

Land use Modeling Using Satellite Photomaps

Jerome Richard P. Felizarta
Substation Planning Engineer

1 October 2015



MERALCO
Ang liwanag ng bukas



Outline



I. Load Forecasting

a. Brief Background

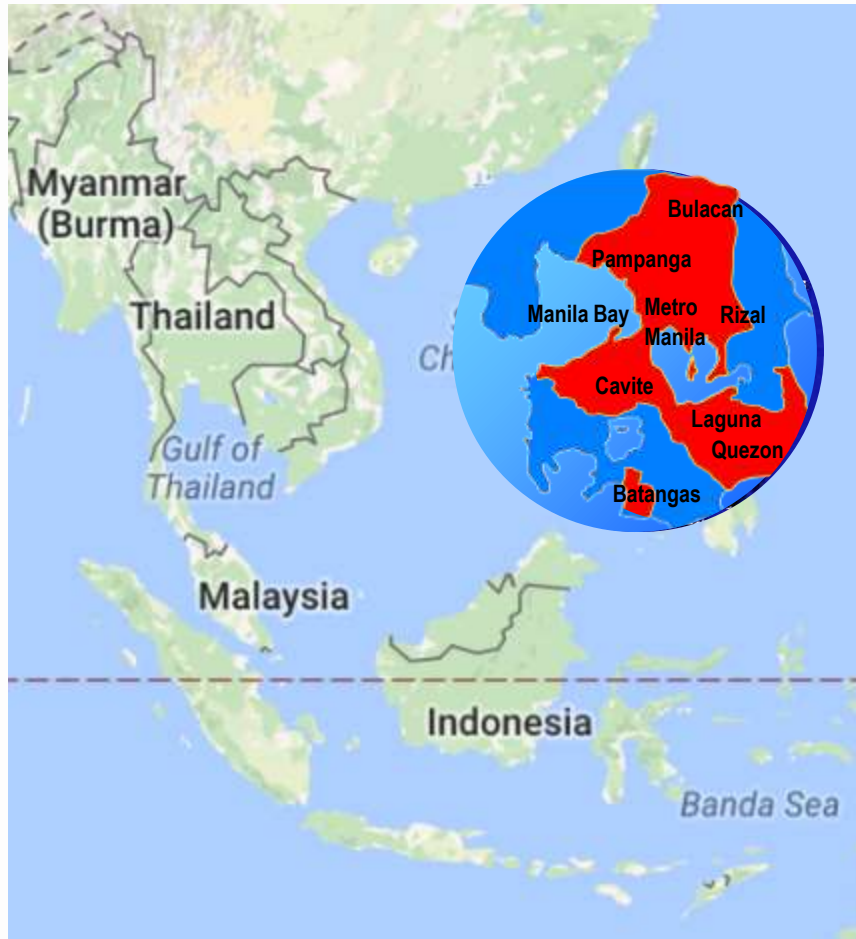
II. Land use Modeling

a. Use of Satellite Photomaps

b. Challenges encountered

III. Benefits

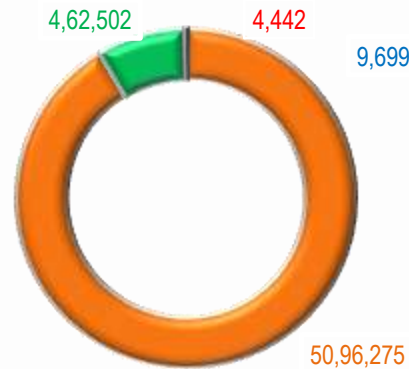
MERALCO's Franchise Area



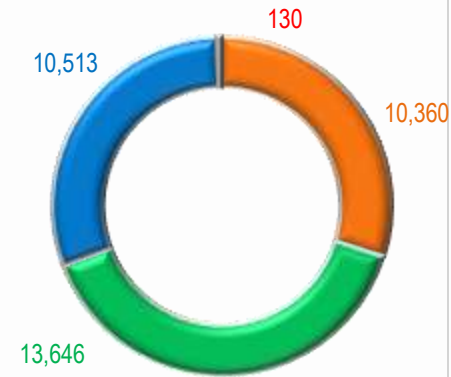
Franchise Area	9,337 sq.km
Coverage	114 cities and Municipalities
Service Area	50% of Phillipine's GDP
Electrification	100%
Customers	5.57 Million
Peak Demand	6, 121 MW
Energy Sales	34, 649 GWh

* Data as of CY2014

No. of Customers



GWh Energy Sales



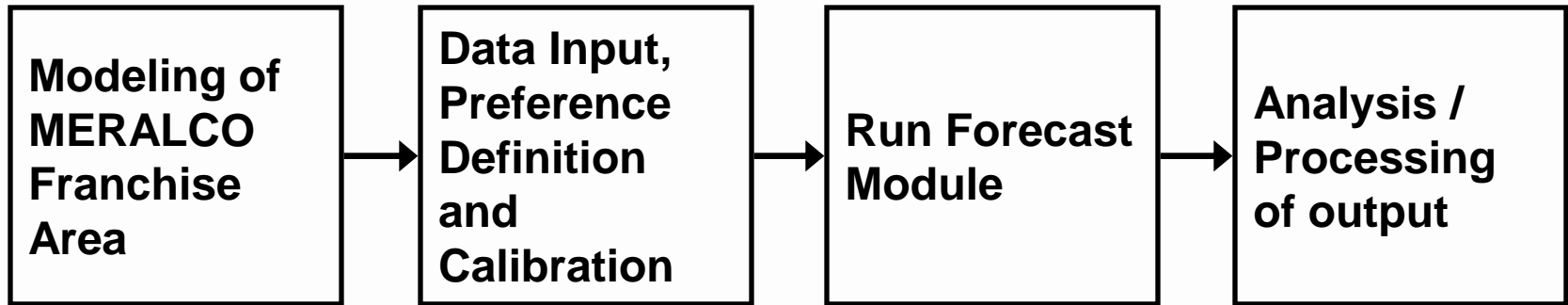
- Residential
- Commercial
- Industrial
- Streetlights

Load Forecasting



- Load forecasting is used to identify both the existing and projected system deficiencies of the electric distribution system that will serve as input to come up with the substation development/expansion plans.
- A software is used to conduct the load forecast and the substation expansion plans which uses satellite imagery and GIS technology.
- The software uses a geographically exact computer model of Meralco's substations and customer locations which are created from the Satellite Image of the Meralco service area.

Glimpse of the Load Forecasting Process



- **Satellite photomaps**
- **Land-use**
- Highways
- Substation area coverage
- Substation location
- Waterways
- Zoning
- Government infrastructure projects

- Customer growth
- Energy Sales Growth
- Substation peak load
- Land-use preference
- Urban pole
- Load profiles

- Substation load forecast
- Power transformer load forecast
- Identify capacity deficiencies

Land use Modeling



LAND USE TYPES

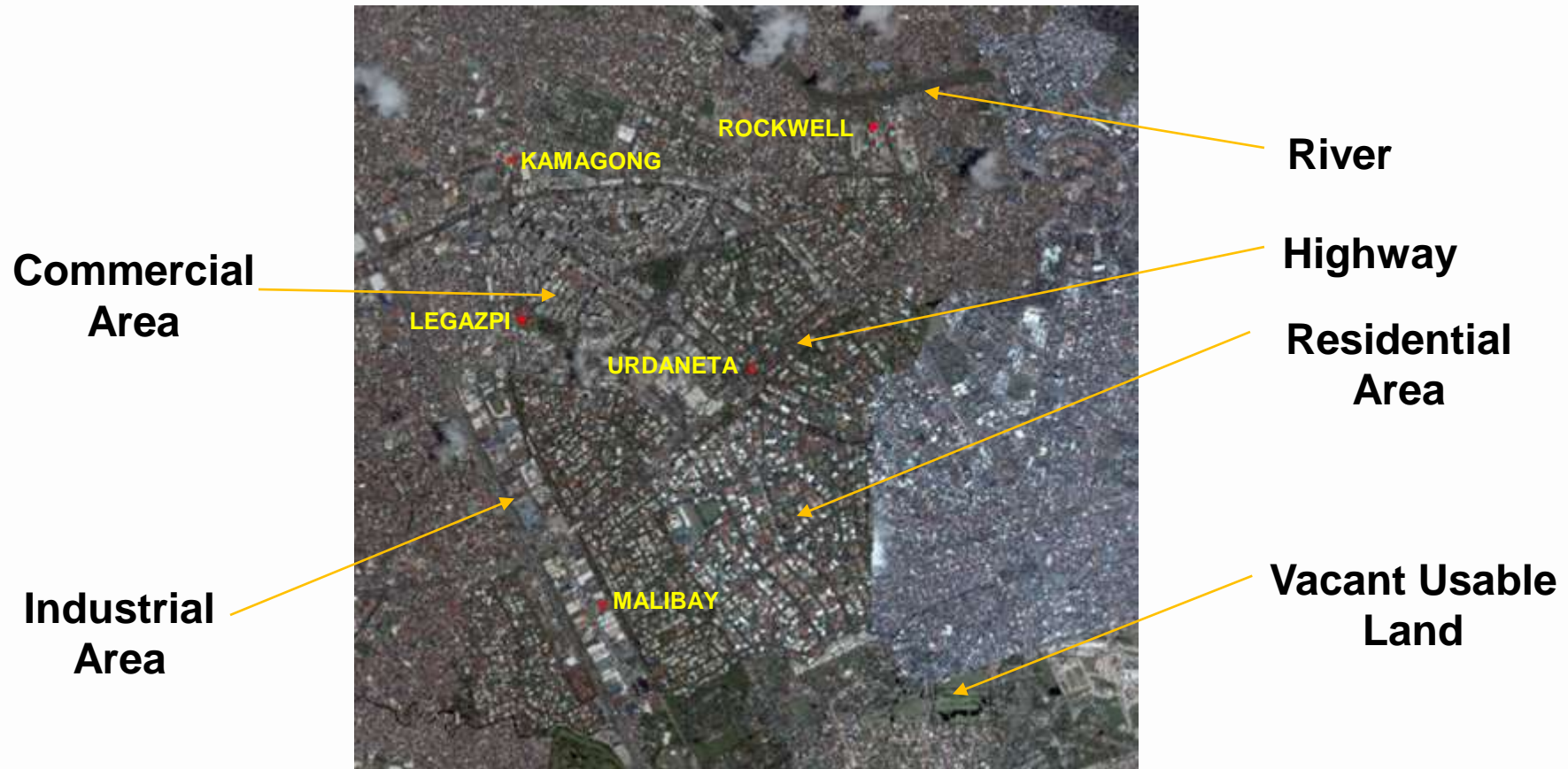
#	LAND USE CLASS NAME	TYPE
1	LIGHT RESIDENTIAL	RES
2	MEDIUM RESIDENTIAL	RES
3	HEAVY RESIDENTIAL	RES
4	CONDOMINIUM	RES
5	EXECUTIVE RESIDENTIAL	RES
6	LIGHT COMMERCIAL	COM
7	MEDIUM COMMERCIAL	COM
8	MALL/SHOPPING CENTERS	COM
9	HEAVY COMMERCIAL 1	COM
10	HEAVY COMMERCIAL 2	COM
11	LIGHT INDUSTRIAL	IND
12	MEDIUM INDUSTRIAL	IND
13	HEAVY INDUSTRIAL	IND
14	SUPER HEAVY INDUSTRIAL	IND
15	INDUSTRIAL ESTATES	IND
16		NONE
17	INSTITUTIONAL	OTHER
18	POBLACION	OTHER
19		NONE
20		NONE

Class Description

- 1-20** Load bearing & forecastable (Light, Medium, Heavy Residential, Commercial and Industrial)
- 21-90** User defined (Marsh, Cemetery)
- 91-98** Vacant Restricted (Airport, Lake, Mountain)
- 99** Vacant Available

Landuse Modeling

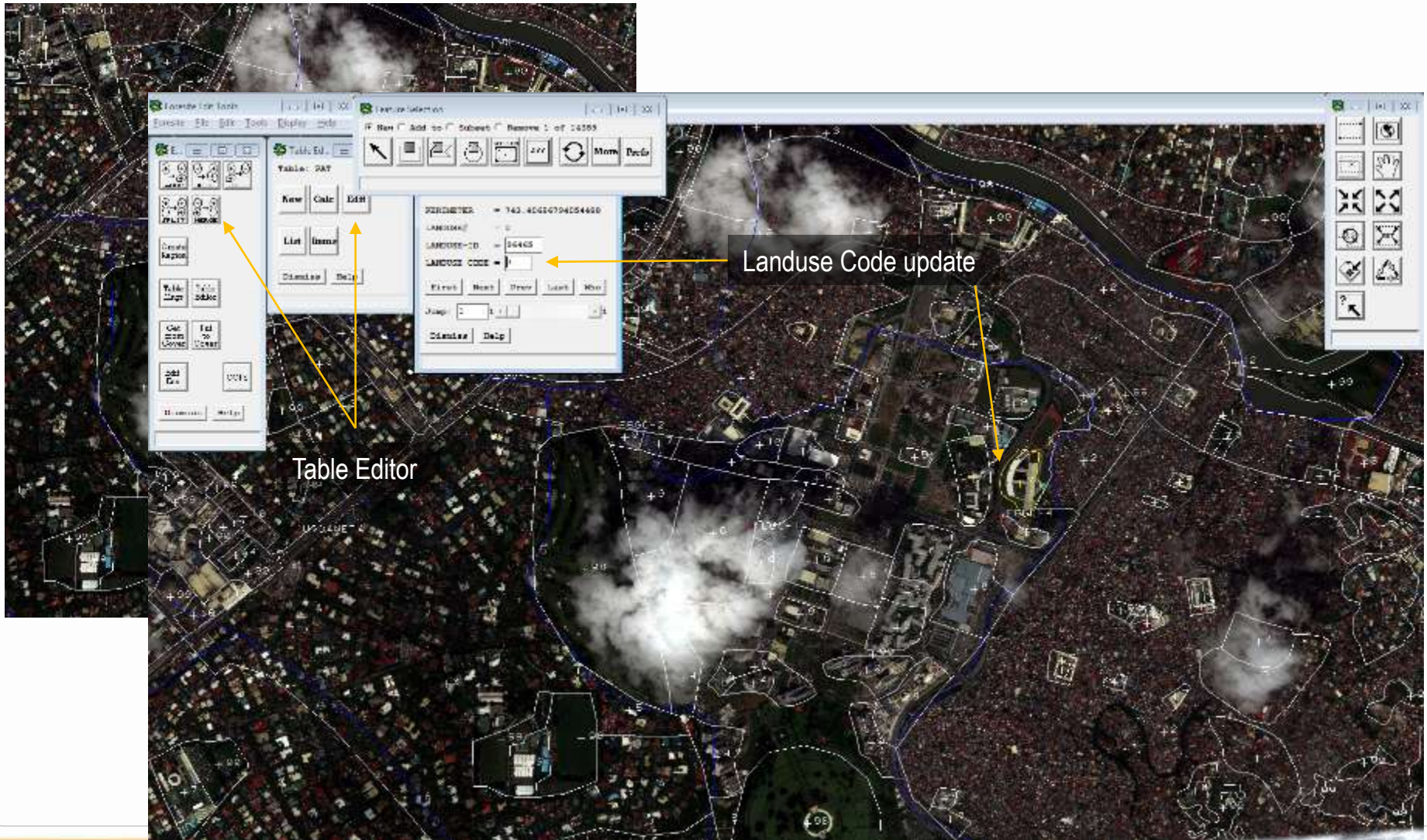
Geographic Modeling of Meralco Customers and Substations



Satellite Photomaps Portion of
Meralco Franchise Area




Landuse Modeling

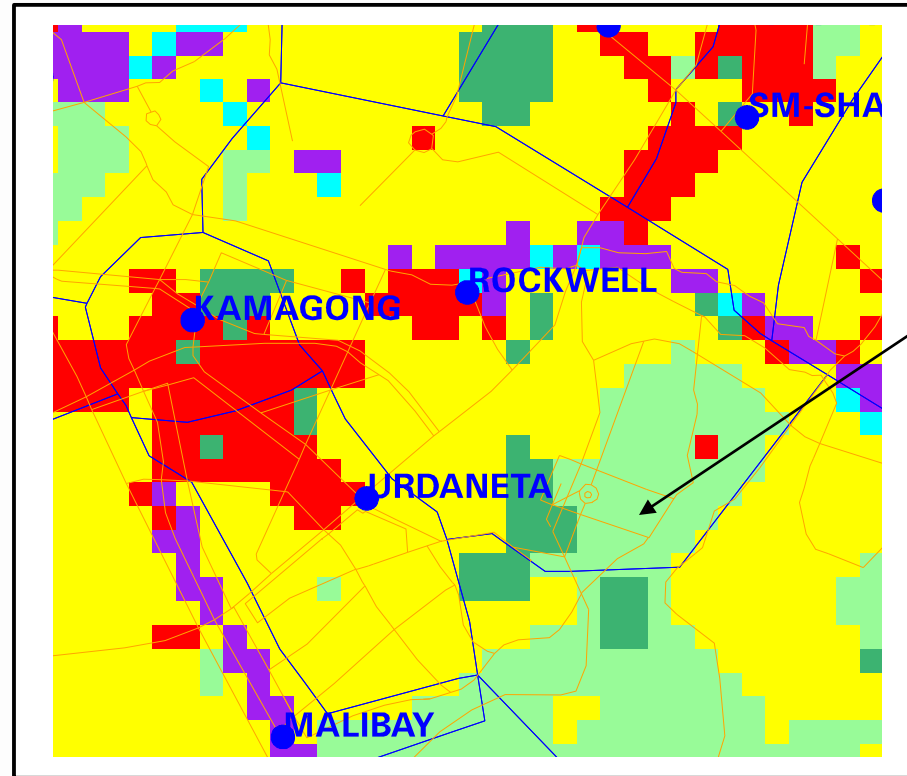
SAMPLE DIGITIZATION OF LANDUSE



Landuse Modeling

SAMPLE CASE ANALYSIS

-  Substation Location
-  Residential
-  Commercial
-  Industrial
-  Vacant Available
-  Vacant Restricted
-  Water
-  Highway
-  Substation Area

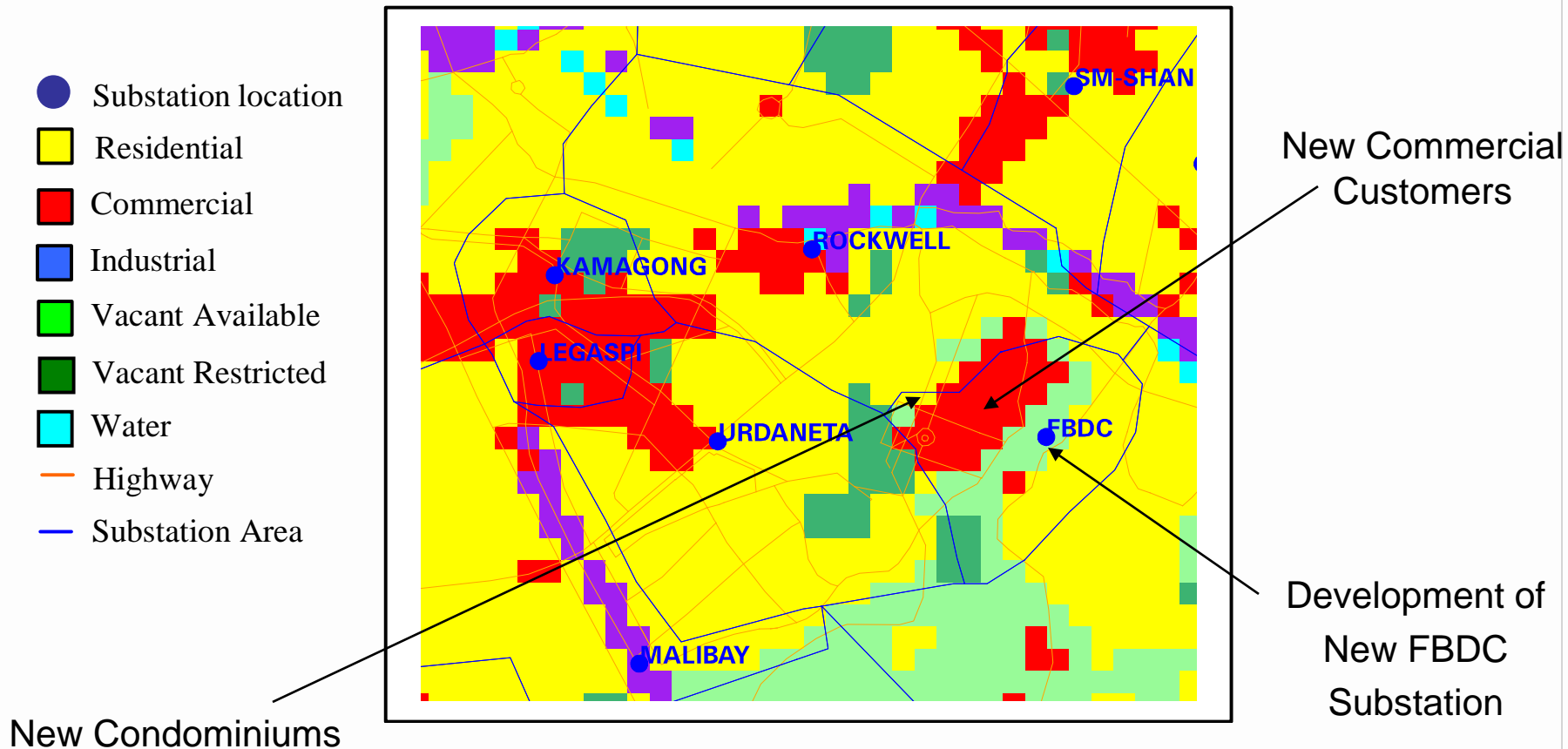


Vacant Available
Land

Existing Customer Location &
Substation Areas

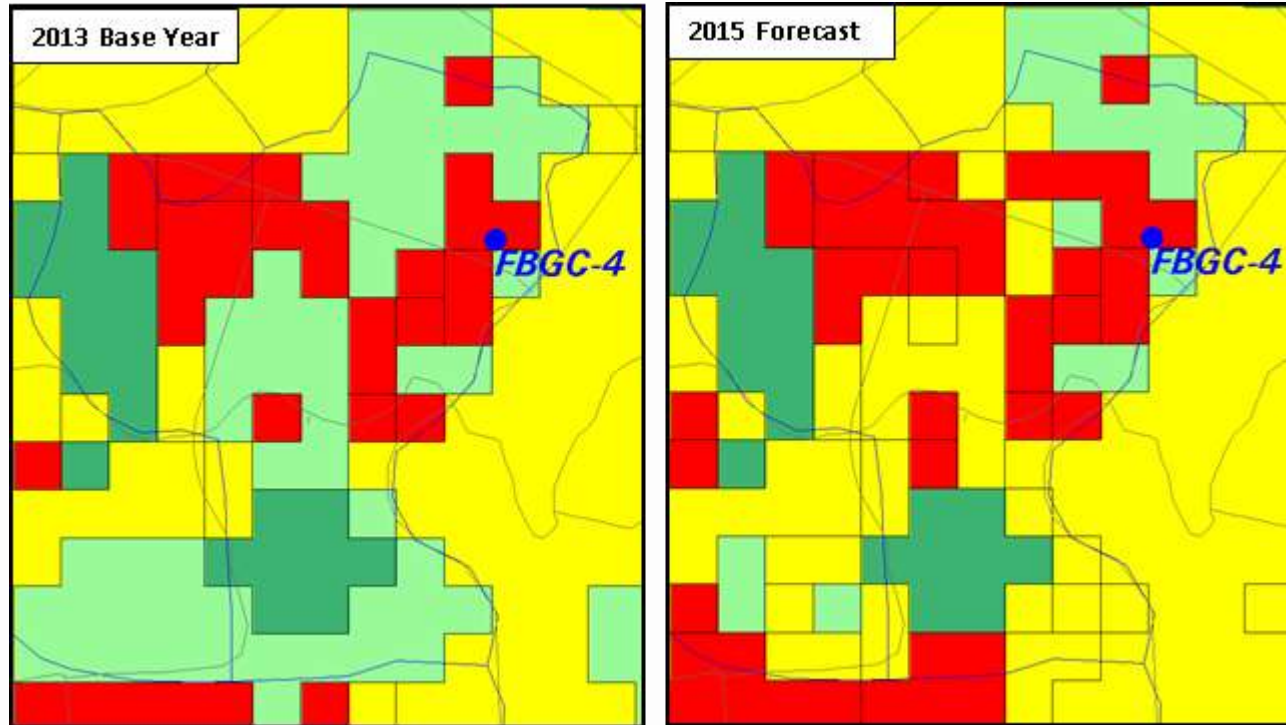
Landuse Modeling

SAMPLE CASE ANALYSIS









Land use Modeling

SAMPLE CASE ANALYSIS



Legend:

-  - Residential (mixed-use condominiums, townhouses, high residential buildings)
-  - Commercial (banks, restaurants, malls/shopping centers, hotels, hospital and commercial buildings)
-  - Vacant Usable (lands with possibility of being load-bearing)
-  - Vacant Restricted (parks, tourist spots, golf courses, cemeteries and non-developable lands)
-  - Substation Coverage
-  - Major Highways

Land use Modeling



OUTPUT OF LOAD FORECASTING SOFTWARE

System Summary

Substation Plan Results

System Summary

Year	Total	Substation	Feeder	Losses	Maximum			System	
	Cost (\$1000)	Cost (\$1000)	Cost (\$1000)	Cost (\$1000)	Losses (MW)	Voltage (percent)	Unreserved Load (MVA)	Served Load (MVA)	
1	4435033	20640	291375	4342414	324731	114	0	6189	6189
2	4709542	21360	290988	4393194	343835	117	0	6508	6508
3	4861548	22320	288480	4850579	334649	121	62	6660	6722
4	5344950	23040	291890	5030220	351646	125	77	6916	6993
5	5921238	23760	300139	5597391	363023	128	94	7198	7292
6	6753768	24480	303453	6428835	399881	132	96	7478	7573
7	7756869	25680	306120	7425069	431469	136	10	7846	7856
8	8891680	26160	309511	8556009	466264	183	11	8135	8146
9	10266336	26880	313215	9926241	508235	188	11	8436	8447
10	13884149	26640	326149	13537360	649416	199	0	9079	9079

Display Substation Costs Display Other Substation Information

Close Help

Substation Results

ARC

Record	SUBNUM	LOAD	MVACAP	PERCENT	LOSSES	MAXVLDRP
1	1	58.7	50.00	117.40	788	7
2	2	100.6	100.00	100.60	13912	35
3	3	126.0	130.00	96.92	10329	31
4	4	55.1	80.00	68.88	2586	12
5	5	67.1	100.00	67.10	2112	11
6	6	92.6	100.00	92.60	4056	18
7	7	98.3	100.00	98.30	5639	20
8	8	31.5	50.00	63.00	107	1
9	9	56.8	50.00	113.60	4449	20
10	10	124.4	150.00	82.93	7968	21
11	11	97.7	110.00	88.82	4472	13
12	12	63.2	50.00	126.40	4657	37
13	13	88.2	100.00	88.20	5454	19
14	14	104.9	100.00	104.90	2716	11
15	15	98.1	100.00	98.10	1978	7
16	16	66.8	50.00	133.60	12203	48
17	17	37.1	50.00	74.20	1647	15
18	18	151.4	150.00	100.93	7473	16
19	19	93.5	100.00	93.50	2943	12
20	20	117.2	100.00	117.20	4840	11
21	21	159.4	150.00	106.60	11188	20
22	22	91.9	110.00	83.55	7180	29
23	23	90.8	100.00	90.80	1590	6
24	24	117.6	100.00	117.60	4991	10
25	25	24.8	50.00	49.60	2459	33
26	26	143.0	160.00	89.38	8753	23
27	27	66.9	100.00	66.90	2635	11
28	28	49.7	50.00	99.40	532	3
29	29	109.5	130.00	83.46	3086	10
30	30	60.1	50.00	120.20	1357	8
31	31	45.4	50.00	90.80	1901	10
32	32	151.6	180.00	84.22	12856	20

Continue Pause Quit

Land use Modeling



CHALLENGES

- High investment cost for data acquisition of satellite imagery for the entire franchise area.
- Data quality of maps particularly on cloud coverage, and tile stitching or orthorectification.
- Software limitations on the use of large sized satellite maps.
- Familiarity on the actual geographic area.

Land use Modeling

CHALLENGES – SAMPLE MAP WITH CLOUD COVER



Data Quality of satellite photomaps and familiarity in the area can affect the efficiency and accuracy of the landuse updates.

Land use Modeling



BENEFITS/CONCLUSION

- Use of satellite maps allows a good understanding of the load growth patterns in the electric service area.
- Use of satellite maps allows the exact geographic modeling of electric load, electric facilities, customer locations and their relationships
- Use of satellite maps provides colorful maps that can be used as qualitative reference for electric network expansion planning



MERALCO
Ang liwanag ng bukas

End of Presentation

References



ABB Foresite

- Network Planner User and Training Guide