



## **Measuring, Allocation and Managing Utility Expenses in Mixed-Use Developments**

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# Presentation Outline

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## 1. About Mixed-Use Developments

- Mixed-use developments defined
- Where the industry is going
- Importance of metering

## 2. Mixed-Use Development Metering Design

- Suite-specific metering design
- Common area metering design
- Case studies
- Central plant metering design

## 3. Commercial Considerations

- Billing and allocation
- Legal implications
- Customer relationship management

# ABOUT MIXED-USE DEVELOPMENTS

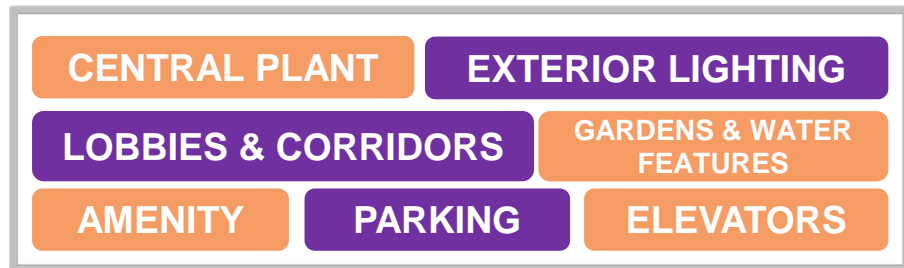


# What are mixed-use developments?



Dedicated Facilities

- Buildings that blend residential and non-residential uses (restaurants, commercial office space, retail stores, etc.), physically and functionally integrated, with pedestrian connections.



Shared Facilities



## Where the industry is moving

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### Mixed-use walkable neighbourhoods are an ideal that city planners are striving towards

1. Resurgence of urbanism leading people to move back into urban centres
2. They make better use of a city's infrastructure; purely residential neighbourhoods are mostly vacant during work hours, underutilizing city infrastructure (water pipes, city buses)
3. Proximity of shopping, work, residences; reduced traffic congestion and lower energy consumption related to transportation
4. For Developers, use land more efficiently and help reduce long-term maintenance cost of building by distributing costs between various tenants in the building
5. Revitalizing neighbourhoods experiencing periods of decline (i.e. King St West)

# Emerald Park Condos, Toronto

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- 42 and 33 storey buildings, mixed residential and retail space at Yonge & Bogert Ave





# E-Condo, Toronto

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- 58 and 38 storey buildings, mixed residential and retail space at Yonge & Eglinton Ave



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## Benefits of Metering

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- Ensure fair allocation of utility costs based on energy intensity
  - i.e. energy footprint for a restaurant is not the same as a retail store
- Distribution of costs for shared spaces
  - Central plant, exterior lighting, lobbies & corridors, amenities, parking, elevators, etc.



# Importance of Proper Planning

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- Metering must be considered at the building design stage; account for how to allocation costs
- Avoid cost of thinking as an afterthought
- Liability questions

# MIXED-USE DEVELOPMENT METERING DESIGN



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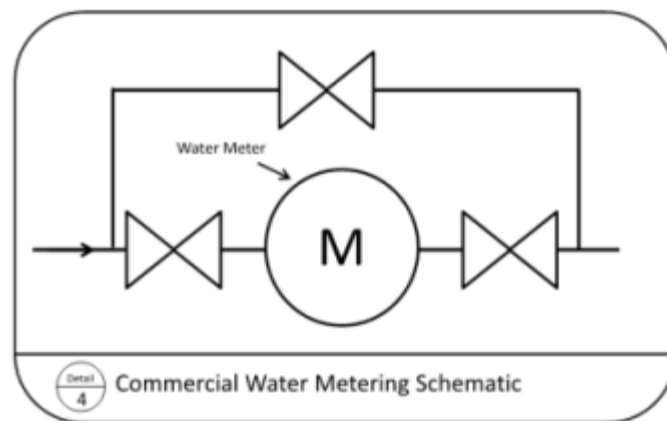
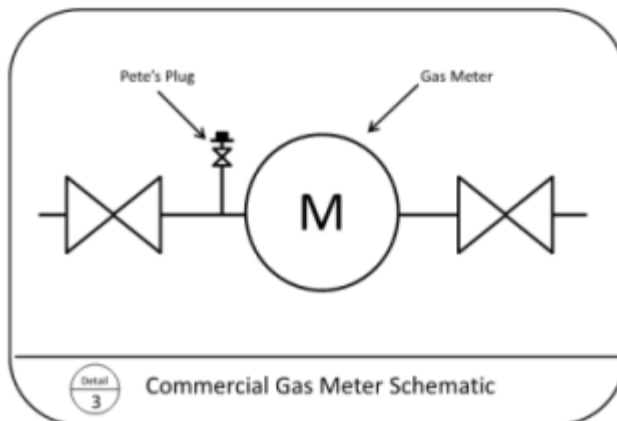
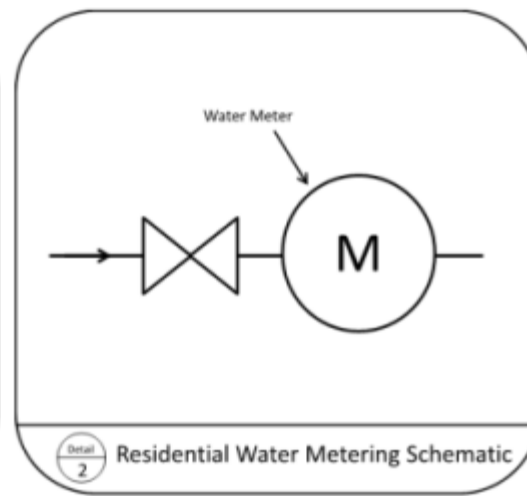
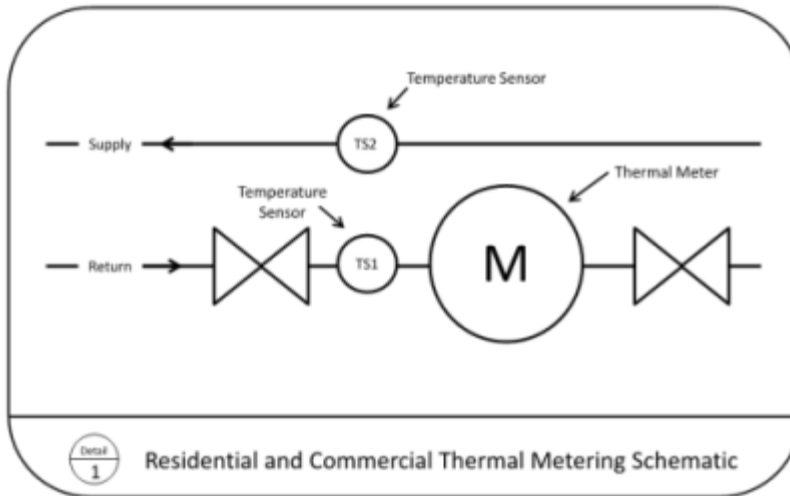
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# Metering Types

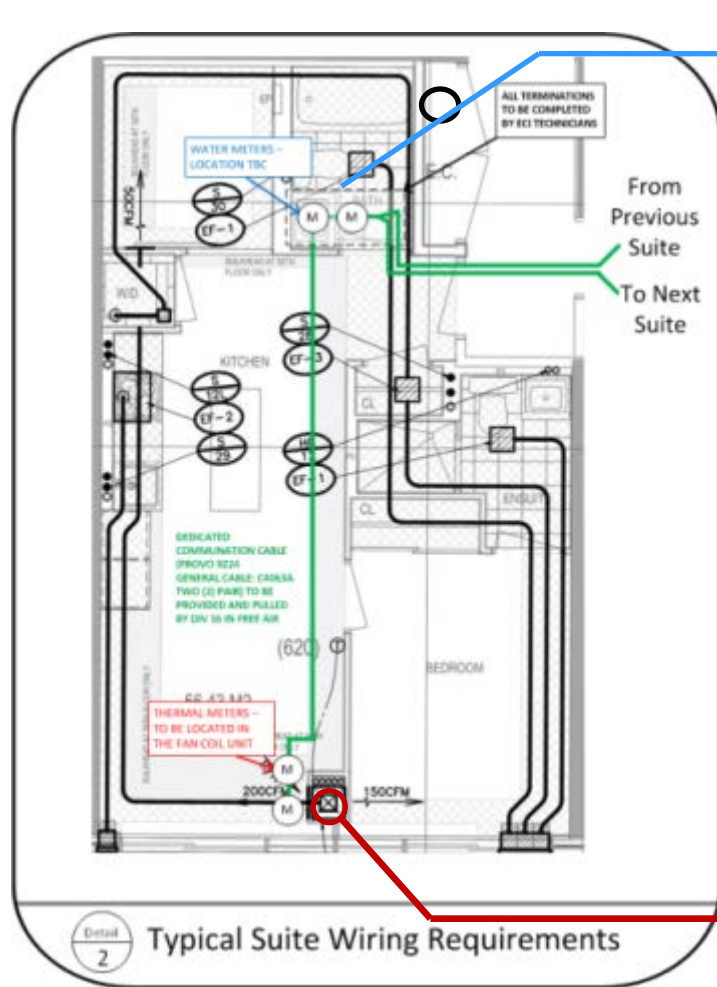
SERVICE	No. of Meters	METER LOCATION	DESIGN REQUIREMENTS	COMMUNICATION TYPE	DATA MANAGEMENT	COMMISSIONING
ELECTRICITY	One	Common Area <i>Electrical Closets</i>	<ul style="list-style-type: none"> <li>Multi-tenant panel meters</li> <li>Up to 12 suites per meter</li> <li>Independent of suite power</li> <li>2 x 200:5 CTs per suite</li> </ul>	<ul style="list-style-type: none"> <li>Power line communication (PLC) <b>OR</b></li> <li>Hard-wired connection</li> <li>RS-485 cable across separate voltages (PLC)</li> </ul>	<ul style="list-style-type: none"> <li>Cat5e - Modem</li> </ul>	<ul style="list-style-type: none"> <li>Suite verification</li> <li>Load test</li> </ul>
WATER	Two	In-suite Manifold Location (s) - Vanity, Coat Closets	<ul style="list-style-type: none"> <li>DHW and DCW</li> <li>Vertical or horizontal orientation</li> <li>Spacers</li> <li>Shut-off valves</li> <li>By-pass loop (recommended)</li> <li>Hatchway for accessibility</li> </ul>	<ul style="list-style-type: none"> <li>Wireless <b>OR</b></li> <li>M-Bus (together with Thermal)</li> </ul>	<ul style="list-style-type: none"> <li>Cat5e - RDL500</li> </ul>	<ul style="list-style-type: none"> <li>Flow test</li> </ul>
THERMAL	Two-Four	In-suite Fan Coil Unit (s)	<ul style="list-style-type: none"> <li>Pre-manufactured</li> <li>Initial spacers</li> <li>Shut-off valves</li> <li>By-pass loop (recommended)</li> <li>Two temperature sensors</li> <li>One flow meter (HWR)</li> </ul>	<ul style="list-style-type: none"> <li>M-Bus (together with Water)</li> </ul>	<ul style="list-style-type: none"> <li>Cat6 - Ethernet</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspection</li> </ul>
GAS	One	Gas Demarcation Point - Common Area	<ul style="list-style-type: none"> <li>Low pressure - 7" WC</li> <li>Spacers</li> <li>Shut-off valves</li> <li>Pressure test point (Pete's plug)</li> <li>By-pass loop (recommended)</li> </ul>	<ul style="list-style-type: none"> <li>Wireless - AMR</li> </ul>	<ul style="list-style-type: none"> <li>Manual Download</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspection</li> <li>Pressure test</li> <li>Suite verification</li> </ul>

# Metering Types

- Residential and commercial mechanical metering schematics



# In-suite Metering Layout



# Common Area Design

## Base Building Design - Scattered Type

- Complex metering design - more meters deployed
- Complex billing allocation – must utilize additive metering (less desirable)

### UTILITY DEMARCATION POINT

SHARED RESIDENTIAL-  
HOSPITALITY

RESIDENTIAL  
PHASE 1 SUITES

SHARED  
COMMERCIAL-  
HOSPITALITY

RESIDENTIAL  
PHASE 1 COMMON

HOTEL  
COMMON

HOTEL SUITES

RESIDENTIAL  
PHASE 2 SUITES

COMMERCIAL  
COMMON

RESIDENTIAL  
PHASE 2 COMMON

SHARED –  
ALL ENTITIES

COMMERCIAL  
TENANTS

MUNICIPAL/PUBLIC

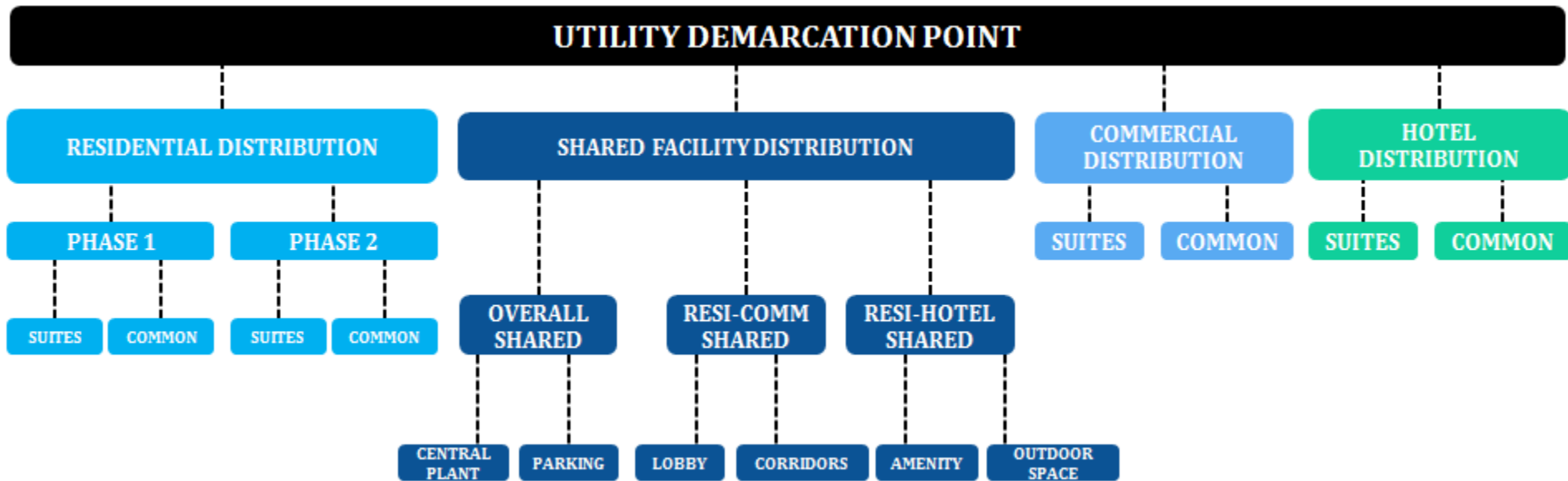
LOAD RESEARCH  
(M&V)

SHARED RESIDENTIAL-  
COMMERCIAL

# Common Area Design

## Base Building Design - Branched Type

- Simpler metering design - less meters deployed
- Simpler billing allocation – can utilize deductive metering (more desirable)





# Case Study 1: Mixed Hotel and Residential

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- Entities involved :

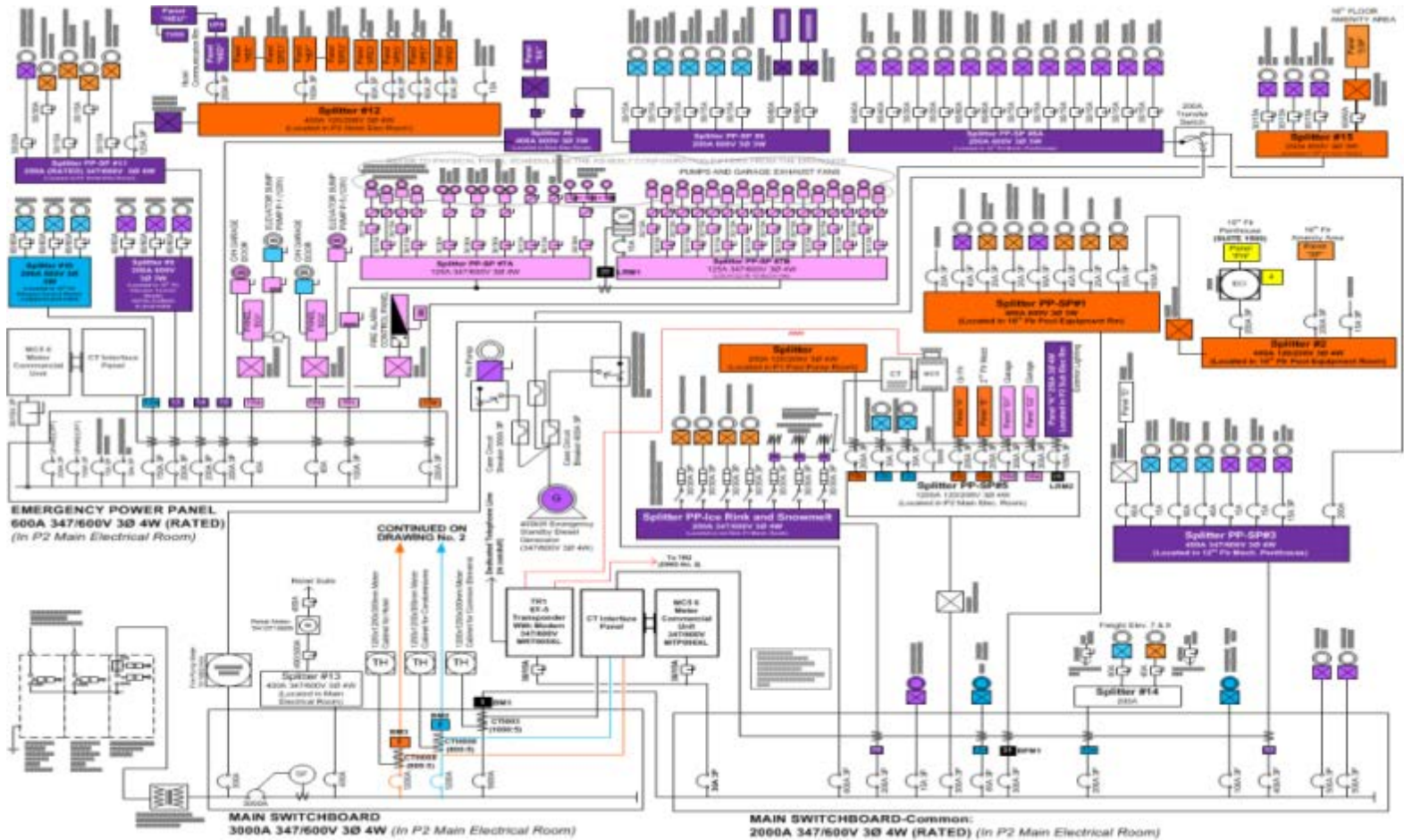
1. Condominium
2. Hotel
3. Development Office
4. Shared Facilities (various)
5. Two-Way Shared Facilities



- Type of sub-metering - **Electrical**
- Electrical base building design – **Scattered**
- Metering design coordination occurred **post-construction**
- Complex metering design resulting in complex allocation formulas
- Far from perfect allocations – resulting in ongoing efforts to resolve between condominium corporation, property management and hotel management
- Led to significant additional metering and labor costs post project completion

# Case Study 1: Mixed Hotel and Residential

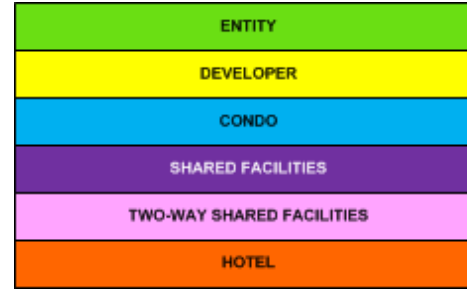
## Electrical Metering Single Line Diagram



# Case Study 1: Mixed Hotel and Residential

## Allocation Summary

MAIN DISTRIBUTION METER SCHEDULE				
Nr	ECI POINT NAME	DESCRIPTION	BILL TO ENTITY	Nr
1	BM1	BOUNDARY METER – COMMON ELEMENTS	NOT DIRECT BILLED – USED IN VIRTUAL CALCULATIONS	1
2	BM2	BOUNDARY METER – CONDO DISTRIBUTION	NOT DIRECT BILLED – USED IN VIRTUAL CALCULATIONS	2
3	BM3	BOUNDARY METER – HOTEL DISTRIBUTION	NOT DIRECT BILLED – USED IN VIRTUAL CALCULATIONS	3



COMMON ELEMENTS DISTRIBUTION METER SCHEDULE						
Nr	ECI POINT NAME	CUSTOMER POINT NAME	BILL TO ENTITY	BRIEF DESCRIPTION (PLEASE SEE SINGLE LINE FOR DETAIL)	BILLING DETAILS / CONFIGURATION	Nr
12a	COMM12a	CONDO ELEVATORS (SPLITTER #10)	CONDO	SPLITTER #10: CONDO ELEVATORS	CONDO COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 12a, 12b, 12c, 12d, 12e]	12a
13	COMM13	S.F. ELEVATORS (SPLITTER #9)	SHARED FACILITIES	SPLITTER #9: HOTEL/CONDO ELEVATORS	INDIVIDUAL BILL	13
14	COMM14	TWO-WAY S.F. & HOTEL (PP-SP#11 & SPLITTER#12)	SHARED FACILITIES	SPLITTER PP-SP#11 & SP#12: HOTEL SUITE & UPS SYSTEM, ...	INDIVIDUAL BILL	14
15	COMM15	S.F. (SPLITTER #6 AND 8)	SHARED FACILITIES	SPLITTER #6 & 8: STAIRWELL LIGHTING, ...	INDIVIDUAL BILL	15
16a	COMM16a	GARAGE (PANEL EG1)	TWO-WAY SHARED FACILITIES	PANEL EG1 (GARAGE), FACP, ELEV. SUMP, ...	TWO-WAY S.F. COMBINED BILL (MULTI. FEEDS): [PTS Nr 16a, 16b, 16c, 16d, 16e]	16a
16b	COMM16b	GARAGE (PANEL EG2)	TWO-WAY SHARED FACILITIES	PANEL EG2 (GARAGE), ELEVATOR SUMP, OH DOOR, ...	TWO-WAY S.F. COMBINED BILL (MULTI. FEEDS): [PTS Nr 16a, 16b, 16c, 16d, 16e]	16b
16c	COMM16c	TWO-WAY S.F. (PP-SP#7A & PPSP-#7B)	TWO-WAY SHARED FACILITIES	PP-SP#7A & PP-SP#7B: PUMPS, STR. PRES. & GARAGE EXHST. FANS	TWO-WAY S.F. COMBINED BILL (MULTI. FEEDS): [PTS Nr 16a, 16b, 16c, 16d, 16e]	16c
19a	COMM19a	HOTEL (SPLITTER #15)	HOTEL	SPLITTER #15: STR. PRESS. FANS, PNL ESP (16" FLR AMENITY)	HOTEL COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 19a, 19b, 19c, 19d]	19a
20	LRM1	N/A	NOT DIRECT BILLED – INCLUDED IN PT. Nr 19 ABOVE	SPLITTER PP-SP#7B: PUMPS, STR. PRES. & GARAGE EXHST. FANS	N/A	20
19b	COMM19b	HOTEL WATER FEATURE (SPLITTER)	HOTEL	SPLITTER: P1 POOL PUMP ROOM RM. (REFLECTION POOL?)	HOTEL COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 19a, 19b, 19c, 19d]	19b
12b	COMM12b	CONDO (COMPACTOR#1)	CONDO	COMPACTOR #1	CONDO COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 12a, 12b, 12c, 12d, 12e]	12b
12c	COMM12c	CONDO (COMPACTOR#2)	CONDO	COMPACTOR #2	CONDO COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 12a, 12b, 12c, 12d, 12e]	12c
19c	COMM19c	HOTEL (PANEL A)	HOTEL	PANEL A (HOTEL) GROUND FLR	HOTEL COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 19a, 19b, 19c, 19d]	19c
19d	COMM19d	HOTEL (PANEL B)	HOTEL	PANEL B (HOTEL) 2 <sup>ND</sup> FLR. MEZZ.	HOTEL COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 19a, 19b, 19c, 19d]	19d
16d	COMM16d	GARAGE (PANEL G1)	TWO-WAY SHARED FACILITIES	PANEL G1: GARAGE	TWO-WAY S.F. COMBINED BILL (MULTI. FEEDS): [PTS Nr 16a, 16b, 16c, 16d, 16e]	16d
16e	COMM16e	GARAGE (PANEL G2)	TWO-WAY SHARED FACILITIES	PANEL G2: GARAGE	TWO-WAY S.F. COMBINED BILL (MULTI. FEEDS): [PTS Nr 16a, 16b, 16c, 16d, 16e]	16e
28	LRM2	N/A	NOT DIRECT BILLED – PAID VIA VIRTUAL MTR (V/CABM)	PANEL K: EXT LIGHTING	N/A	28
29	COMM29	TWO-WAY S.F. & HOTEL (RINK & SNOWMELT)	SHARED FACILITIES	SPLITTER PP ICE RINK AND SNOWMELT	INDIVIDUAL BILL	29
12d	COMM12d	CONDO – MUA	CONDO	MUA	CONDO COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 12a, 12b, 12c, 12d, 12e]	12d
31	BFM1	N/A	NOT DIRECT BILLED – PAID VIA VIRTUAL MTR (V/CABM)	SPLITTER PP-SP#1 & SPLITTER #2: POOL EQUIP., ROOF MUA & A/C, 1501	N/A	31
12e	COMM12e	CONDO *	CONDO *	SPLITTER #14: FREIGHT ELEV.	CONDO COMBINED BILL (MULTIPLE FEEDS): [PTS Nr 12a, 12b, 12c, 12d, 12e]	12e
33	COMM33	TWO-WAY S.F. & CONDO (SPLITTER PP-SP#3 & PP-SP#8A)	SHARED FACILITIES	SPLITTER PP-SP#3: MECH EQUIP.	INDIVIDUAL BILL	33

\* (AGREED TO BE BILLED TO CONDO SINCE ELEVATOR NOT USED BY OTHERS. CONDO TO NOTIFY ENERCARE IF SITUATION CHANGES)

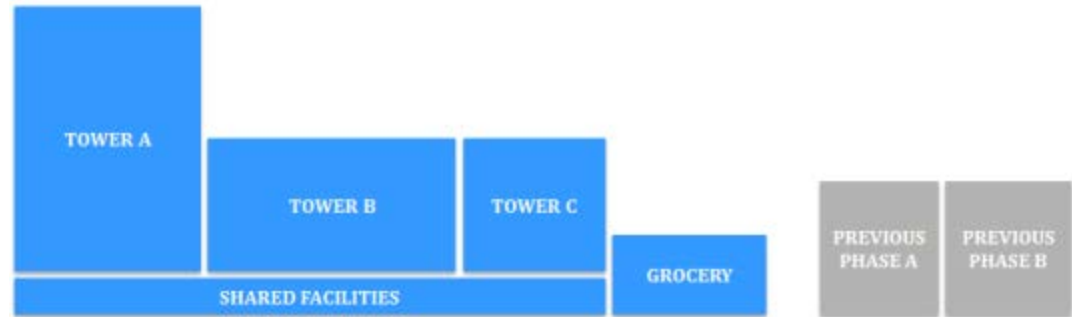
VIRTUAL METER SCHEDULE							
Nr	ECI POINT NAME	CUSTOMER POINT NAME	BILL TO ENTITY	BRIEF DESCRIPTION (PLEASE SEE EQUATION & SINGLE LINE FOR DETAIL)	BILLING DETAILS / CONFIGURATION	EQUATION	Nr
N/A	V/CABM	SHARED FACILITIES (JOINT)	SHARED FACILITIES	VIRTUAL JOINT COMMON AREA (INCLUDES CHILLERS)	INDIVIDUAL BILL	V/CABM = BFM1 + BFM2 + COMM#13a + COMM#12b + COMM#12c + COMM#12d + COMM#12e + COMM#13 + COMM#14 + COMM#15 + COMM#16a + COMM#16b + COMM#16c + COMM#16d + COMM#16e + COMM#19a + COMM#19b + COMM#19c + COMM#19d + COMM#29 + COMM#33	N/A

## Case Study 2: Multi-Phase Residential and Commercial

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- Entities involved :

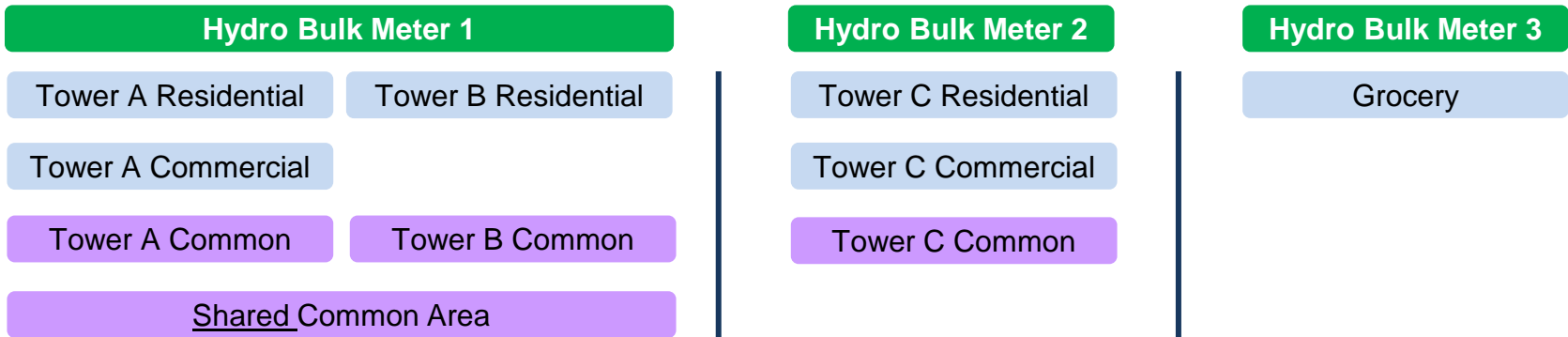
1. Five (5) condominiums
  - Three (3) new
  - Two (2) previous
2. Commercial + Grocery
3. Shared Facilities (various)



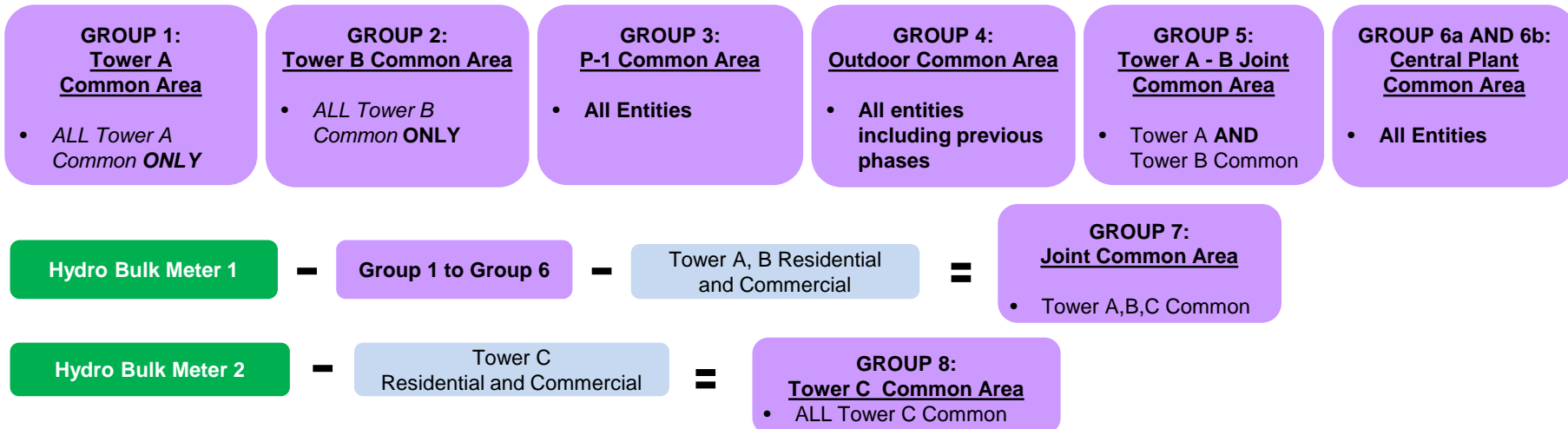
- Type of sub-metering – **Electrical/Mechanical**
- Electrical base building design – **Scattered**
- Metering design coordination occurred **pre-construction**
- Complex metering design resulting in multiple metering formulas and allocations
- Close to perfect allocation – leaving little doubt or need for future efforts between entities condominium corporations and commercial tenants

# Case Study 2: Multi-Phase Residential and Commercial

## Electrical Distribution Summary



## Requested Common Area Allocation




# Case Study 2: Multi-Phase Residential and Commercial

## Sub-metering Panel Schedules

- Colour coded circuits indicate the corresponding common area groups
- Necessary equipment per panel listed below for ease of installation
- Metering design integrated into base-building design documents


BILLING COLOR SCHEME	
COLOUR	BILL
#	BILL 1 – TOWER B COMMON AREA
#	BILL 2 – TOWER A COMMON AREA
#	BILL 3 – P-1 COMMON AREA
#	BILL 5 – EXTERIOR COMMON AREA
#	BILL 6 – TOWER A/B ROW JOINT COMMON AREA
#	BILL 7A – CENTRAL PLANT-DHW AND UH (NON-BILLABLE)
#	BILL 7B – CENTRAL PLANT-HP (NON-BILLABLE)
#	INDIVIDUAL BILLING METERS (COMMERCIAL, BM ETC..)

### Roof Power Distribution Panel (RDP) Tower 'B' Roof Boiler Room (Page 1) 800A 600V 3PH 3W

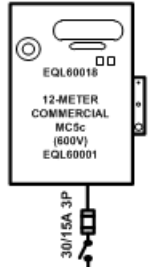


### Metering Point Summary

POINT#	Bill	<i>RDP</i>	Breaker Amp.	Circuit #	CT Type
15	Bill 1	MJA-1	400A-3P	SLD	2 X CT040006
16	Bill 7 b	Fluid Cooler(Package) FC-1	100A-3P	SLD	2 X CTA022/024
17	Bill 7 b	Fluid Cooler(Package) FC-2	100A-3P	SLD	2 X CTA022/024
18	Bill 7 b	Fluid Cooler(Package) FC-3	100A-3P	SLD	2 X CTA022/024
19	Bill 7 b	Cond. Water Pump CWP-1	400A-3P	SLD	2 X CT040006
20	Bill 7 b	Cond. Water Pump CWP-2	400A-3P	SLD	2 X CT040006
21	Bill 7 b	HB-1 Circulator Pump	30A-3P	SLD	2 X CTA022/024
22	Bill 7 b	HB-2 Circulator Pump	30A-3P	SLD	2 X CTA022/024
23	Bill 7 a	DHB-1 Circulator Pump	30A-3P	SLD	2 X CTA022/024
24	Bill 7 a	DHB-2 Circulator Pump	30A-3P	SLD	2 X CTA022/024
25	Bill 7 a	DHB-3 Circulator Pump	30A-3P	SLD	2 X CTA022/024
26	Bill 7 a	Heating Pump HWP-1	100A-3P	SLD	2 X CTA022/024
27	Bill 7 a	Heating Pump HWP-2	100A-3P	SLD	2 X CTA022/024



### Equipment Summary



12-METER  
COMMERCIAL  
MC (600V)  
EQL60001

30/15A 3P

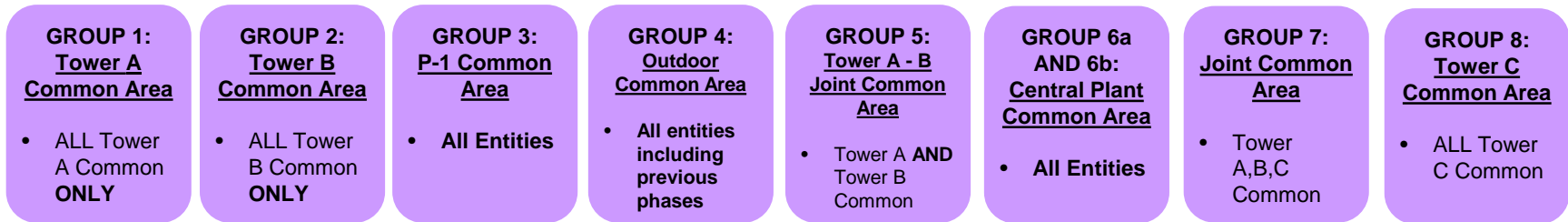
**Meters:**  
1 x EQL60018  
1 x EQL60001

**CTs:**  
4 x CT040006  
3 x CT0RED01\*\*  
3 x CT0BLU03\*\*

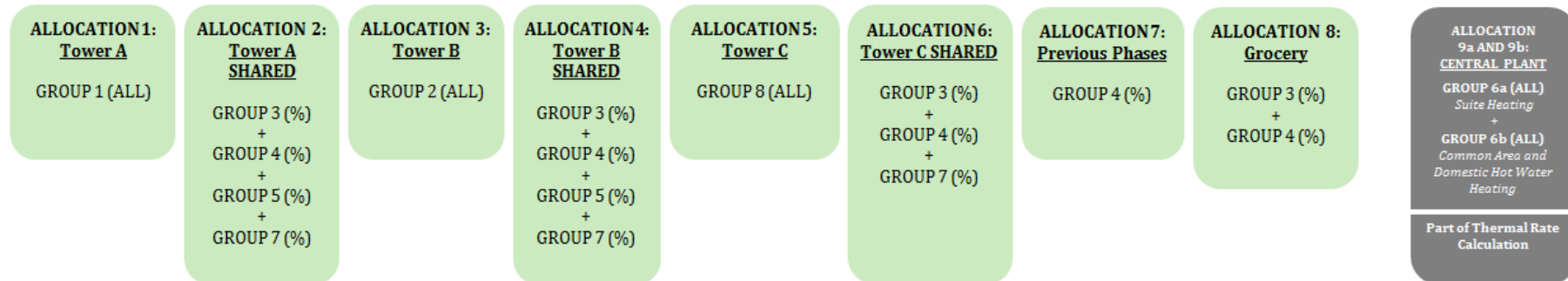
**Transponders:**  
NONE

# Case Study 2: Multi-Phase Residential and Commercial

## Common Area Metering Groups



## Billing Allocation





## Case Study 3: Multi-phase Residential and Commercial

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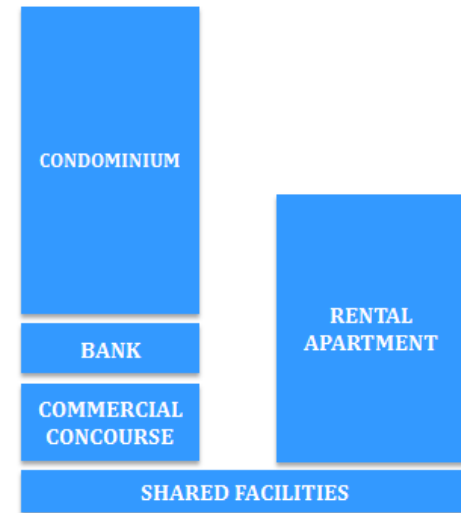
- Entities involved :

1. Condominium
2. Rental Apartment
3. Bank
4. Commercial Concourse
5. Shared Facilities (various)

- Type of sub-metering – **Electrical/Mechanical**

- Mechanical base building design – **Branched**

- Commercial and residential - separate heating/cooling loops
- Metering design coordination occurred **pre-tender**
- Thermal rate derivation via central plant metering
- Seamless design coordination with the Developer and consultants during pre-tender phase led to a simplified metering design and billing allocation formulas

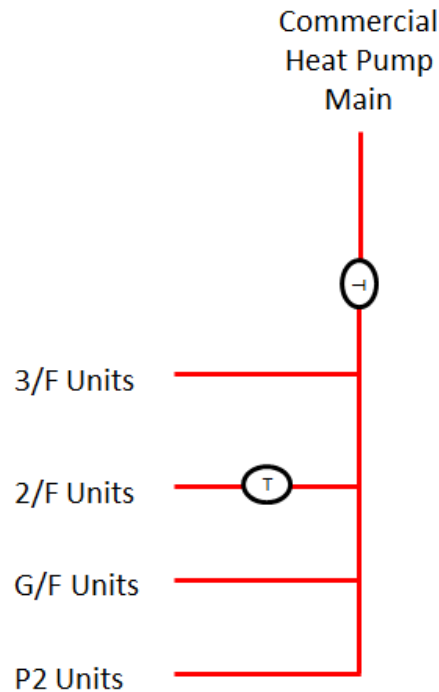


# Case Study 3: Multi-phase Residential and Commercial

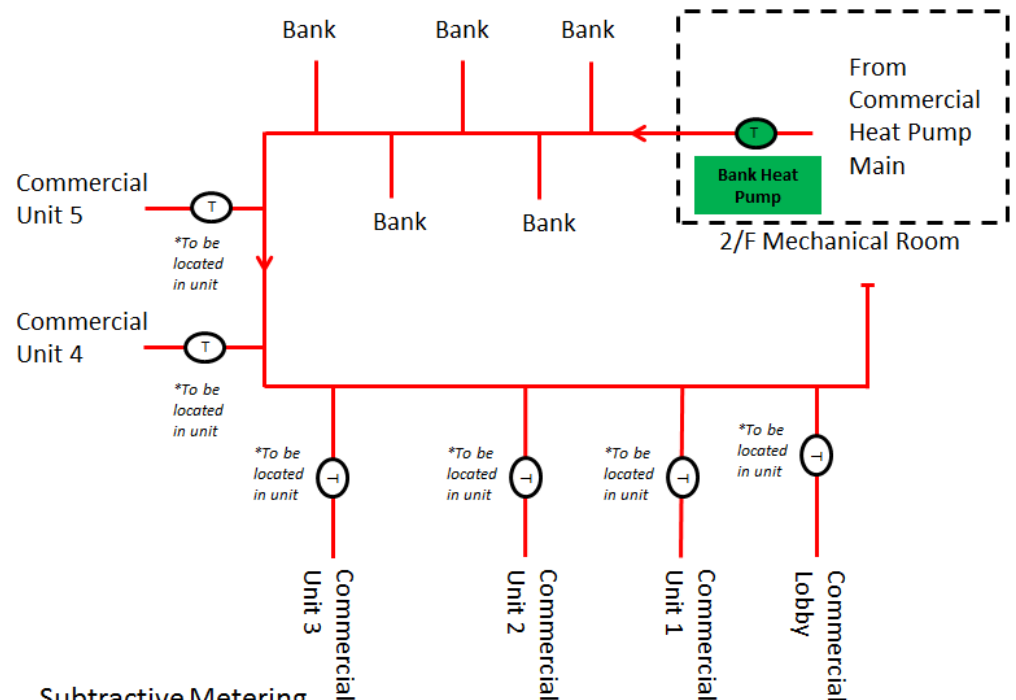
## Mechanical Base Building Design – Branched

- Example - Commercial concourse

### Main Commercial Heat Pump Loop



### Heating Pump Loop – Second Floor



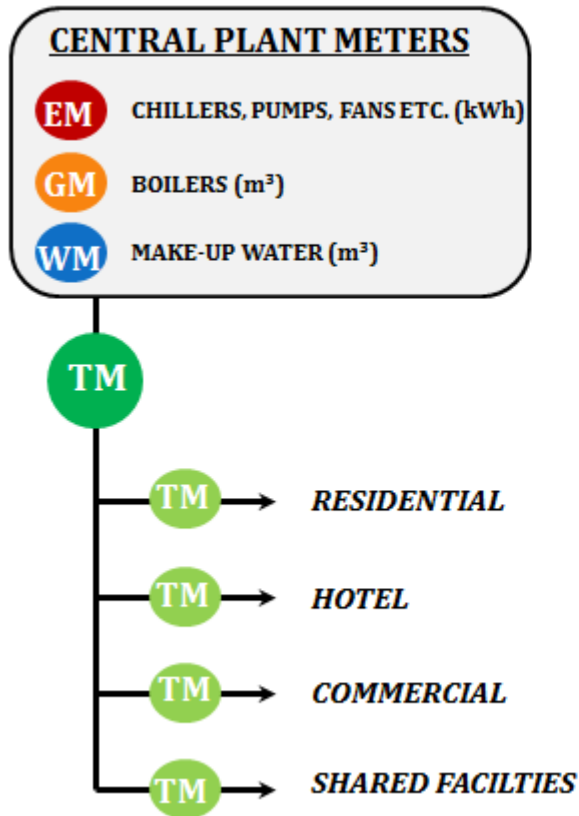
### Subtractive Metering

Bank Heat Pump Consumption =  -  Commercial Unit 1 through Commercial Unit 5 -  Commercial Lobby

# Case Study 3: Multi-phase Residential and Commercial

## Central Plant Metering – Thermal Rate Derivation

- Example - Commercial concourse



- Total cost of central plant is a combination of

**EM** Electricity Meter

**GM** Gas Meter

**WM** Water Meter

- Total amount of energy produced by central plant is measured by

**TM** Thermal Meter

## Case Study 3: Multi-phase Residential and Commercial

### Thermal Rate Derivation

Comparing utility bills to central plant meter consumption...

$$\begin{matrix} \text{EM} & \text{GM} \\ & \\ \text{WM} \end{matrix} = \text{Total cost (\$) of Central Plant}$$

Bulk Thermal Meters

$$\text{TM} = \Delta T \cdot \text{Flow Rate} = \text{Energy (Jules or BTU)}$$

$$\text{THERMAL RATE (\$/J)} = \frac{\text{TOTAL COST (\$) CENTRAL PLANT (ELECTRICITY, WATER AND GAS)}}{\text{TOTAL ENERGY (J) CENTRAL PLANT (THERMAL)}}$$

- The thermal rate is applied to all residential suite or commercial unit thermal meters to calculate their respective share of the central plant usage:

$$\text{THERMAL BILL (\$)} = \text{THERMAL RATE (\$/J)} \times \text{TM THERMAL METER READING (J)}$$

- The remainder of the central plant consumption can be attributed to common area consumption (not metered) and can be allocated via condo fees

# Case Study 3: Multi-phase Residential and Commercial

- End-result – Billing Allocation Mode:
- Each entity has individual electricity, water, thermal and gas meter to capture consumption
- Common areas shared between residential and/or commercial are identified and metered

	CONDOMINIUM			RENTAL APARTMENT	
	RESIDENTIAL	COMMERCIAL	COMMON	RESIDENTIAL	COMMON
ELECTRICAL	632 SUITES	1 BANK (GND/FLOOR 2) 2 GND RETAIL 9 P2 RETAIL 6 FLOOR 2 RETAIL 17 FLOOR 3 RETAIL 1 SIGNAGE	1 CONDO COMMON (VIRTUAL) 1 JOINT COMMON 1 COMMERCIAL COMMON (VIRTUAL) LRM CENTRAL PLANT METERING	469 SUITES	1 RENTAL COMMON (VIRTUAL) 1 JOINT COMMON (VIRTUAL) LRM CENTRAL PLANT METERING
WATER	1264 SUITES	1 BANK (GND/FLOOR 2) 2 GND RETAIL 9 P2 RETAIL 6 FLOOR 2 RETAIL 17 FLOOR 3 RETAIL	LRM COOLING TOWER MAKE UP WATER	938 SUITES	LRM COOLING TOWER MAKE UP WATER
THERMAL	1264 SUITES	1 BANK (GND/FLOOR 2) 2 GND RETAIL 9 P2 RETAIL 6 FLOOR 2 RETAIL 17 FLOOR 3 RETAIL	LRM HEATING LOOP FLOW METER LRM COOLING LOOP FLOW METER	938 SUITES	LRM HEATING LOOP FLOW METER LRM COOLING LOOP FLOW METER
GAS			LRM HEATING BOILERS		LRM HEATING BOILERS

## Lessons Learned and Recommendations

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- Early metering design review – pre-tender preferred (cost savings)
- Inclusion of detailed metering specifications in project drawings – easier contractor coordination
- Branched base building design – electrical and mechanical
- Importance of central plant metering and branched central plants (*if possible*)
- **Early coordination between all parties** – developers, consultants, contractors, PMs (if possible)
- Early review of resulting billing allocations

# COMMERCIAL CONSIDERATIONS



# Billing and Allocation

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- Allocation methodology for shared spaces
  - Square footage, anticipated usage, percentages, combination
  - Must be reasoned and easy to explain
  - Rate setting (in case of thermal energy)
- Administration Fees
  - Expectation setting (complex metering can drive significant monthly administration costs)
- Quality of Equipment
  - Use Measurement Canada approved equipment exclusively for electricity meters
  - Recommended to deploy EN1434 (EU thermal metering standard) approved thermal meters
  - Demonstrating accuracy to all stakeholders is critical to the credibility of the metering program

## Legal Considerations

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- Develop and disclose a Declaration Shared Facilities Agreement that specifically contemplates the utility allocation arrangement
- Shared Facilities Agreement should clearly describe the allocation methodology used, how rates are established
- Condominium Corporation Agreements should reference sharing agreements
- Typically, the agreements are long-term, involving multiple commercial parties, combined with a complex technical solution – agreements need to contemplate any unravelling of the arrangement.
- Freehold lease agreements also need to be considered

# Relationship Management

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- Complex metering and billing arrangements require active an ongoing management by your sub-metering service provider
- Proper design and legal documentation is very helpful in articulating program dynamics
- The rationale behind the sharing/allocation formulas needs to be explained to all stakeholders, particularly condominium boards
- A close working relationship between Property Management and the sub-metering provider is critical to success – PMs need to understand the arrangement to put stakeholders at ease
- Regular communication ensures a seamless transition and long-term cost sharing methodology that works for all parties

# Questions?

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