



Open Windows

Getting to Energy Efficiency in NYC Buildings

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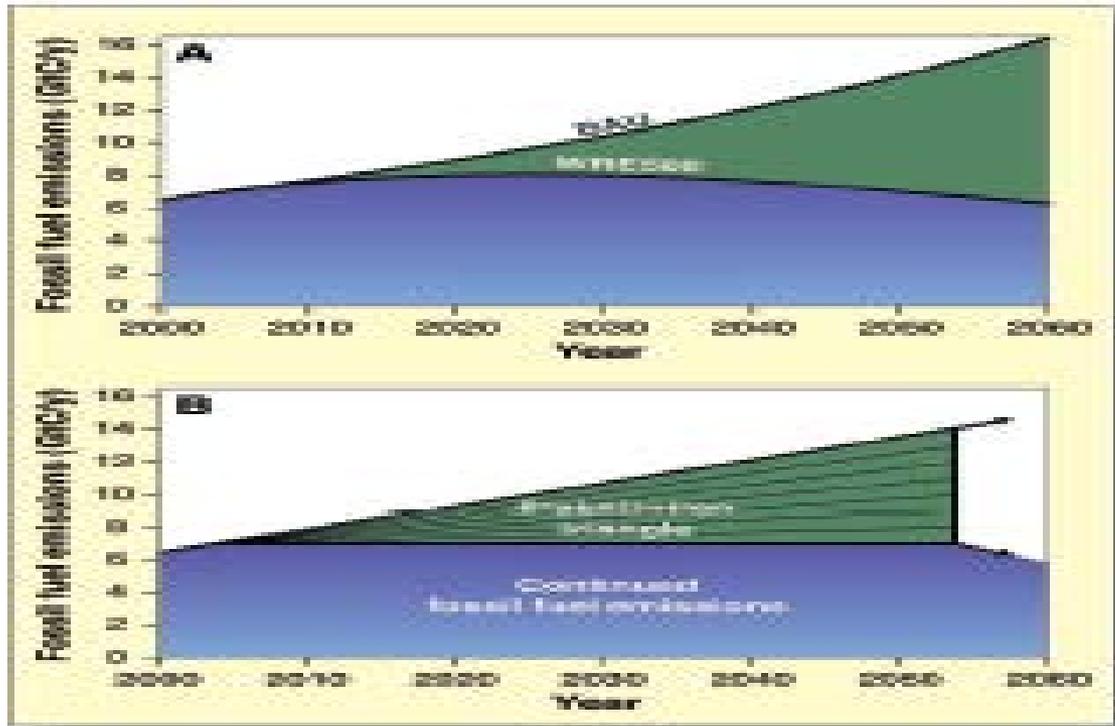




The CUNY Building Performance Lab

- A serious* perspective on operational challenges in building performance and energy efficiency in NYC
 - Industry collaboration with CUNY education and research
 - Workforce development for building operations
 - Seed-funded by NYSERDA
- serious -- *seasoned, somewhat skeptical; informed by experience and practical knowledge*

Our Open Carbon Window: Sticking a wedge into it



- Robert Socolow, Princeton physicist
- Conceptualize the challenge
- Divide the wedge into manageable segments



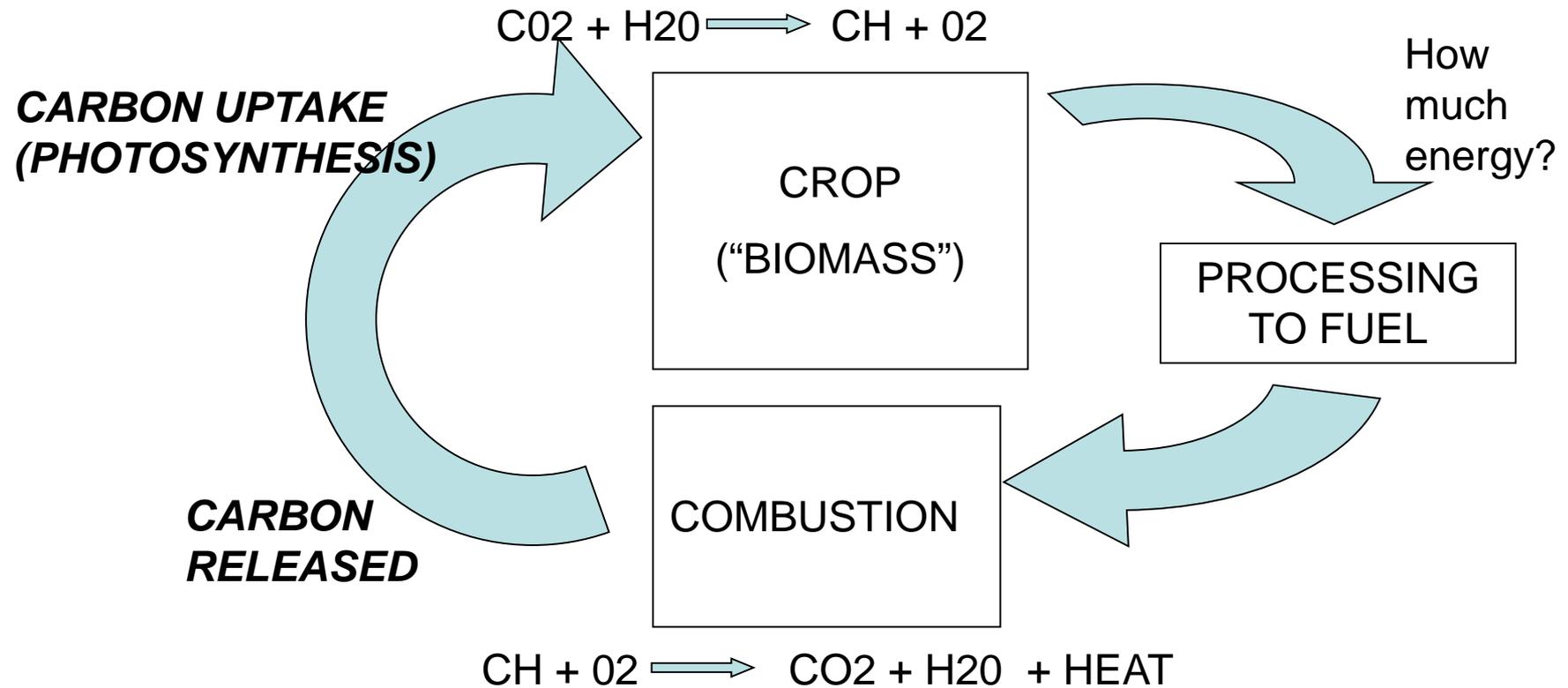
Our Open Carbon Window: What *IS* the connection between carbon and energy use?



- Fossil and biomass fuels are CH molecules. Combustion produces and releases CO₂.
- Biomass made by photosynthetic uptake of CO₂ from atmosphere, so its combustion is, to some extent, carbon neutral. Also the basis of “forestry-based sequestration.”

Our open carbon window: Sticking a wedge into it

The Biofuel Carbon Cycle



Our open carbon window:

Sticking a wedge into it - **Energy Efficiency**

- The largest “soft-path” wedge, by far
- Many technologies
- Many actions

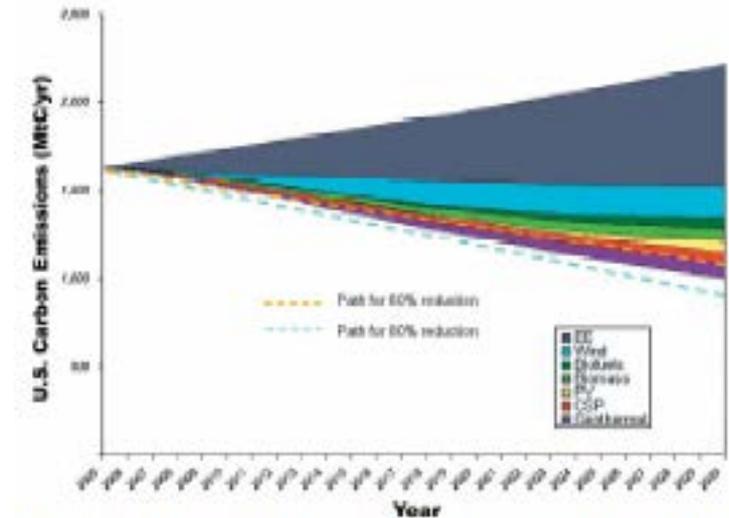


Table 1.

Potential carbon reductions (in MtC/yr in 2030) based on the middle of the range of carbon conversions.

Energy efficiency	688
Concentrating solar power	63
Photovoltaics	63
Wind	181
Biofuels	58
Biomass	75
Geothermal	83



Our open carbon window: Sticking a wedge into it: Energy Efficiency

How EE gets brought to market

- Codes
 - Effects new construction and building systems at points of major renovation
- Standards, regulatory or voluntary
 - Effects especially appliances, mass-market equipment
- Projects
 - Direct marketing of cost-effective measures

The Bank Window



- Little work gets done without a source of money
- Energy Efficiency as the “Next Window” for investing in urban buildings ??

The Bank Window

- Projects Line Up for Capital



- Capital Lines Up for Projects



The Bank Window: Capital's EE Opportunity

- Technology & Equipment Investment
 - New technologies and industries that will mfr it
- Project Finance
 - Getting EE technologies applied and installed
- Carbon Trading
 - Certifying and securitizing the impacts of projects



Capital's EE Opportunity

Energy Project Finance

- High cost-effectiveness
 - 3-5 year simple paybacks = 20 - 30% ROI
- Multiple partners and cash flows
 - Owner - “shared-savings”, equipment benefits
 - Government, Utilities - incentives (subsidies)
 - Brokers and Traders
- Specialist firms to realize technical potential -- “ESCOs”
 - Energy Performance Contracts
 - Clinton Foundation model for C40 global large cities



Capital's EE Opportunity Energy Project Finance

How an Energy Performance Contract Works

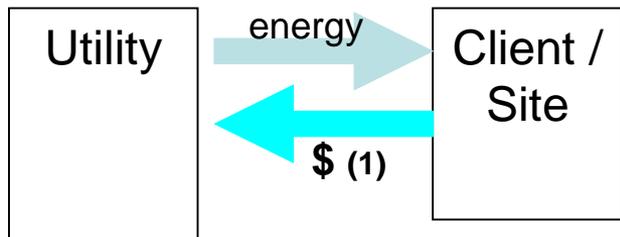
- Invest in goods & services for a site that will realize energy savings
- Site pays for project financing (loan or lease) with (a part of) energy savings for a specified contract period
- Purchasing a future stream of (avoided) energy payments
- Performance Guarantee

Capital's EE Opportunity

Energy Project Finance

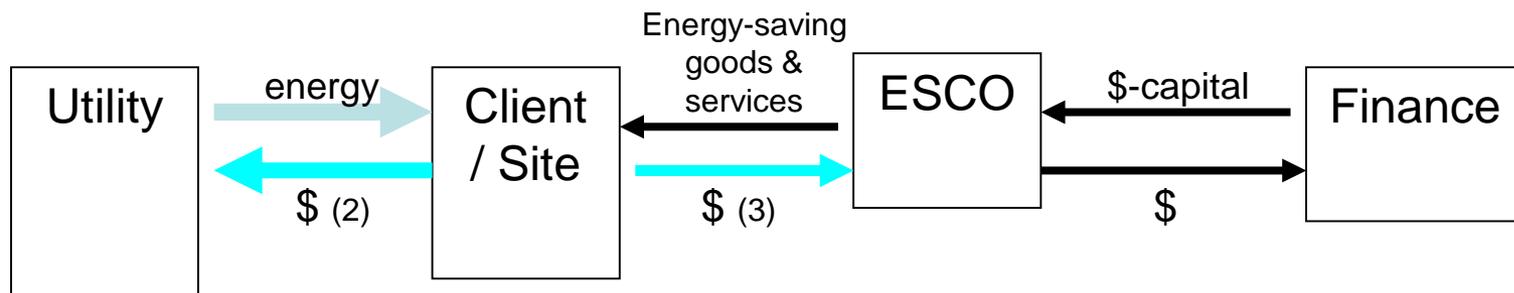
How an Energy Performance Contract Works

Base Case (no EPC)



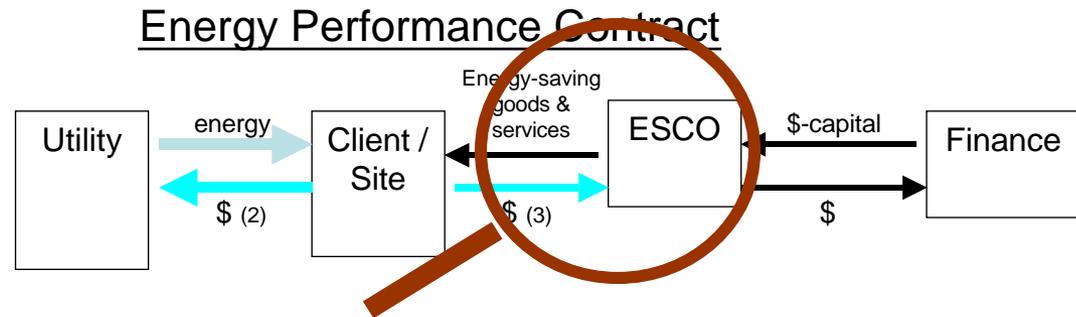
$$\$ (1) > \$ (2) + \$ (3)$$

Energy Performance Contract



Capital's EE Opportunity

Project Finance & Performance Contracts



ESCO Performance Contract Process

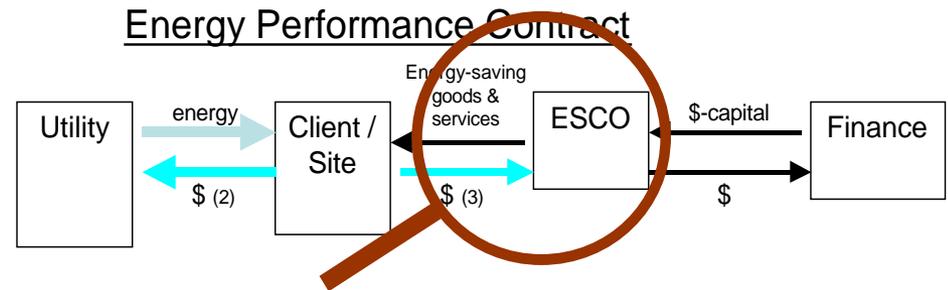
- Energy Audit – identify and quantify opportunities
- Finance & Contract
- Design & Install
- Operate (who?)
- **Monitor & Verify Performance - “IPMVP”**

Capital's EE Opportunity

Project Finance & Performance Contracts

What Kinds of Work

- Lighting
- Mechanical (HVAC) systems
- Controls
- CHP, Cogeneration, Heat Recovery
- Building Shells
- Renewables for final step towards “net zero”





NYC OPPORTUNITY (WINDOW OF)

Key Facts

- 950,000 buildings
- \$10 billion annual energy
 - Almost 2/3 of cost is for electricity
 - But electricity only about 1/2 of Carbon
(because of nuclear, hydro, coal, gas mix)

(facts courtesy of NYC Mayor's Office documents)

NYC OPPORTUNITY (WINDOW OF)

How is Energy Use Distributed?

Energy Usage by Building Type in New York City
Percent of total energy in British Thermal Units (BTU)

WHAT WE USE FOR ENERGY FOR

BUILDING TYPE	HEAT	HOTWATER	LIGHTING	APPLIANCES*	COOLING**	OTHER	TOTAL
1-4 family residential	7.6%	2.6%	1.7%	2.2%	0.6%	0.0%	14.7%
Multi-family residential	7.4%	7.4%	3.0%	3.9%	1.2%	0.0%	22.0%
Commercial	8.5%	2.8%	10.2%	4.5%	4.5%	0.9%	31.4%
Industrial	2.6%	2.1%	4.0%	3.3%	1.1%	0.2%	13.0%
Institutional/government	6.3%	4.0%	3.6%	1.7%	1.4%	0.9%	17.9%
ALL TYPES	32.4%	18.9%	22.5%	15.6%	8.8%	2.0%	100%

Source: Con Edison; KeySpan; U.S. Department of Energy;
New York State Energy Research and Development Authority

*Appliances include electronics and refrigerators as well as other appliances

**Cooling includes ventilation as well as air conditioning

NYC OPPORTUNITY (WINDOW OF) Projected Growth

- Not static picture
- Greatest growth in electricity

NYC OPPORTUNITY (WINDOW OF)

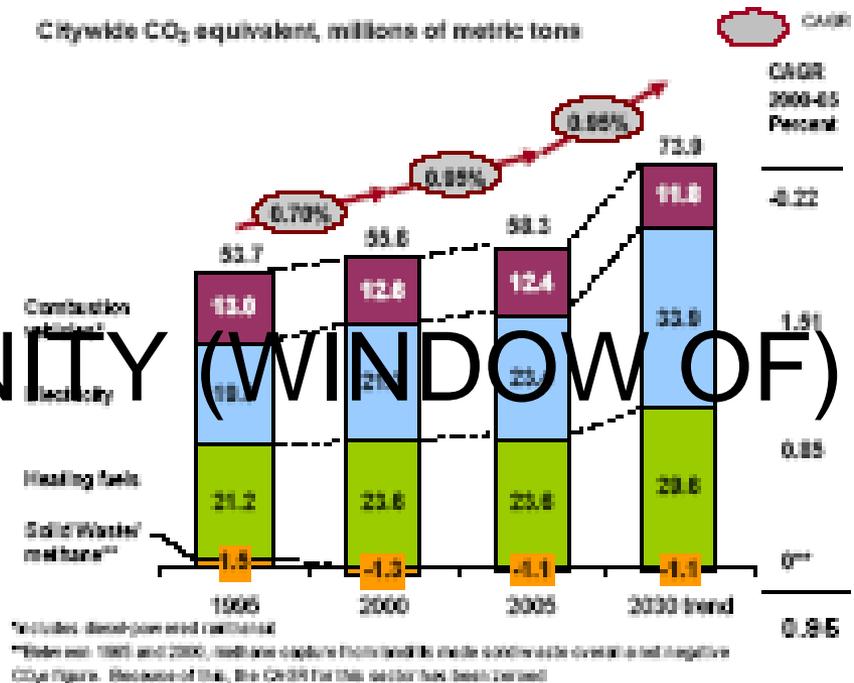


Figure 4. New York City citywide CO₂e emissions, showing compound annual growth rates for combustion vehicles, electricity, and heating fuels. A 0.91 percent CAGR assumes business-as-usual conditions.

NYC OPPORTUNITY (WINDOW OF) PlaNYC2030 “Wedge” targets

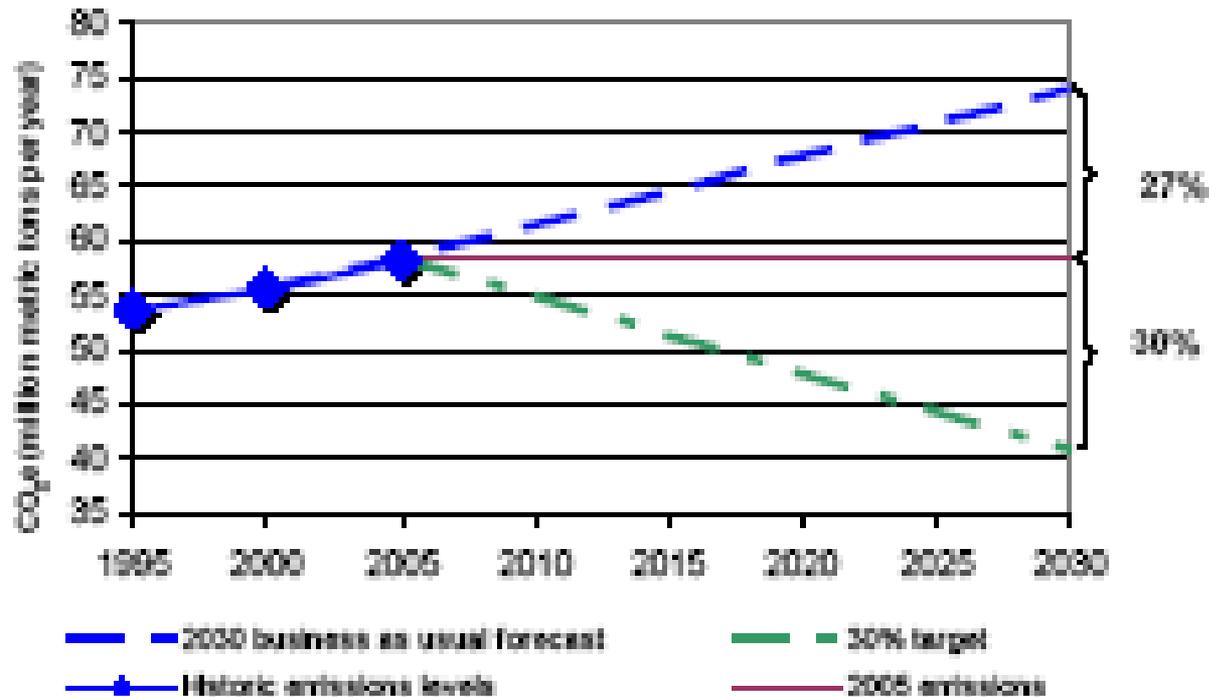


Figure 13. New York citywide CO₂e emissions forecast and target.

NYC OPPORTUNITY (WINDOW OF) Capital Requirement of the 2030 Wedge

*Some back-of-envelope projecting
based on \$10 billion NYC annual energy expense*

30% savings at, say, a
5-year overall
average payback =
\$15 billion market
(capital required)

50% savings at, say, a
10-year overall
average payback =
\$50 billion market
(capital required)

Note, NYC proposing \$80 million/year program for its municipal properties, about 10% of overall NYC energy expense

NYC OPPORTUNITY (WINDOW OF) PlaNYC2030 Sample Programs

Key Areas for Targeted Energy Efficiency Initiatives

Initiative	Description of Initiatives/Program Examples	Approx. Investment		Impact	
		Est. Energy (kWh/yr)	Est. Cost (\$M)	Percentage of Commercial Buildings Energy Consumption	% Citywide Energy Savings Potential
1. DOE ASSISTANT IN NEW YORK (2009-2012)	<ul style="list-style-type: none"> City equipment to readily monitor Low reduction in heating and operations by code Applied through various programs, lighting upgrades, and improved maintenance 	100,000 (public schools)	NA	7-8%	1.0%
	<ul style="list-style-type: none"> Address challenges to monitoring, include a state agreement Ways to monitor the city government largely code Standardizing a code-compliance or enforcement (energy audit measures) Financial incentives/motivators 	100,000 (public schools)	100,000	10-15%	1.0%-1.5%
2. COMMERCIAL & INDUSTRIAL Department 32	<ul style="list-style-type: none"> Energy upgrades for large commercial & industrial buildings (100,000 sq. ft.) Standardizing a code-compliance or enforcement (energy audit measures) Standardizing code, enforcement, energy audit Financial incentives/motivators 	100,000 (public schools)	100,000	10-15%	1.0%
	<ul style="list-style-type: none"> Lighting systems brought up to energy code Regulation of specific types of buildings or change of energy 	10,000 (public schools)	10,000	10-15%	1.0%
3. NEW YORK Department 32	<ul style="list-style-type: none"> Energy upgrades for large residential buildings (100,000 sq. ft.) Standardizing a code-compliance or enforcement (energy audit measures) Standardizing code, enforcement, energy audit Financial incentives/motivators 	100,000 (public schools)	100,000	10-15%	1.0%
	<ul style="list-style-type: none"> Large-scale residential energy audits for all residential properties Financial incentives/motivators for all residential properties 	10,000-20,000	100	immediate	1.0%
4. NEW YORK Department 32	<ul style="list-style-type: none"> New construction to exceed energy code by 20% (immediate energy code) Standardizing a code-compliance or enforcement (energy audit measures) Standardizing code, enforcement, energy audit 	100,000 (public schools)	10	10-15%	0.5%
	<ul style="list-style-type: none"> Standardizing incentives for higher energy savings (electromechanical measures) For grid or program based large scale with energy efficiency savings 	100,000	100,000	10-15%	0.5%
5. APPLIANCES & ELECTRONICS Department 32	<ul style="list-style-type: none"> Incentives to high efficiency for appliances, electronics, and air conditioners Widespread programs to reduce and improve Energy performance in other types of government buildings 	10,000	100	immediate	1.0%
	<ul style="list-style-type: none"> Work to state a national level for improved standards for appliances and electronics Standard and compliance for all code-making agencies, enforcement Programs to encourage the code process for energy efficiency standards 	NA	NA		0.5%

100% = 100% of the proposed work up energy efficiency. NA = not applicable.

Source: NYC Mayor's Office of Energy, from Planning and Sustainability



“Open Windows” M.Bobker Presentation 8/4/07 to Governor’s Island series on NYC Sustainability

NYC OPPORTUNITY (WINDOW OF)

If the \$\$ and the Projects are there,
isn't EE a No-Brainer?

TWO WORDS:

“OPERATIONAL RISK”



The Final Window for Today

Operational Risk in Performance Contracts

- Is the project designed per intent?
- Is the project built as designed?
- Does the project perform as projected?
- Are savings maintained over time?
- Does anyone take the time to find out?

The Final Window for Today Operational Risk in Performance Contracts

THE STORY OF THE OPEN WINDOWS

- From late 1970's through 1980's, virtually all NYC apartment building windows replaced
- How many of them stay open in winter?
- Why?



The Final Window for Today

Operational Risk in Performance Contracts

THE STORY OF VFD MOTOR CONTROLS



- Through the 1990's, hundreds of large pump and fans had variable speed controls added.
- How many of them are actually varying motor speeds?
- Why?



The Final Window for Today

Operational Risk in Performance Contracts

HOW TO “KEEP THE WINDOWS CLOSED”?

- Understanding of adoptive behaviors in context of other priorities, metrics
 - Why do we chronically over-condition our buildings?
- Better feedback loops
 - better building conditions information
 - accountability for energy use
- Education and new skills



The Final Window for Today

Operational Risk in Performance Contracts

HOW TO “KEEP THE WINDOWS CLOSED”?

- Must recognize the reality of operational “low-hanging fruit” and how to harvest it
 - important experience documents significant program enhancement and reliability
- Capital will fail without inclusion of these management and manpower elements

Some extra slides on Carbon Markets

What is the source of EE's perceived opportunity for capital?

- Derivative Market in Carbon
 - *Certified* carbon emissions reductions
 - Sell certificates -- additional source of revenues on top of energy savings
- Carbon Markets preferred to (carbon) tax
 - Kyoto Protocol - CDM
 - US - Local and Voluntary Markets
 - RGGI, Chicago CX

Out the Window?

Leakage & Hot Air in Carbon Markets

- Origin of the “hot air” concept under Kyoto trading – the case of Russia’s phantom CER’s
 - Illustrates “Baseline” as key. Difficulties in measuring energy reductions.
- Other kinds of “Leakage”
 - Additionality (free-ridership)
 - Persistence
- Certification Process