What Gets Measured, Gets Done—The Potential for Remote Sensing Techniques and Methodologies in Environmental Policy Development and Regulation

- In December 2009, New York City enacted its Greener Greater Buildings Plan, a suite of related local laws, one of which—Local Law 84/2009—created an annual disclosure by owners of certain buildings of enumerated building performance measures, including the Energy Star rating.

- The theory underlying the disclosure mechanism in Local Law 84/2009 is a theory that disclosure will lead to change in behavior or practice.

- There is an adage in public administration that "what gets measured, gets done", which serves as both a tool and a warning.

- The literature on Local Law 84/2009 and the result of the rudimentary mapping exercise that is the subject of this final project seem to suggest that Local Law 84/2009 is not the most effective tool to change behavior and practice, though Local Law 84/2009 does appear to be successful if evaluated solely on the basis of compliance with the reporting requirement.

- The development and increased use, however, of science-based remote sensing, including remote assessment of building façade energy efficiency that was the subject of Assignment 3.1, suggests the possibility of effective tools for evaluating private behavior and practice as a basis for revising current regulation to improve the cost-benefit of regulation intended to reduce activities thought to contribute to negative environmental conditions.

- If the goal of Local Law 84/2009, like any public regulation of private activity intended to effect a policy objective, is to change private behavior and practice, it is time to evaluate its effectiveness by performing a cost-benefit analysis to assess whether the benefits realized from the regulation equal or exceed the costs imposed by it.

- The standard public policy analysis of regulations intended to capture and transfer the costs of negative externalities from private activity back to the private actors in order to "price" private activities and move the quantity of these activities to a socially desired level, involves application of the Pareto efficiency model.

Summary of LL 84/2009 Literature Review

- LL 84/2009—a benchmarking program—requires owners of private commercial buildings at least equal to 50,000 square feet (covered buildings) to report energy and water consumption data, enter data into the U.S. Environmental Protection Agency's online tool called ENERGY STAR Portfolio Manager and report ENERGY STAR score, generating at this time datasets of covered building performance for calendar years 2011 to 2014.
    - LL 91/2016 expanded covered building to include commercial buildings at least equal to 25,000 square feet, thus increasing reported building performance data starting in 2018.
- City's rationale for LL 84/2009 was to produce baseline information necessary to analyze performance and simultaneously create conditions among private sector building owners to implement practices to improve buildings' environmental performance.
- City's implementation of Greener Greater City Plan confirmed research on a a range of variables on U.S. green building policies suggesting "early adopter" policy innovator cities tend to have lower carbon emissions per capita, have better educated residents and have more restrictive land use restrictions.
- Buildings are focus of local efforts to effect environmental mitigation policies:
    - widely understood nature of scale of emissions attributed to buildings sector
    - building regulations are relatively low-cost, less politically charged, and can have more immediate impact, compared to comprehensive land use and transportation network changes
- First evaluation deemed LL 84/2009 "rousing success" with approximately 75% compliance rate, considered very high for initial roll-out; 2014 compliance rate was 87%
- Second year evaluation more sober and suggested overly optimistic initial expectations and limitations to the "'peer bragging' effect" expected from benchmarking, showing impact of "what gets measured, gets done"
    - though controllable expense, typical energy costs of $3-$5 per square foot represents small portion of overall real estate economic equation so that for most real estate practitioners, energy performance is not top priority
    - energy-intensive building may still be considered 'high performance' if generate sufficient rent and maintain low vacancy rate--for most property investors, building performance refers primarily to financial investments, such as return on investment (ROI)
    - energy efficiency is only considered to be contributing to building performance to extent it can be demonstrated to generate direct financial benefits, through higher ROI or lower asset risk
    - real estate attorneys have advised many non-compliant sellers to simply reduce the sales price by the amount of fines in lieu of compliance

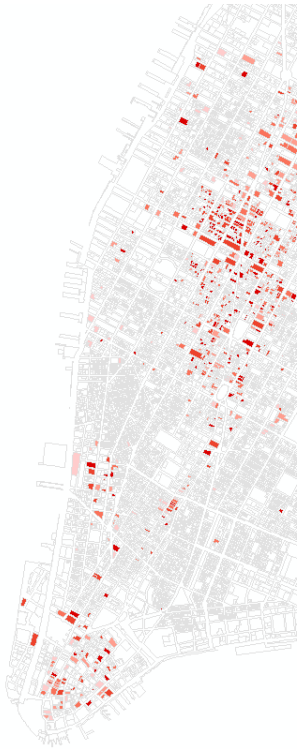
Summary of Remote Sensing Thermal Imaging Literature Review

- Three academic studies noted advantages of remote sensor imaging:
  - satellite-acquired data limitations to studying urban buildings and infrastructure solved by techniques providing persistent coverage and unchanging perspective, together with easy and low-cost operations
  - high quality data sets for quantitative analysis in "real time" mode, immediate availability of imagery, ability to see live image during data acquisition, electronic format of video data, and relatively low price
- Tel Aviv (1/30-31/94; thermal video radiometry, 3-14 µm spectral region, and airborne infrared video radiometry) study of thermal behavior of urban materials located in Tel Aviv UHI
  - earlier research found temperature differences on vertical facets are generated primarily by differences in the thermal properties of the material involved as well as differential patterns of irradiated and shaded surfaces within sensor field of view.
  - though specific findings for subject buildings were based on summer-time temperature conditions and location around wide square, methodology would also permit analysis of buildings in urban areas such as the City with areas of narrow streets or bounded by high buildings (urban canyon)
  - thermal behavior of urban surfaces yielded a remarkable database for urban planners
- New York City (10/26-11/16/13; Point Grey Flea 3 8.8 megapixel camera, 7.6- 13.2 µm spectral region) study of aggregate light activity in buildings linked to astronomical techniques statistical physics
- New York City (8 days in 2015, hyperspectral imaging) study collected images of Manhattan West Side generating thermal image on slide 5.
  - thermal image reveals significant thermal heat loss along the West Side; Javits Convention Center in red is entirely clad in glass, while Empire State Building in blue underwent significant retrofitting of its buildings systems, including windows.
- Potential of modern technology deployed by local government actors to assess individual building phenomena to inform policies and regulations
  - City noted, in recent LL84/2009 report, windows conduct about five times more heat than walls, so buildings with greater window areas are expected to have increased heating and cooling loads; other thermal loss mechanisms such as infiltration are important; need for study using more LL 87/2009 data or data from other cities to explore cooling energy use and other factors such as age or effective energy code at time of construction due to code design implications and contrast with models' predictions
  - Remote sensing techniques generate quantitative building performance data, which can be translated into financial cost data that are measures real estate industry operators and financiers can understand in relation to their particular buildings. Linking building disclosure data with scientifically-derived remote sensing data can help benchmarking regulations actually change behavior and practice.

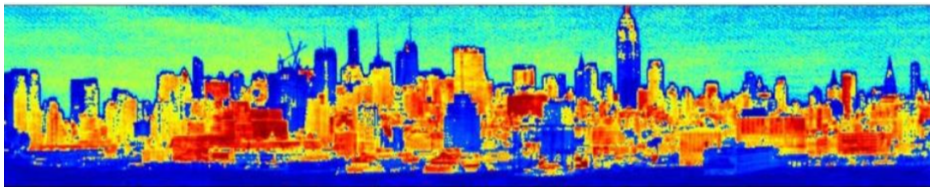
Mapping of annual building performance disclosure data appears to confirm assessment from literature that LL 84/2009 has succeeded only as a disclosure program but has failed to generate changes in building management behavior and practices sufficient to justify private costs of the program

2015 LL84 Energy and Water Data Disclosure (Data for Calendar Year 2014), 2014 LL84 Energy and Water Data Disclosure (Data for Calendar Year 2013), 2013 LL84 Energy and Water Data Disclosure (Data for Calendar Year 2012) and 2012 LL84 Energy and Water Data Disclosure (Data for Calendar Year 2011) @ http://www.nyc.gov/html/gbee/html/plan/ll84_scores.shtml

Potential for In-depth Analysis of New York City's Urban Heat Island Effect



West Side Energy Star CY 2014



- Map of Energy Star performance related to portion West Side thermal map

Inconclusive Results of Using Energy Star Ratings on 3 Buildings in West Side Map

Building	BBL	Address	Depth ft	Width ft	Height ft	Reported Energy Star Rating/100	U = heat transfer coefficient	T1 C	T2 C	(T2-T1)	Wall Area ft^2	Wall Q =U * Wall A* (T2-T1) = Heat Transm.	Annual Electricty Consump. kWh	Annual Fuel Consump. Therms --> kWh	Daily Building Energy Consump. kWh	Daily Building Energy Consump. Lost Due to Heat Tfr kWh
2 MTC	3001480007	100 Myrtle Street	230	160	189	0.96	0.04	15	20	5	30240	6048	13528000	14733241.3	77428.05836	3097.122334
3 MTC	3020580017	339 Bridge Street	200	190	161	0.72	0.28	13	20	7	30590	59956.4	10954000	11526561.4	61590.57918	17245.36217
4 MTC	3020590001	4 Metrotech Center	200	500	379	0.65	0.35	12	20	8	189500	530600	32863000	34391138.7	184257.9142	64490.26999
BoA	1009950003	One Bryant Park				Not Available	Not Available	8.9	20	11.1						
Empire	1008350041	350 5th Avenue				0.84	0.16	9.6	20	10.4	2,100,000	3494400	86316000	34391138.7	330704.4896	52912.71833
Javits	1006800001	655 W. 34 Street				Not Covered Bldg	Not Covered Bldg	11.4	20	8.6						