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Urban-scale Building Energy Modeling, Part 6

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Virtual Reality – UBEM (Urban Building Energy Modeling)

Learning Objectives

1. Understand how one can estimate the actual rate of adoption of energy efficient building technologies at the urban, state, and even national level.
2. Name at least three non-energy or non-economic measures that influence the adoption of energy efficient building technologies.
3. Describe how UBEM can be used to make well-informed utility planning decisions.
4. Recognize key structural and operating requirements for an urbanscale energy modeling platform.

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Outline/Agenda

- What is Reality Modeling?
- Image-based 3-D Reconstruction
- Large Commercial Building Energy Benchmarking Dataset
- Integrating 3-D urban model with data: energy, water, and metadata
- Conclusions

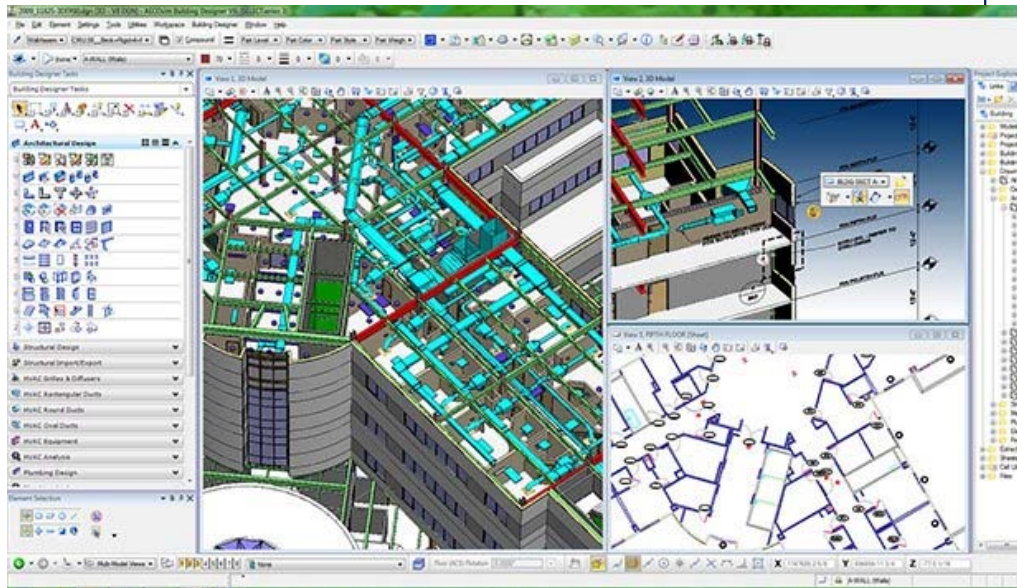
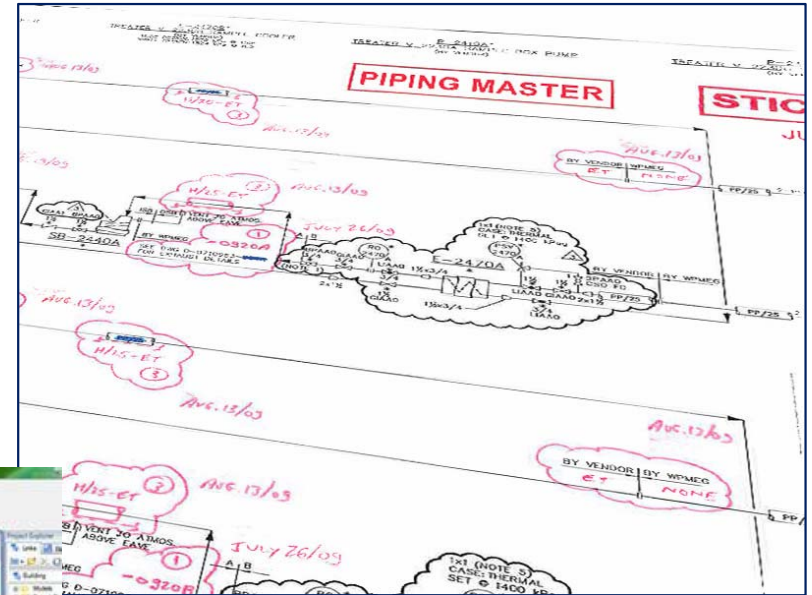
What is Reality Modeling?

- Images & video



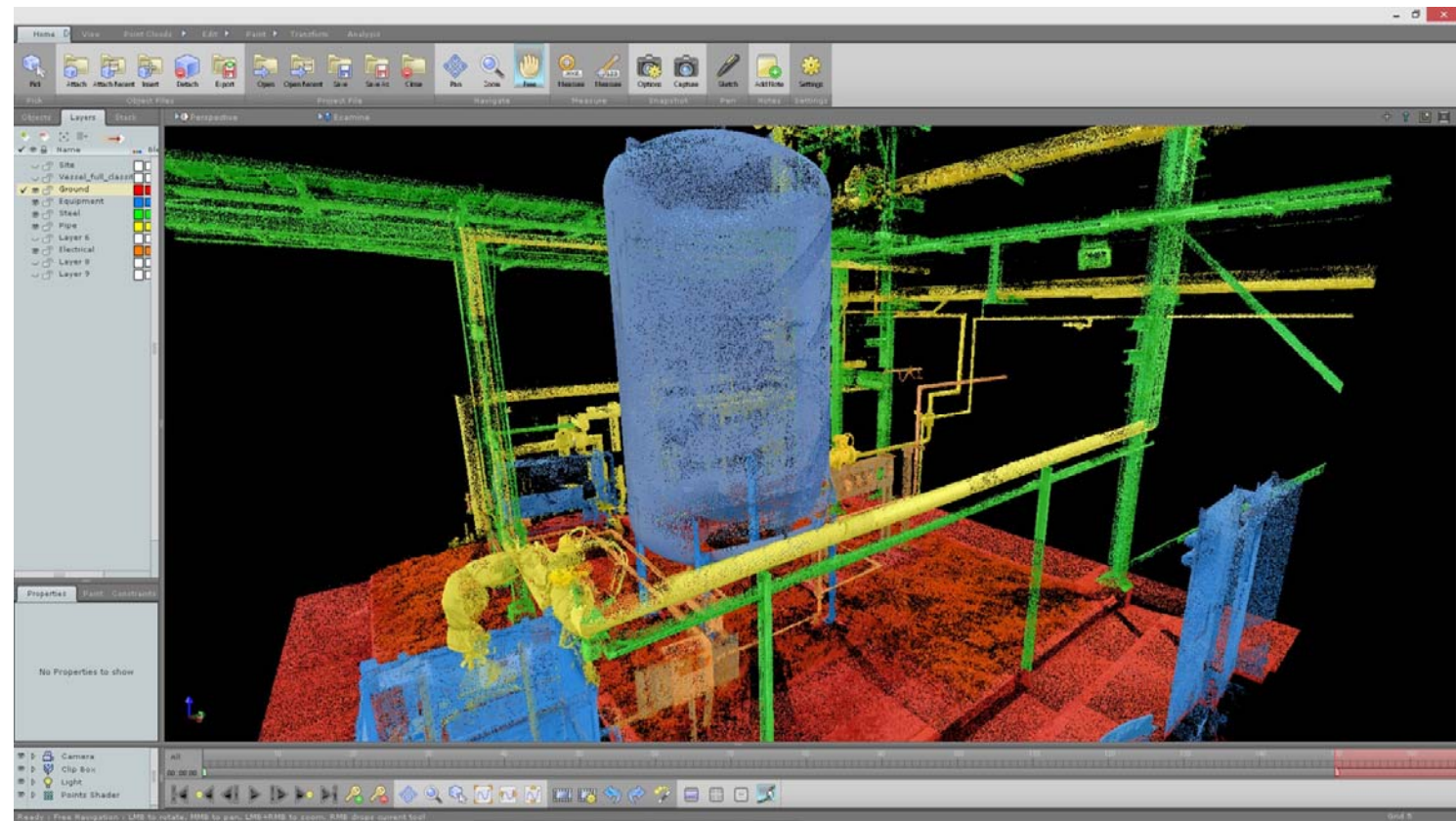
What is Reality Modeling?

- Images & video
- As-built drawings & models



What is Reality Modeling?

- Images & video
- As-built drawings & models
- Point clouds



What is Reality Modeling?

- Images & video
- As-built drawings & models
- Point clouds
- Image-based 3-D reconstruction

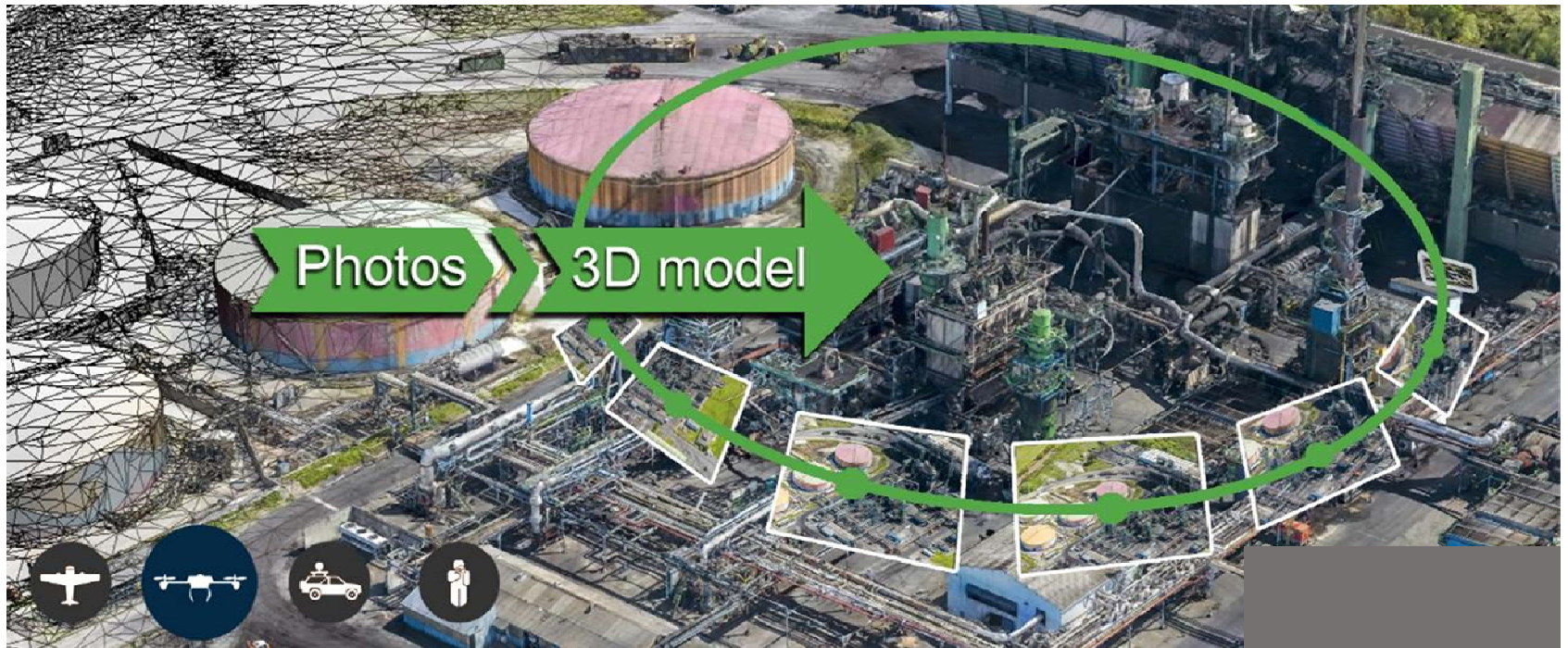


Image-based 3-D Reconstruction

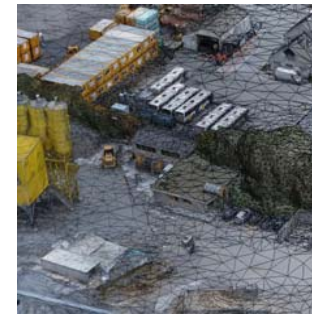


Image-based 3-D Reconstruction: Process

CAPTURE



PROCESS

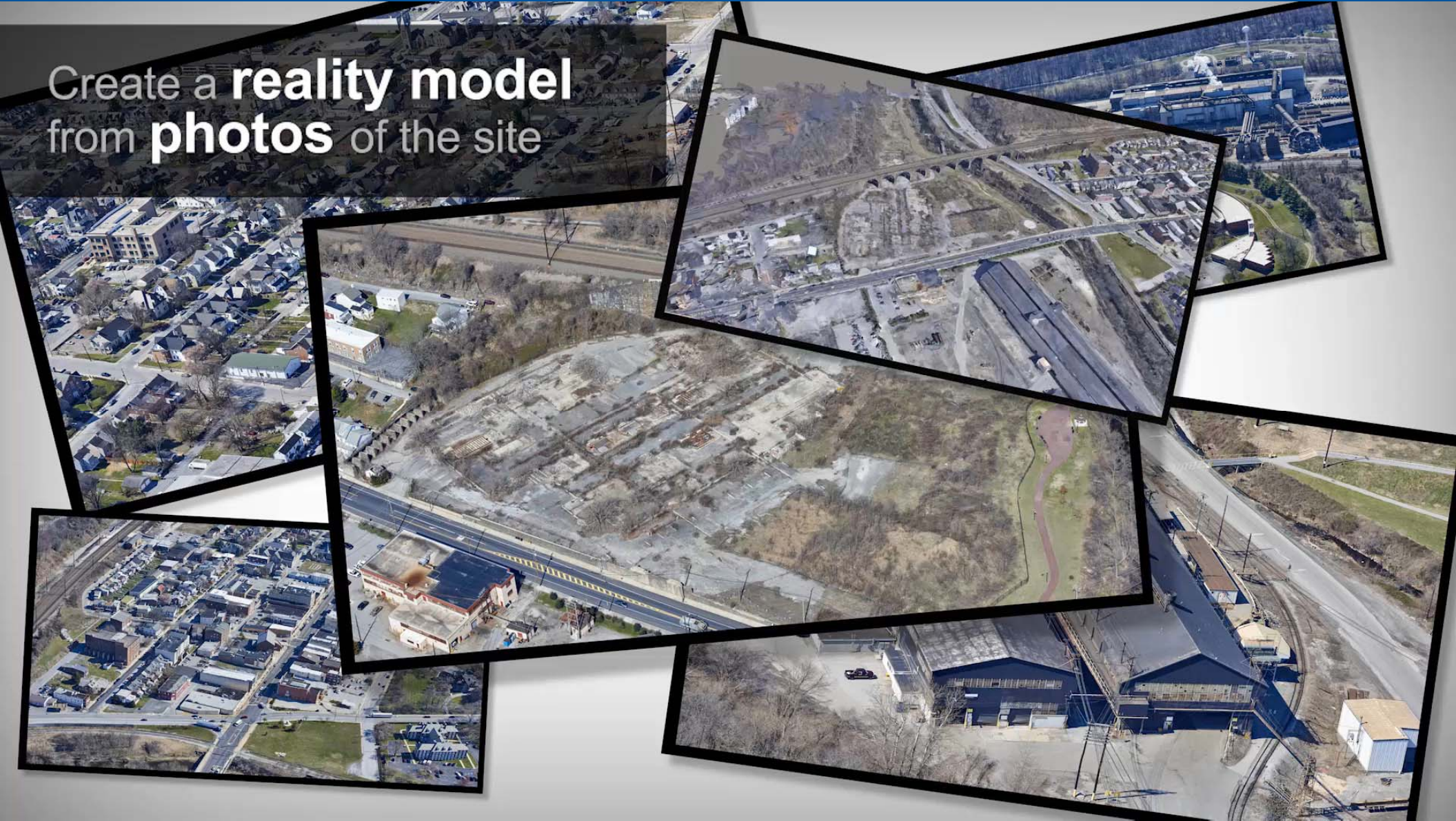


Reality Model
Scalable Mesh

CONSUME



Create a **reality model**
from **photos** of the site



Urban Mesh Model



Benchmarking Database

- Philadelphia Large Commercial Building Energy Benchmarking
 - <https://www.opendataphilly.org/dataset/large-commercial-building-energy-benchmarking>
- Large Commercial Buildings
- Area, address, building type, other metadata
- Data:
 - EUI-site (kBtu/sq ft)
 - EUI-source (kBtu/sq ft)
 - Natural gas use (kBtu)
 - Fuel Oil use (kBtu)
 - Electricity use (kBtu)
 - Water use (kgal)
 - Energy Star score

Benchmark Data

Grid Graph Map 1000 records « 0 – 100 »

Search data ... Go » Filters

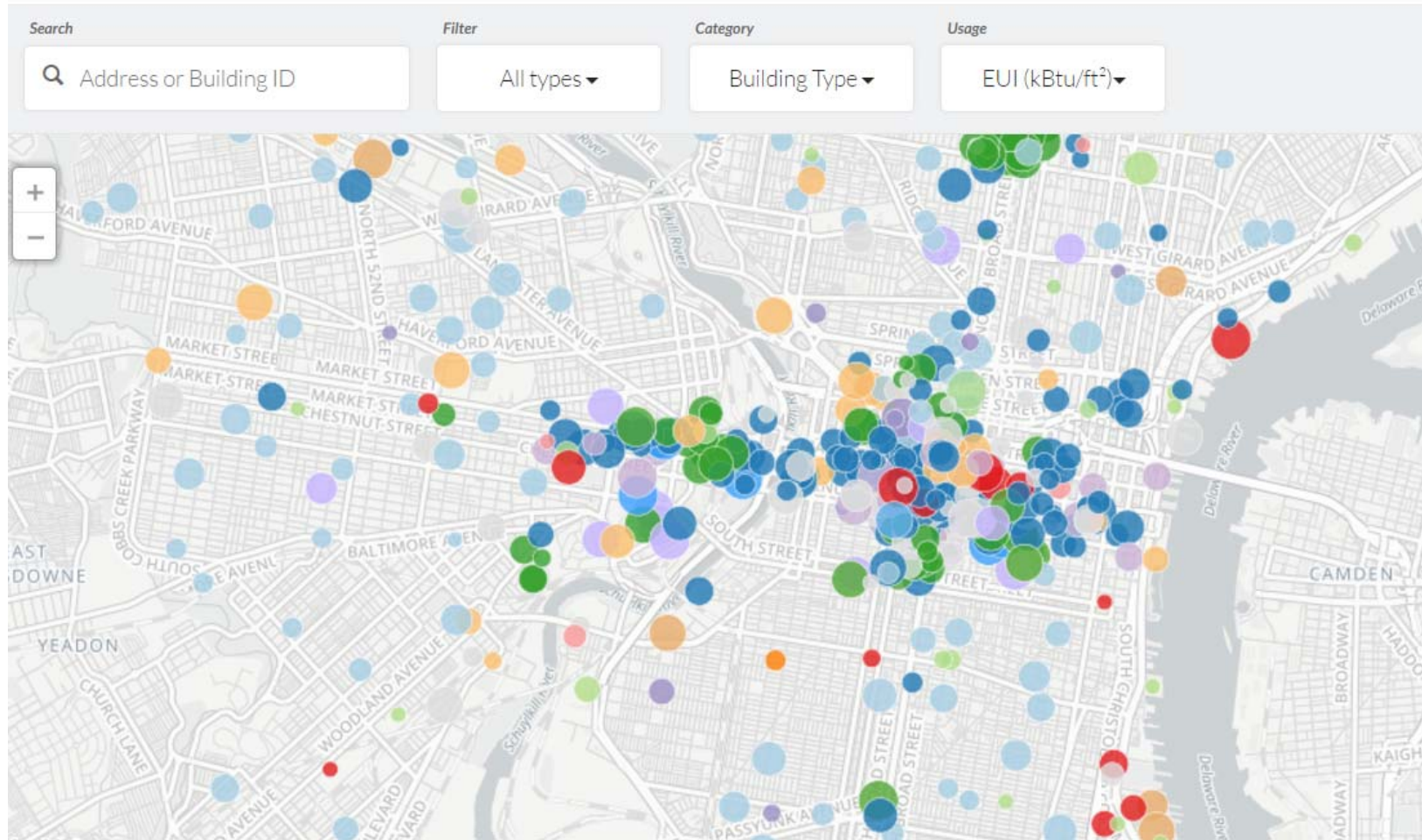
portfolio_...	number_...	postal_co...	property_...	source_e...	total_ghg...	district_s...	site_eui_...	location_...	primary_...	natural_g...	e
3330960	1	19120	Lowell	245.2	651	Not Availa...	136.5		K-12 School	5,108,484...	
3952012	1	19116	10814 NE...	35.6	715.1	Not Availa...	21.4		Other - Se...	6,566,999...	
3989966	1	19124	Juniata	34.1	88.9	Not Availa...	13.6		Self-Stora...	243,912.00	
3330939	1	19143	Dobson	146.5	373	Not Availa...	115.1		K-12 School	5,401,817...	
3330927	1	19128	Levering	121.5	546.1	Not Availa...	97.6		K-12 School	78,090.40	
3330786	1	19143	Comegys	145.8	491.7	Not Availa...	105.8		K-12 School	6,296,429...	
3330783	1	19143	Bryant	128.9	588.7	Not Availa...	101		K-12 School	8,485,597...	
3569714	1	19147	1163-65 S...	167.2	373.2	Not Availa...	54.4		Office	94,435.00	
3963826	1	19106	Archworks...	159.3	362.6	Not Availa...	50.7		Office	Not Availa...	
3633488	1	19153	Pacifico F...	148.5	348.3	Not Availa...	47.3		Automobil...	Not Availa...	
2858208	1	19102	Anderson ...	141	858.1	Not Availa...	60.9		College/U...	3,309,558...	
2917145	1	19107	Terra Hall	173	2143.20	7,888,006...	73.8		College/U...	398,637.70	
2851911	1	19147	Gershman...	161.8	550	Not Availa...	86.3		College/U...	3,918,224...	
3619585	19	19144	Philadelph...	200.2	5843.70	Not Availa...	92.3		College/U...	18,777,33...	
3762530	2	19104	7,7A-Boss...	373.8	3024.10	6,614,051...	193.5		College/U...	13,603,59...	
3762531	1	19104	8-Creese	332.8	979.9	3,597,734...	151.2		College/U...	1,058,029...	
3762532	1	19104	9B,9A,9C-...	305.8	2329.80	9,299,550...	137.4		College/U...	1,417,458...	
3762535	1	19104	13-Nesbitt	248.4	1018.10	4,951,046...	113.4		College/U...	821.4	

Mapping and Charts

THE CITY OF PHILADELPHIA
MAYOR'S OFFICE OF
SUSTAINABILITY



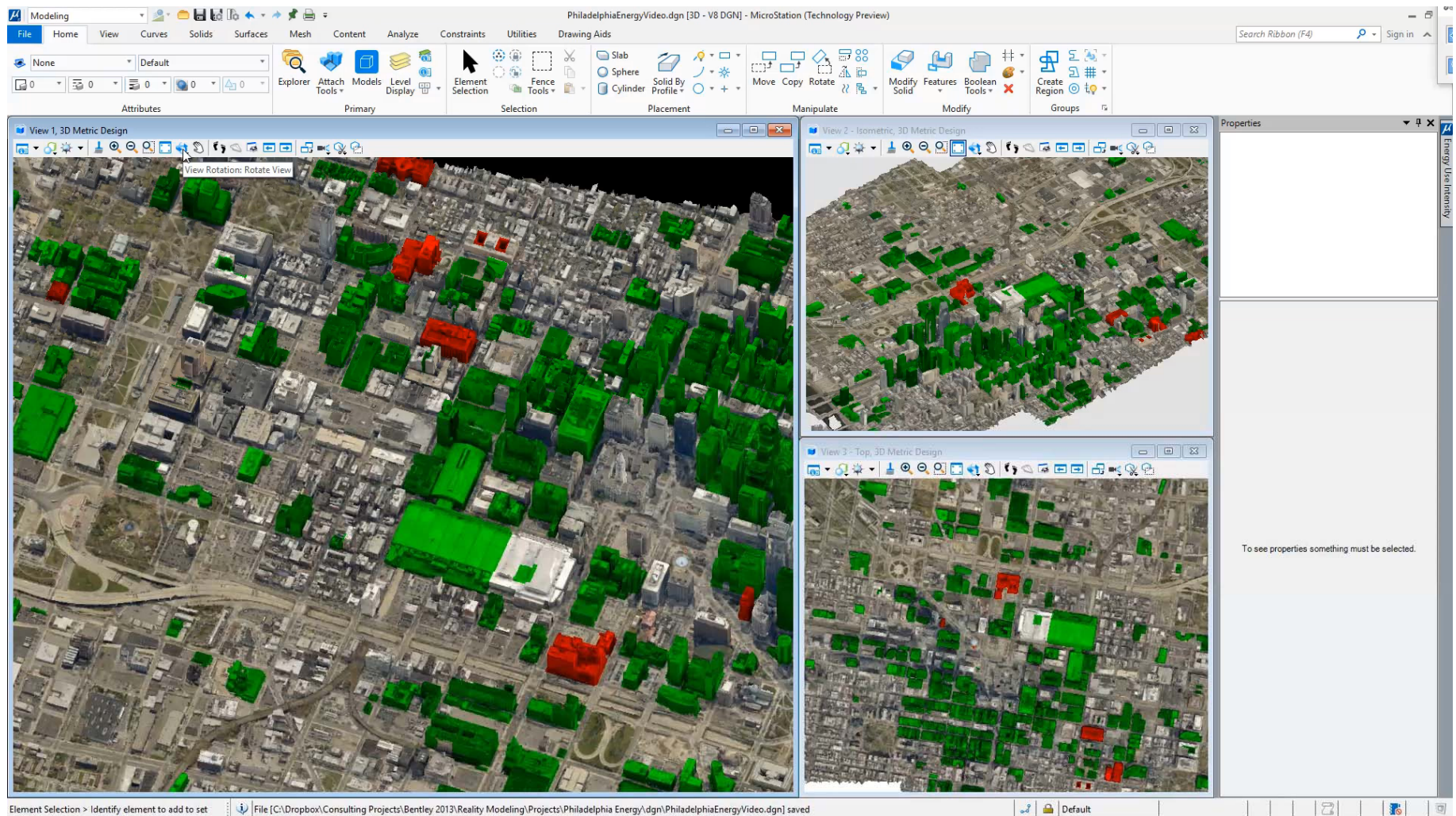
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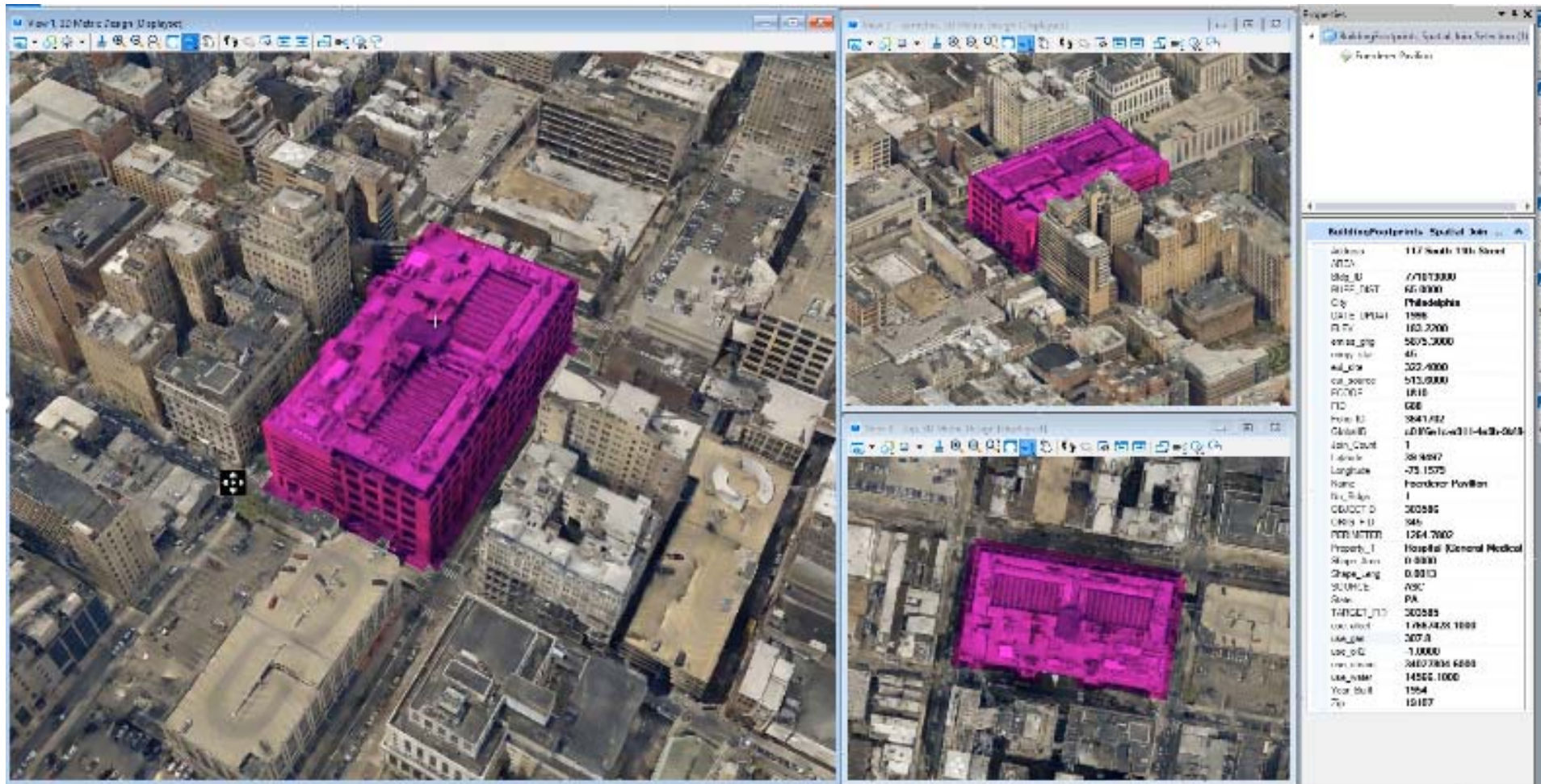
Energy and Water



Exploring Individual Buildings



Exploring Building Data within the Urban Model



The image displays three screenshots of a 3D urban model software interface, showing a building highlighted in pink. The top-left screenshot shows a wide view of the city. The top-right screenshot shows a closer view of the pink building. The bottom-left screenshot shows a top-down view of the pink building. The right side of the image shows a 'Properties' window with a table of building data.

BuildingFootprints_Spatial Join	
Address	117 South 13th Street
AREA	
BLDG_ID	77073000
BLDG_FOOT	67,0000
City	Philadelphia
CRS_ID	1588
CRS_NAME	160,7000
CRS_SRS	5675,3000
CRS_ZONE	45
CRS_ZONE	322,4000
CRS_ZONE	513,0000
CRS_ZONE	1818
CRS_ZONE	608
CRS_ZONE	3841,002
CRS_ZONE	4,016,000,000-4,016,000
CRS_ZONE	1
CRS_ZONE	38,8897
CRS_ZONE	-73,1575
CRS_ZONE	Footcreek Pavilion
CRS_ZONE	1
CRS_ZONE	300585
CRS_ZONE	945
CRS_ZONE	1264,7000
CRS_ZONE	Hospital, General Medical
CRS_ZONE	0,0000
CRS_ZONE	0,0000
CRS_ZONE	700
CRS_ZONE	PA
CRS_ZONE	300585
CRS_ZONE	1,688,000,000
CRS_ZONE	307.0
CRS_ZONE	1,0000
CRS_ZONE	3407,3835,6888
CRS_ZONE	14555,1000
CRS_ZONE	1564
CRS_ZONE	12187

Conclusions

- Easy and quick to capture a 3-D model of a building, community or campus through photogrammetry
- Integrating 3-D with BIM and data can create virtual, interactive urban model that can be kept up to data
- Not just limited to BIM or individual buildings
- Powerful tool for policymaking or building owners

QUESTIONS?

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