90 BY 50: NYC CAN REDUCE ITS CARBON FOOTPRINT
90% BY 2050

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OUR THANKS TO:

WHY 90 BY 50 FOR NEW YORK CITY?

• Global targets derived from reasonable chance of avoiding disaster.
• Targets for developed countries follow from need to allow for growth in developing world – 80% reductions for developed world by 2050.
• The developed world targets apply to NYC.
• NYC only tracks some emissions, omits building materials, food, airplane fuel.
• So we chose 90% for the emissions we do track.

WHAT'S NEEDED SEEMS SO DIFFICULT THAT NYC HAS, SO FAR, SETTLED ON EASIER TARGETS.
(And NYC has been among the most aggressive of US polities; there are no firm Federal commitments.)

-5.6%/year
-1.2 MMT/year

Obama, Cancun 2010; 17% below 2005 emissions by 2020.
Obama, EPA, 2014; Power plants 30% below 2005 emissions by 2030.

WHERE WE'RE STARTING

Focus on Buildings:
• 75% of emissions,
• Technology is understood,
• Urban Green's area.

Other Sectors:
We covered transportation, waste, others, but will omit here.

CREATED COMPUTER MODELS OF EIGHT BUILDINGS TO REPRESENT THE CITY IN 2010.

The models' characteristics were tuned to generate NYC's emissions, when scaled up by floor area.

Not shown:
• High Rise Masonry, Residential
• High Rise Window Wall, Residential
• High Rise Masonry, Commercial

The PLUTO data base told us how many of each type of building there are, and what area they occupy, so we can scale individual results up to represent the entire city.

Total citywide building area: 5.3 billion ft²

Building type/area data Source: PLUTO = Primary Land Use Taxlot Output, NYC Dept. of Finance.
First, control air flow:
- Air-seal everything,
- Heat recovery ventilation.
Control heat flow:
- Triple glazed windows,
- Insulation,
- Sunshades.
Then the best HVAC:
- Ground source heat pumps or
- Mini-split air-to-air heat pumps and
- Air source hot water heat pumps.
And on-building power:
- Photovoltaics where feasible.
All are available today.

2050 BUILDING IMPROVEMENTS - COSTS

- Cost estimates by the Lend-Lease costing department, also vetted by various experts.
- Costs presented are 2010 prices.
- Work that would be done anyway is not included, only the increment for high performance.
- Caveat: we did not include the costs of extensive internal rewiring, since much will be done anyway.

2050 TRANSPORTATION

A broad-brush look at electrification of much of the transportation infrastructure. Assumptions include:
- Electric trolleys replace many buses, others become hybrids,
- Second Avenue subway and other extensions,
- A new commuter train tunnel to New Jersey,
- A freight tunnel under NY Harbor to Brooklyn,
- Electrification of all rail traffic, and
- Realization of 54.5 mpg federal CAFÉ standards, including many hybrids, and
- Continued use of diesel by heavy trucks and some buses.
Result: substantial reduction in emissions.

2050 BUILDING ENERGY USE - 2010 AND 2050

City-wide fuel use in buildings goes to zero, and source Energy Use Intensity (EUI) drops to low but achievable levels. Peak electric demand is up 60%.

2050 TRANSPORTATION

- No more natural gas means no more fugitive gas from distribution.
- Assume all other leaks stopped (SF6, HFCs).
- All fugitive gas from landfills, sewage treatment captured and used for generation.
- Could a European-quality solid waste combustion plant at East 14th Street and/or in Brooklyn fire the Con Edison steam system?
- There is enough trash to supply the steam system at our reduced loads, but
- Many operational and political questions are open.

2050 BUILDINGS – COSTS & SAVINGS

Expenditures (Present Value): $94 billion
Savings (Present Value): $87 billion

"Neutral" because of our harsh assumptions:
- We held costs at 2010 levels; they will drop.
- We held fuel prices at 2010 values; will rise.
- All costs are for retrofits; incorporation in new construction will be much less expensive.

WASTE AND OTHER SECTORS

- No more natural gas means no more fugitive gas from distribution.
- Assume all other leaks stopped (SF6, HFCs).
- All fugitive gas from landfills, sewage treatment captured and used for generation.
- Could a European-quality solid waste combustion plant at East 14th Street and/or in Brooklyn fire the Con Edison steam system?
- There is enough trash to supply the steam system at our reduced loads, but
- Many operational and political questions are open.
We will need a total of about 57 TWh of carbon-free electric energy. New York City’s supply already includes the equivalent of 34% (19 TWh) of carbon-free electric energy. And we can harvest 11 TWh from PV modules on ½ of our building’s roofs. The remaining 27 TWh can be made up by:

- 360 Wind Turbines off shore OR
- Solar photovoltaic farms of 86 million m² covering 66 square miles (a lot of which could be in NYC covering parking lots, highways, etc.) OR
- The Champlain-Hudson Power Express 1.0 GW power line (but can note in this manner to purchase power from Canadian hydro OR
- 3-4 more nuclear power plants (at 1000 MW each) OR
- Any combination of the above.

With smaller contributions from:

- Powering total electric generation
- Solid waste combustion in supply steam system

*This is totally practical, although perhaps not cheap.*

**THE RESULT**

6/12/14

**CHANGES IN ELECTRIC ENERGY AND PEAK DEMAND FOR 2010, BASE CASE RETROPTS AND RELAXED CASE**

<table>
<thead>
<tr>
<th></th>
<th>Building Electric Energy Consumption</th>
<th>PV Production</th>
<th>Net Electric Energy Consumption</th>
<th>Peak Demand: (2010 July day, 2050 January night)</th>
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</thead>
<tbody>
<tr>
<td>2010</td>
<td>50.8 TWh</td>
<td>13.6 TWh</td>
<td>39.9 TWh</td>
<td>6.0 MW</td>
</tr>
<tr>
<td>2050 Base Case</td>
<td>50.6 TWh</td>
<td>13.6 TWh</td>
<td>39.9 TWh</td>
<td>12.6 MW</td>
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<tr>
<td>2050 Relaxed Case</td>
<td>53.7 TWh</td>
<td>15.1 TWh</td>
<td>38.6 TWh</td>
<td>43.6 MW</td>
</tr>
</tbody>
</table>

**SO HERE'S HOW WE GIVE LIFE TO A LOW CARBON FUTURE:**

**THANK YOU AND CREDITS**

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Full report available at: [http://urbangreencouncil.org/content/projects/90-50](http://urbangreencouncil.org/content/projects/90-50)

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