 010-1010

Time Zone: US Pacific Time

Processing Information

Most Recent Usage Transaction Date/Time: 02-28-2020 12:00AM PST

Record Actions: Edit, Delete, Deactivate

Record Information

Factor Overrides

Usage Calculation Groups

Fallback Usage Calculation Groups

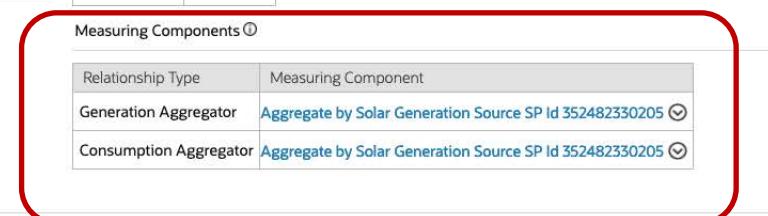
Rate History

Measuring Components

Relationship Type: Measuring Component

Generation Aggregator: Aggregate by Solar Generation Source SP Id 352482330205

Consumption Aggregator: Aggregate by Solar Generation Source SP Id 352482330205



1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Rule

Standard Vector and Interval Calculation rules will allow for reference to established Aggregation MC associated with the Usage Subscription

Usage Calculation Rule - Math Maintenance

Main

Calculation Group	Shared Generation Usage Calc Group
Calculation Rule	* DETTOUALLOC
Sequence	* 30
Description	* Determine Total and Framed (TOU) Current period Allocation
Detailed Description	
Calculation Rule Category	* Usage Calculation

Interval Vector 1 ⓘ

Type	Direct Channel on Subscription
Direct Channel Relationship Type	Generation Aggregator
Use Primary Measurement	Yes

Interval Vector 2 ⓘ

Interval Vector 3 ⓘ

Interval Vector 4 ⓘ

Interval Vector 5 ⓘ

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Calculation Results

Provide list of usage calculation rule(s) that will output the desired results for billing

Usage Transaction: Sent / 01-29-2020 12:00AM PST - 02-28-2020 12:00AM PST / Shared Generation Usage Ca...										Add	Search	Bookmark	Refresh
Main		Log											
Kilowatt-Hours	Aggregated Cumulative Usage	131,779.796280	Other						NEM Cumulative Generation/Usage for Benefitting Account Calc Group	GETCMLOAD			
Kilowatt-Hours	Cumulative Generation	44,745.892040	Other						NEM Cumulative Generation/Usage for Benefitting Account Calc Group	GETCMGEN			
Kilowatt-Hours	Previous Bill Periods' Allocations	0.000000	Other						NEM Cumulative Generation/Usage for Benefitting Account Calc Group	GETPREVALL			
Kilowatt-Hours	Relative Proportion of Load Percentage	0.060824	Other						Shared Generation Usage Calc Group	GET_CPERALL			
Kilowatt-Hours	Bill Period Allocation - Scalar	2,721.638287	Other						Shared Generation Usage Calc Group	CALCCURPER			

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

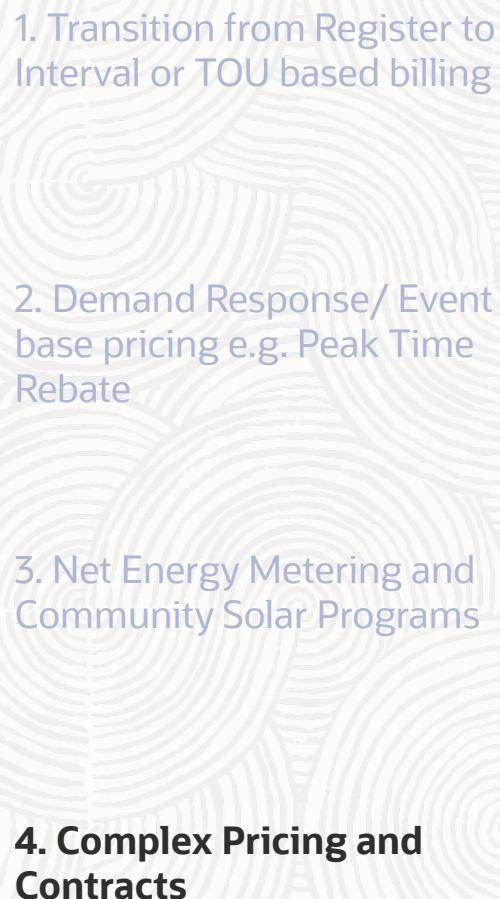
3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Rate Schedule Execution- Bill Calculation Results

Usage Calculation Rules Service Quantity (SQ) results are then passed to rating calculations (SQ rule- Quantity times Bill Factor).

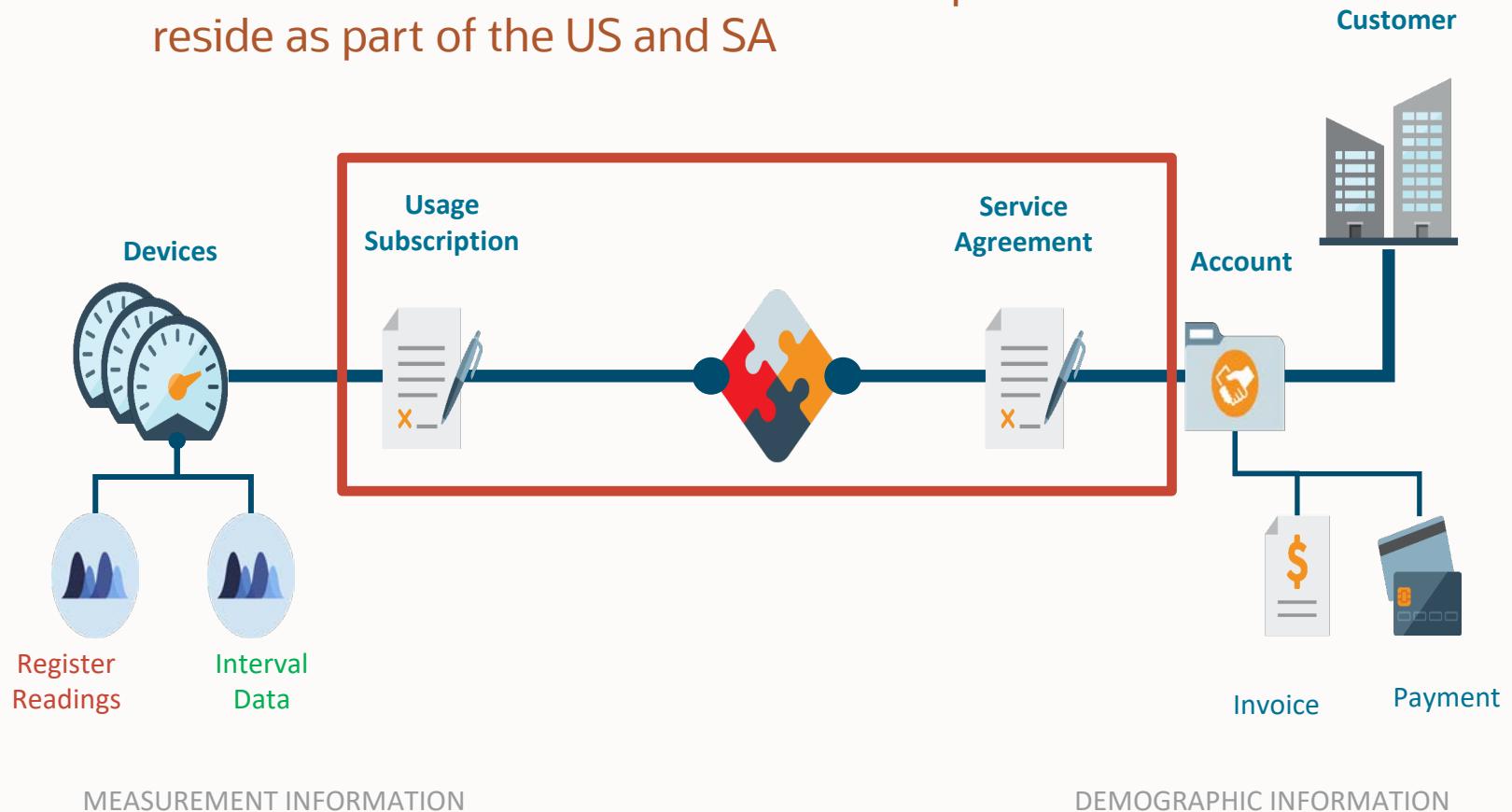
Bill Seg Info		Oracle / E-Residential NEM-A Sub SA, Freezable, Period: 01-28-2020 - 02-27-2020, \$1,399.56, 1992166716					Bill Segment ID	199295298325	Search		
Bill Seg Hdr		1 of 2									
Sequence	Start Date	01-29-2020	End Date	02-27-2020	Amount	\$1,399.56					
Desc on Bill	Energy Charges	Rate Version	<input checked="" type="checkbox"/> Electric NEM Energy Charges (Benefitting) 01-01-2010								
Sequence	Description on Bill			Calculated Amount		Print	Appears in Summary	Unit of Measure	Time of Use		
1	300.00 kWh at \$0.282 per kWh			\$84.60		<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours			
2	4,412.61 kWh at \$0.298 per kWh			\$1,314.96		<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours			
3	0.00 kWh at \$-0.282 per kWh			\$0.00		<input type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours			



1. Transition from Register to Interval or TOU based billing
2. Demand Response/ Event base pricing e.g. Peak Time Rebate
3. Net Energy Metering and Community Solar Programs
4. Complex Pricing and Contracts

Standard Data Model

Standard data model allows for various parameters that reside as part of the US and SA



1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Factors

Factors can be used to reference billing factors (flat, rate charges), but they can also be used for baseline comparisons, interval data adjustments and pricing adjustments when referencing a profile

	Factor Char Value/Factor Value Details	Add	Edit	Delete
1	Electric Residential	+		
2	01-01-2010 0:00:00, AVG-RES-KWH-60 / Standalone for kWh 60min		∅	∅
3	Water Residential	+		
4	01-01-2010 0:00:00, W-RES-SFH / Standalone for CCF (Water) 60min		∅	∅

1. Transition from Register to Interval or TOU based billing

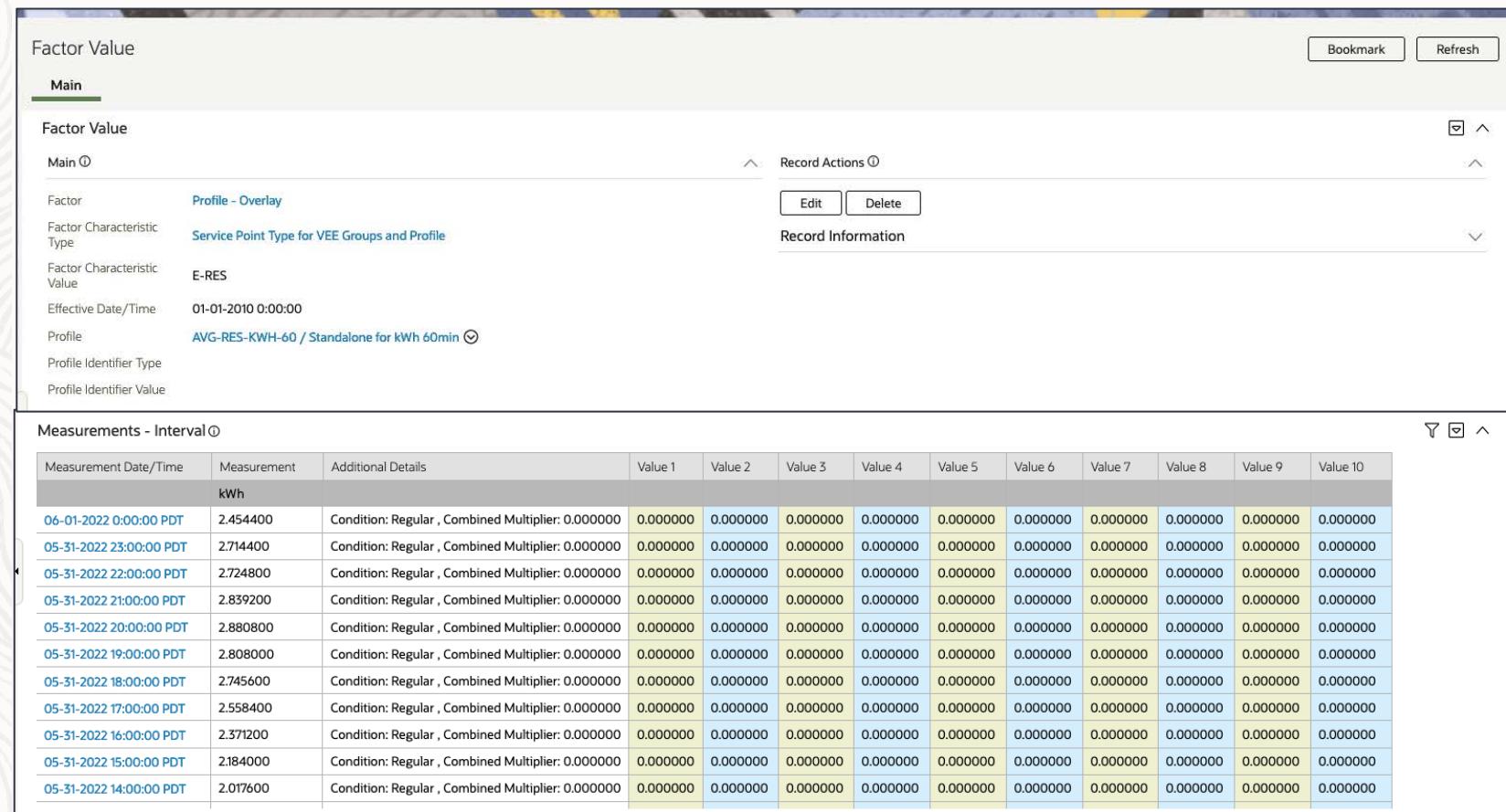
2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Profile Factor- Standalone Measuring Component

Profile Factors can be linked to a Standalone Measuring Component to include any type of time series data that is required as part of interval data required calculations.



The screenshot shows a software interface for managing profile factors and their measurements. At the top, there are buttons for 'Bookmark' and 'Refresh'. Below that, a 'Factor Value' section is displayed with a 'Main' tab selected. The 'Factor Value' section contains the following details:

Factor	Profile - Overlay
Factor Characteristic Type	Service Point Type for VEE Groups and Profile
Factor Characteristic Value	E-RES
Effective Date/Time	01-01-2010 0:00:00
Profile	AVG-RES-KWH-60 / Standalone for kWh 60min
Profile Identifier Type	
Profile Identifier Value	

Below this is a 'Record Actions' section with 'Edit' and 'Delete' buttons. A 'Record Information' section is also present. The bottom part of the interface is titled 'Measurements - Interval' and contains a table with the following data:

Measurement Date/Time	Measurement	Additional Details	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6	Value 7	Value 8	Value 9	Value 10
06-01-2022 0:00:00 PDT	2.454400	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 23:00:00 PDT	2.714400	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 22:00:00 PDT	2.724800	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 21:00:00 PDT	2.839200	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 20:00:00 PDT	2.880800	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 19:00:00 PDT	2.808000	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 18:00:00 PDT	2.745600	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 17:00:00 PDT	2.558400	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 16:00:00 PDT	2.371200	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 15:00:00 PDT	2.184000	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
05-31-2022 14:00:00 PDT	2.017600	Condition: Regular , Combined Multiplier: 0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Rule reference and use of Profile Factors*

Factors can be used for interval pricing and used as part of usage and billing processing

Main

Calculation Group	Firm Gas Transportation Cash-out with Contract End-User Billing Rate Usage Calc Group
Calculation Rule	<input type="text"/>
Sequence	<input type="text"/>
Description	<input type="text"/>
Detailed Description	<input type="text"/>
Calculation Rule Category	<input type="text"/>

Interval Vector 1 ⓘ

Type	<input type="text"/>
------	----------------------

Interval Vector 2 ⓘ

Interval Vector 3 ⓘ

Interval Vector 4 ⓘ

Interval Vector 5 ⓘ

Scalar Variables ⓘ

	Type	Set Function	Interval Set	Reference Interval Set	
<input type="button" value="+"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Vector Processing ⓘ

Common Interval Size	<input type="text"/>
Vector Formula Source	<input type="text"/>

Result ⓘ

Unit of Measure	<input type="text"/>
Time of Use	<input type="text"/>
Service Quantity Identifier	<input type="text"/>

✓

- Direct Channel on Subscription
- Specific Measuring Component
- Specific Measuring Component by Identifier
- Totalized Measuring Component Set
- Profile Factor
- Physical Channels Linked To Usage Subscription
- Quantities Stored on Transaction

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Contract Quantities

Contract Quantities are available to be configured for customer specific parameters

Service Agreement
Bookmark
Clear
Save
Refresh

Main
Rate Info
SA/SP
Chars, Qty & Rec. Charges
Misc
Contract Options
Billing Scenario
SA Portal

SA Info
Oracle / Electric Commercial, TOUDMD, Active, 01-01-2021, 0208230596
SA ID

Characteristics

	Effective Date	Characteristic Type	Characteristic Value
+	Delete	* 01-01-2021 Calendar	* <input type="text"/>

Contract Quantity

	Effective Date	Contract Quantity Type	Contract Quantity
+	Delete	* 01-01-2021 Calendar	* <input type="text"/> Maximum Demand
1000.000000			

Budget Amount

	Effective Date	Recurring Charge Amount
+	Delete	* 01-01-2021 Calendar

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Usage Calculation results

Sometimes usage calculation rules service quantity (SQ) results are not enough and more steps for pre-billing are necessary...

Usage Request: Oracle / Electric Commercial, Bill Determinants Processed, 02-01-2021 - 03-01-2021

Main Log

Usage Response Details

Usage Start Date/Time: 02-01-2021 12:00AM
Usage End Date/Time: 03-01-2021 12:00AM
Estimated:
SA Skipped:

Usage Periods

Period: 02-01-2021 12:00AM - 03-01-2021 12:00AM (Interval)
Standard Period: 02-01-2021 12:00AM - 03-01-2021 12:00AM

Sequence	UOM	TOU	SQI	Quantity	Seconds Per Interval	SQ Highlight
1	Kilowatt-Hours			31,212.625100		
2	Kilowatt-Hours	Off Peak		26,268.758900		
3	Kilowatt-Hours	On Peak		4,943.866200		
4	Kilowatt			70.319600		
5	Kilowatt	Off Peak		70.319600		
6	Kilowatt	On Peak		58.288400		
7	Kilovolt-Ampere Reactive			23.908800		
8	Kilovolt-Ampere Hours			5.977200		
9	Power Factor			1.000000		

Exception Details

Messages

Item Information

Sequence	Item Type	Item Count	Start Date/Time	End Date/Time	Daily Service Quantity	UOM
----------	-----------	------------	-----------------	---------------	------------------------	-----

Service Point 1 Usage Periods

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Rate Schedule- Pre-Processing Calculation

Additional pre-billing steps are required in addition to usage bill determinant processing is required

Rate Schedule: Electric TOU General Service with Demand

Add Search Bookmark Refresh

Main

Main

Rate Schedule	TOUDMD
Description	Electric TOU General Service with Demand
Service Type	Electric
Frequency	Monthly
Currency Code	United States Dollars
Allow Estimates	Yes
Allow RV Proration	Yes
RV Selection Date	

Record Actions

Edit Delete Duplicate

Record Information

Valid Device Configuration Types

Go to CCB Rate Schedule Extendable Lookup

Device Configuration Type
Electric Auto Read - kWh, kVArh - 15 min intervals
Electric Auto Read - kWh, kVArh - 30 min intervals

Bill Messages

Bill Message	Start Date	End Date
Earth Day	03-12-2017	04-12-2017

Pre-Processing Calculation Groups

Add Calculation Group

Sequence	Description	Calculation Group	Rule Cross Reference
10	Get Number of Delivery Points	Get Number of Delivery Points on Service	Add/Remove Links
20	Derive Current and annual Seasonal TOU Demand	Determine TOU Billable Demand	Add/Remove Links
30	Sum and Derive Current TOU Energy Consumption	Determine TOU Billable Energy	Add/Remove Links

Rate Version Calculation Groups

Add Calculation Group

Effective Date	Description On Bill	Calculation Group	Rule Cross Reference
01-01-2000	Electric time of use %D	Electric Time of Use General Service	Add/Remove Links

Post-Processing Calculation Groups

Add Calculation Group

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

Rate Schedule- Pre-Processing Calculation

Service Quantities evaluation based on contract quantities and established factor values or historical service quantities

Calculation Rule: Calculate Excess Demand

Main

Calculation Group	Determine TOU Billable Demand						
Calculation Rule	GETEXCESSDEMANDSUM						
Sequence	60						
Business Object	Calculate Service Quantity						
Description	Calculate Excess Demand						
Detailed Description							
Execution Option	Always						
Scalar Variable 1	Type: Contract Quantity Missing Value Action: Error Contract Quantity Type: Maximum Demand Prorate Method: Maximum						
Scalar Variable 2	Type: Service Quantity Missing Value Action: Error Unit of Measure: Kilowatt Time of Use: On Peak Service Quantity Identifier: Billable SQ to Use: Billable						
Scalar Variable 3	Type: Service Quantity Missing Value Action: Error Unit of Measure: Kilowatt Time of Use: Off Peak						
Calculation Details							
Calculation Rule Processing	Always						
Fail Action	Error						
Calculation Rule Output	Service Quantity						
Retain SQ	Yes						
Round Service Quantity	No						
Formula Source	Conditional Formula						
Sequence	Operand 1	Operator	Operand 2	True Action	True Formula	False Action	False Formula
1	MAX(V2,V3)	<=	V1	Apply True Formula	0*MAX(V2,V3)	Apply False Formula	abs(V1-MAX(V2,V3))

Add Search Bookmark Refresh

Record Information

Result

Unit of Measure	Kilowatt
Time of Use	
Service Quantity Identifier	Excess

Navigation icons: back, forward, search, refresh, etc.

1. Transition from Register to Interval or TOU based billing

2. Demand Response/ Event base pricing e.g. Peak Time Rebate

3. Net Energy Metering and Community Solar Programs

4. Complex Pricing and Contracts

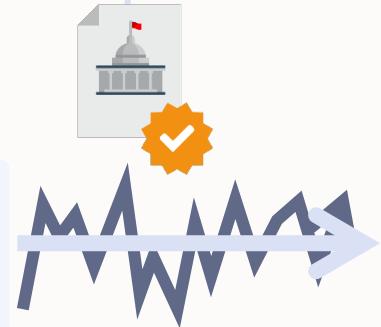
Rate Schedule Execution- Bill Calculation Results

Usage Calculation Rules Service Quantity (SQ) results are then passed to rating calculations (SQ rule- Quantity times Bill Factor)

Bill Seg Info		Oracle / Electric Commercial, Freezable, Period: 02-01-2021 - 03-01-2021, \$8,360.55, 0208230596					Bill Segment ID <small>*</small> <input type="text" value="020305114590"/> <small>Q</small>
Bill Seg Hdr		1 of 1					
Sequence	Start Date	02-02-2021	End Date	03-01-2021	Amount	\$8,360.55	
Desc on Bill	Electric time of use	Rate Version	Electric TOU General Service with Demand 01-01-2000				
Sequence	Description on Bill			Calculated Amount	Print	Appears in Summary	Unit of Measure
1	Service Charge: 1.00 delivery points @ \$1,500.00			\$1,500.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2	Admin Charge: 1.00 delivery points @ \$350.00			\$350.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
3	On Peak Demand Charge: 300.00 On Peak kW @ \$10.69			\$3,207.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt
4	Maximum Demand Charge: 300.000 Maximum kW @ \$6.18			\$1,854.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt
5	Excess Demand Charge: 0.00 Excess kW @ \$10.69			\$0.00	<input type="checkbox"/>	<input type="checkbox"/>	Kilowatt
6	On peak Energy Charge: 4,943.87 On Peak kWh @ \$0.06103			\$301.72	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours
7	Off peak 200 HUD: 11,836.29 kWh at \$0.04879 per kWh (0 - 11,836.29 kWh)			\$577.49	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours
8	Off peak 200 HUD: 11,836.30 kWh at \$0.00871 per kWh (11,836.29 - 23,672.59 kWh)			\$103.09	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours
9	Off peak 200 HUD: 2,596.17 kWh at \$0.00502 per kWh (23,672.59 - 26,268.76 kWh)			\$13.03	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Kilowatt-Hours
10	City sales tax 11.5%			\$0.00	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
11	State sales tax 7.5%			\$454.22	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
12	Tax total			\$454.22	<input type="checkbox"/>	<input type="checkbox"/>	

Ready with your AMI Billing Journey TODAY and Beyond!!!!

Volume based Rates



Consumption X \$ (Price)

Time-of-Use



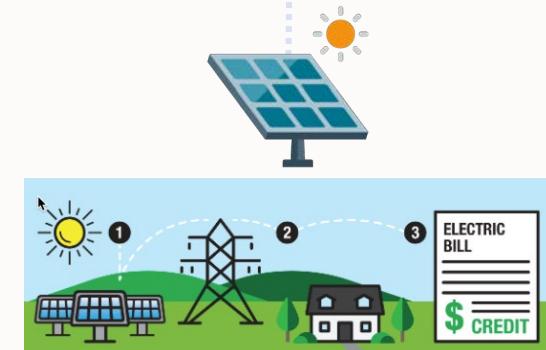
Time-varying rates based on peak usage times

Demand Response



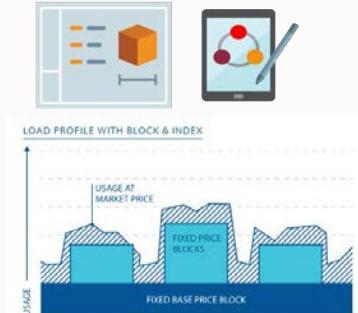
Dynamic Pricing, Event based curtailment billing

Renewable Energy



Managing of renewable solar generation and allocations

More Customer Programs...



Complex Pricing and Contracts



Conclusion

Our 3 Key Takeaways:

- Oracle Energy & Water has several products that use to support through AMI billing evolution.
- Complex Billing concepts are not new they are being normalized with AMI.
- Oracle continues its investments in standardizing these complex billing concepts to allow utilities to quickly implement.
- Please contact us for more information.



Complex Billing Concepts

Oracle's commitment to modern utilities' AMI related billing needs

Ha Bui

Principal Solution Consultant
Oracle Energy & Water

Thank you



ORACLE

Questions?

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713-591-5343

ORACLE

