

NYC City Council Comments
2/27/15

Buck Moorhead, AIA
New York Passive House / Board of Directors
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RE: Site-Sourced and Stored Renewable Energy

Some advice from Buckminster Fuller

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."

R. Buckminster Fuller

Mayor DeBlasio's ONE CITY: BUILT TO LAST plan, and Local Law ⁶⁶378 are strong steps toward a new paradigm, a paradigm that will begin to "build a new model that makes the existing model obsolete".

Part of this new paradigm is energy efficiency, labeled the "fifth fuel" for being in effect the cheapest and cleanest choice for balancing the energy supply and demand in a sustainable world.

The International Energy Agency (IEA) estimates that since the 1970s, energy efficiency improvements in 11 countries saved the equivalent of 1,337 million tons of oil in 2011, worth US\$743 billion. This figure is larger than the combined total energy consumption in the European Union or Asia (excluding China) for the same year. (www.climatechange.org)

Michael Liebreich, Chairman of the Advisory Board at Bloomberg New Energy Finance, explained how energy efficiency is triggering market shifts such as decentralized renewable energy. He said: "Energy efficiency is removing demand at a great rate. The current market is described by a flat or falling demand for energy in the developed world and growing demand for different forms of decentralized energy generation."

Our existing model is a fossil-fuel based economy, or as Al Appleton calls it, the "black" economy. To mitigate climate change, we must leave much of our accessible, known fossil fuel reserves where they are, in the ground.

The new model, the new paradigm, is the green economy. We are hearing today about many exciting and creative strategies to create and store renewable energy; that are part of this green economy.

In NYC, 75% of our energy use is in our buildings.

Passive House, a building energy conservation design strategy developed in Germany in the 1990's, leads to buildings that use 80-90% less energy for heating & cooling. These design principles, based on energy conservation measures first employed in North America in the 1970's, are imbedded in a computer program that allows one to design and construct buildings that have a predictable energy use. As scientists, the Passive House Institute has been data-

monitoring buildings to confirm that outcomes are matching the predictions. Over 30,000 Passive House projects have been built in Europe since 1990.

It is encouraging that Passive House is referenced in Mayor DeBlasio's One City: Built to Last, as an important strategy and tool required to reach "80 x 50". It must be clearly understood that to reach 80 x 50, building energy conservation standards such as Passive House are absolutely essential. All of the wonderful alternative energy generation and storage ideas discussed today will not get us to 80 x 50 without substantial energy conservation as produced by the Passive House standards.

It should be understood that Passive House standards are applicable to the retrofit of existing buildings, as well new construction as referenced.

Existing buildings are our challenge.

In thirty years, 85% of existing buildings will still be here. Bringing new construction to Passive House or equivalent standards is the "low hanging fruit" Retrofitting the existing buildings is the challenge. We need to incentivize this retrofit process for occupied multi-family rental and coop buildings, and commercial buildings.

Passive House is a global movement. These low energy buildings are schools, prisons, 1600 unit apartments complexes, offices, court buildings, fire stations.

As of January 1, 2015, all new buildings in Brussels must meet the Passive House standard, meaning they will all use 80-90% less energy for heating & cooling, and there is a strict standard for source energy use on a per square foot basis.

Brussels, while a smaller city, is a good model for NYC to look to for lessons learned

Luxembourg has adopted regulations so that all new buildings will be built to Passive House standards, as of 2017

In the European Union, by 2020, all new buildings are to be near zero or net zero. And any residual energy they may require has to be generated on its own site. This is in 5 years!!!

There is no mystery or magic to this. These good efforts are happening around the world and in our own City. There are numerous completed Passive House projects here and others in the planning and construction phases. There is a 40-unit market rate Passive House rental building in the planning stages for a Manhattan site considering electric heat for the units, because its heating demand will be so low.

New York Passive House (NYPH) is a group of dedicated professionals committed to outreach and education regarding Passive House in New York City and the region. We appreciate the City Council's support of 80 x 50 and understanding of the role that Passive House will play in the implementation of this goal.

The implementation will require much effort on all our parts. It will ultimately require a combination of incentives and regulations.

One City Built to Last is the genesis of a master plan for our energy future that will wean us off fossil fuels, off-fracked shale gas. It is not "natural". We do not need an expanded gas infrastructure.

It will be a master plan that is not determined by companies that will benefit financially by that plan but rather an energy master plan determined by us, and by you, our representatives.

It will be a master plan that looks comprehensively at our energy sources, the public health, and global environmental risks.

NYC can lead the way in our country. This City Council can push our City forward, thoughtfully and intelligently.

Buck Moorhead, AIA

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**Micah Kotch, Director of NY Prize and Strategic Advisor for Innovation
New York State Energy Research and Development Authority (NYSERDA)
NYC Council/Committee on Environmental Protection
10 a.m. Feb. 27, 2015**

NY Prize and the Growing Role of On-Site Power in NYC

Good morning, members of the committee. Thank you for the opportunity to testify before you today. My name is Micah Kotch and I serve as director of NY Prize as well as strategic advisor for the New York State Energy Research and Development Authority, otherwise known as NYSERDA. We are the clean energy arm of New York State -- a public-benefit corporation with the goal of animating clean energy solutions and the clean-energy market.

Under Governor Cuomo, New York State is taking bold new steps to address critical energy challenges and explore how we generate and consume energy via the State's overarching energy plan known as Reforming the Energy (REV). REV is designed to enable self-sustaining, clean energy markets that will support the state's energy infrastructure and drive innovation. The strategy is comprised of three action-oriented pillars that will transform the way electricity is distributed and used by consumers, the evolution of state-run energy programs, and what we call "leading by example," which refers to governments integrating and demonstrating new clean energy strategies.

NYSERDA is changing as well. We are moving to a market-based approach that will enable the whole clean-energy supply chain -- everyone from product developers to consumers, from financial institutions to building managers -- to create a self-sustaining energy market.

But importantly, as we change, we are even more committed to using our resources to support low to moderate income residents to ensure these populations are not left out of the clean energy economy as we support the growth of clean energy markets. NYSERDA will indeed continue to support our work with low- to moderate-income communities, offering end-user incentives to increase energy efficiency and distributed generation adoption. These solutions will exist principally as a bridge where we invest to accelerate the development of these solutions.

When Governor Cuomo first took office, he made it clear that transforming the way energy is produced and delivered in New York was one of his major goals. Superstorm Sandy, which hit NY nearly two years later with widespread outages and an estimated \$50 billion in damage, further drove home the need for a fundamental shift to become better prepared for keeping the lights on in an emergency.

And it's not only the damage from storms that is costing our citizens. A number of critical issues drive the need to reform New York's electricity market, including the fact that approximately \$30 billion — paid for entirely by New York's electric customers — will need to be spent over the next decade to maintain current generation and distribution capabilities, compared with \$17 billion over the past 10 years. Further, as extreme weather events continue to affect communities

across our state, it is becoming increasingly clear that meaningful action to mitigate climate change is necessary.

These reasons are why we've recently launched the NY Prize program. This is a three-stage competition leading to large-scale demonstration projects designed to optimize grid resiliency and consumer load flexibility by promoting microgrids.

A microgrid is a community-based power grid that gets its electricity from on-site generation, usually a combination of gas turbines and renewable sources such as solar or wind, and sometimes energy storage. The purpose is to provide power more efficiently than the grid, as well as providing "islanding" capacity in case of a power outage. In New York City, this famously took place at Co-op City and New York University during and after Sandy, thanks to the campus microgrid system in place, which was supported by NYSERDA in both cases.

Through NY Prize, we propose to support the installation of microgrids around the state to improve power resiliency and efficiency while demonstrating the benefits of this innovative technology to encourage even more projects in the future.

NY Prize will inform the REV process, and ultimately, will result in at least five "REV Labs" across the state, where community microgrids show a path to a stronger bulk power system via an increase in greater system efficiency, affordability, choice and control for customers. We anticipate funding feasibility work in storm-impacted communities right here in New York City, as the competition is now open and can be found at prize.ny.gov

One of the fundamental recognitions of the REV initiative is that our electricity grid contains a diverse set of value streams related to data, customer satisfaction, reliability and resilience, convenience, and ancillary services, among others. Some of these "societal benefits" are not valued by the market today, but may be in the future. That's why it's vital that NY Prize projects show how new technologies and business models can capitalize on these various value streams and how benefits can be distributed between the utility, third parties, and customers.

Traditional sources of energy are expensive and inefficient. Pollution from these sites can create public health impacts and costs, particularly in low and moderate income communities across New York, where energy costs hit families disproportionately harder.

The challenges we face collectively from the power grid are daunting. Huge portions of the electric grid are aging and increasingly stressed during periods of peak demand and extreme weather. An estimated 43 percent of the State's 11,000 miles of transmission lines will require replacement in the next 30 years, and 7 percent of our energy is wasted via line losses across both the transmission and distribution (T&D) systems.

It is these improvements that will cost an additional \$30 billion on upgrades over the next decade. We shouldn't just patch an antiquated system.

One of the biggest expenses in maintaining a power grid is ensuring the system has enough power to handle peak load -- the largest demand placed on the system, usually on a hot, humid afternoon in July or August. If we can bring peak demand down, we can avoid spending huge

amounts of money to meet that load need. On-site power, such as through a microgrid, is one way to do this.

Through NY Prize, we have thrown down the gauntlet for community microgrid projects that test new services and business models and provide the investor-owned utility with experience managing the grid with distributed resources. New York is looking for community microgrids that incorporate clean distributed generation, energy storage, demand-response and energy efficiency.

NY Prize is not about installing more diesel-fired backup standby generators. We are purposefully technology-agnostic, and we will fund generation. Our competition will not fund single-customer microgrids that benefit one load behind the meter. We are about extending today's proven microgrid model to the next level -- multiple customers including at least one critical facility, with an ability to island as well as benefit the bulk power system during normal "blue-sky" operating conditions.

The "critical facility" element is important. Any qualifying microgrid must include a qualifying facility, including hospitals or critical care centers, police or fire stations, water or sewer treatment, schools and universities, and shelters and facilities of refuge. On the NY Prize website, we've shown where these critical facilities exist across New York City, and in areas across the State that have been identified by the utilities as places where on-site power can help defer massive infrastructure investments or system constraints.

There are three stages in the NY Prize program. The first, which is currently accepting proposals, will provide up to \$100,000 to a community for a feasibility study for a proposed microgrid. We expect to make approximately 25 of these awards, depending on the proposals, and no cost-share is required. We'll be accepting proposals until May 15.

The second stage will be much more competitive, and will include cost-share from our partners. In this stage, which will run from May 16 to February of next year, we expect to make eight to 10 awards of up to \$1 million each to qualifying applicants. This funding will pay for technically-complex and fully-engineered designs for a working microgrid system. These are massive, expensive and complicated systems, each of which has unique challenges and needs. This stage will address these concerns and help us discover the most technically- and economically-feasible projects.

The third stage will begin in July and run through the end of 2017. In this round, we'll be awarding up to \$7 million to five to seven projects. We'll be expecting considerable cost-share for the completion of these systems.

What's the benefit of funding these microgrids? Aside from helping the communities involved become more resilient, more efficient, more clean and more affordable in terms of power costs, we're also modeling the technology for other regions. And we're establishing technical standards that can be used to reduce the cost of future microgrid systems in New York State and elsewhere.

As I mentioned earlier, there are several elements to a microgrid that can be used to provide on-site power. All of these have been used to great success around New York City.

One element is a combined heat and power unit, usually referred to as co-generation or CHP. CHP replaces a typical building combination of grid power and a hot water boiler. By going to a combined system -- which generates power from natural gas or fuel cell and then captures and reuses the waste heat -- buildings can raise their efficiency from about 50 to 75 percent.

NYSERDA has been supporting CHP since 2000 and has helped in the installation of dozens of these units in New York City and around the state. In the city, CHP systems can be found at such diverse locations as Fox News, NY Presbyterian Hospital, the NY Marriott Downtown, the Sheridan New York Hotel and Tower, Sunrise Bakery, The New York Times, and numerous apartment and condominium complexes.

Solar power can be another element of a microgrid, and we have seen significant growth in this renewable resource. Governor Cuomo launched NY Sun in 2012, a program that will bring up to 3,000 megawatts of solar power to the state by 2023. This \$1 billion initiative to scale-up the installation of solar is already moving the state closer to having a sustainable, self-sufficient solar industry.

In New York City, we've already seen the installation of a number of high-profile solar projects, including such sites as Anheuser Busch in the Bronx, a Whole Foods in Brooklyn, Fed Ex in

Queens and Macy's Furniture in Staten Island, among many others. Hundreds of smaller projects have gone up on the roofs of smaller businesses and private homes around the city.

NY-Sun includes a program called Community Solar, which encourages groups of solar power buyers in a region to band together to take advantage of lowered cost, and K Solar, which encourages solar investment at schools around the state. Both of these programs offer opportunities for projects in New York City. In fact, I was part of the first community solar program in New York City, a program called 'Solarize Brooklyn' (now known as hercomessolar.nyc) which reached over 400 of our neighbors in Kensington/Windsor Terrace through neighbor-to-neighbor outreach and resulted in 23 installations of rooftop solar and solar thermal systems for Brooklyn residents.

The last element to bring energy efficiency improvements to a microgrid is energy storage. Electricity is not consumed at a constant level. Demand is constantly rising and falling based on need through the day and night. This change causes further inefficiencies in the electric grid, particularly as older, less-efficient fossil-fuel-fired plants are brought online to meet peak demand. Energy storage can help deflect that.

By storing energy when it's not needed and providing it upon demand, energy storage smoothes out power consumption across the grid, making the system more reliable as well as efficient. It can also store renewable power for when it's needed, allowing solar power generated during the day to be used at night, or wind power generated during a breeze to be used later after the wind dies down.

Storage incorporates a wide range of mature technologies such as pumped hydro and lead acid batteries and emerging solutions including advanced batteries, flywheels, and thermal storage, each offering a unique set of attributes that best addresses specific performance requirements.

What can energy storage do for New York City? New York's electric grid is built to reliably meet well over 30,000 MW of peak demand -- a demand that arises only 60 hours per year. That's 33 percent larger than the average peak electric load across the state.

Con Ed is already investing in energy storage in order to save significant investment costs required to keep up with rising power demand. For instance, Con Ed is investing \$50 million in utility-scale storage within its territory (part of \$500 million in demand-side management) in order to avoid building a \$1 billion substation.

Incorporating grid-connected energy storage with PV systems, microgrids, and community energy storage systems will increase the resiliency of the grid to withstand service interruptions in individual circuits and allow customer islanding during an outage. As one example, in 2014 Solar City predicted that every PV customer would have battery backup in 10 years – presenting an opportunity to increase local resiliency while also providing broader grid benefits.

New York City is now home to about a half-dozen energy storage projects, including a demonstration project at the City University of New York, a two-megawatt system at Barclay Tower, a Subway storage project that captures energy created during regenerative braking of

subway cars, and a system that uses locally-generated solar power to provide charging for electric vehicles. New York City is also home to companies creating jobs around this on-site energy revolution; companies like Voltaiq, BlocPower, and other innovative entrepreneurial startups are being supported by both NYSERDA and the New York City Economic Development Corporation, and it's important that we're able to capture the economic development benefits that come with a shift to open new markets.

The microgrid projects supported by NY Prize will contain the above elements, and possibly others as well. Once in place, these projects will become a vital element of Governor Cuomo's vision for a power delivery system ready to meet the challenges of a changing climate.

Thank you.

Site-Sourced and Stored Renewable Energy Conference

Presentations Appendix

SITE SOURCE & STORED
RENEWABLE ENERGY IN
NEW YORK CITY

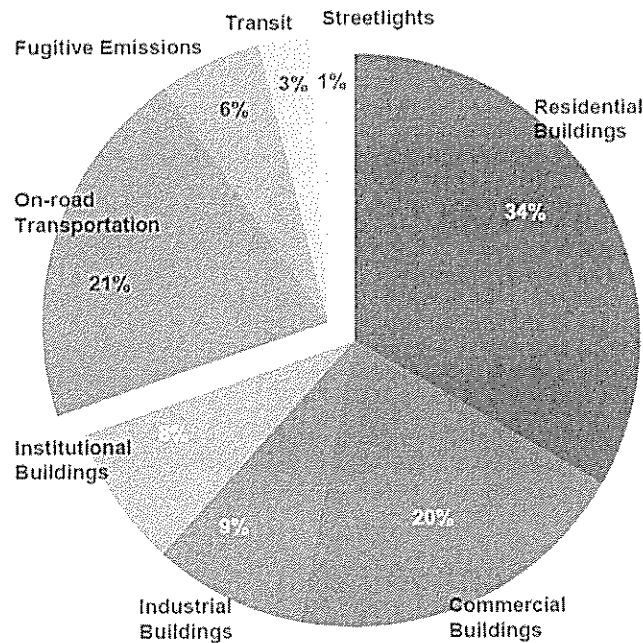
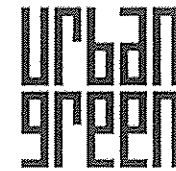
CITY COUNCIL
SPECIAL HEARING
FEB. 27. 2015



LESS IS MORE:
Our Biggest Renewable Resource
is the Energy We Don't Use

Laurie Kerr, FAIA, LEED AP

NEW YORK CITY'S CARBON EMISSIONS ARE DOMINATED BY ITS BUILDINGS – ESPECIALLY ITS EXISTING BUILDINGS

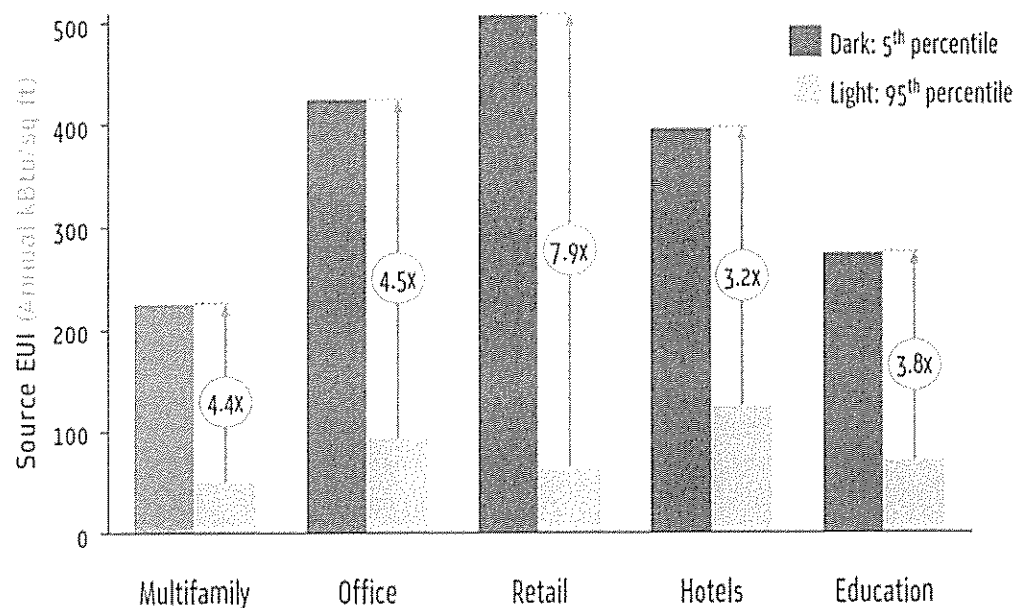


OVER **70%** OF NYC'S GREENHOUSE GAS EMISSIONS COME FROM ENERGY USED IN BUILDINGS



BY 2050, ROUGHLY **80%** OF THE BUILDINGS IN NYC WILL BE BUILDINGS WE ALREADY HAVE TODAY

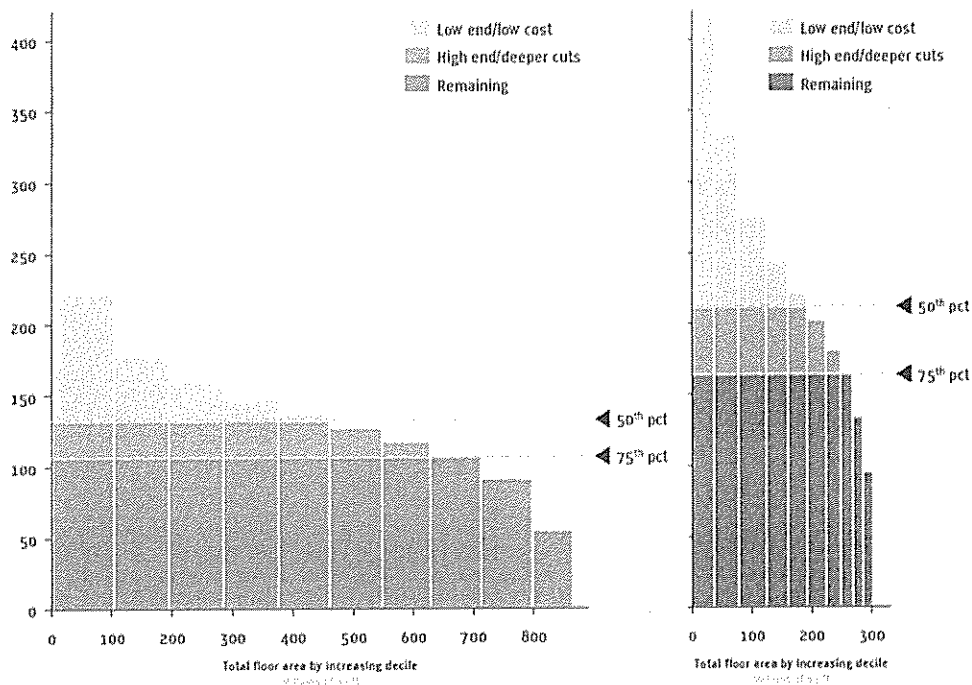
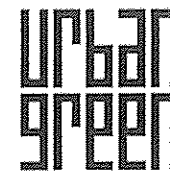
THE CITY FOUND A HUGE RANGE OF ENERGY USE IN SIMILAR BUILDING TYPES ...



4 TO 8 TIMES

THE ENERGY IS USED BY THE
POOR PERFORMING BUILDINGS,
AS PER THE NYC
BENCHMARKING ANALYSIS

... WHICH POINTS TO A HUGE POTENTIAL FOR SAVINGS FROM EFFICIENCY



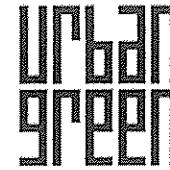
18% TO 31%

CITYWIDE ENERGY REDUCTIONS
COULD BE ACHIEVED BY
IMPROVING THE POOR
PERFORMERS

\$400 TO \$600 ANNUAL

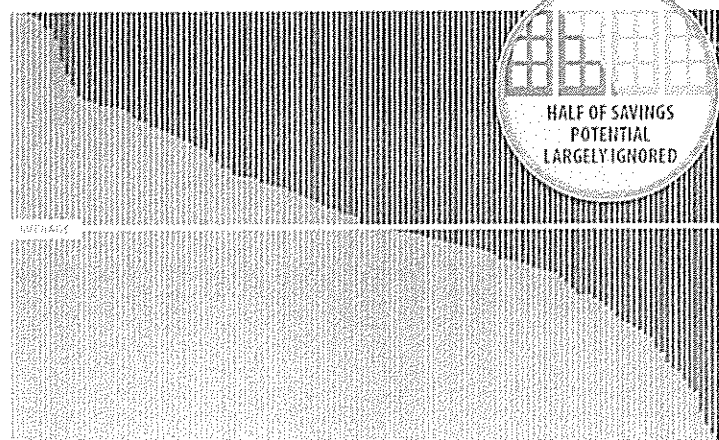
SAVINGS FOR EACH NEW
YORKER ON AVERAGE ... BY
USING LESS ENERGY

HALF OF THESE SAVINGS COULD COME FROM OPERATING BUILDINGS MORE EFFICIENTLY



LOW / NO-COST OPERATIONAL CHANGES COULD DOUBLE ENERGY EFFICIENCY IN COMMERCIAL BUILDINGS

RETROFIT VS. OPERATIONAL SAVINGS POTENTIAL SPLIT



- ↑ EQUIPMENT SEQUENCING
- ⌚ HVAC SCHEDULING
- HVAC SEQUENCING

FIRSTFUEL
BUILDING ENERGY ANALYTICS

FIRSTFUEL SAMPLE BUILDING PORTFOLIO (60M SQFT)

53 percent of all energy efficiency savings in commercial buildings are achievable through low/no-cost operational improvements. The portfolio above represents \$12M in operational savings potential with a substantial return on investment.

MOST COMMON OPERATIONAL SAVINGS

Can be implemented immediately by building operators, once identified, often at little cost and fast payback periods.

⌚ HVAC SCHEDULING

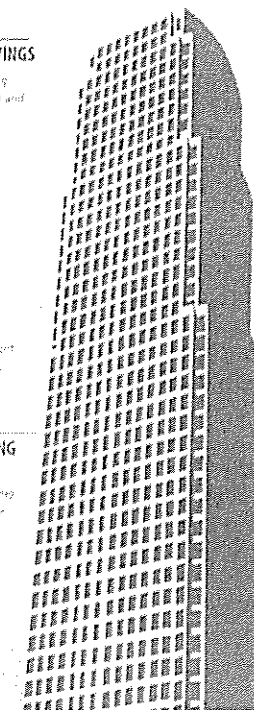
60% of sampled buildings demonstrate an opportunity to adjust thermostat settings and alter fan speeds.

⚙️ EQUIPMENT SEQUENCING

Over 40% of sampled buildings have equipment that was improperly commissioned, resulting in inefficient operation and excess demand.

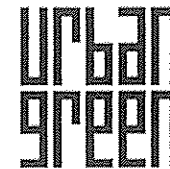
↓ SIMULTANEOUS HEATING & COOLING

Many buildings use heating systems during 70+ degree weather temperatures, with cooling systems working in parallel to the heat source.

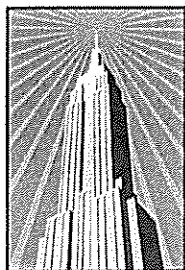


WE ALREADY REQUIRE OUR LARGE BUILDINGS TO BE TUNED EVERY 10 YEARS,
NOW WE HAVE TO REQUIRE THAT BUILDING OPERATORS BE TRAINED

**ALSO, MANY OF OUR BUILDINGS WILL NEED TO UNDERGO
DEEP RETROFITS (35% TO 60% REDUCTIONS)**



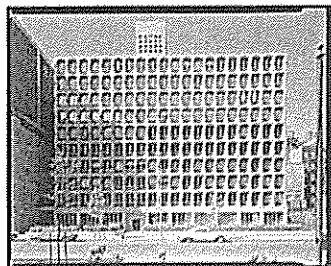
CURRENT EXAMPLES:



EMPIRE STATE
BUILDING

EMPIRE STATE BUILDING

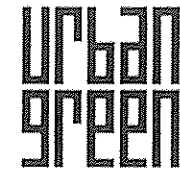
38% REDUCTIONS



FASHION INSTITUTE OF
TECHNOLOGY

39% PORTFOLIO-WIDE
REDUCTIONS

THE CITY SHOULD LEAD WITH ITS OWN PORTFOLIO

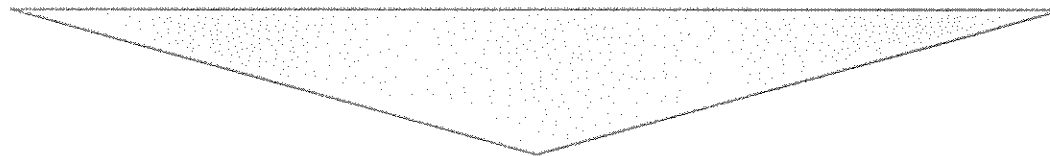


NEW CONSTRUCTION

- ALL NEW BUILDINGS 30% BETTER THAN CODE + LEED
- **SOME** (20%?) NEW BUILDINGS 60% BETTER THAN CODE, PASSIVE HOUSE, OR NET ZERO

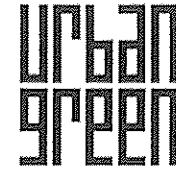
EXISTING BUILDINGS

- ALREADY COMMITTED TO 35% REDUCTION BY 2025; STEP THAT DOWN OVER TIME TO A 2050 GOAL
- ALL LARGE BUILDINGS MUST BE RETROFITTED EVERY 10 YRS; REQUIRE THAT SOME OF THESE (10%?) BE DEEP RETROFITS

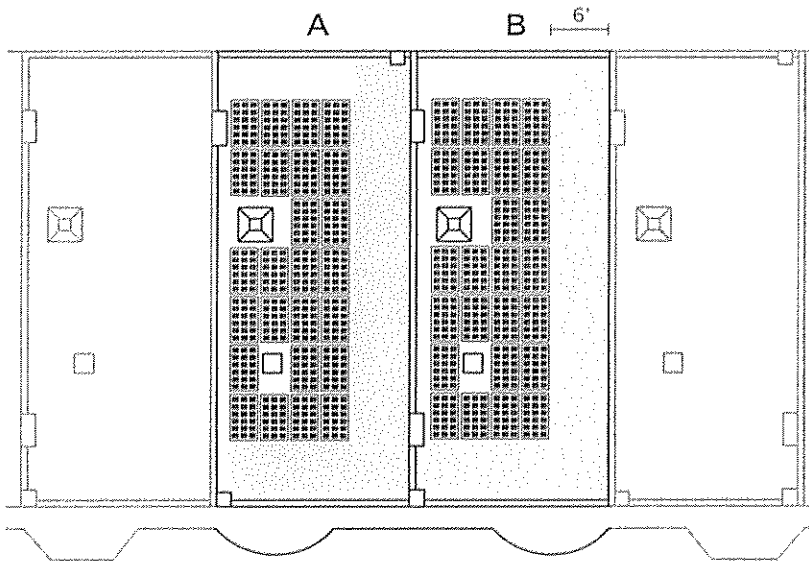


**BUILD THE EXPERTISE IN HIGH EFFICIENCY AND DEEP RETROFITS
SO NYC CAN GO TO SCALE**

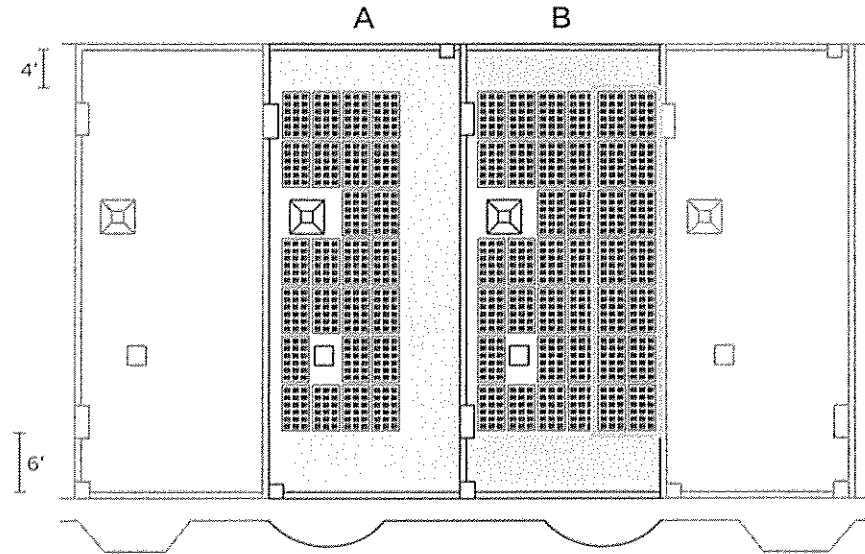
REMOVE BARRIERS TO SOLAR ENERGY



Current Required Fire Paths

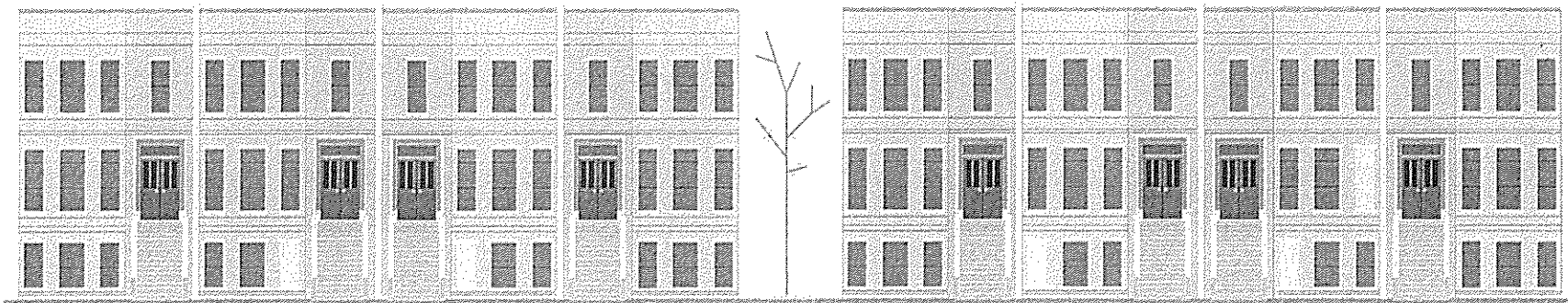


Proposed Required Fire Paths



BUILDING B:

SOLAR PANELS	+56%
COST	+18%
UNIT COST	-25%



urban green

CARBON FREE NYC

Richard Leigh
Director of Research
Urban Green Council

Get half the reduction from better buildings

First, control air flow:

- Air-seal everything,
- Heat recovery ventilation.

Control heat flow:

- Triple glazed windows,
- Insulation,
- Sunshades.

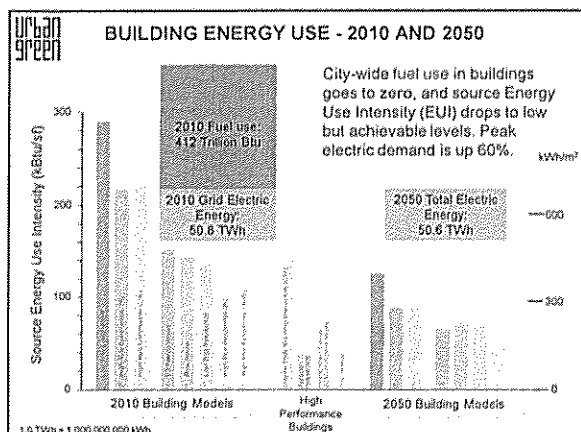
Then the best HVAC:

- 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.

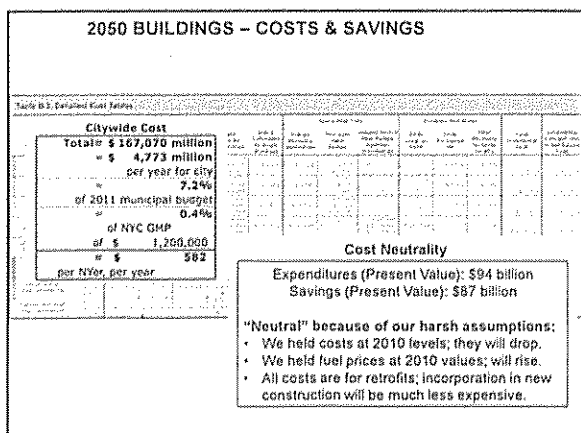
All are available today.



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 re-wiring, since much will be done anyway.

Building Type	Incremental Retrofit Cost	Cost/Unit	Cost/sf
1 or 2 Family House	\$26,000	\$26,000	
Row House	\$16,700	\$16,700	
Low Rise Residential	\$13,200	\$13,200	
Medium High Rise Residential	\$14,400,000	\$17,000	
Medium High Rise Residential	\$14,400,000	\$17,000	
Low Rise Commercial	\$5,540,000		\$56.58
Medium High Rise Commercial	\$6,970,000		\$50.41
Medium High Rise Commercial	\$10,000,000		\$56.00



THE RESULT

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 1/2 of our building's roofs.

The remaining 27 TWh can be made up by:

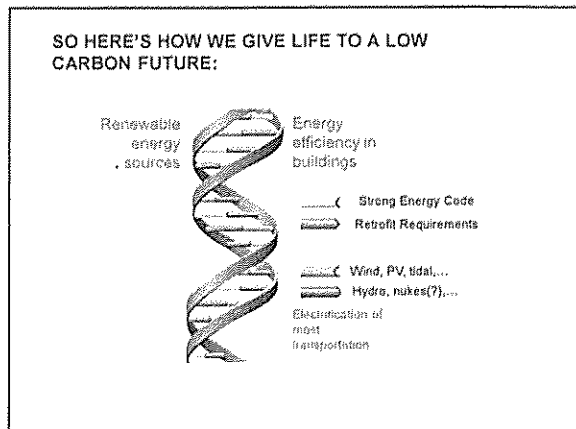
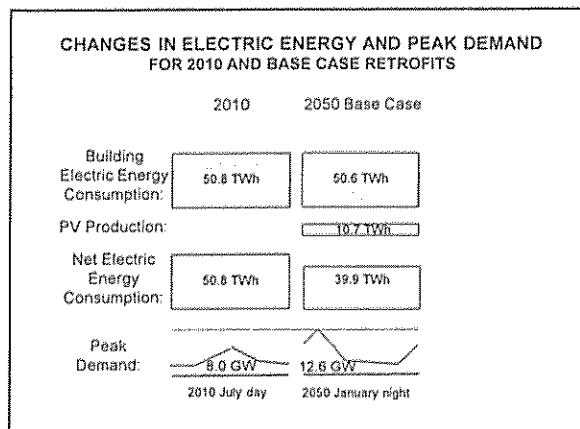
- 2600 4.0 MW wind turbines off shore OR
- Solar photovoltaic farms of 66 million m² covering 66 square miles (a lot of which could be in NYC covering parking lots, highways, etc.) OR
- The Champlain-Hudson Power Express 1.0 GW power line plus two more to purchase power from Canadian hydro OR
- 3-4 more nuclear power plants (at 1000 MW each) OR
- Any combination of the above.

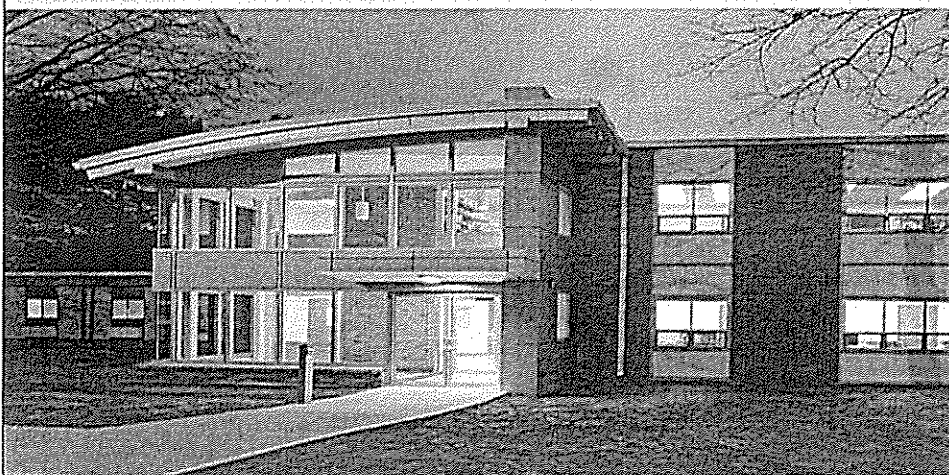
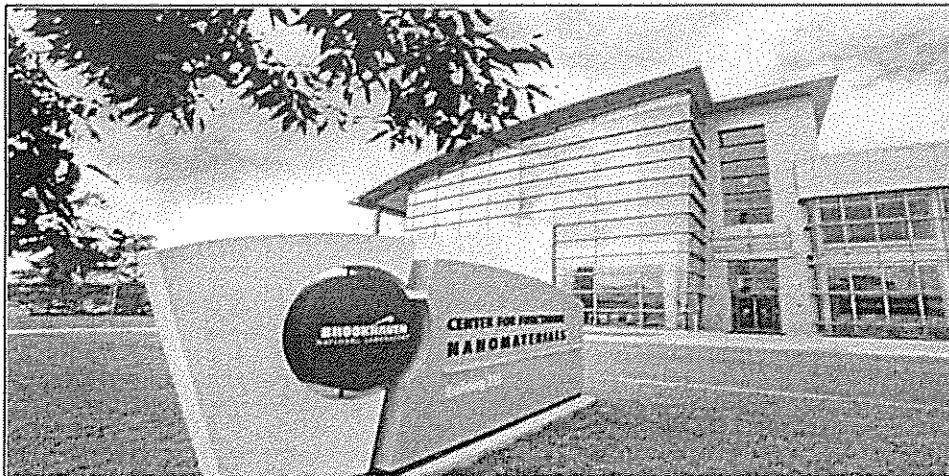
With smaller contributions from:

- Flowing tidal electric generation
- Solid waste combustion to supply steam system

This is totally practical, although perhaps not cheap.

1.0 TWh = 1,000,000,000 kWh





The role of Brookhaven National Laboratory in advancing Renewable Energy Technology

David Manning
Director, Stakeholder Relations

BROOKHAVEN
NATIONAL LABORATORY



Brookhaven Lab at a Glance...

- Est. 1947
- Managed by Brookhaven Science Associates founded by Stony Brook University and Battelle Memorial Institute under contract with the U.S. DOE
 - Core universities: Harvard, Princeton, Yale, MIT, Columbia, Cornell
 - One of five Office of Science, multi-program Labs
 - Only one in Northeast
- Over 3,000 employees with 98% living on LI
 - 400 Grad Students (BNL payroll)
- Over \$700 M annual budget
- 5,320 acres with 350 buildings
- Major user facility for university and industry researchers
 - Over 4,000 users per year
 - Stony Brook University is Lab's largest user
- Fundamental, basic research to innovation, development and commercialization of technologies: energy S&T, nuclear and high energy physics, bio and environmental sciences, national security



U.S. DEPARTMENT OF
ENERGY

Office of
Science



Stony Brook University

Battelle

The Business of Innovation

Slide 2

1

Not sure if I will use htis or what should be on it. It is repetitive with lter slides but is a nice start.

Doon Gibbs, 3/12/2014

Brookhaven National Laboratory

Research Facilities

RHIC

Blue Gene/Q
Supercomputer

Interdisciplinary Energy
Science Building

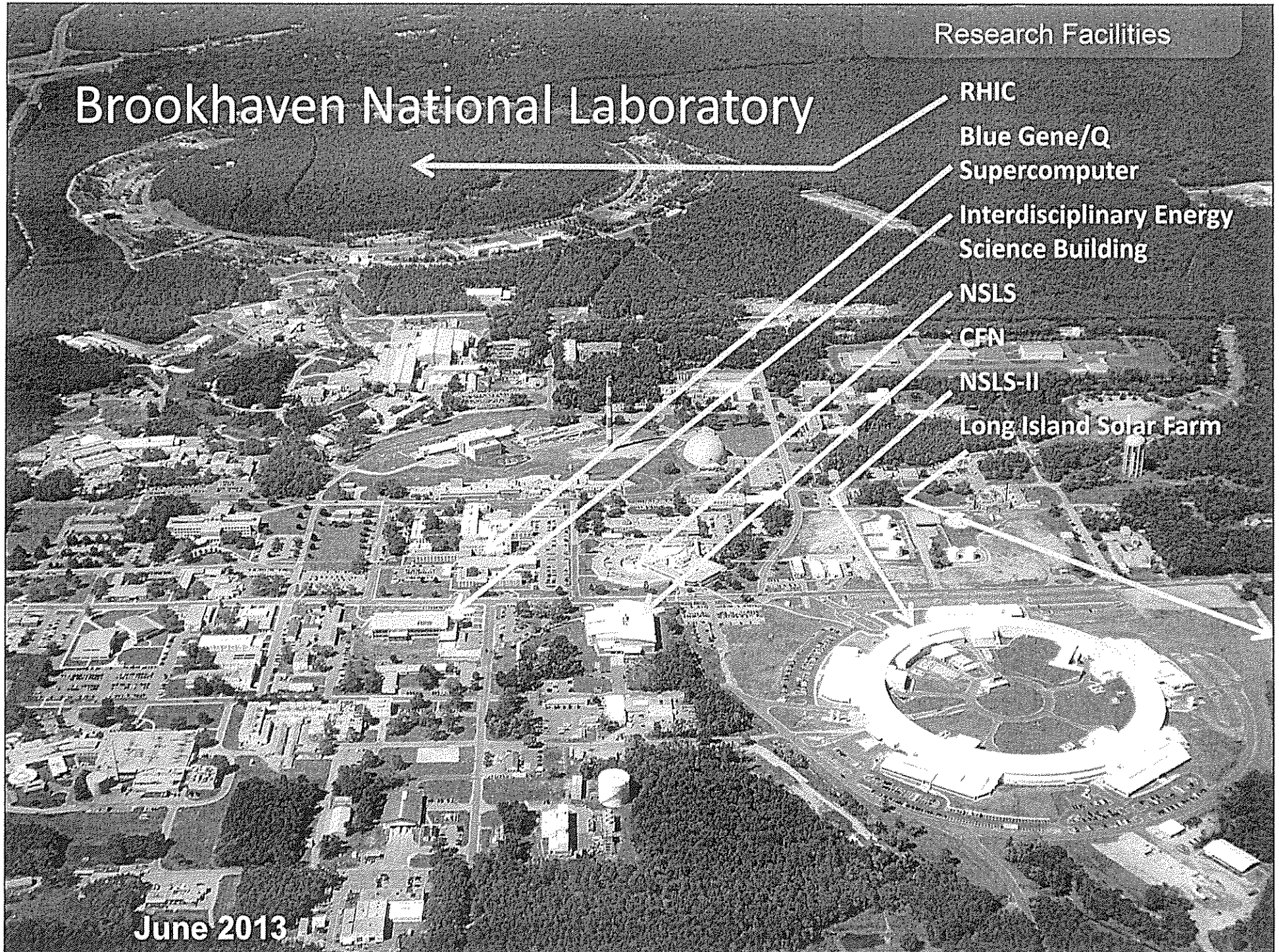
NSLS

CFN

NSLS-II

Long Island Solar Farm

June 2013



Research Leadership



1957



1976



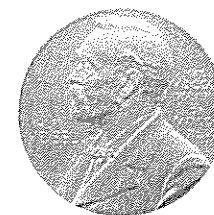
1980



1988



2002



2003



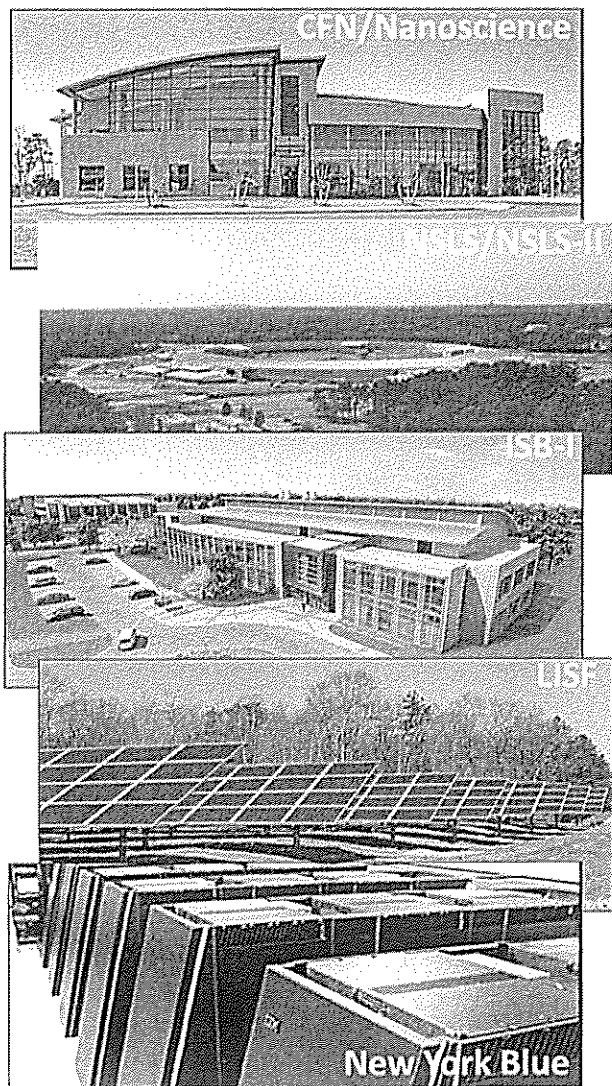
2009



2009 National Medal of Engineering

5 Nat'l Medal of Science winners
1 Nat'l Medal of Engineering
5 Fermi Awards
11 Lawrence Awards
2 Wolf Prizes
20 NAS/NAE members

Brookhaven Energy R&D: Integration



BNL Core
Research



NY State Consortia/Resources

ENERGY FOCUS AREAS

- Advanced Materials
- Chemistry for Sustainable Energy
- Energy Storage
- Electric Grid

Collaborators/Joint Appointments



Stony Brook University



Rensselaer



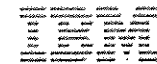
GE



R·I·T



SYRACUSE

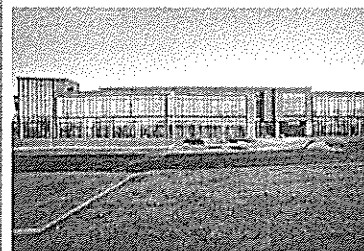


Strategic Roadmap



Chemistry for Sustainable Energy

- Fuel synthesis
- Fuel use
- Chemical dynamics fundamentals



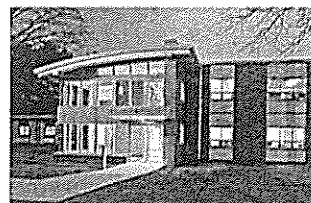
Advanced materials

- Strongly correlated electron physics
- Applications of materials



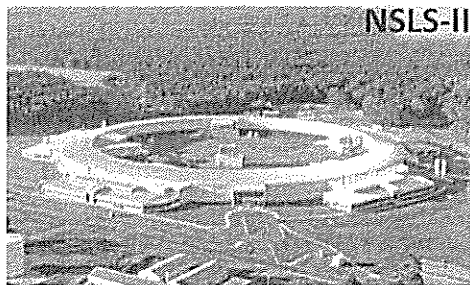
Energy Storage

- m2M EFRC
- EERE, ARPA-E
- Integrated Energy Science Center in Energy Storage



Energy Delivery and Efficiency

- Combustion efficiency
- Electric grid distribution system
- Materials for energy applications



NSLS-II

Photon Science

- Accelerator innovation
- World leading photon science: bio to geo to soft to hard to...
- User Community

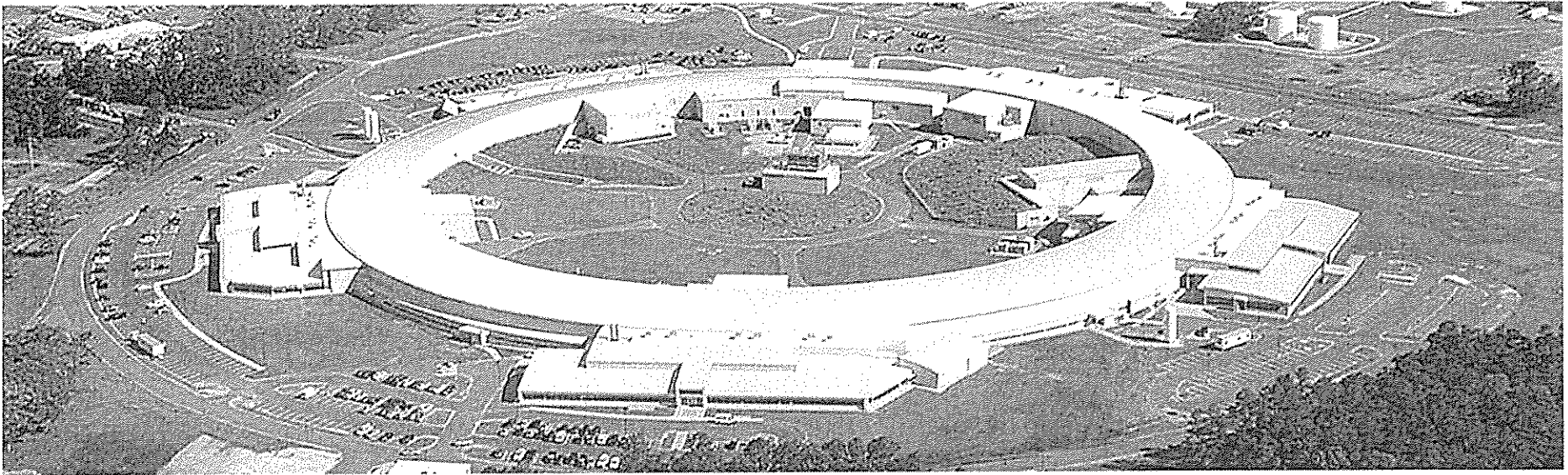


CFN

Nanoscience

- Operando
- Nano-architectures
- Assembly
- User Community

National Synchrotron Light Source-II (NSLS-II)



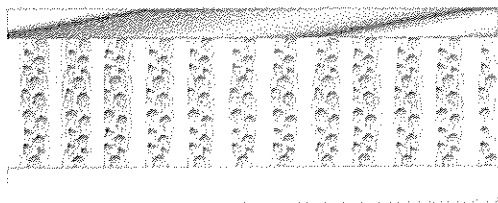
- Newest Facility at BNL: World-leading synchrotron light source for soft-medium x-ray range
- Ribbon Cutting Feb. 6, 2015
- ~\$1B base facility (including 7 project beamlines)
- ~\$2B fully built out over next decade (60 beamlines)

Materials for the Electric Grid

Generation

Organic photovoltaics

- Inexpensive for large scale deployment
- Issue of efficiency



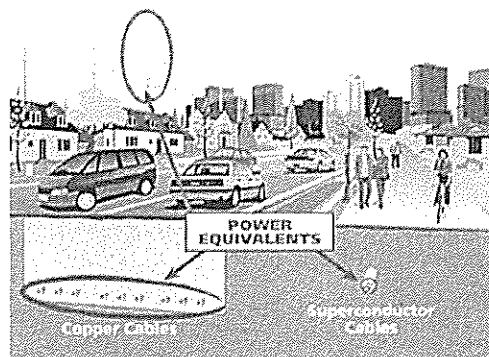
- BNL Contribution
- Nano-structured PV with double the efficiency per active unit area

EFRC Center for Excitonics (MIT)

Transmission

Superconducting Lines

- Power density driver



- BNL Contribution
- Reel-to-reel growth of superconducting materials



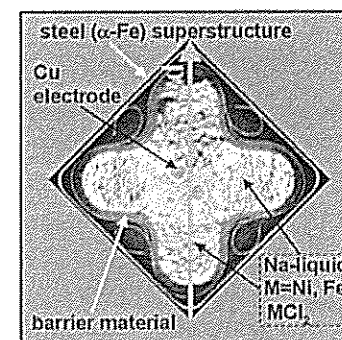
American Superconductor®

EFRC Center for Emergent Superconductivity (BNL)

Storage

Batteries

- X-ray probes, materials

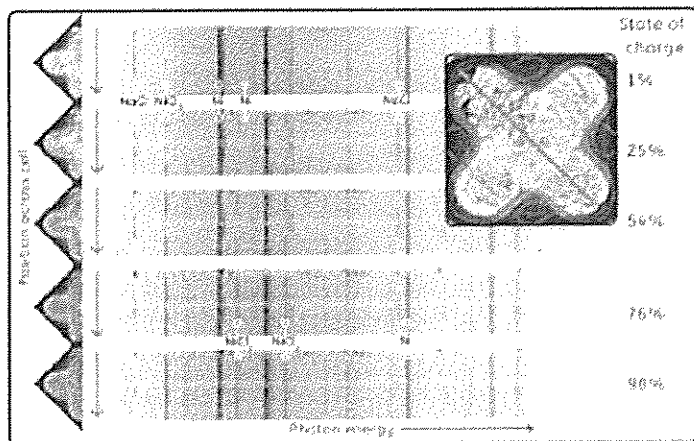


- BNL Contribution
- X-ray tools probing real batteries in operation
- SMES
- Grid scale storage



EFRC Center for Mesoscale Transport Phenomena (SBU)

A Center for Energy Storage



"Our collaborations with the National Synchrotron Light Source have helped to improve our fundamental knowledge and in turn have allowed us to realize significant gains in battery performance. These advancements are foundational to our new business and our ability to bring leadership technology to market.. "

Glen Merfeld

Energy Storage Leader, GE Global Research



Building on GE success

Energy Storage Consortium: Coordination and Synergy

- Facility expertise in photon based and electron based techniques for Energy Storage
- EFRC (m2M)
- EERE
- Batt program
- ARPA-E
- NYBEST
- Industry (GE, Toyota...)

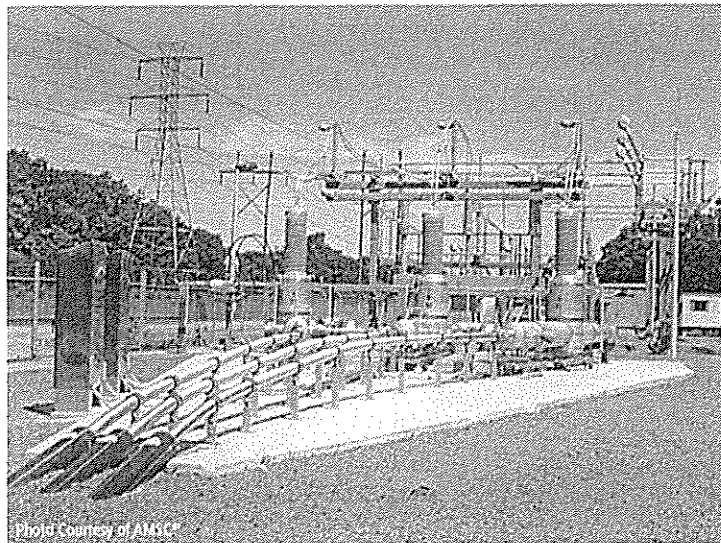


Esther Takeuchi:

Director, Integrated
Energy Science Center
in Energy Storage

Discovery to Deployment: Applications of advanced materials

Electricity transmission



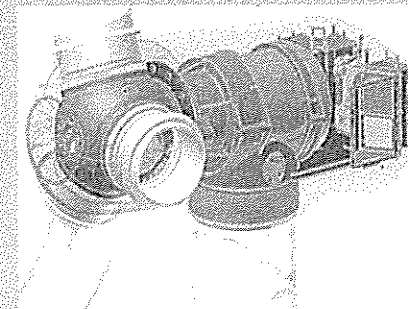
Power cable LI. In use since 2008

Also:

- Electrical storage
- Large field magnets
- Maglev trains

Electricity Generation

Superconducting Direct
Drive Wind Generator
(10MW+)



BNL Grid R&D: Distribution, Congestion, Resilience

- We are delivering to regional utilities, NYS and NYSEERDA
 - Power flow modeling and analysis
 - Resilience modeling (e.g. storm damage prediction)
 - Microgrid research/optimization
 - Cost savings, enhanced reliability, resilience, recovery, and greater renewable penetration

- Grid capabilities include:
 - Advanced distribution system modeling
 - Long Island Solar Farm; BNL Microgrid; Northeast Solar Energy Research Center
 - NYS Utilities, NYSEERDA, ESDC
 - NYS Smart Grid Consortium



Orange & Rockland
Pike County Light & Power Co.
Rockland Electric Company

nyserda
Energy Innovation Solutions

PSEG LONG ISLAND
We make things work for you

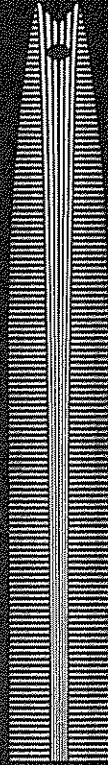
NYS
SmartGrid
Consortium

BROOKHAVEN
NATIONAL LABORATORY

Pertamina Energy Tower

Scott Duncan is a Design Director from SOM's New York office, where he has led projects ranging from a New York City public school to a conference center in Saudi Arabia with a roof planted with desert grasses to the net zero energy super tall Pertamina Energy Tower planned for Jakarta, Indonesia.


Luke Leung is the Director of the MEP + Sustainable Engineering Studio for SOM. Leung leads his team in attaining the highest levels of human, environmental, and financial performance. Project highlights include the Burj Khalifa, currently the world's tallest man-made structure and more than 40 LEED® certified or registered buildings, including a LEED® Platinum building with the first large-scale horizontal wind turbine in Chicago.



PERTAMINA ENERGY TOWER

EXECUTIVE SUMMARY
DECEMBER 2014





*A highly efficient and sustainable
workplace for **Pertamina**. A new
destination for **Jakarta**. A symbol
of the future for **Indonesia**.*

A DESTINATION FOR JAKARTA A SYMBOL FOR INDONESIA

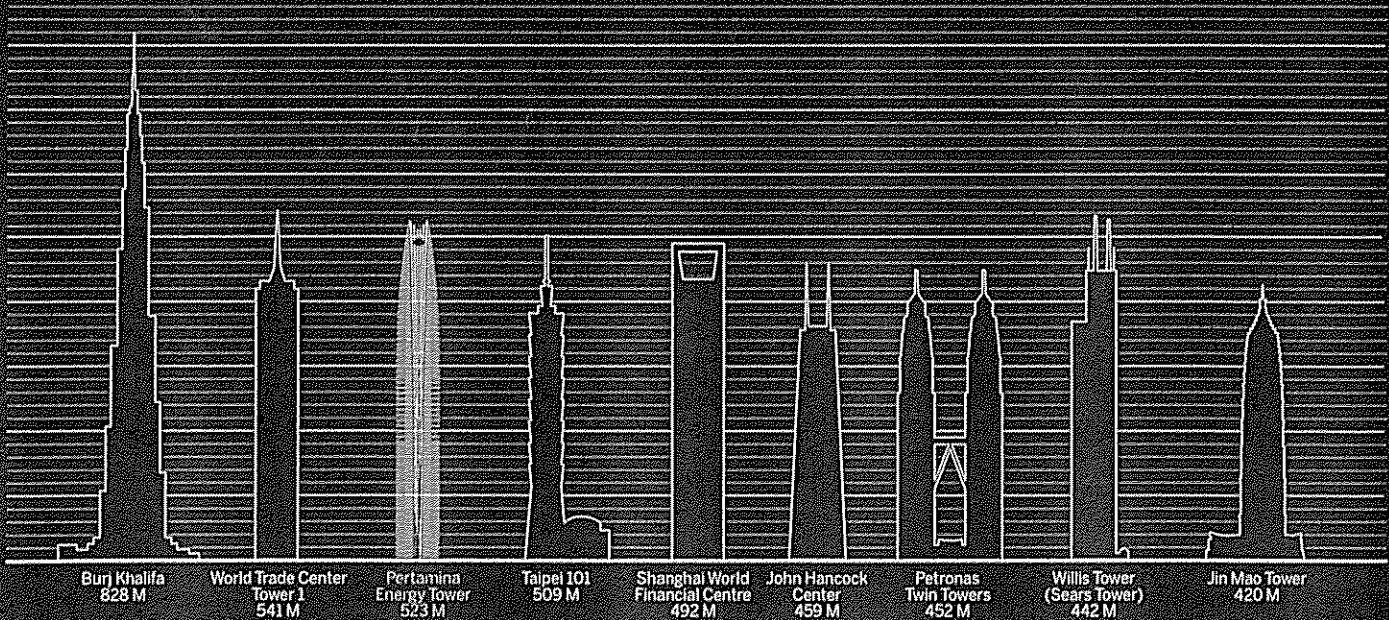
"The Pertamina Energy Tower and campus should serve as a model of design for the entire country of Indonesia."

— Professor Gunawan Tjahjono

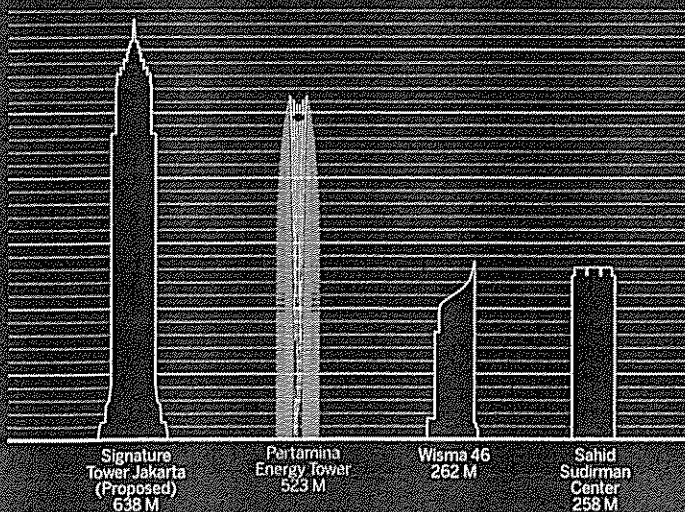
This ground-breaking project is the world's first supertall for which energy is the primary design driver — energy conservation, energy generation, and the energy of its people.

Pertamina Energy Tower will rise 523 meters above Jakarta as a stunning new landmark on the capital's skyline. The 99-story "beacon of energy" will set a new standard for sustainable development, bringing together 18,000 employees on its innovative, dynamic campus. The tower aims to be the first net-positive energy, carbon-neutral supertall building.

INTERNATIONAL SUPERTALL TOWERS



TOWERS IN JAKARTA



BUILDING A SKYSCRAPER, GROWING A NATION

Petronas Towers (Malaysia)

- Rapid economic and social development dramatically decreased poverty level from 49% in 1974 to 6% in 2004.
- Petronas Towers symbolized the country's transformation from into an industrial powerhouse on the global stage.

Jin Mao, World Financial Center, Shanghai Tower (China)

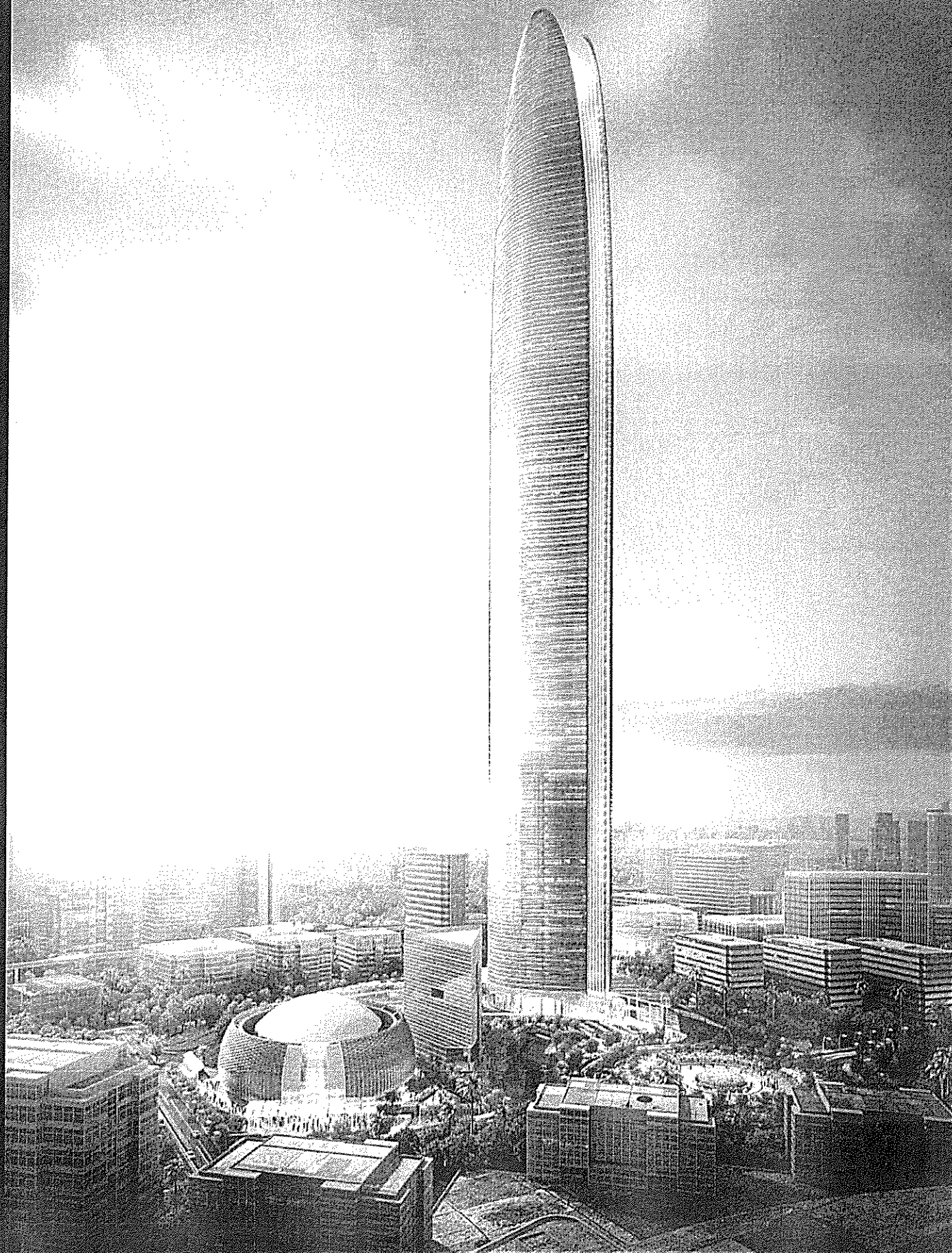
- Skyscrapers in Shanghai have made the city a showpiece for China's booming economy
- The towers in are mostly occupied by domestic and overseas financial and insurance corporations
- The towers have fueled tourism growth and symbolize the city's emergence as China's national economic center

Burj Khalifa (United Arab Emirates)

- Burj Khalifa was an anchor project to drive investment towards the downtown area for the development of a central business district.
- The tower construction has increased the rent and hotel rates in the surrounding neighborhood.
- The tower has become a "tourist magnet" and contributing significantly to the Dubai tourist industry, which is now 14% of the GDP.

Taipei 101 (Taiwan)

- The Tower represents the country's strong, wealthy infrastructure because large Taiwanese companies have invested in the building, which also attracts foreign investors.
- The tower has contributed to the increase in tourism and symbolizes the growth in GDP



A GREEN NEIGHBOR FOR EPICENTRUM

The new campus will be a pedestrian-friendly environment. Inspired by the lush and green landscapes of the Indonesian archipelago, Pertamina's campus is designed to be an "outdoor classroom" for visitors, employees, and neighborhood residents.

The Pertamina Energy Tower will be the centerpiece of this "city within a city" that blends together living, working and playing. The Mosque and Pavilion will be the Rasuna Epicentrum neighborhood's newest civic buildings, providing a spiritual and social space as well as a cultural and artistic venue.

The campus will integrate into the neighboring residential and retail community by creating an environment where people can comfortably enjoy a variety of outdoor activities such as dining and exercise. Situated near existing bus rapid transit and Jalan Rasuna Said, the new consolidated campus will take advantage of mass transportation and reduce Jakarta's automobile and air pollution.



Rasuna Epicentrum is one of the newest examples of pedestrian-friendly development in Jakarta. Pertamina's new campus will continue this style of development.



The pedestrian neighborhood in Epicentrum.



The new campus connects to mass transit.

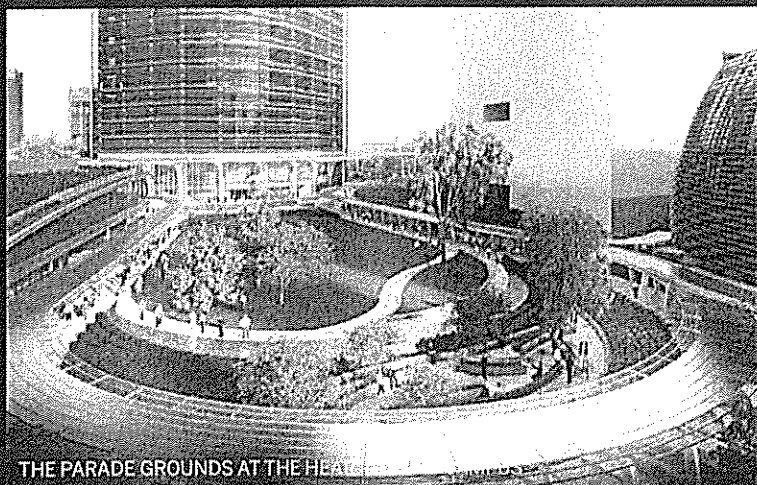
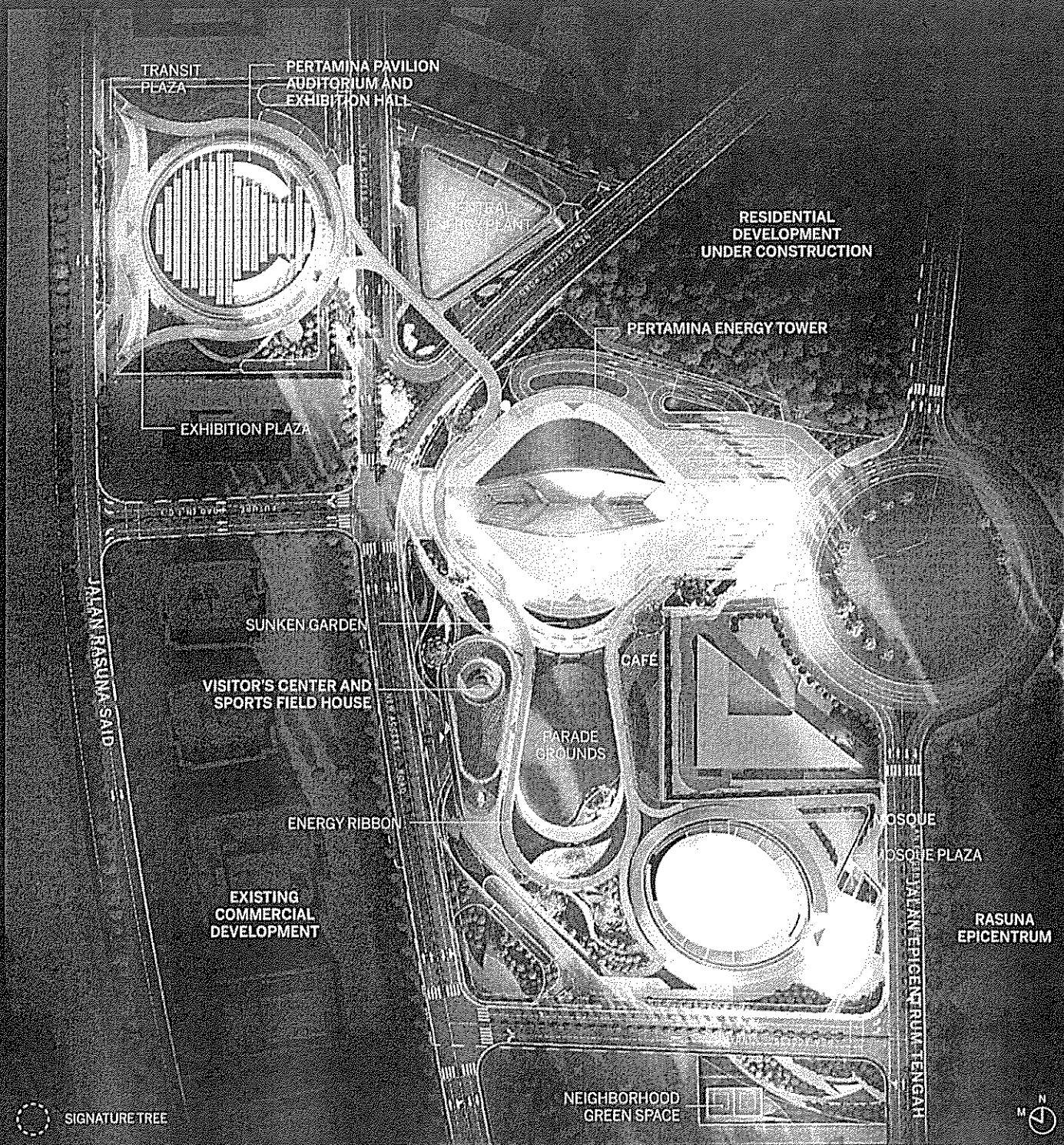


A CONSOLIDATED CAMPUS FOR PERTAMINA

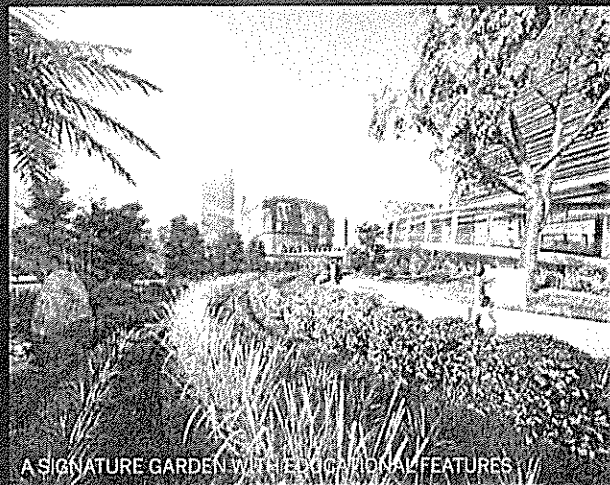
As Pertamina's operations are anticipated to grow in the next few years, consolidation onto a new campus will help to improve internal operations, reduce traffic around the city, and eliminate redundancy in services if offices are dispersed around the city.

GOLD AWARD FOR PERTAMINA ENERGY TOWER CAMPUS

Pertamina Energy Tower has been awarded a Gold Award for "Best Futura Mega Project" at the 2014 MIPIM Asia Awards, a prestigious international accolade that recognizes excellence in real estate development with a focus on sustainable, forward-looking development.



THE PARADE GROUNDS AT THE HEART OF THE DEVELOPMENT

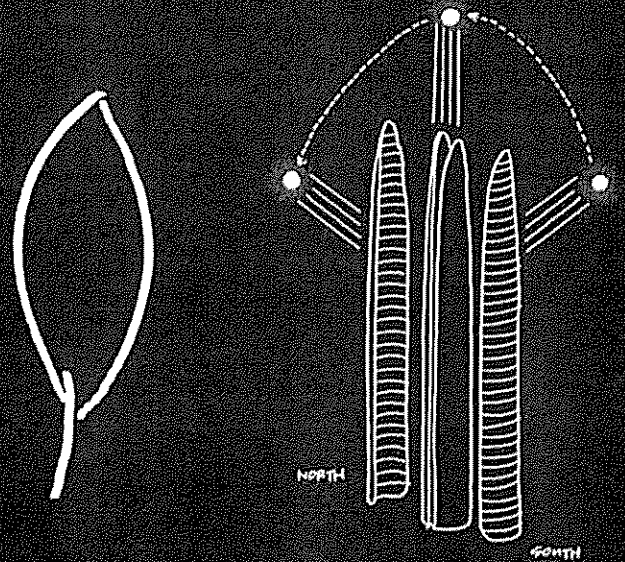


A SIGNATURE GARDEN WITH EDUCATIONAL FEATURES

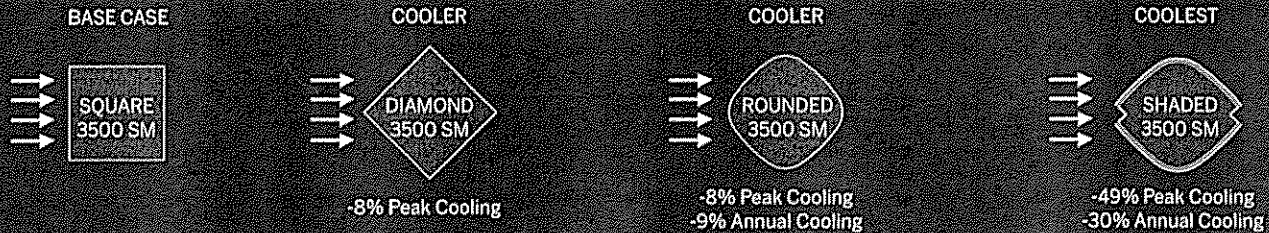
A MODEL FOR SUSTAINABLE DESIGN

Pertamina's new headquarters will be a highly visible model for sustainable development in Jakarta. Climate-sensitivity is a signature force in the design concepts of the campus buildings and landscape.

The Pertamina Energy Tower will be the first supertall tower in the world shaped specifically to mitigate solar heat gain. Sustainable strategies are at the core of the every component in the project. By taking advantage of solar, geothermal, and wind power — each abundant resources in Indonesia — the project maximizes energy efficiency opportunities in order to earn a Platinum level certification under the Green Building Council Indonesia Greenship New Building rating system.



PLAN FORM EVOLUTION

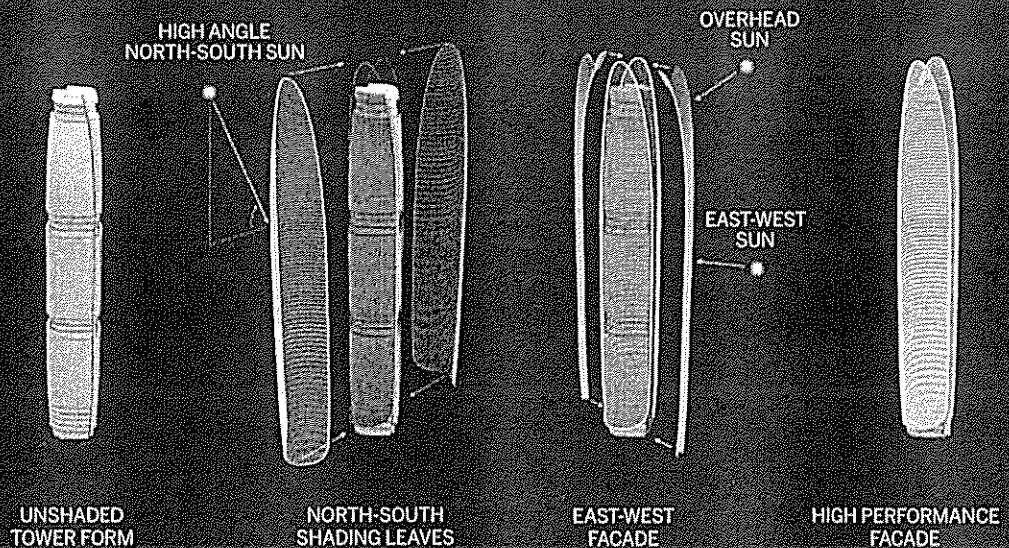


FACADE AND SOLAR SHADING DESIGN

900 kWh/m²yr

0 kWh/m²yr

The tower's sophisticated form is carefully calibrated to reduce the effects of the morning and afternoon sun by angling the north and south facades and placing a deep wall on the east and west. The shading concept reduces the cooling load of the tower, resulting in substantial reductions for air conditioning operating costs.



THE FUTURE OF ENERGY AND ARCHITECTURE

The consolidated campus will be a world-class workplace that is designed for a green future.

With 40% of the world's geothermal resources, Indonesia has great potential for tapping energy from the ground. Geothermal energy is proposed as a clean and cutting-edge technology to power Pertamina's new campus using a "combined heat and power" cogeneration system, a system proven to be safe and successful in cities like Paris, Munich and The Hague. If implemented, geothermal will allow Pertamina's new campus to be the first net-zero (or net-positive) supertall tower in the world.

REDUCTION STRATEGIES

- Optimum orientation
- External shading
- Thermal Mass
- Night Purging
- Decouple ventilation load from internal load
- Green roofs
- High albedo roofs
- Occupancy sensors
- Demand control ventilation
- Cogeneration
- District cooling
- Active chilled beams
- Displacement ventilation
- LED lamps
- Passive dehumidification
- Regenerative elevator brakes
- High efficient chillers
- High density cooling towers
- Waste reduction

ABSORPTION

- Rain water harvesting
- Daylight harvesting

WATER RECLAMATION

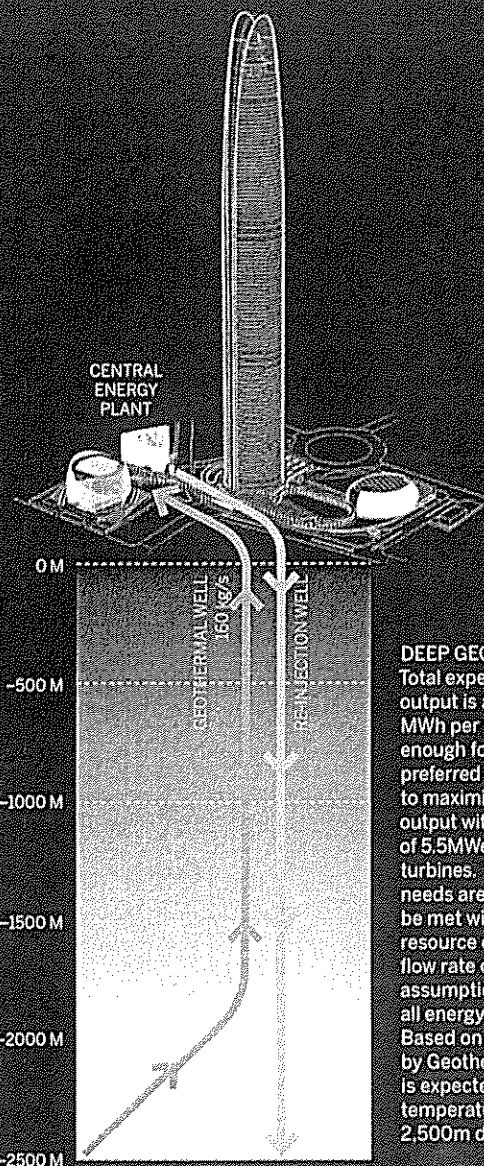
- Black water treatment
- Aquifer reinjection

ENERGY GENERATION

- PV cells
- Wind turbines
- Deep well geothermal

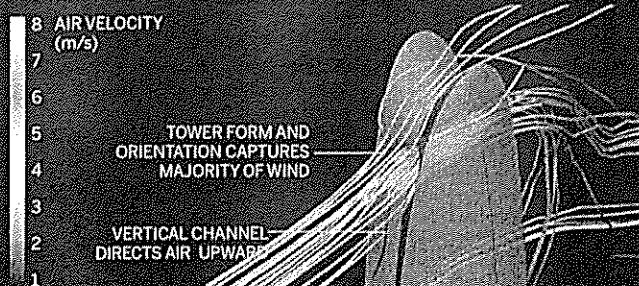
IMPROVED ENVIRONMENT

- Local landscape species
- Noise control
- Enhance microclimate



DEEP GEOTHERMAL

Total expected geothermal output is around 45,000 MWh per year, more than enough for the campus. The preferred design option is to maximize the electrical output with the installation of 5.5MWe organic vapor turbines. The current project needs are estimated to be met with a minimum resource of 150°C with a flow rate of 160 kg/s. This assumption is the basis for all energy balance analysis. Based on preliminary studies by Geothermal experts, it is expected to find this temperature ranges at about 2,500m deep.



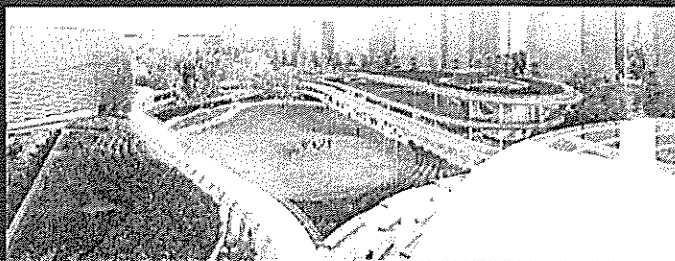
"WIND FUNNEL" ACCELERATES WIND TO GENERATE ELECTRICITY



SOLAR PANELS GENERATE ELECTRICITY AND PROVIDE SHADE



BIOSWALE FILTERS WATER USING PLANTS AND NATURAL ABSORPTION

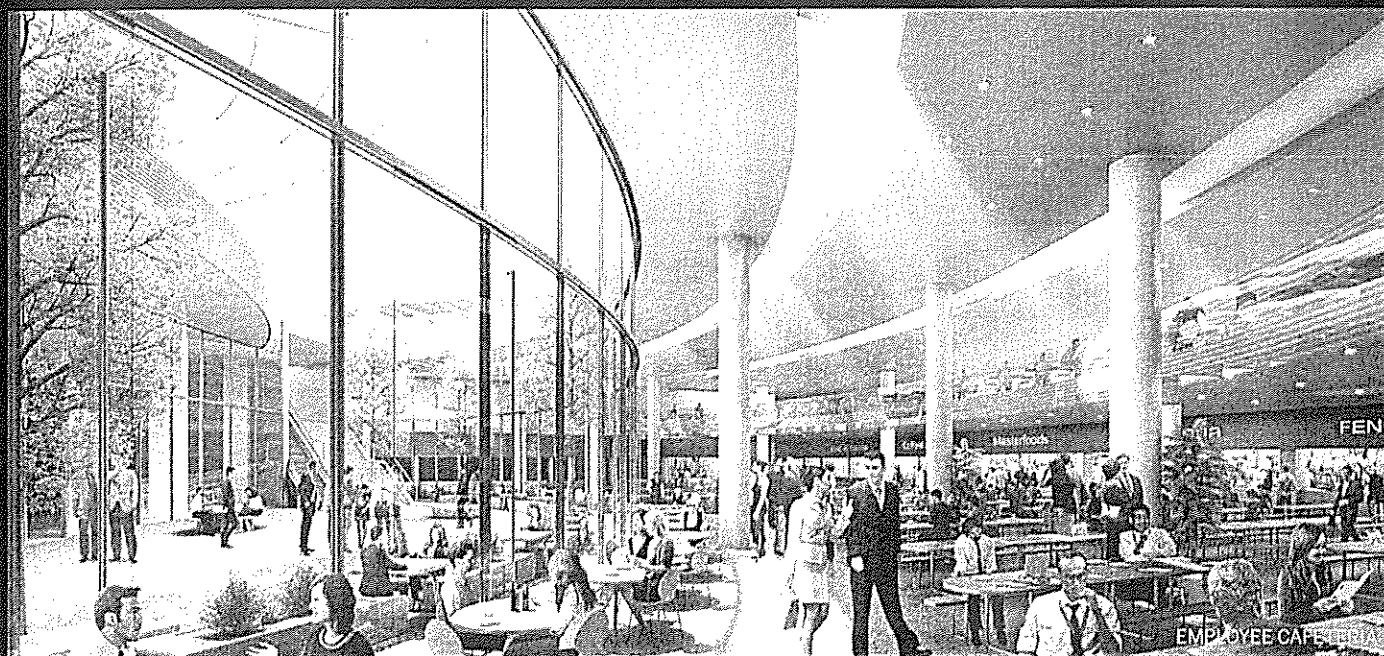


GREEN ROOF "FARMS" AND THE PARADE GROUNDS

A COLLABORATIVE CAMPUS AND AN EFFICIENT WORKPLACE

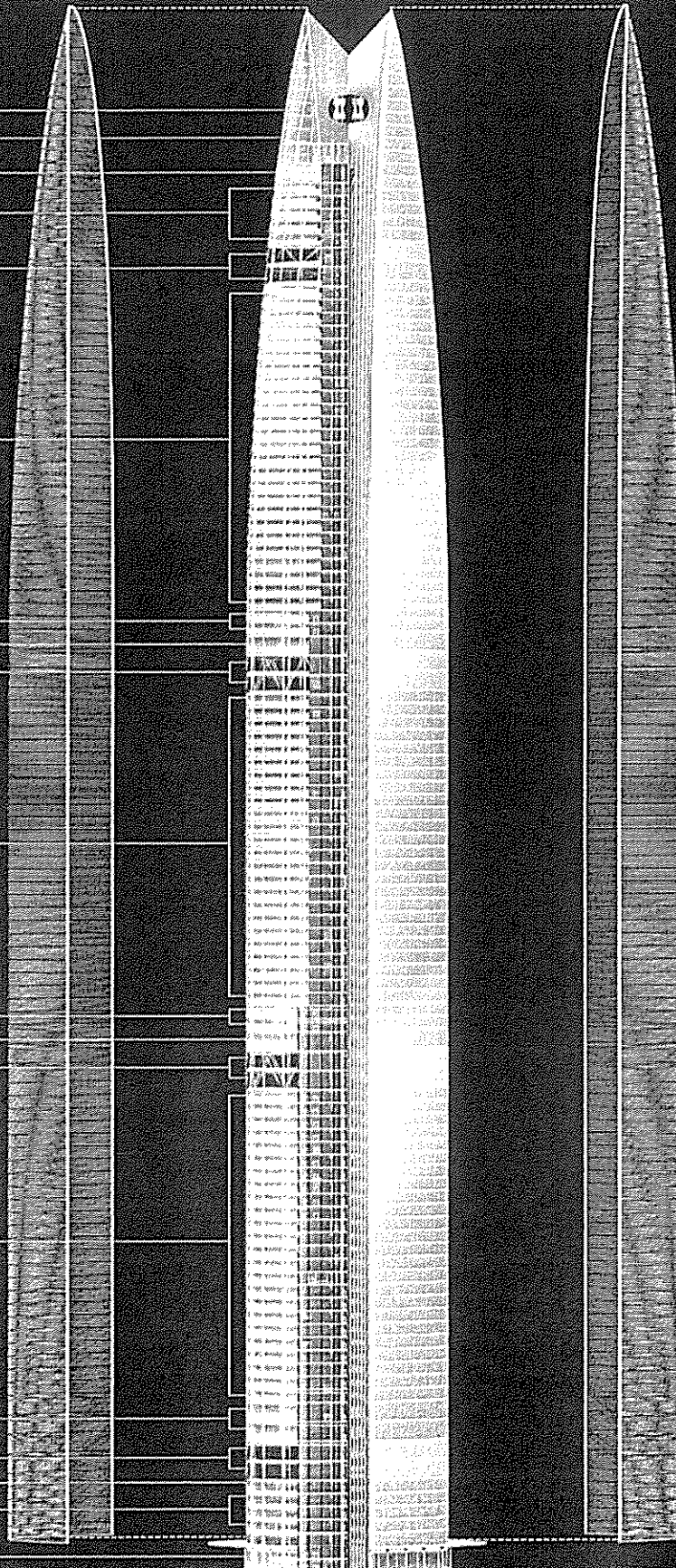
The campus is a collaborative model for a corporate headquarters — one that is more like a bustling city — with vibrant public spaces and communal meeting areas.

The consolidation of Pertamina's offices across Jakarta into a single complex aims to enhance internal communication and efficiency. Compared to a dispersed number of offices, a single campus eliminates redundancy in office services, mechanical demands, and ultimately allows for efficient interaction between people, increased productivity, reduction in overhead costs.



TOP OF TOWER 523 M

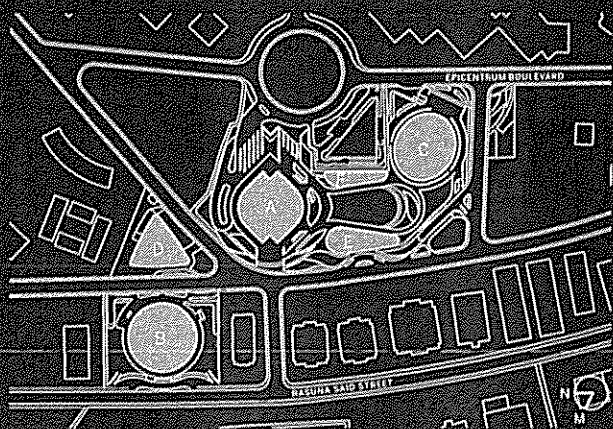
- WIND TURBINES (99C)
- OBSERVATION DECK (99B)
- RESTAURANT (99-99A)
- EXECUTIVE FLOORS (94-98)
- MECHANICAL (92-93)
- DEPARTMENT OFFICES (67-91)
- SKY LOBBY (65-66)
- CAFETERIA (64)
- MECHANICAL & REFUGE (62-63)
- DEPARTMENT OFFICES (38-61)
- SKY LOBBY (36-37)
- CAFETERIA (35)
- MECHANICAL & REFUGE (33-34)
- DEPARTMENT OFFICES (9-32)
- DATA CENTER (7-8)
- MECHANICAL (5-6)
- DAY CARE AND MEDICAL (4)
- COMMON MEETING ROOMS (1-3)
- MAIN LOBBY (UG)



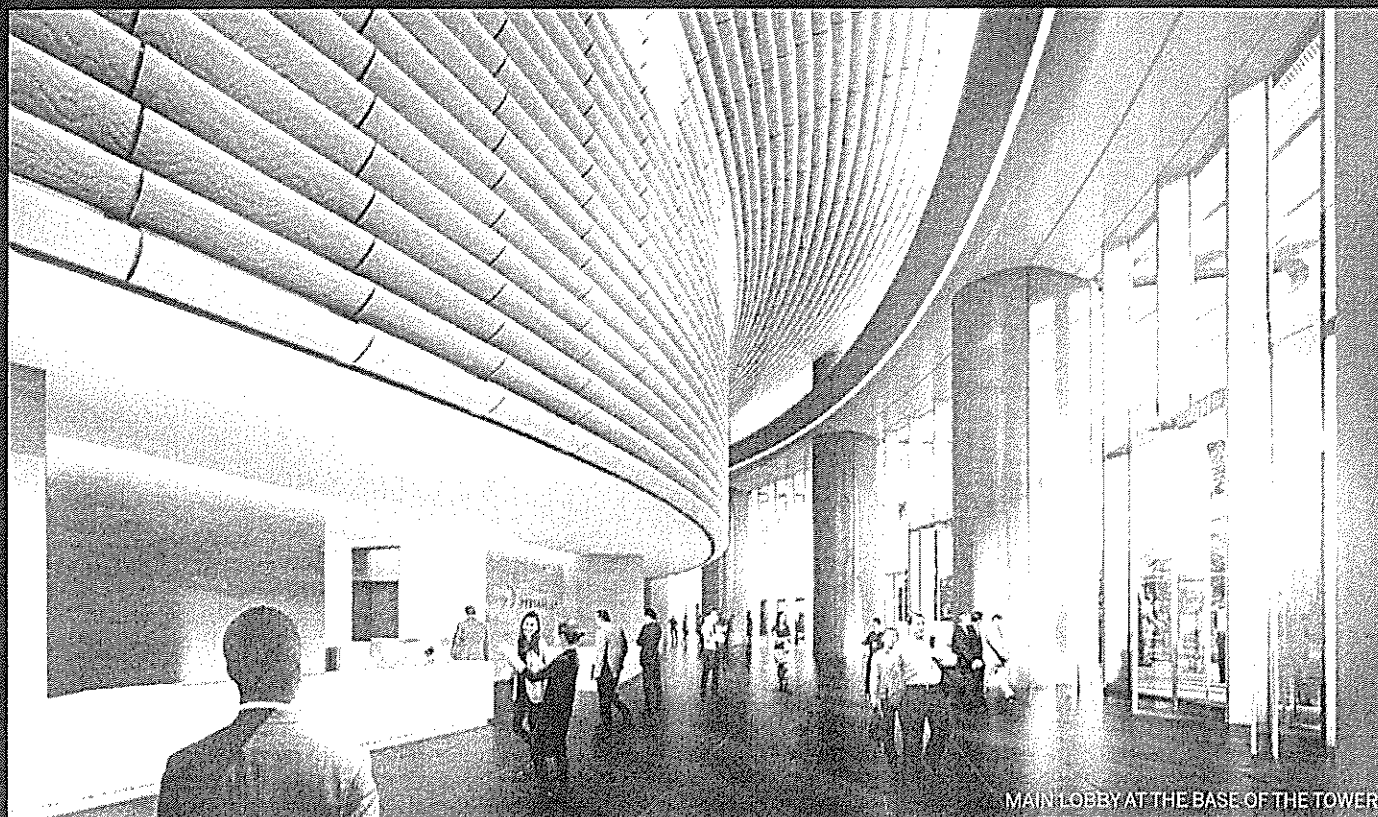
WORLD CLASS SAFETY, EFFICIENCY, SUSTAINABILITY

The headquarters' performance-driven design supports and reflects the ambition of Pertamina's mission and forges an innovative model of green development in Jakarta.

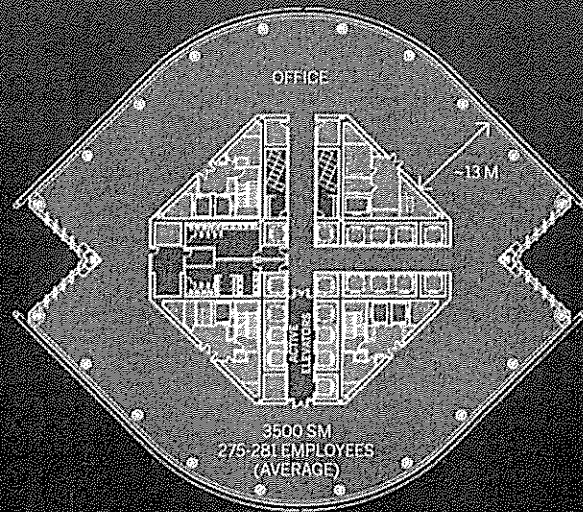
The design of the building follows or exceeds many international standards for safety and efficiency. The highly efficient elevator system utilizes a combination of local and express elevators to move over 18,000 employees smoothly to their offices and meeting rooms. The local and express elevators transfer at two sky lobbies, spaces which connect to cafeteria and shared amenities. The internal core design ensures a safe evacuation within a two-hour period, complying with the international standards for refuge areas and lifeboat elevators.



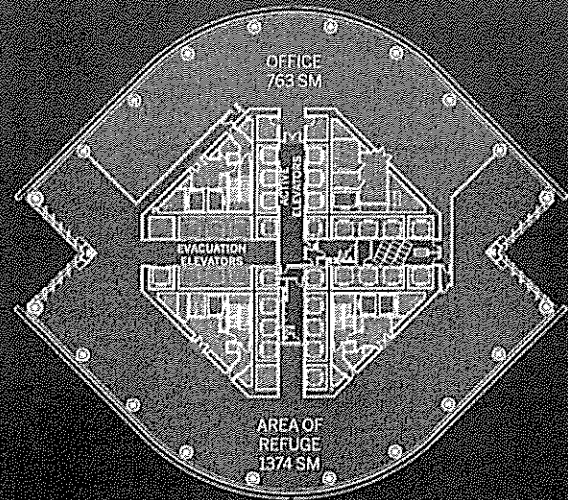
BUILDING	AREA (M ²)
Pertamina Energy Tower (A)	319,449
Pertamina Pavilion (B)	19,010
Pertamina Mosque (C)	11,459
Central Energy Plant (D)	17,193
Visitor's Center (E)	4,049
Cafe (F)	1,478
Basement Programs	21,709
Total FAR (Floor Area Ratio) Zoning Area	394,347
Total Site Area	55,843
Achieved FAR (Total Area x 80% / Total Site Area)	5.65 (6.0 Maximum)
Basement Parking	148,929
Provided Parking	3,620 Cars 2,436 Motorcycles 405 Bicycles



MAIN LOBBY AT THE BASE OF THE TOWER



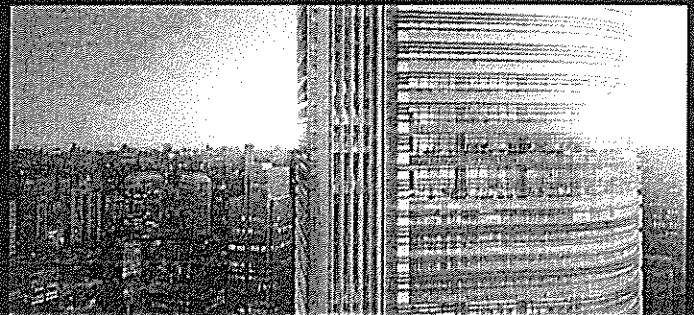
TYPICAL OFFICE FLOOR



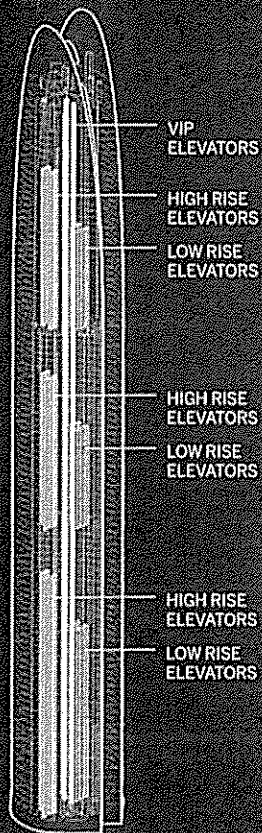
AREA OF REFUGE FLOOR



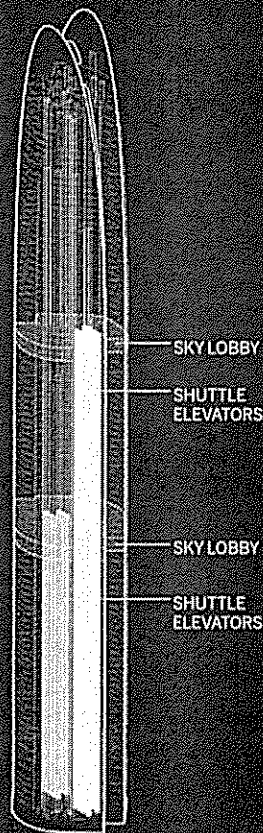
TYPICAL EAST-FACING CONFERENCE ROOM



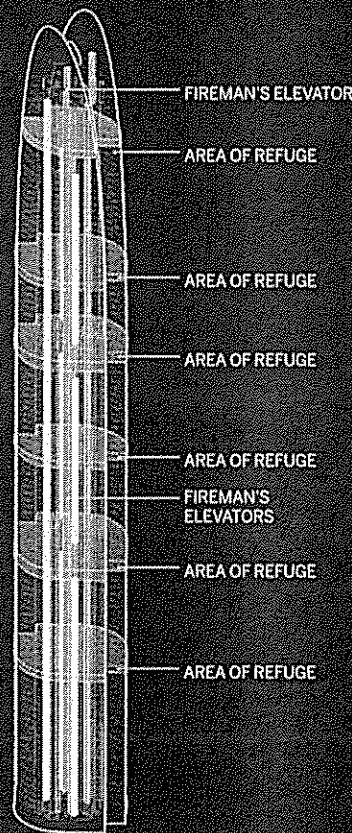
EXTERIOR FACADE



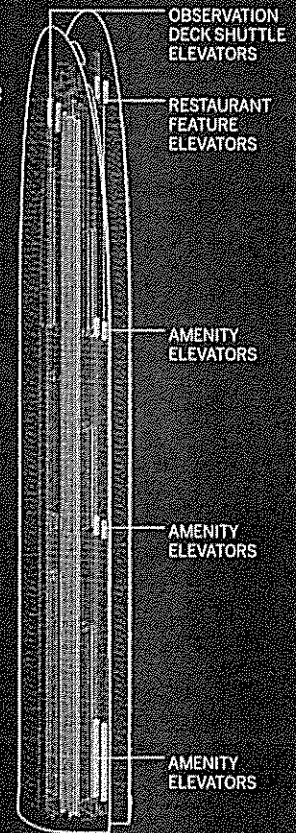
LOCAL & EXPRESS PASSENGER ELEVATORS



EXPRESS PASSENGER SHUTTLES



FIRE AND SERVICE ELEVATORS

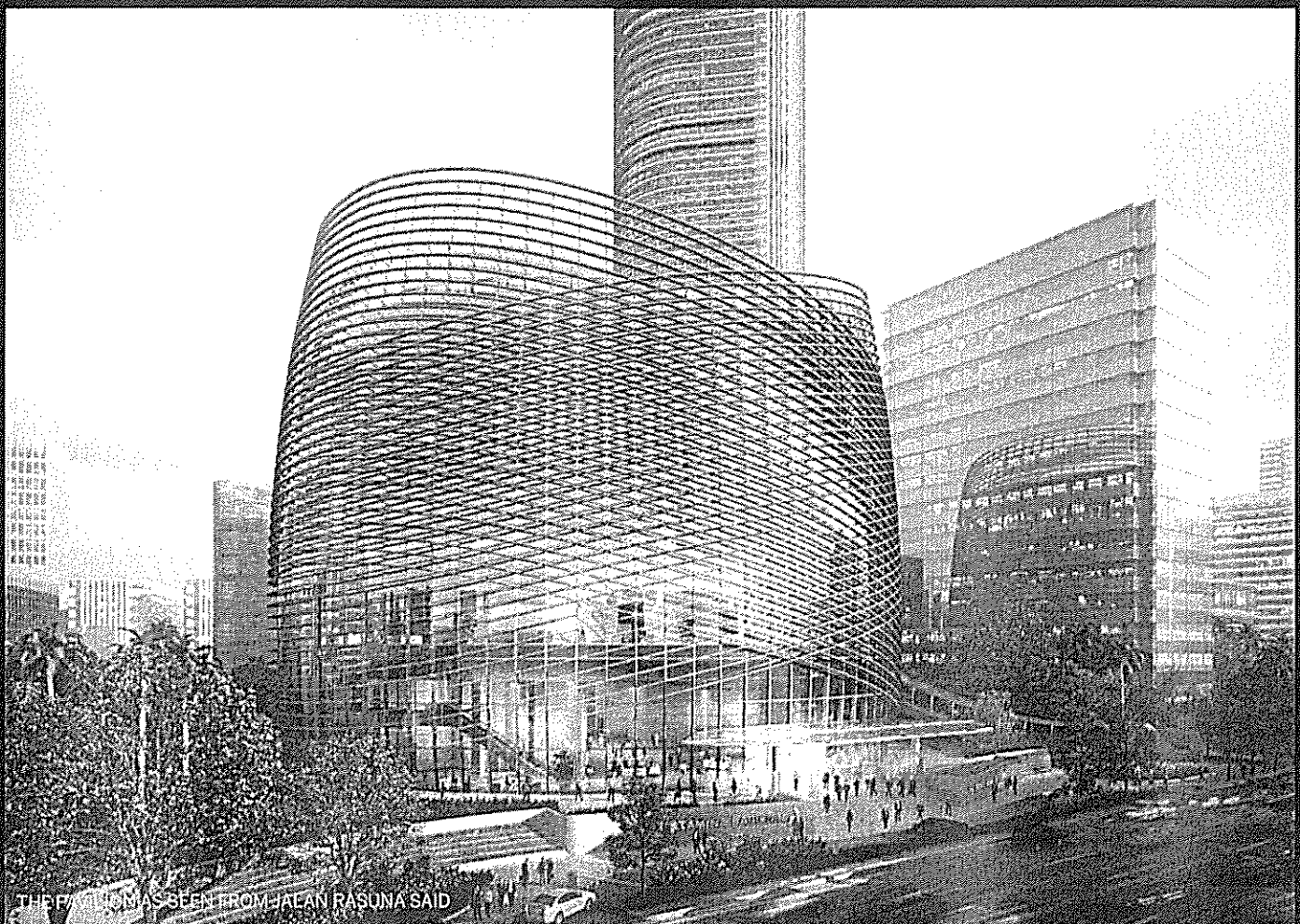
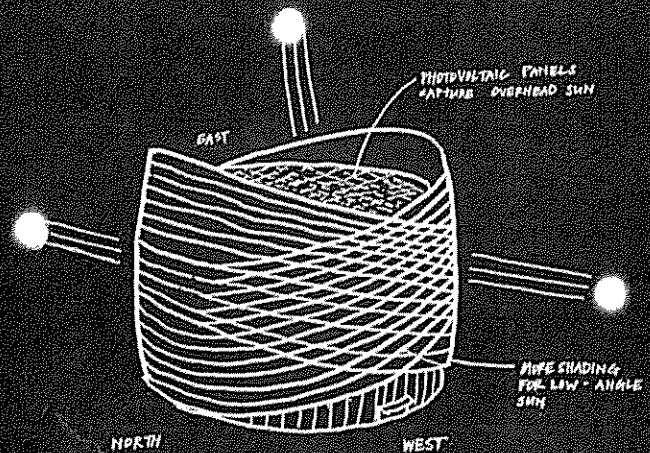


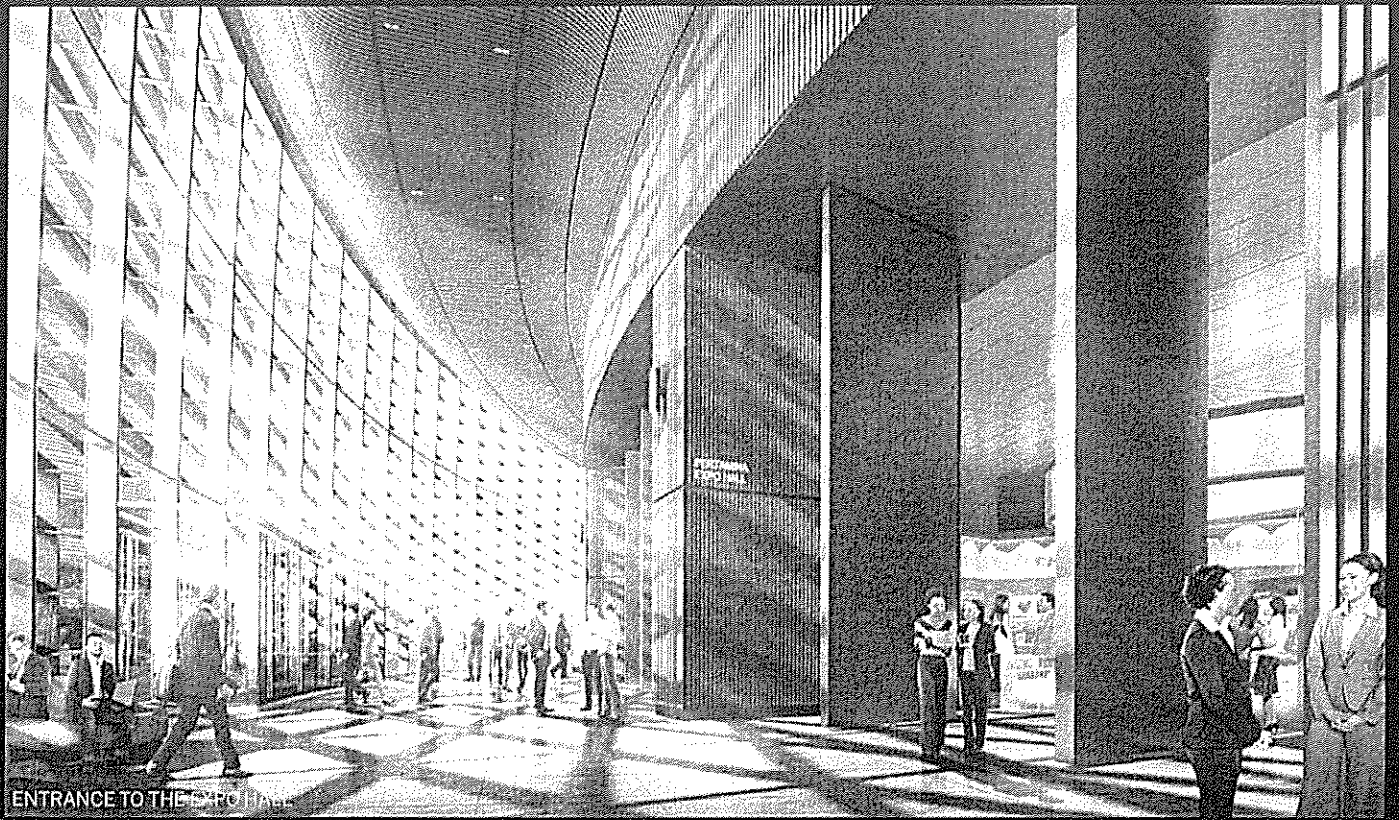
SPECIAL ELEVATORS

PERTAMINA PAVILION: A LANDMARK ON JALAN RASUNA SAID

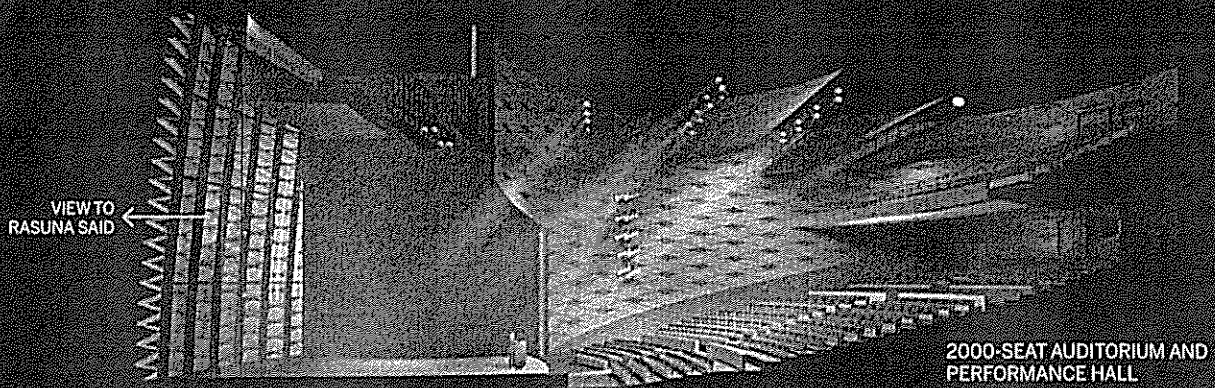
The Pavilion is envisioned as a landmark space for arts and cultural exchange, exhibitions, and corporate conferences. The striking exterior façade is inspired by the rich history of Indonesian textiles and optimized for solar protection.

As the "public face" of Pertamina on Jalan Rasuna Said, the Pavilion is well-situated to host both internal corporate events as well as performances open to the public. The Pavilion houses a 2000-seat auditorium, a multifunction exhibition and banquet hall. Dramatic interior design "weaves" together Indonesian patterns and modern design elements.





ENTRANCE TO THE EXPO HALL



VIEW TO
RASUNA SAID

2000-SEAT AUDITORIUM AND
PERFORMANCE HALL

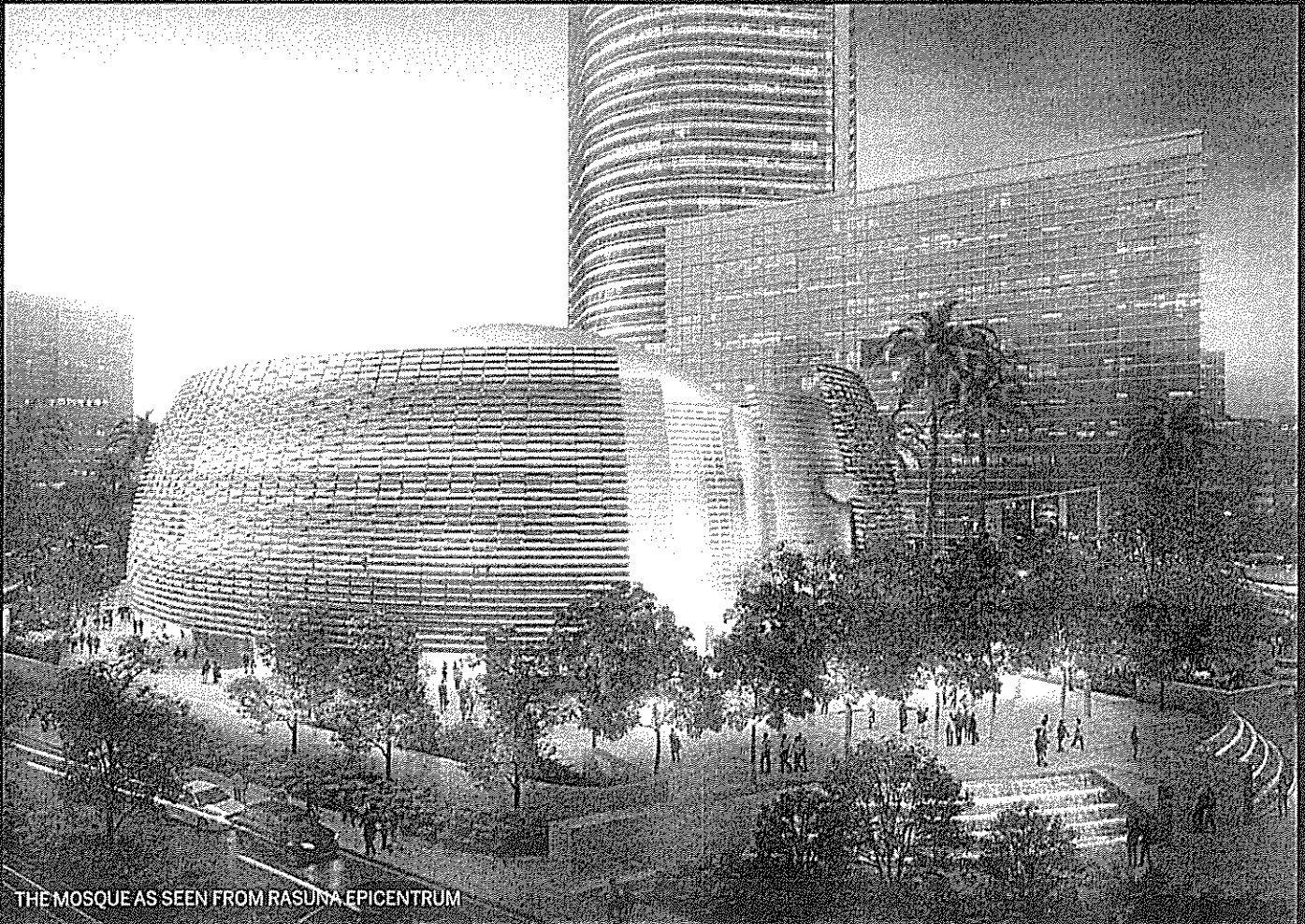
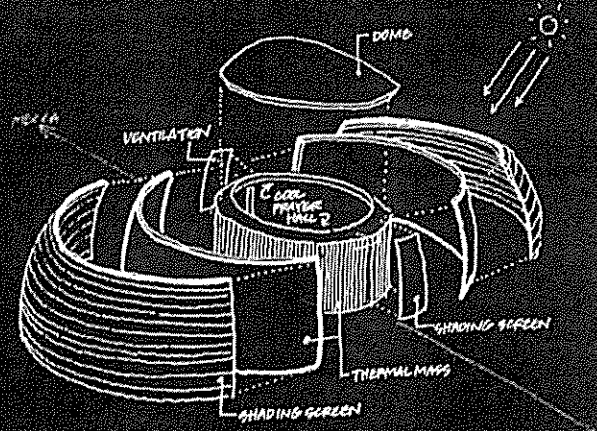


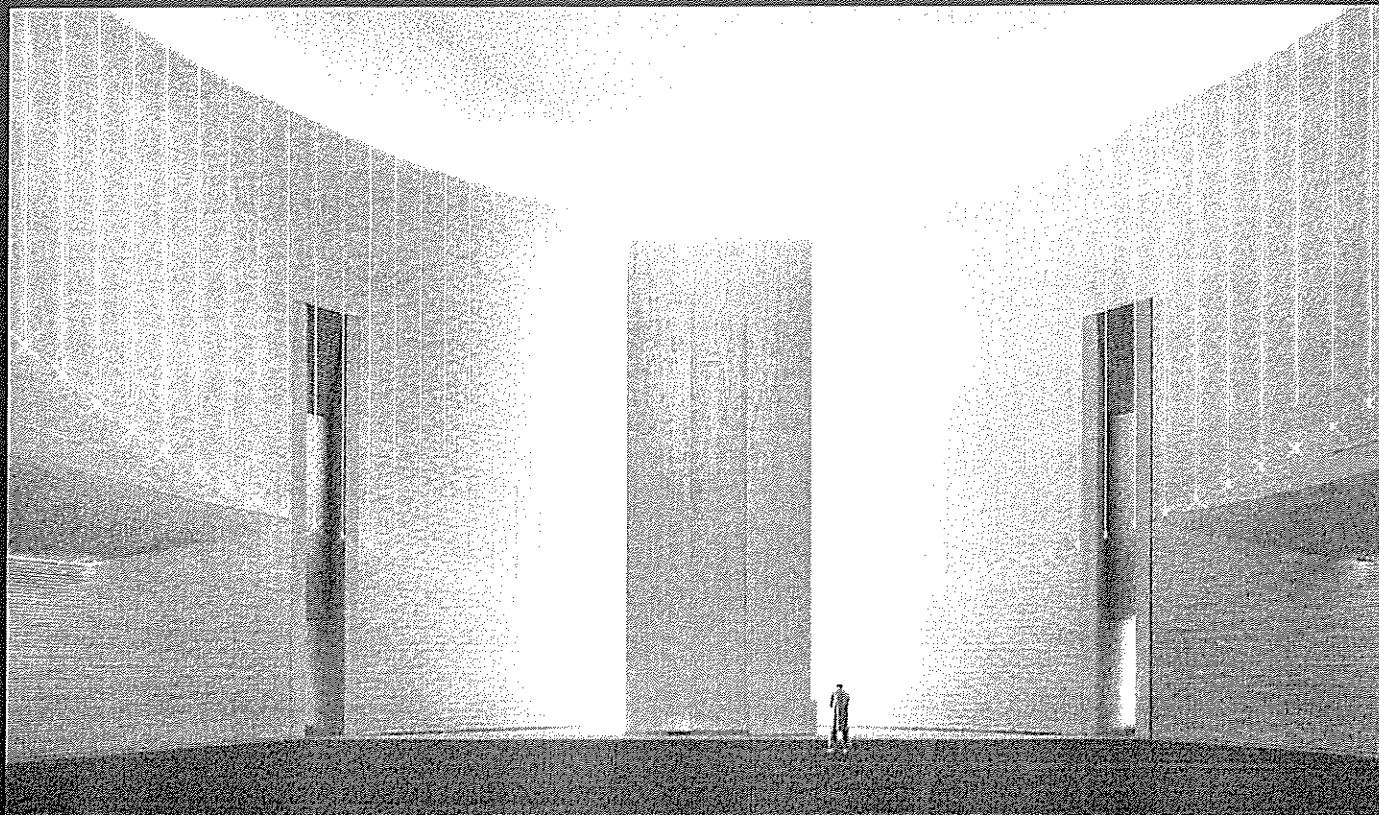
VIEW FROM THE STAGE

PERTAMINA MOSQUE: A SPIRITUAL CENTER FOR THE NEIGHBORHOOD

The Mosque anchors the southeastern corner of the campus and offers the adjacent Epicentrum community a space for prayer and gathering.

The building contains a naturally cooled prayer hall for over 2000 prayers above ground, and a hall below ground for either 1000 prayers or social events such as weddings or community gatherings. Designed with multiple protective layers, a highly permeable exterior shading envelope is a shield against the sun and rain while allowing air to penetrate deep into the prayer hall. Thick walls of stone-clad concrete provide "thermal mass" — where cool night time air temperatures are naturally stored in the concrete walls and released gradually throughout the day — eliminating the need for conventional air conditioning.



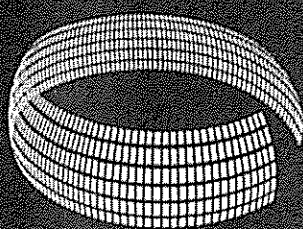


INDONESIAN IKAT AND THE "SOLAR CRESCENT"

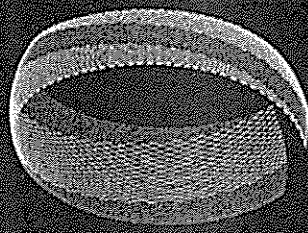
The curved sides of the Mosque present a gradient of orientations toward the sun. The deeper shades reduce direct solar heat gain on the interior mass based on the highest areas of solar insolation. The fin patterning results in a pattern on the facade that is inspired by traditional Indonesian ikat but shaped by solar performance in a "crescent" form that represents Islam.

99 POINTS OF LIGHT

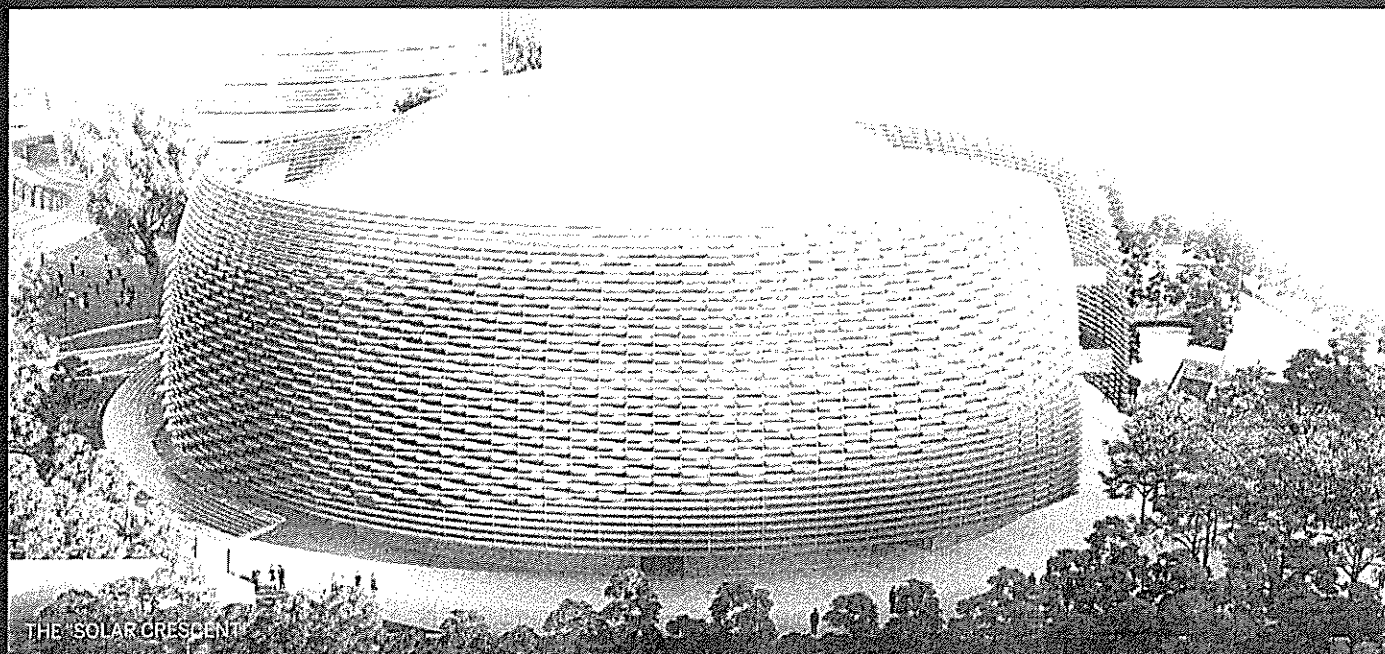
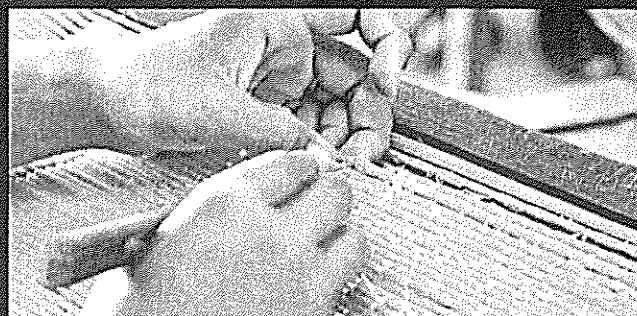
The interior of the prayer hall uses 99 points of light, an important number in Islamic tradition. Horizontal stone tiles relate to the pattern of ikat on the exterior.



SOLAR ANALYSIS



SOLAR CRESCENT



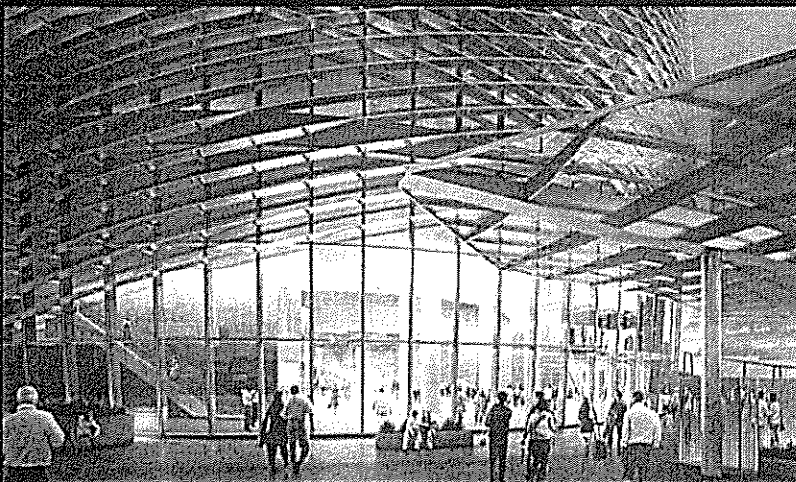
THE "SOLAR CRESCENT"

A CLASSROOM FOR ENERGY INNOVATION A GLOBAL ATTRACTION

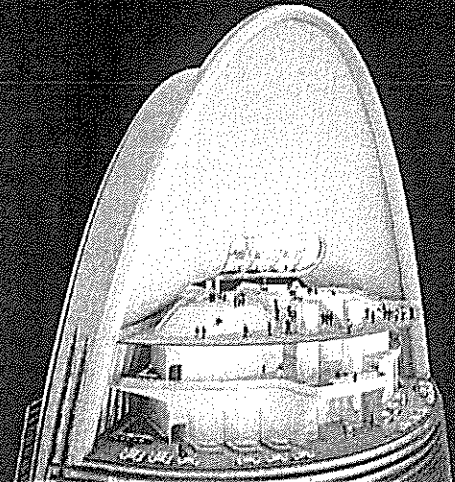
For an energy company, innovation on the new campus will incorporate educational opportunities that expand awareness of energy responsibility and innovative design to demonstrate how sustainability can enhance the built environment.

For employees, visitors, and tourists, sustainable design and renewable energy will be apparent in the architecture of the buildings and on display in educational exhibits and walking tours through the lush landscape.

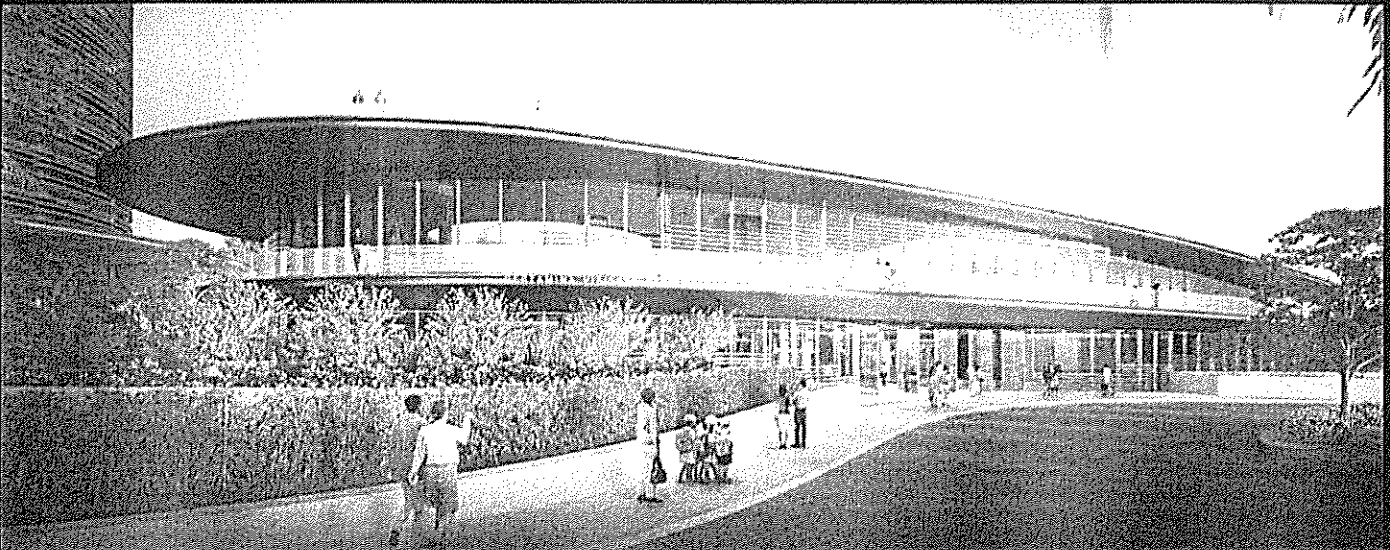
The Tower's observation deck will not only feature panoramic vistas of the surrounding city, but also a closer look at the inner workings of the Tower's wind turbines. Visible from afar, these turbines symbolize Pertamina's sustainability mission and inspire generations to come. A permanent gallery located in the Pavilion will showcase Pertamina's energy research and technological advancements. The Mosque's protective architectural layers demonstrate natural cooling without air conditioning even in Jakarta's hot tropical climate.



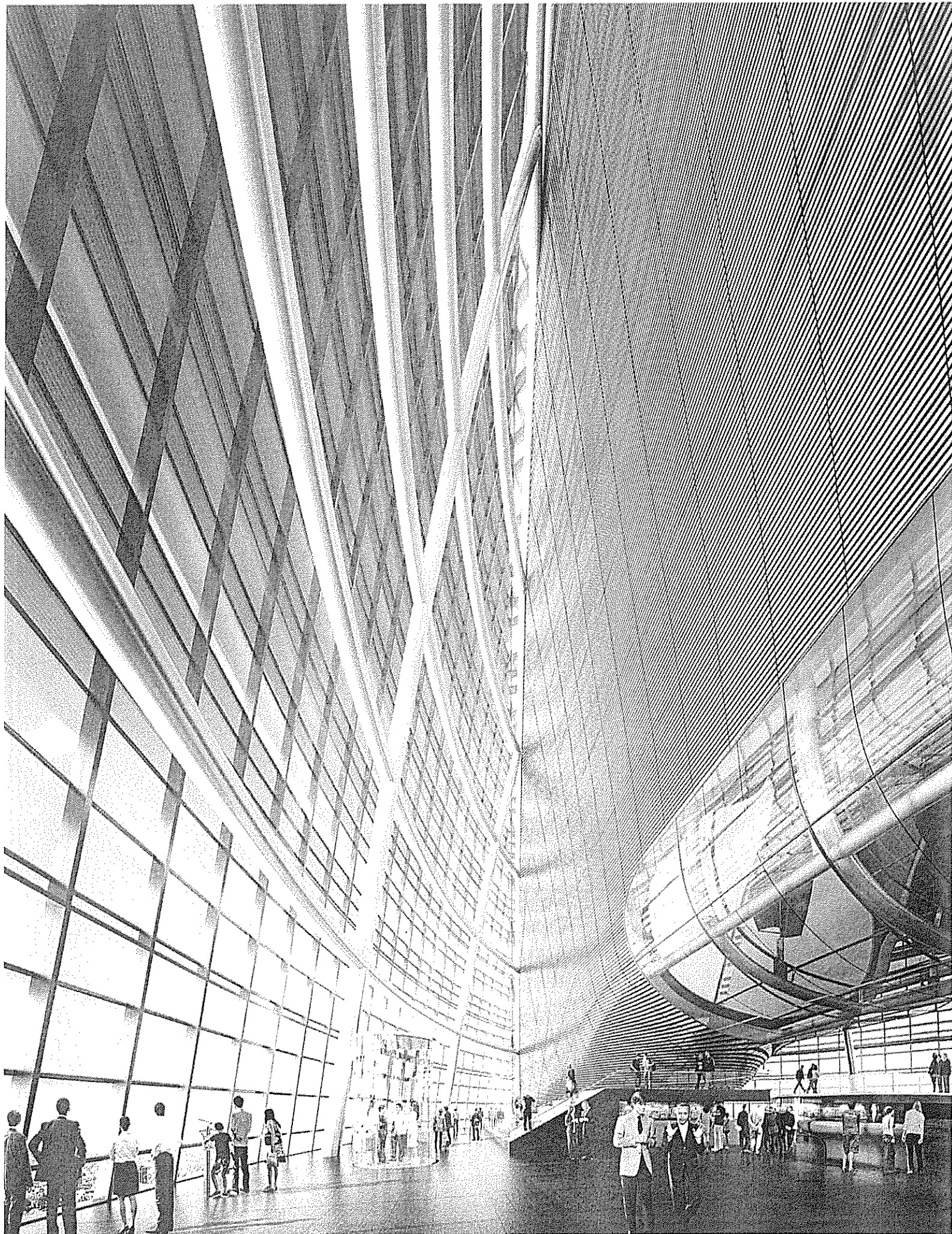
PERTAMINA PAVILION GALLERY TO SHOWCASE TECHNOLOGY



TOWER OBSERVATION DECK TO FEATURE WIND TURBINES



PERTAMINA VISITOR'S CENTER IS THE MAIN ENTRY FOR TOURISTS VISITING THE CAMPUS AND OBSERVATION DECK





PT LAPITB
Turner International
PT Airmas Asri
PT Asdi Swastya
PT Wiratman and Associates
Rider Levett Bucknall



Thomas Balsley Associates
Rolf Jensen & Associates, Inc.
Inhabit Group
Fisher Marantz Stone
Ducibella Venter & Santore
Weidlinger Associates, Inc.
PT Narama Mandiri

Van Deusen & Associates
Fisher Dachs Associates
Shen Milsom & Wilke
Jones Lang LaSalle
Meinhardt Group
CKP Hospitality
PT Tata Letak Andrawina

**WRITTEN TESTIMONY OF PROFESSOR SANJOY BANERJEE
DISTINGUISHED PROFESSOR OF CHEMICAL ENGINEERING AND CHAIR OF THE CUNY ENERGY INSTITUTE**

**HEARING BEFORE THE CITY COUNCIL
COMMITTEE ON ENVIRONMENTAL PROTECTION
FEBRUARY 27, 2015**

Good day Chairman Richards and members of the Committee. I appreciate the opportunity to testify today on Site-Sourced and Stored Renewable Energy, and especially how energy storage is important for New York City and for the developing energy landscape of the world in the coming years.

I am Sanjoy Banerjee, founder and chair of the CUNY Energy Institute. The primary mission of the Energy Institute is to promote the energy independence of the United States. However, as New York is our home, we are also specifically concerned with the energy needs of dense urban environments. In 2013 we spun out a company, Urban Electric Power, located down the hill on 127th Street, which focuses on electrical storage for urban environments. The market for urban-focused energy solutions is large and growing as the world urbanizes. Not only is New York a dense urban environment, one of the first in fact, but also Mumbai, Jakarta, Mexico City, and many others that will have to deliver the growing energy needs of a computer-savvy world to growing populations.

The electrical grid currently has very little storage capacity, which means that generally power is generated at the same time it is used, and generation facilities ramp up and down throughout the day to exactly match demand. For many reasons, industry leaders and policy makers have begun to focus on the need to change this. Viewed metaphorically, an electrical grid without storage is like a computer without a hard drive. Uncoupling the tight lock between generation and demand will allow making electricity use more efficient. The most obvious example is in increasing the prevalence of solar and wind power. These clean and renewable generation methods unfortunately do not respond to the needs to ramp up or down—rather the sun shines when it shines and the wind blows when it blows. For this reason the amount of solar and wind that can be incorporated into the grid is currently limited. However, storage, for example with batteries, allows excess power to be saved for later, when there is greater demand.

This is why storage is critical for becoming carbon neutral, because it is needed to buffer intermittent renewables. However, there are other needs for storage which are more specific to urban environments like New York. One is grid resiliency and backup power. Severe weather is the largest cause of power outages in the US, and as climate change continues to bring us more extreme weather events we can only expect more frequent interruptions in power. Superstorm Sandy made 2012 an especially bad year for the cost of outages, with some estimates being as high as \$52 billion.

Buildings and institutions in New York often have fossil fuel generators for backup power, with the generators located on the upper floors due to vibrations and emissions, and the combustible diesel fuel stored in the cellar, for safety. Not only does this situation produce carbon emissions, but it introduces points of failure. After Sandy, Bellevue Hospital Center had to be evacuated when the fuel pumps in the basement shorted due to flooding, rendering them unable to feed the 13th-floor generators. The New York Times reported that the National Guard, with the help of medical students, mounted a bucket brigade to ferry fuel up to the generators during the evacuation.

Batteries, unlike generators, are silent, produce no vibrations, and have no emissions. Importantly, they could be located anywhere in a building, and can be built at any size, from that needed for a single house to that needed for a large institution. Two things are needed to make building scale batteries standard: demonstrations providing the will and know-how; and of course the appropriate batteries, which are inexpensive and safe enough for this kind of distributed use throughout the city.

The advanced Li-ion batteries that have made portable computing a reality for us all are designed to be very energy dense, meaning they are light and small. However, there are disadvantages in using these for grid-level storage. The materials within the batteries are flammable, and sensitive to water and air. This means the battery can become autocatalytic, essentially hot enough to ignite itself, and then burning out of control. We have all seen internet stories about cell phones or laptops that have caught fire. However, at the scale of a battery meant to power a building or buffer the grid, such a fire would be catastrophic, especially in a dense location like New York. The batteries needed for grid-level storage will need to be non-inflammable, such as a water-based system. This is in addition to the need for low cost and high energy density.

As another example, we have an ongoing conversation with Con Edison about their desire to have modular batteries for use in substations, to defer construction of new infrastructure. For example Con Edison has announced that if an alternative way to shave peak demand is not found, a \$1.1 billion substation expansion will be required for Brooklyn and Queens by 2019. This is because our population is growing at a record rate: 2% in the period 2010-2012, to an all time record of over 8,300,000. This increase places an overall strain on the city's electrical grid. But to meet Con Edison's needs, these modular batteries will have to have a low cost with high safety and high energy density.

This demonstrates how we, with UEP, are working to fulfill the mission of the CUNY Energy Institute, and solve emerging challenges to increase the energy independence and safety of the US and New York. Going forward, we seek opportunities for battery demonstration in user environments, because this is the true test as to whether our research and development efforts are aiming the right direction, fulfilling the needs of potential battery users. We look forward to working with the Committee to find ways to integrate battery storage into this great city of ours. Thank you for the opportunity to testify today. I would be happy to address any questions.

Solar + Storage for Improving the Resiliency of the City's Infrastructure

NYC Hearing of the Committee on Environmental Protection
Site-Sourced and Stored Renewable Energy
February 27th, 2015

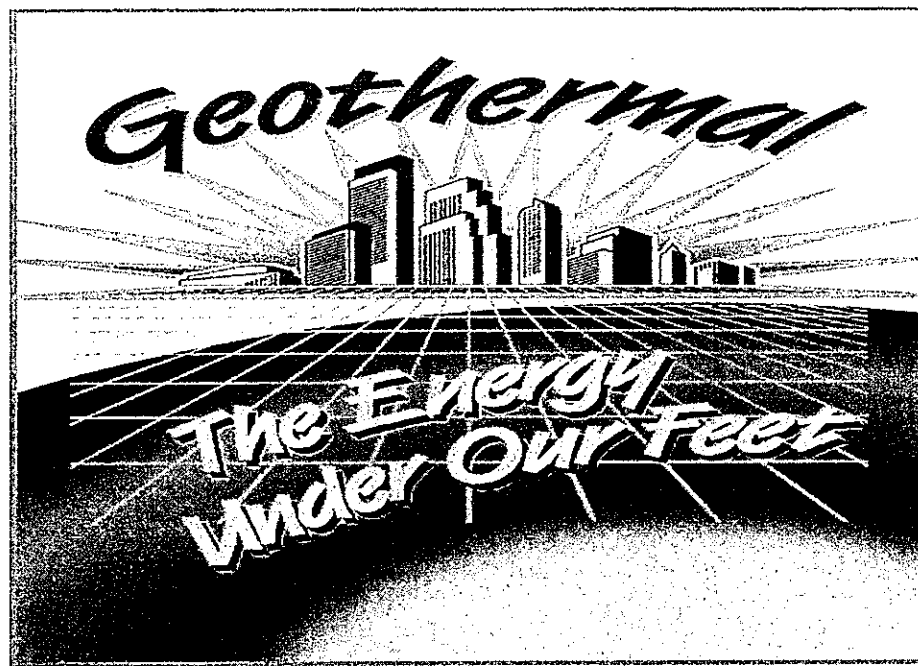
Sanjoy Banerjee, Distinguished Prof Chemical Engineering, Director of the CUNY Energy Institute at the City College of New York & Urban Electric Power Founder & Chairman
banerjee@che.ccny.cuny.edu

First let me thank the distinguished members of the committee for holding hearings on this important topic and for the opportunity to speak. My name is Sanjoy Banerjee. I'm the Director of the CUNY Energy Institute and Founder & Chairman for Urban Electric Power, both located in historical West Harlem.

When emergency strikes the city needs to be ready to provide shelter, food and electricity to citizens. As Sandy showed, storms can hit in patches seemingly randomly. The city needs to be able to adapt existing emergency facilities for shelter in advance and make available facilities with only hour's notice. These facilities need to be able to provide energy, sometimes for up to 4 or 5 days as evidenced during the aftermath of Sandy. Diesel generators can last two days before the diesel runs out and the fuel supply chain may break as we experienced during the aftermath of Sandy. There is a need for a different type of energy to ensure resiliency and self-sufficiency of NYC buildings. One that is compact and safe and can be safely stored on site or easily transported when and where needed quickly and easily. Urban Electric Power, based on research developed at the CUNY Energy Institute, has developed safe rechargeable energy storage systems that are based on rechargeable alkaline cells, like a Duracell, and will stay charged 10+ years without any risks of fire hazard. The energy storage systems can be reused several hundred times and they are very

compact for tight buildings or easy transport– in fact they hold more energy per unit volume than the batteries in our phones. For example a 1MWh system – enough to run emergency systems of a large building for one day – will take 3,000 liters or 100 cubic ft. for the batteries and auxiliary systems. The whole system can be assembled and connected to solar installations on site or can be site-sourced and transported in a small container (6 ft x 6 ft x 3 ft) and weighs less than two cars. The energy storage systems are low cost, require no maintenance, and can be safely connected in dense urban areas where needed. The storage systems are plug and play and can be used (a) as the only site source of energy for a number of days, (b) to harness the power of solar energy for daytime charging and night time use for extended use, (c) or to extend the life of diesel generators when working diesel is available. One or more of such energy storage systems, connected to the solar system of a building, can provide around-the-clock energy virtually making the globally and Urban Electric Power is installing two solar tied systems this year at a college and high school within the 5 boroughs to provide resilient solar generated power electricity.

We encourage the members of the committee to come and see our facilities in Harlem and to continue to explore these alternative solutions to the extraordinary problems that NYC faces today. Thank you again for your attention and the opportunity to speak. I'm available to answer any question the members of the committees may have.



Jack DiEnna
Executive Director
The Geothermal National & International Initiative



Geothermal National and International Initiative Inc.
1615 M. Street N.W. Suite 800 Washington DC 20036

The Road to 30%!

Why Geothermal Heat Pumps?

The US Department of Energy states, **36%** of the **primary energy** used in the US is from energy use in buildings. This is more than the energy used by the transportation industry.

AND

40% of the total energy used in a building is for space conditioning and water heating.



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Environmental Stability.

The US Environmental Protection Agency states that GHPs reduce Greenhouse Gas Emissions (the leading contributor to Climate Change) by up to **40%** over convention HVAC systems.



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Why Geothermal Heat Pumps?

At this time it is estimated that there are **two million** systems installed in the US that represents less than **2%** of the HVAC market. Although the GHP footprint is a small one, it is estimated these units have had a significant impact on energy savings and environmental issues, which are:

- Conserved** over **42 million** barrels of crude annually
- Eliminated** approximately **12 million tons of CO2** (that is the equivalence of taking **2.6 million** cars off the road or planting over **995 million** trees)



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PEAK LOAD / DEMAND REDUCTION

In a report by the National Renewable Energy Laboratory (NREL) they determined that every installed ton of GHP capacity reduced peak load by **.55 - .88 kW** so GHPs can provide a cost effective, environmentally responsible solution to a utility's "*peak load*" energy problem.

Western Farmer's Cooperative based in OK & NM, in a program that they have been running since 2013, has captured metrics that support that finding. Participating homes in their program saw the **peak demand** for their HVAC system drop by **38%** or a **reduction of .55 kW** per ton of installed capacity.



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PEAK LOAD / DEMAND REDUCTION

The Western Farmer's program also pointed to the fact that **every kW** saved equals **\$2,000** of energy generation resources that does not have to be built and that if **20%** of their customer base changed to GHPs, **one half billion dollars** of generation infrastructure would not be needed.

This would allow for a **major reduction** in the planned new generation that must be built in the coming years.



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WATER SAVINGS:

In a comparison study done on a **300 ton cooling system**
GHPs vs Water Cooled Chiller the results were dramatic...

Annual Savings:

Potable Water Savings (gals.) – **4,730,400**

Bleed Savings (gals) - 1,892,160

Water Cost Savings - \$32,106.72

Sewer Cost Savings - \$12,866.69

(based on 96 gal per Rm per day, double occupancy)




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Job Creation / Retention & Training

In an Industry study done in 2010 it was determined that a commercial project involves **22 different job classifications**.

The International Ground Source Heat Pump Association has, in partnership with the Association of Energy Engineers, ASHRAE and NATE, developed the **training and certifications** needed to ensure a strong infrastructure to support the growth of geothermal heat pumps both nationally and internationally. The logo consists of the word "GEO" in a serif font, followed by a circular emblem containing a stylized globe with latitude and longitude lines, and then the letters "NII" in the same serif font.

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Geothermal Heat Pump Technology

Kensington Capa High School, Philadelphia, PA

90,000 Sq. Ft. Closed Loop GHP Project

Brownfield Site, LEED Platinum

96 Boreholes @ 500 Ft Deep =

48,000 Drilling Ft @ \$20 /Ft = **\$960K**

Simple payback (Yrs.) 7.60 (no grants)

20 year Life Cycle Cost (GHP vs Conventional)

Construction - +\$1 M

Operating Cost /yr- -\$180K

Maintenance Cost/yr- -\$19,800

20 yr Life Cycle Cost- +\$2,632,160.00



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Geothermal Heat Pump Technology

Kensington Capa High School, Philadelphia, PA

RESULTS

School “Incidents” (crime & Violence) Dropped 66%

Truancy dropped 25%

Test Scores have Quadrupled

Graduation has gone from 30% to 67%

One Students quote: “I am poor now but I am no longer without hope.”



**Geothermal National and International Initiative Inc.
1615 M.Street N.W. Suite 800 Washington DC 20036**

The Road to 30%!

Geothermal Heat Pump Technology

50,000 sf Building w/ 1,000 sf Data Center
(in the suburbs of Phila.)

Building is **LEED Platinum** and completely geothermal.

64 Boreholes @ 500 Ft Deep – Closed Loop Vertical Bore.

260 Ton capacity – 60 Tons dedicated to the data center



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The Road to 30%!

Geothermal Heat Pump Technology

HVAC 20 Year Life Cycle Cost Analysis

Baseline HVAC System vs Geothermal HVAC System

Construction- \$1,500,000 vs \$2,000,000 = +33,3%

Operating Cost/ yr. \$201,000 vs \$119,000 = -40.8%

Maintenance Cost/yr. \$16,000 vs \$5,000 = -68.8%

20Yr Lifecycle Cost* \$6,440,00 vs \$5,280,000 = -18.0%

***7% interest for 20 years**

Simple Payback* (years) **8.62 yrs.**

***This is without taking advantage of any rebates or grants!**



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The Road to 30%!

Geothermal Heat Pump Technology

**We cannot solve our problems with
the same thinking we used when
we created them.”**

- Albert Einstein

GEO  NII

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**If you have any questions or
need further information please
contact me at 610-659-4998 or
e-mail me at [jdienna@geo-
nii.org](mailto:jdienna@geonii.org)**



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The Road to 30%!

SUMMARY OF FEASIBILITY OF GEOTHERMAL HEAT PUMP SYSTEM DEVELOPMENT IN NEW YORK CITY

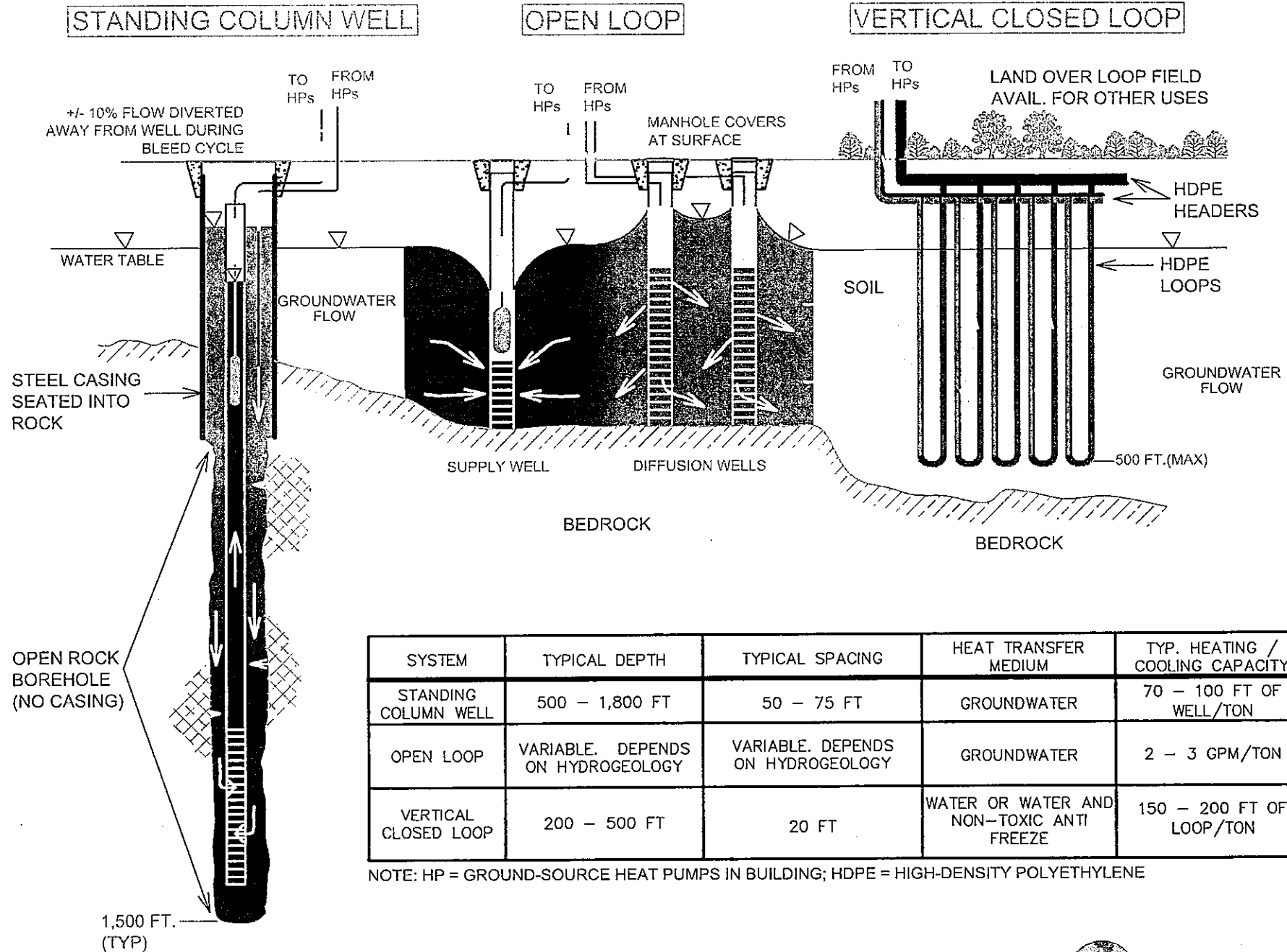
**By John Rhyner, P.G., LEED AP
P.W. Grosser Consulting
Bohemia, New York
johnr@pwgrosser.com
(631) 589-6353**

There has been a steady increase over the past 15 years in the number of buildings in New York City where geothermal energy is being used or considered for indoor heating and/or cooling. There are three main types of geothermal systems in use in the five boroughs, including open loop, vertical closed loop, and standing column wells (see illustration next page).

The primary factor that determines which types of systems are feasible is the type of geology beneath the site. The city's geology varies widely...from predominantly bedrock beneath Manhattan and the Bronx, to mostly unconsolidated sand and gravel aquifers beneath Brooklyn and Queens, to a mixture of both beneath Staten Island. A second important factor is the availability of outdoor land area to drill and install the geothermal wells or "loops" using drilling rigs. New York City's *Geothermal Heat Pump Manual*, published by the Department of Design and Construction (and co-authored by P.W. Grosser) presents the types of feasible geothermal systems by borough and geology. Going one step further, recent Columbia University graduate-level research has projected the extent of areas that are feasible based on geology combined with access for drilling and whether enough geothermal capacity is available in the ground to meet the buildings' heating and cooling demand.

This presentation will review the types of geothermal systems that are feasible based on geology in New York City and the findings of the Columbia research.

MAIN TYPES OF GEOTHERMAL HEAT EXCHANGERS



Demonstration of the Feasibility of Geothermal Sourced Thermal Grids (GSTG) to Produce Site-Sourced Energy

Presentation to the New York City Council Committee on Environmental Protection-EggGeo
20150216.docx

EggGeothermal Presentation to the New York City Council Committee on Environmental
Protection

Renewable Energy Conference

Site-Sourced and Stored Renewable Energy in New York City

February 27th, 2015, 10 a.m. to 3 p.m. at City College, Harlem

Title of Paper:

**Demonstration of the Feasibility of Geothermal Sourced Thermal Grids (GSTG) to Produce
Site-Sourced Energy**

1. Explanation of Geothermal Exchange
2. Stored Solar Energy in the Earth Related to Energy Storage or Thermal Batteries
3. Types of Geothermal Exchange Applicable to New York
4. Building Systems and Types that Produce or Absorb Energy
5. Geothermal Energy Transfer or Thermal Load Sharing (TLS) Related to Mini-Grids
6. Elimination of Combustion Heating and related CO2 emissions
7. Fresh Water Consumption by Cooling Towers and Elimination through Geothermal Sourcing
8. Wind and Storm Hardening; Elimination of Fuel Tank and Cooling Towers
9. Strengthening of City's Infrastructure and Resilience
10. Example of a Geothermal Sourced Mini-Grid
11. Recommendations
 - a. Promotion of geothermal sourced mini-grids
 - b. Legislation to encourage sale of waste-heat
12. Summary Facts/Figures
13. Reasoning for Geothermal Sourced Thermal-Grid Implementation beyond Common Thinking

Demonstration of the Feasibility of Geothermal Sourced Thermal Grids (GSTG) to Produce Site-Sourced Energy

Note: The terms "Thermal- Grid" and "Mini-Grid" are almost interchangeable. "Mini-Grid" is used to indicate smaller scale of about a city block or less.

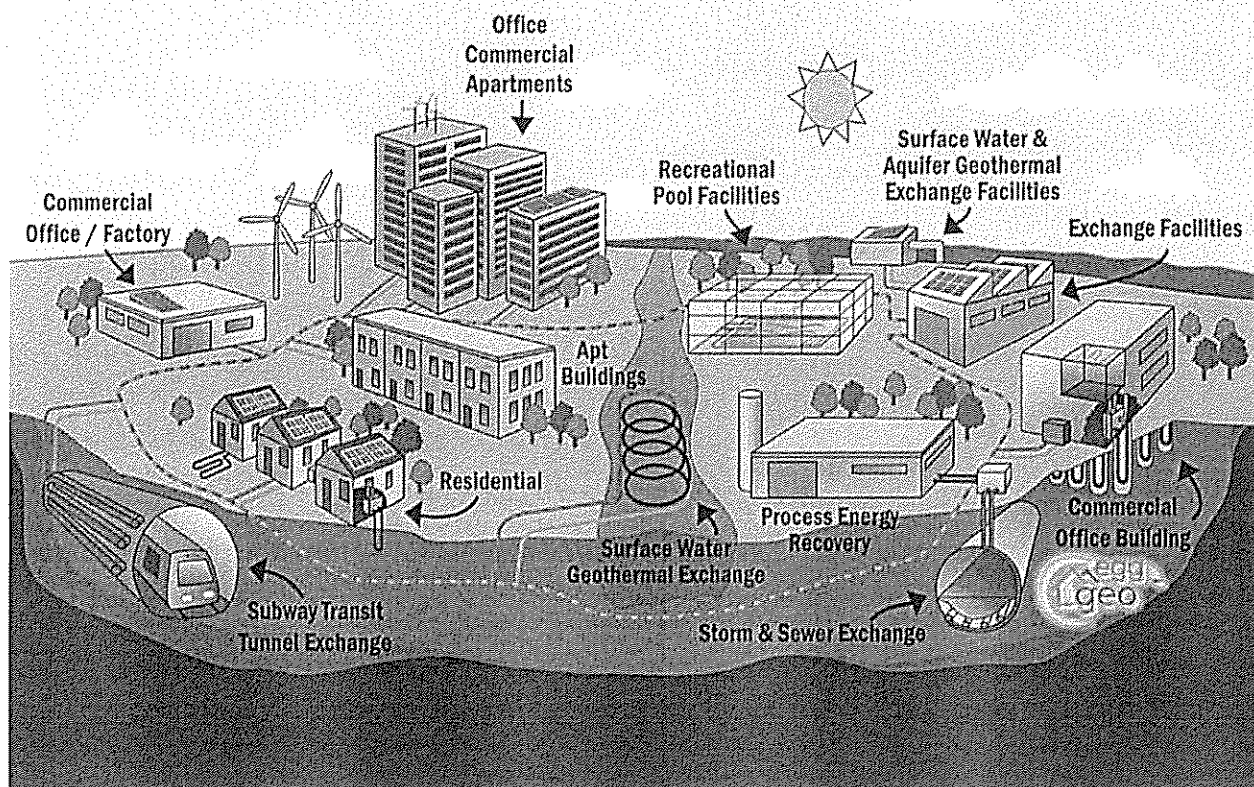


Figure 1

1. Explanation of Geothermal Exchange

The earth absorbs 50% of the energy that hits the surface, and that energy goes into the ground so that we can use it later on. Even when it's cold and wintry, that heat energy is just a few feet below the surface ready to help us heat (and cool) our cities.

Much like the way the way the roots of a tree exchange the essentials of life with their leaves and branches, a geothermal-sourced heat pump (GSHP) system provides unmatched comfort and tranquility to our buildings and occupants.

Outside, temperatures fluctuate with the changing seasons, but underground temperatures don't change nearly as much, because the earth is a solar anchored thermal collector and battery, receiving and storing energy. This is easily understood as the temperature below the ground remains relatively constant year round. A geothermal heat pump system takes advantage of these constant temperatures utilizing

Demonstration of the Feasibility of Geothermal Sourced Thermal Grids (GSTG) to Produce Site-Sourced Energy

the earth as a thermal battery to provide renewable heat energy for distribution by use of a GSHP system.

2. Stored Solar Energy in the Earth Related to Energy Storage or Thermal Batteries

The mass of the earth acts as a thermal battery, providing stored energy for use at any time and for any reason. For cooling purposes, the relatively cool temperature of the earth (47F-50F) is a superior heat sink to ambient air temperatures. In the heating mode, the temperature of the earth is significantly warmer than the temperature of the ambient air, and having absorbed and stored heat from the summer-time cooling and solar absorption providing a nearly infinite heat source.

3. Types of Geothermal Exchange Applicable to/in New York

New York geology is conducive to a few different kinds of geothermal source exchangers. Closed Loop (CL) Exchange, Standing Column Well (SCW), Ground Water (GW) Exchange, and Surface Water (SW) Exchange. Considering the economy of size and volume, each of these types of geothermal exchangers may have

advantages under differing circumstances in the City. [Figure 2]

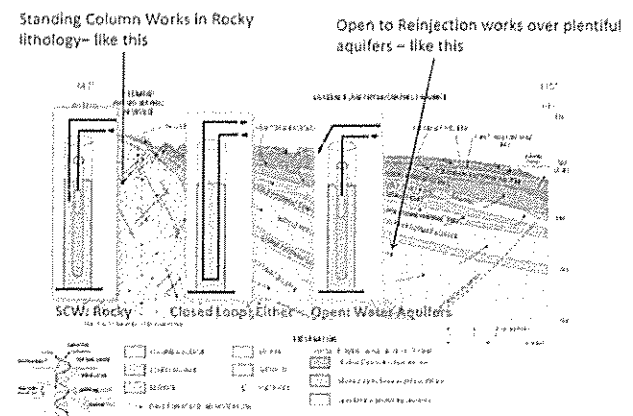


Figure 2

4. Building Systems and Types that Produce or Absorb Energy

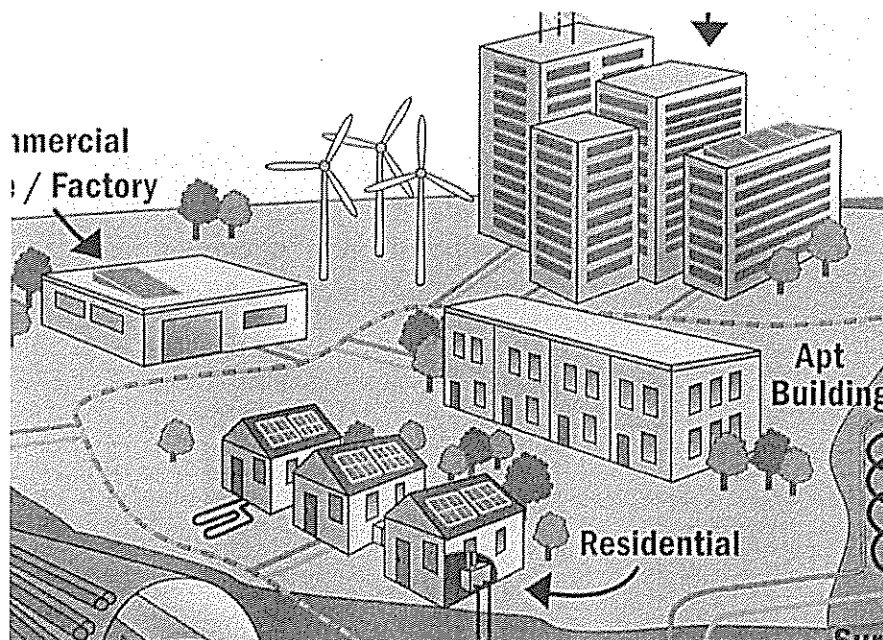


Figure 3

Buildings and systems that either use or reject heat energy are all candidates for GSTG heat exchange. Some building systems consume waste (excess) heat energy and some produce waste heat energy. These include residential, commercial and industrial HVAC. Additional systems include subways, storm water and sanitary sewer, and

Demonstration of the Feasibility of Geothermal Sourced Thermal Grids (GSTG) to Produce Site-Sourced Energy

commercial/industrial heat rejection. [Figure 3]

5. Geo-Thermal Energy Transfer or Thermal Load Sharing (TLS) Related to Mini-Grids

A single city block contains many, if not all of these opportunities for operating as a geothermal sourced thermal-grid (GSTG)[Figure 3]. Most highly populated commercial office building spaces are primarily cooling dominant. Buildings operating on the “sunny” or south facing side of the block reject heat that can be piped or rejected into the mini-grid for use by the buildings and systems in need of heat energy. Sanitary sewer discharge has considerable energy available from fixtures that are at least room temperature or warmer. Heat can be extracted from sanitary sewer discharge for use in any number of heating applications.

6. Elimination of Combustion Heating and Related CO₂ Emissions

Combustion heating is the primary producer of CO₂ from buildings [Bob Wyman’s Table 7 (Table 1 here)]. With properly engineered GSTG’s, combustion heating can be eliminated and resorted to in only the most extreme of emergency situation (i.e.: backup boilers). The benefits include enhanced safety through the elimination of flames within the buildings, elimination of combustion related CO₂ emissions, and elimination of fuel tanks.

Table 7: Fossil Fuel CO₂ Emissions Factors

Fuel Type	CO ₂ Emissions Factor (lbs/kWh) ¹
Fuel Oil (#2)	0.56
Propane and Liquid Propane	0.47
Natural Gas	0.40

¹ See: EPA *Emission Factors for Greenhouse Gas Inventories*.

Table 1

7. Fresh Water Consumption by Cooling Towers and Elimination through Geothermal Sourcing

Fresh water consumption from operation of evaporative cooling towers in NYC can be eliminated through GSTG’s. Cooling towers provide primary cooling to condenser water for air conditioners and chiller systems, but evaporative cooling towers also consume millions of gallons of fresh water each day in the City [Figure 4]. A building with 1,000,000 square feet may have a

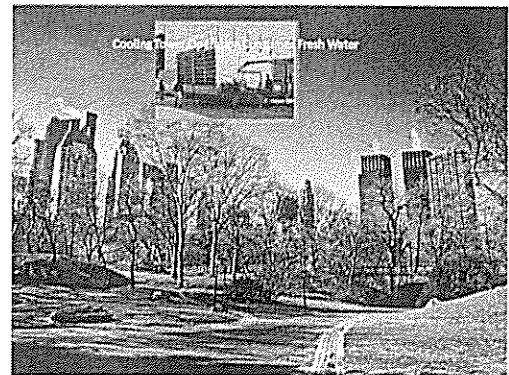


Figure 4

Demonstration of the Feasibility of Geothermal Sourced Thermal Grids (GSTG) to Produce Site-Sourced Energy

cooling capacity of about 4000 tons, and its cooling tower may consume 230,000 gallons of fresh water per day. A properly engineered geothermal sourced mini-grid will use waste heat where it's needed first, and send excess waste heat into the earth for later usage, eliminating cooling towers and related fresh water consumption [Figure 5].

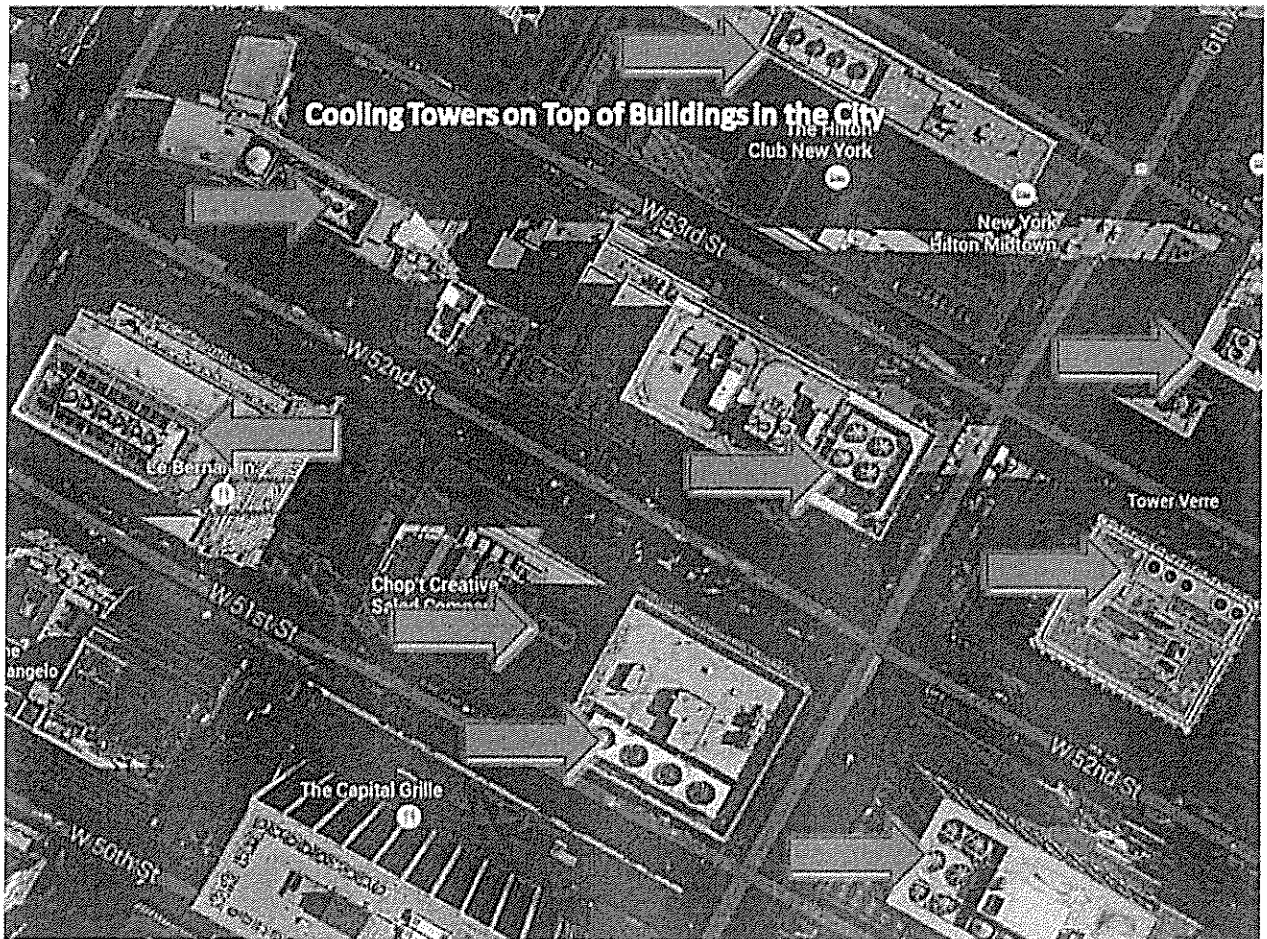


Figure 5

8. Wind and Storm Hardening; Elimination of Fuel Tank and Cooling Towers

During Hurricane Sandy, among the damage reported were building components exposed to weather, such as outside equipment like cooling towers [Figure 5]. Fuel tanks used to supply gas and oil for combustion heating were damaged as rising water caused them to be carried away. Hurricane and storm hardening can be simplified (because outside equipment can be eliminated) as it pertains to HVAC equipment through the implementation of geothermal sourced heating and cooling systems.

9. Strengthening of City's Infrastructure and Resilience

The City's infrastructure can be strengthened by implementation of geothermal sourced mini-grids and equipment life will be extended. With the elimination of outdoor HVAC

Multi-source Heat Pump Technology and Seasonal Thermal Storage

Gaylord Olson

Princeton, NJ

Jan. 22. 2015

A useful direction to consider for HVAC in the future is a more cost-effective use of existing water-to-water heat pumps. This can be accomplished in several ways:

1. Allow for source fluid to be either outdoor air, solar thermal water, or water from underground, whichever is better at any time (multi-source approach).
2. Utilize two separate regions for the underground water, one being permanently warm, and the other being permanently cold (seasonal thermal storage).
3. Use a valve and pump system which can interconnect the various fluid sources with the heat pump in many configurations (series, parallel, etc.) so an optimum flow pattern can always be used, depending on specific temperature differentials.

With the functionality described above, the heat pump will have a significantly higher coefficient of performance (COP) and efficiency than is the case for more conventional designs (which generally use the ground for only heat exchange, not heat storage). With source fluid temperatures high enough for direct hydronic floor heating, a heat pump might not be needed (or could be bypassed).

Similarly, for source fluid temperature low enough, the fluid could be sent directly to chilled beams, again avoiding or bypassing the heat pump.

Technology for some aspects of the ideas above have been developed in Europe and Canada. Seasonal storage with both hot and cold regions underground is shown in multiple projects from ICAX Limited in London, England. Combining solar thermal collection with seasonal storage underground has been shown at Drake Landing Solar Community in Alberta, Canada. The valve and pump interconnection concept mentioned above is shown in U.S. Patent Number

8726682.

Sustainable CUNY – DG HUB Overview

Site Sourced and Stored Renewable Energy Conference

Since 2006, Sustainable CUNY has led the implementation of multiple state and federal solar initiatives on behalf of NYC and NYS, built the NYC Solar Map and is in the process of building the NYS Solar Map and Portal. Tria Case, CUNY Director of Sustainability and her team determined in the aftermath of Hurricane Sandy that, while the 672 solar arrays on New York City (NYC) rooftops at that time sustained little or no damage during the storm, they were unable to supply critically needed power during the subsequent outage. New York State (NYS) now has more than 18,000 solar photovoltaic (PV) systems and is one of the fastest growing solar markets in America, yet there are few PV systems with battery storage in NYC, and NYS utilities have no process to track resilient PV systems. NY's rapidly growing PV market remains underutilized as a resilient resource due to multiple barriers to adding storage capability. Therefore, in 2013 Sustainable CUNY formed the Smart Distributed Generation (DG) Hub to strategize pathways to integrating distributed generation (DG) resources into emergency and resiliency planning and has received federal, State and City support for the DG Hub - Resilient Solar Project. This DG Hub project was developed by Sustainable CUNY in partnership with the National Renewable Energy Laboratory and Meister Consulting Group, and is supported by the U.S Department of Energy, the New York State Energy Research and Development Authority, the New York Power Authority, and over 20 stakeholders committed to the project including the NYC Mayor's Office, Consolidated Edison, National Grid, the Electric Power Research Institute, General Electric, SMA, Solar City, and more. The three-year project will create a roadmap for the integration and tracking of resilient solar systems, which can supply emergency power and provide energy storage, as well as conduct an analysis for deploying resilient PV systems on designated critical infrastructure facilities. Additionally, the Smart DG Hub will develop a calculator that will help capture the full spectrum of value streams for solar systems with battery storage, such as supplying emergency power, peak shaving, and load shifting capabilities, consequently providing decision makers with the necessary tools to make educated investments.

UGE Abstract

Site-Sourced and Stored Renewable Energy Conference – Feb 27, 2105

Abstract Submitted: January 22, 2015

Renewable energy has a bright future in New York City due to a confluence of factors. Solar, wind, and storage technology have all advanced significantly and, with economies of scale, their costs have come down significantly -- so much so that solar energy in New York is now cheaper than buying electricity from the utility. Grid infrastructure is also aging and, as evidenced during Hurricane Sandy, the centralized electricity model puts New York's reliable energy supply at risk during storms and other natural disasters. Additionally, financing structures like net metering and PPA agreements spur adoption and attract investors in the process. All of this means we have reached a tipping point, where investment in renewable energy, including wind, solar, and microgrid systems, can make New York more resilient to the impacts of climate change, while lowering carbon emissions and reducing costs for energy consumers.

Solar and wind technology have already made their mark on the five boroughs and growth is only accelerating. The Pearson Court Square in Queens and Whole Foods Market in Brooklyn are just two of the many buildings utilizing on-site wind turbines and solar energy to power their facility. UGE spearheaded these projects and, as a worldwide renewable energy developer based in NYC, we can discuss the evolution of the various technologies and their economic, environmental, and social benefits for New York City's future.



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**UGE International
Paper Submission**

Site-Sourced and Stored Renewable Energy Conference – Feb 27, 2015

Abstract Submitted: January 22, 2015

Paper Submitted: February 6, 2015

Distributed Renewable Energy: The future of energy in New York City

In the wake of Hurricane Sandy, over 7.9 million homes and business were left without power, some having to wait months for it to be restored. These businesses were inoperable without electricity, affecting not only the business owners and employees, but also the customers rallying for supplies after the storm. This sent a larger shockwave throughout the country, as the storm highlighted our dependence on the central grid. Businesses and customers alike realized that even in dire circumstances, the power needed to run their businesses was a necessity.

The solution to this problem lies in on-site renewable energy systems, also known as distributed renewable energy (DRE). These on-site systems utilize solar, wind, or hybrid components, as well as energy storage, to produce power at the site itself, and can be designed for on or off-grid use. Distributed renewable energy has caught the attention of many commercial building owners, as storm threats and the falling costs of the technology demonstrate that the benefits of distributed renewable energy extend beyond the environment.

Technology overview

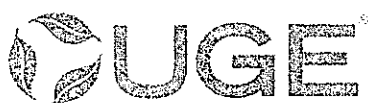
Distributed renewable energy has two main characteristics: It is produced on-site at the location where the energy is being used and it comes from renewable resources. This model is different from both conventional electric utilities (where electricity is produced at a central location and then delivered to buildings via a grid network) and from utility scale renewable energy, such as a wind or solar farm.

UGE designs energy systems that integrate vertical axis wind turbines, solar panels, battery storage, or a combination of all of these. By first understanding the energy challenge faced and then creating the system that will best solve it, numerous benefits are attained, including increased energy production, more reliable generation, and higher energy density.

Renewable resources depend heavily on their location, so correct siting and the right type of system is incredibly important for performance and energy production. UGE has advanced siting tools that help analyze the sun and wind at a given location to choose the best combination of technology.

Solar panels

Photovoltaic modules, comprised of silicon-based cells, capture the energy from the sun's light and convert it into energy. These panels are generally installed on rooftops, ground-mounted systems, or on carports in parking lots.



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Wind turbines

UGE's vertical axis wind turbines look different from the more traditional "fan" type of turbine that you see on a wind farm. These small turbines, designed to catch wind from any direction, are installed nearby or directly on the roofs of buildings, including several in New York.

Storage and Batteries

One question often asked about renewable energy: What happens when the wind's not blowing or the sun's not shining? What happens when the grid is down? The solution is often battery storage, which can capture energy so the system maintains constant uptime. Storage technology has evolved considerably, with new innovations and cost reductions making it increasingly feasible, especially for fully off-grid systems.

UGE provides flexible storage solutions depending on project size and application. Whether the system requires full site autonomy or greater resiliency from grid-outages, the right energy storage system guarantees renewable energy is always accessible.

Resiliency, Energy Storage, and Security

Since 1985, there has been a tenfold increase in the number of weather-related power outages. This number is expected to rise as weather patterns become harder to predict and more violent. While the environmental benefits of renewable energy are more widely known, the systems are now being increasingly sought after for reliability and resiliency, meaning that the building's energy is fully functional even when the surrounding power grid is down. When on-site generation is paired with a battery storage system, the system has the ability to keep the critical loads supplied even during power failures. The idea of having a guaranteed, reliable power source during natural disasters and power failures is very attractive to business owners, and DRE systems provide a secure solution. When this idea is paired with policy incentives and competitive financing options, there should be no reason to experience the kind of chaos after Sandy again.

For example, Whole Foods Market has been credited as one of the greenest companies in America. Although the company has a green history, they recently set renewable energy targets that are ambitious even for a sustainable company. These long-term goals call for a large push in energy use reduction and on-site generation, with their new Brooklyn, NY flagship location leading the way. The store has 2 EV charging stations, 19 LED off-grid streetlights designed by UGE, and a 324 kW solar array able to supply up to 30 percent of the store's total energy use. There is also a 157 kW CHP system, designed to keep the store functioning in the event of a utility grid failure. In an area hit hard by the effects of Hurricane Sandy, the push for an expansive on-site energy system was as much about sustainability and cost savings as it was about the energy security it offered. While the system does not completely power the store, it does produce enough electricity to allow it to stay open during grid disruptions. By being able to produce accessible electricity for people to use during times of utility power failure, the Brooklyn store has assumed the role as community shelter for the surrounding neighborhood.

Businesses and commercial buildings are also examining ways to increase their energy security. The NYC Development Corporation is encouraging more businesses to think ahead to



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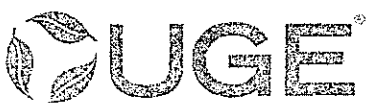
the next storm with RISE: NYC, a competition created in the wake of Hurricane Sandy. RISE is identifying new technologies to make New York businesses more resilient to the effects of future storms and climate change. The competition will offer up to \$USD 30 million in funds for suitable ideas. This marks a drastic change in the way businesses are thinking about current technologies and their application, most notably renewable energy.

As a finalist in the competition, UGE has designed a smart microgrid power solution comprised of solar photovoltaic panels (PV), vertical axis wind turbines, energy storage, a natural gas generator, and smart monitoring/control power electronics. During normal utility grid operation, the system offsets grid electricity by providing renewable energy to the grid via net metering to reduce peak grid loads and provide financial benefit to the owner. During utility service disruptions, the smart controller automatically initiates microgrid mode, in which the system disconnects from the utility grid to provide back-up power to critical building systems that have been prioritized on a separate circuit. Anti-islanding electronics isolate the grid connection from back-up power, allowing utility workers to service damaged power lines safely, and complying with existing regulations.

These solutions can alleviate many of the infrastructure difficulties that arise as a result of storms. After Superstorm Sandy, many businesses were without power. Businesses with access to diesel generators relied on them for electricity and were subject to low fuel availability and high prices. Particularly during prolonged outages, there is a risk of diesel back-up generators depleting locally available fuel, in which case businesses cannot operate. Additionally, diesel fuel has environmental impacts including depletion of finite resources, greenhouse gas emissions, noise pollution, and community health impacts. Conventional back-up power methods have disruptive shortcomings that include high cost, low energy security, and low environmental sustainability.

UGE's smart microgrid power system stores energy produced from renewable wind and solar sources in batteries, enabling critical power systems to function during utility service interruptions. When combined with a natural gas generator, these solutions guarantee that critical systems remain powered when the grid fails. Moreover, the system provides electricity to the utility grid at a fixed cost during normal grid operation, stabilizing rates, and easing generation and distribution demand on the grid. For small businesses, this means less rate volatility. The wind/solar system is carbon-neutral, as it does not rely on energy produced by fossil fuels, and the natural gas generators are only used in the rare case of a prolonged period of no wind and no sun. The smart microgrid power system solves critical power issues at the nexus of energy cost, sustainability, and energy security.

In 2013, Siemens released a report from their Infrastructure and Cities committee that talked about the importance of resilient infrastructure, with special attention given to the NYC metropolitan area. "We can't prevent natural disasters, but with our knowledge and our technologies we can better protect our infrastructures. Resilient infrastructure is not an option but a must!" said Ronald Busch, CEO of Siemens' infrastructure and Cities Sector. The report highlighted that repairing infrastructure without considering resiliency measures is extremely cost-intensive. However, development into resilient solutions not only protects against future damage, but is often more cost-efficient, energy-efficient, and reliable. With the frequency of natural disasters expected to keep increasing, the need for investment in resilient infrastructure



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is going to be ever more important. This thinking marks a drastic change in the way businesses are thinking about current technologies and their application, most notably renewable energy.

Cost and Policy

The market for distributed renewable energy has been growing rapidly in recent years, largely due to the lower costs in the technology being paired with rising costs in traditional fossil fuels. Last year marked the fourth straight year that renewables outpaced fossil fuels in terms of net investment in power capacity additions, with over USD 249.4 billion invested. As the market and surrounding industry for DRE expands, economies of scale have begun to form around them. Their costs have come down significantly -- so much so that solar energy in New York is now cheaper than buying electricity from the utility. The decrease in cost, paired with aggressive policy incentives and financing options has spurred a strong interest from residential and commercial clients looking for a high ROI.

In Long Island City, Queens, UGE installed three VisionAIR5 turbines on top of a newly-built apartment building in Pearson Square Court. Producing 9.6 kilowatts, the turbines produce power that offsets the common areas in the building, including the lobby, hallways, gym, and roof lounge.

At 388 Bridge Street, a 590-foot apartment complex in downtown Brooklyn, UGE 4-K's can be seen spinning atop the building, visible from the Long Island Expressway and surrounding streets. At several schools around the area, UGE wind turbines provide students with energy as well as an educational tool to help them learn about the importance of sustainability.

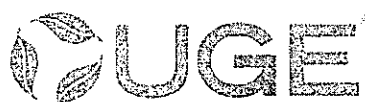
Before these installations were set in motion, UGE conducted a site analysis to determine which renewable energy solutions would generate the optimal amount of electricity. The evaluation measured the site's surroundings and how solar and wind resources would impact energy generation. For example, both the Pearson and 388 Bridge Street sites have unobstructed locations for the turbines to gain maximum winds.

The market for renewable energy is exponentially growing in New York and around the world. The systems are getting smarter, more cost competitive, and the demand for clean energy in urban areas is rising.

Financing

Creating new financing structures is an important piece of the renewable energy puzzle, as the upfront cost of the system is usually the largest barrier to implementation. The most credited finance method for the growth of DRE is the power purchasing agreement (PPA). These contracts allow clients to receive a renewable energy system at little to no cost, other than offering the available space to the developer. The client receives a low, fixed-rate for the electricity, while the developer then sells any excess electricity back into the grid. Both residential and commercial clients use this model to secure long-term, low-rate electricity.

Many companies involved in renewable energy technology are also pushing for the support of policy to bolster the DRE market, such as a restructured production tax credit for renewable energies. This would provide an incentive by compensating companies for the



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development of RET. Lowering the cost of development; such policies incite rapid growth and expansion in the industry. Between 2007 and 2012, wind capacity more than tripled to USD 18 billion annually with help from a PTC for wind energy. Policies such as PTC, PPA, and feed-in tariffs help commercial clients make easier decisions about RET by eliminating most of, if not all of the financial risk.

Investment

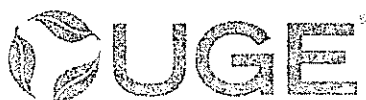
Citizens of the 21st century are much more aware of the world around them, and care about how their governments and companies act within that world. Building tenants are increasingly sustainability-minded and demand this same awareness from the companies they endorse. Many businesses and governments are looking to the future, and have set renewable energy targets, LEED building goals, and other sustainability objectives. Renewable resources - wind, water power, solar, geothermal and biomass - already provide nearly 11 percent of the energy that New Yorkers use for transportation, space heating, industrial processes and electric power, according to NYSERDA and the federal Department of Energy.

UGE's solutions help achieve this goal -- and they're innovative because they decrease small businesses' operating expenses, while simultaneously decreasing the businesses' carbon dioxide emissions and their associated costs to society. It is widely accepted that carbon dioxide (CO₂) emissions impose costs on society. Emissions contribute to global warming and negatively affect the health and well-being of communities. The Economics for Equity and the Environment Network estimates that the social cost of CO₂ ranges from \$28 to \$893 per metric ton.

What's Next

The outlook for renewable energy in New York City is bright as the right policies, technology, and public awareness converge. Distributed renewable energy is the fastest growing source of energy worldwide, and with New Yorkers facing some of the highest electricity prices in the country, solar and wind already provide a competitive alternative that is not only less expensive, but more reliable and 100% carbon free.

New York is one of the leaders in transitioning to renewable energy, with Reforming the Energy Vision policies intended to fundamentally change utility regulation to support a more distributed, consumer-oriented energy system. The solar market alone has also created roughly 5,000 jobs in New York. These changes will undoubtedly lead to greater adoption and new technological innovation, meaning that the next time a natural disaster strikes, buildings across the city will be much better prepared, to the benefit of businesses and, most importantly, the people who depend on them.



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Fact Sheet
Sims Municipal Recycling (SMR)
Sunset Park Material Recovery Facility (MRF)
Wind Turbine

Sims Municipal Recycling (SMR) commissioned New York City's first commercial-scale wind turbine to generate electricity for the Sunset Park MRF, which is the central processing plant for all of New York City's curbside recyclables. The 100kW wind turbine is located on the 30th Street Pier in Sunset Park, Brooklyn, and takes advantage of the waterfront's naturally windy location.

Key Facts

- The wind turbine was manufactured by Northern Power Systems and installed by Aegis Renewable Energy in 2014.
- The wind turbine has a capacity of 100kW. Commercial-scale turbines are considered to be between 25kW and 500kW. All other wind turbines in New York City are residential scale (generally less than 1kW). Industrial-scale turbines, normally used in wind farms, are much larger, ranging from 500kW to 3,000kW.
- The turbine's rotor hub is approximately 120 feet above the ground level; with the blades, the turbine is nearly 160 feet tall.
- The capital cost was approximately \$750,000, and the turbine will pay for itself in about 5 years, depending on wind and electricity costs.
- The permitting process for the turbine began four years ago. Installation of the foundation and erection of the tower and turbine took approximately one month last fall.
- The wind turbine will provide up to 4 percent of the energy consumed by the MRF. Between the wind turbine and the 600kW solar array, the MRF now produces up to 20 percent of its electricity requirement from renewables.

About Northern Power Systems Corp.

Founded in 1974, Northern Power Systems designs, manufactures, and sells wind turbines and power technology products, and provides engineering development services and technology licenses for energy applications. Northern Power Systems has installed more than 425 operational turbines worldwide with more than 6 million operational hours and continues plans for aggressive growth and development. With headquarters in Barre, Vermont, and additional offices in Europe, Northern Power Systems provides customers with clean, cost-effective, and reliable renewable energy on a global scale.

About Aegis Renewable Energy

Aegis Renewable Energy offers full-service community-scale renewable energy solutions for farms, businesses, non-profits, and municipalities. Wind, Solar and Anaerobic Digesters (cow manure and food waste) are included in Aegis' services, designed to help clients save money and the planet. Aegis Renewable Energy is located in Waitsfield, Vermont, and provides cost-evaluation, permitting, and financing support; installation; and maintenance services throughout New England.

Fact Sheet
Sims Municipal Recycling
Sunset Park Material Recovery Facility (MRF)

Opened in December 2013, the Sunset Park MRF serves as the principal processing facility for all of New York City's curbside metal, glass and plastic recyclables as part of a long-term contract between Sims Municipal Recycling (SMR) and the New York City Department of Sanitation (DSNY). SMR is a division of Sims Metal Management Limited, a global scrap-metal and electronics recycling company.

Key Facts

- The Sunset Park MRF processes more than 15,000 tons a month of metal, glass and plastic collected by the Department of Sanitation.
- The Sunset Park MRF is a central element of PlaNYC 2030 to develop sustainable waste management in New York City.
- The contract between SMR and DSNY, which includes the Sunset Park MRF as well as SMR facilities in the Bronx, Queens and Jersey City, will ensure environmentally sound and cost-effective municipal recycling for New York City for up to 40 years.
- The Sunset Park MRF is a joint project between SMR, DSNY, the Department of Small Business Services (SBS) and the New York City Economic Development Corporation (EDC). The parties have invested more than \$110 million in the development of the facility.
- The facility represents major new industrial development on Brooklyn's working waterfront, creating jobs for approximately 85 full-time employees.
- The facility is situated on an 11-acre city-owned pier in the South Brooklyn Marine Terminal in Sunset Park, Brooklyn — the former site of an NYPD impoundment lot.
- The Sunset Park MRF is accessible by barge, rail and truck. Most of the inbound material arrives by barge from SMR facilities in Queens and the Bronx, with material from Brooklyn arriving directly in DSNY collection trucks. Most of the material leaves by barge and rail.
- The Sunset Park MRF removes an estimated 240,000 DSNY collection truck miles per year from city roadways — reducing congestion, fuel consumption and vehicle emissions.
- New York City's first commercial-scale wind turbine was installed on site in fall 2014. The 100kW turbine will provide up to 4 percent of the energy consumed by the MRF.

- The facility is home to one of New York City's largest solar power installations (600kW).
- The on-site wind turbine and solar panel array enable the MRF to produce up to 20 percent of its electricity requirement from renewable sources.
- Stormwater is managed on site, with a gravity-fed stormwater system based on landscape features, bioswales and a retention pond.
- To mitigate the effects of dredging, the City constructed three artificial reefs at the end of the pier to create intertidal habitat for marine and bird life.
- SMR installed 190 linear feet of "fuzzy rope" nets on the back side of the barge mooring pier to cultivate mussels to filter harbor water and support marine life.
- Recycled glass and crushed rock from the Second Avenue subway construction were used to elevate portions of the site by four feet, including all buildings, high-voltage electrical gear, scales and recycling equipment. As a result, these structures remain above the new FEMA 100-year flood maps and all buildings and equipment remained dry during Hurricane Sandy.
- A heavily utilized Recycling Education Center features educational programming with classrooms, theater, interactive exhibits and viewing of recycling operations.
- Designed by Selldorf Architects, the facility won the 2009 Award for Excellence in Design from the NYC Public Design Commission and has been widely recognized in the design community (e.g., *The New York Times*, *Architectural Record* and *the American Institute of Architects*).
- In 2014, the Sunset Park MRF was awarded the first-ever "WEDG-certified" designation from the Metropolitan Waterfront Alliance's Waterfront Edge Design Guidelines (WEDG) Program.

Fact Sheet
Sims Municipal Recycling
Sunset Park Material Recovery Facility (MRF)
Solar Power Installation

The Sunset Park Material Recovery Facility (MRF) is home to one of New York City's largest photovoltaic (solar power) installations. At the time of its fall 2013 installation, the array was the largest in the City. The 600kW system is approximately 60,000 square feet and is located on the roof of the MRF's "tipping" building, which is where trucks and barges deliver the New York City municipal curbside recyclables to be sorted and processed.

Key Facts

- The solar array consists of 2,112 domestically manufactured 280W panels, spanning more than 60,000 square feet.
- The system was designed, installed and commissioned by Brooklyn-based Solar Energy Systems LLC.
- Since commissioning, the 600kW system has produced more than 732,000kWh of electricity.
- The solar array generates up to 17 percent of the energy needed to run the MRF. Combined with the new wind turbine, the MRF now produces up to 20 percent of its electricity requirements on site from renewable sources.
- The Brooklyn solar installation and wind turbine join the Sims Metal Management 750kW solar array installed at the company's Jersey City location. To date, Sims has installed more than 1,450kW of renewable energy capacity in the New York City/ Northern New Jersey area.

About Solar Energy Systems, LLC (SES)

Founded in 1998, the SES base for operations, management and design is headquartered in Brooklyn, New York. As one of the Northeast's leading full-service integrators of commercial solar power systems, SES specializes in delivering turnkey, cost-effective and reliable solar energy solutions to a diverse range of clients in government, private business, and the non-profit sector.

Sims Metal Management Our Commitment to Sustainability

As the world's largest publicly listed metals and electronics recycler, Sims Metal Management Limited (Sims) is committed to the environment, sustainability and the health of the communities in which it operates. Sims works toward progressive recycling solutions and processes to reduce energy requirements, water usage and waste generation.

With its newly built 100kW wind turbine and its 600kW solar array, the Sunset Park Material Recovery Facility (MRF) is an impressive example of local organizations and community leaders coming together to support progressive urban infrastructure. The facility's green design and innovative features make it a strong example of Sims' sustainability efforts.

"Sims works to be a global leader in corporate sustainability, seeking to set industry standards for economic and environmental sustainability," said Galdino Claro, CEO and Managing Director of Sims Metal Management.

In Fiscal Year 2014, Sims recycled 11.9 million tons of metal-bearing material worldwide and, by replacing virgin materials as feedstock for steel mills, it resulted in the reduced need for 13.5 MWh of energy, translating into the reduced emission of 12.8 million tons of CO₂ in the production of steel mill feedstock. Across the group's global operations, Sims reduced energy usage by up to 6 percent and CO₂ emissions by up to 4 percent compared with the prior fiscal year.

At Sims, transparency in its sustainability program is paramount. Energy use, CO₂ emissions, water consumption, waste generation and other metrics are publicly reported in accordance with the Global Reporting Initiative (GRI), one of the world's most widely used standard for sustainability reporting.

Recently built solar arrays at the Sunset Park MRF in Brooklyn (600kW) and the Claremont Terminal recycling facility in Jersey City (750kW) generated more than 500MWh and 200MWh of electricity, respectively, in Fiscal Year 2014. The Sunset Park MRF's arrays provide up to 17 percent of the facility's energy requirements. The new wind turbine is Sims' first foray into wind energy and is expected to generate up to 4 percent of the MRF's energy needs, helping lessen the facility's reliance on non-renewable energy sources.

Sims seeks to cultivate strong partnerships with government entities, local communities, NGOs and non-profits. Community engagement is encouraged and conducted through outreach programs and activities, such as Sims Recycling Solutions' Guinness World Record-breaking Earth Day take-back of more than 250,000 pounds of e-waste.

Sims is listed in the Dow Jones Sustainability Index and has participated in the Carbon Disclosure Project for nine consecutive years. Sims was named a Global 100 Most Sustainable Corporation at the World Economic Forum in Davos, Switzerland, for five years, with a top ranking of 11.

About Sims Metal Management

Sims Metal Management Limited is an Australian-domiciled publicly traded corporation with nearly 100 years of recycling experience. With more than 100 facilities across the United States alone, including those of its joint ventures, Sims Metal Management Limited is the world's largest publicly listed metals and electronics recycler. In addition to growing its business internationally, Sims Metal Management advocates for innovative recycling solutions and is committed to the environment, sustainability and health of the communities in which it does business.

NYC'S FIRST COMMERCIAL-SCALE WIND TURBINE COMES TO BROOKLYN

- *Sunset Park municipal recycling facility pioneers renewable wind-energy production in NYC;*
- *At nearly 160 feet tall, the wind turbine is a beacon for renewable energy and sustainable innovation;*
- *The 100kW wind turbine will generate up to 4% of the electricity consumed by NYC's primary facility for processing of residential curbside recyclables.*

BROOKLYN, NY (January 14, 2015) – New York City's first commercial-scale wind turbine was officially unveiled today. The turbine, which is far and away the City's largest, was erected on the Brooklyn waterfront at the Sunset Park Material Recovery Facility (MRF) on the 30th Street Pier, where it now stands as a proud addition to the borough's skyline.

Sims Metal Management (Sims) and its Sims Municipal Recycling (SMR) division were joined by local officials, community leaders and members of the environmental community to welcome the wind turbine at a morning ribbon-cutting ceremony at the MRF. After several weeks of testing, the turbine is fully operational, harnessing wind energy to help power the recycling processes at the facility.

The largest of its kind in the nation, the SMR Sunset Park MRF serves as the principal sorting and separation center for New York City's residential curbside metal, glass and plastic recyclables. A central element of PlaNYC 2030 for a "greener, greater New York," the recycling facility is part of a long-term contract between SMR and the New York City Department of Sanitation. The contract, which includes additional SMR facilities in the area, ensures sustainable and cost-effective recyclables management for New York City for up to 40 years.

The permitting process for the state-of-the-art wind turbine began four years ago. The 120-foot-tall tower (nearly 160 feet including the blades) was installed last fall. The pier's naturally windy location is an ideal spot for the turbine, which overlooks the MRF and its Recycling Education Center. The capital cost was approximately \$750,000, and the turbine will pay for itself in about 5 years, depending on wind and electricity costs. The turbine, made by Vermont-based Northern Power Systems, is expected to generate up to 4 percent of the energy required to run the MRF, or the equivalent of powering the site's Administrative Building and Education Center. Combined with the photovoltaic (solar power) installation on the roof of the "tipping" building, where trucks and barges deliver material to be sorted and processed, up to 20 percent of the MRF's energy will be generated on site from renewable sources.

"Sims is incredibly proud of the innovative practices implemented at the Sunset Park MRF – and the new wind turbine is certainly a part of that," said Galdino Claro, CEO and Managing Director of Sims Metal Management. "We are the world's largest publicly listed metals and electronics recycler, and through our activities at hundreds of locations around the globe we are committed to being both a local and global leader in sustainability."

Large-scale wind turbines (producing electricity) are not new, with more and more wind farms cropping up in Europe and across the US. And windmills are not new to New York City — the Dutch of New Amsterdam used them to grind grain and pump water, and a windmill is prominent on the City's flag. But modern wind turbines for energy production have been slow to come to NYC. Some small turbines have been mounted on rooftops of residential high-rises, while other notable examples of residential-scale turbines include those at the Brooklyn Navy Yard and the Gowanus Whole Foods. (Residential-scale turbines range up to 25kW;

commercial-scale turbines range between 25kW and 500kW; and industrial-scale turbines, normally used in wind farms, range between 500kW and 3,000kW.)

"As a recycling company, sustainability is central to our mission, and in Brooklyn, we saw the opportunity to advance that agenda in new ways," said Tom Outerbridge, General Manager of Sims Municipal Recycling. "The wind turbine, combined with the solar array, enables the facility to decrease its non-renewable energy consumption substantially."

"Northern Power Systems would like to congratulate the entire Sims team for reaching this impressive energy sustainability milestone, paying dividends forward for decades," said Trevor Atkinson, Sales and Business Development Manager at Northern Power Systems. "We are delighted to have this new installation join our growing global fleet."

The 11-acre facility is located in the South Brooklyn Marine Terminal. The facility, designed by Selldorf Architects, was built to optimize environmental performance and opened in December 2013. The facility won the 2009 Award for Excellence in Design from the NYC Public Design Commission. The Recycling Education Center is open for school groups as well as tours for other organizations and visitors.

About Sims Metal Management

Sims Metal Management Limited is an Australian-domiciled publicly traded corporation with nearly 100 years of recycling experience. With more than 100 facilities across the United States alone, including those of its joint ventures, Sims Metal Management Limited is the world's largest publicly listed metals and electronics recycler. In addition to growing its business internationally, Sims Metal Management advocates for innovative recycling solutions and is committed to the environment, sustainability and health of the communities in which it does business.

Cautionary Statements Regarding Forward-Looking Information

This release may contain forward-looking statements, including statements about Sims Metal Management's financial condition, results of operations, earnings outlook and prospects. Forward-looking statements are typically identified by words such as "plan," "believe," "expect," "anticipate," "intend," "outlook," "estimate," "forecast," "project" and other similar words and expressions.

These forward-looking statements involve certain risks and uncertainties. Our ability to predict results or the actual effects of our plans and strategies is subject to inherent uncertainty. Factors that may cause actual results or earnings to differ materially from these forward-looking statements include those discussed and identified in filings we make with the Australian Securities Exchange and the United States Securities and Exchange Commission ("SEC"), including the risk factors described in the Company's Annual Report on Form 20-F, which we filed with the SEC on 16 October 2013.

Because these forward-looking statements are subject to assumptions and uncertainties, actual results may differ materially from those expressed or implied by these forward-looking statements. You are cautioned not to place undue reliance on these statements, which speak only as of the date of this release.

All subsequent written and oral forward-looking statements concerning the matters addressed in this release and attributable to us or any person acting on our behalf are expressly qualified in their entirety by the cautionary statements contained or referred to in this release. Except to the extent required by applicable law or regulation, we undertake no obligation to update these forward-looking statements to reflect events or circumstances after the date of this release.

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BlocPower: Make Clean Energy & Energy Efficiency Widely Available

Solar and energy efficiency improvements are becoming commonplace in large, modern commercial buildings. But they are still the exception in smaller, older buildings. As a result, many of the cost advantages of the efficient and renewable energy bypass the buildings and people who need it the most.

BlocPower is changing that.

Founded in December 2012, BlocPower is a Brooklyn-based clean tech startup that focuses on organizing portfolios of houses of worship, small businesses, non-profits, multi-family, and other light commercial properties in financially underserved communities in order to market and finance the installation of solar and energy efficiency upgrades.

BlocPower creates micro-portfolios, or “blocs”, of shovel-ready, clean energy projects and connects them to investors seeking social, environmental, and financial returns via an online marketplace. The company focuses on leveraging trends in 3rd party solar, crowdsourcing, “impact” investing, and microfinance to solve the upfront project finance and access to capital challenges that traditionally prevent small businesses, non-profits, and multi-family homeowners in underserved communities from accessing the savings generated through clean energy retrofits.

Aggregating the demand for retrofits allows BlocPower to negotiate the hiring of local unemployed residents to perform installations, which creates significant social value in underemployed communities. BlocPower aims to cut energy costs by a minimum of 20% for the property owners who live and work in the least efficient, oldest, and highest energy intensity buildings in New York City.

The company follows a rigorous process. Once they have identified a bloc of potential retrofits, they analyze the credit worthiness of each customer, perform engineering analyses and aggregate construction quotes for the proper types and mix of efficiency and solar improvements. Each “Bloc” spreads out the risk of default, creates pricing discounts, and increases transactional size--improving the economic feasibility of installing solar and energy efficiency technology in all projects.

BlocPower is the recipient of a \$2.1 million investment from the Department of Energy, in addition to matching services and capital from NYSERDA, Emerald Cities, and Silicon Valley investors such as Andreessen Horowitz, and Kapor Capital. In the past 12 months, the company has assisted several dozen clients representing hundreds of buildings in New York City, including small businesses, houses of worship, and educational institutions.

BlocPower was requested to advise the Office of The Mayor of the City of New York on increasing retrofit volume among sub-50,000 square foot properties in New York City. Earlier this year, BlocPower was selected as a White House Champion of Change.

LISA DICAPRIO, ABSTRACT

2/27 CITY COUNCIL COMMITTEE ON ENVIRONMENTAL PROTECTION
HEARING ON SITE-SOURCED AND STORED RENEWABLE ENERGY

My testimony for the general public portion of the hearing will focus on the policy measures and financial incentives that will facilitate the realization of NYC's renewable energy potential.

For example, the NYC Solar Map identifies 650,000 rooftops with solar potential that could generate 5,847 MW which would provide 49% of peak usage and 14% of NYC's overall electricity consumption. However, there are now only 2,000 solar installations in NYC that generate 35.7 MW of electricity. The lack of sufficient financial incentives is a key obstacle to the expansion of rooftop distributive solar in NYC.

Similarly, with regard to heating and cooling, there are several fossil free options, such as air heat pumps, geothermal, and biodiesel as well as solar thermal for heating water. However, they are not sufficiently incentivized. By contrast, the incentives for buildings to convert from #6 or #4 heating oil to natural gas are expanding NYC's natural gas infrastructure, which is increasing the market for fracked gas.

By providing specific recommendations for increasing renewable energy in NYC, I will contribute to the discussion about how we can meet NYC's new goal of reducing greenhouse gas emissions by 80% by 2050.

LISA DICAPRIO, February 27, 2015

CITY COUNCIL COMMITTEE ON ENVIRONMENTAL PROTECTION
HEARING ON SITE-SOURCED AND STORED RENEWABLE ENERGY

Thank you for the opportunity to speak today. I am a professor of Social Sciences at NYU and a member of several environmental organizations, including 350NYC.

My testimony concerns NYC and New York State policy measures and financial incentives that can facilitate the realization of NYC's renewable energy potential. I will focus on solar photovoltaics and various options for heating and cooling.

INCREASING DISTRIBUTIVE SOLAR PHOTOVOLTAIC INSTALLATIONS:

The NYC Solar Map identifies 650,000 rooftops with solar potential that could generate 5,847 MW of electricity which would provide 49% of peak usage and 14% of NYC's overall electricity consumption. However, there are now only 2,000 solar installations in NYC that generate a total of 35.7 MW of electricity.¹

On a national average, solar is twice as expensive in the U.S. as in Germany, mainly because of differences in permitting, financing, and the market scale of solar installations.

Currently, there are two kinds of financial incentives for solar in NYC: (1) the NYC solar property tax abatement and federal and state tax incentives for the cost of purchasing and installing solar panels and (2) net metering that provides generators of grid-connected solar power with a credit on their utility bill for generating more electricity than they consume.²

However, net metering is less effective than a Feed-in-Tariff which requires utility companies to purchase grid-connected electricity generated by solar or wind based on long-term contracts with a guaranteed, public price. This has proven to be the most effective means for accelerating the installation of renewable energy. Over 90% of solar power in the world is compensated for with a Feed-in-Tariff. In the U.S., Feed-in-Tariffs have been implemented by state legislatures, LIPA on Long Island, and several cities.³

We can also explore incentives for the construction of solar canopies on rooftops and in parking lots that have solar potential. On rooftops, canopies can increase the amount of space allowable for solar panels. In parking lots, canopies do not reduce the amount of parking spaces and can also provide charging stations for electrical vehicles. For example, according to SunEdison which installed a 306 kW solar canopy in the parking lot of the Whole Foods Market in Gowanus Canal in 2013, the solar array will "offset

over 7 million pounds of Carbon Dioxide during its expected 30-year lifetime. This is equivalent to taking over 650 cars off the road for a year, switching 80,000 incandescent bulbs to CFLs, or planting 80 acres of forest.”⁴

HEATING AND COOLING:

New measures are also required to promote more sustainable methods for heating and cooling buildings which are responsible for 71% of all greenhouse gas emissions in NYC.

Boiler conversions are now being carried out to achieve compliance with the heating oil rules announced by the Bloomberg Administration in April 2011 as an update to PlaNYC. These rules mandate the conversion of boilers burning #6 oil and #4 oil to #2 heating oil, a combination of #2 heating oil and biodiesel, 100% biodiesel, or natural gas. No new Certificates of Operations are being issued for #6 heating oil. The deadline for #4 oil conversions is January 1, 2030.

The incentives for natural gas conversions are expanding NYC’s natural gas infrastructure and increasing the market for fracked gas. Throughout NYC, building owners are accepting offers by Con Edison to cluster in order to allow Con Edison to build out new pipelines from the gas main to several buildings in close proximity. These offers require buildings to sign a five year contract for “firm gas” which means that buildings do not have the option to burn oil during this time. Once building owners commit to all of the expenses related to a natural gas conversion, it is unlikely that they will consider other options.

The alternatives are biodiesel for heating and geothermal and air-source heat pumps for both heating and cooling.

Biodiesel requires the least up front costs and can be used as a fuel in boilers, either blended with heating oil or as 100% biodiesel.

To promote biodiesel, we can explore:

- Possibilities for increasing the financial incentives for biodiesel which now consist of a New York State one cent tax credit for biodiesel up to 20 gallons or B20. For example, does NYC have the legal authority to implement a one or two cent NYC tax credit for biodiesel up to 20 gallons?
- Measures to expand compliance with the NYC law requiring the recycling of restaurant oil that is used to produce biodiesel.
- A pilot project for the collection of cooking oil from large apartment buildings beginning with the buildings that are already participating in pilot projects for composting.

The feasibility and cost of geothermal is site specific and must be determined by a geological survey.

Air-source heat pumps use electricity and are appropriate for single unit housing and apartment buildings. While popular in many regions of the world, they are less well-known in the U.S. This technology comprises an indoor air handling unit, an outdoor compressor/condenser, and a conduit that houses key components, such as the power cable and refrigerant tubing, that is connected to the two units. According to a Department of Energy website, "When properly installed, an air-source heat pump can deliver one-and-a-half to three times more heat energy to a home than the electrical energy it consumes. This is possible because a heat pump moves heat rather than converting it from a fuel like combustion heating systems do."⁵

By combining geothermal or air-source heat pumps with green power purchasing, a building can obtain all of its electricity, heating and cooling from renewable energy sources.

PUBLIC EDUCATION AND OUTREACH:

However, even with the most innovative technologies, financial incentives, and policy measures, we will not actualize NYC's renewable energy potential without a systematic, city-wide public education campaign.

First, the Committee on Environmental Protection could organize a hearing like this one on an annual basis. In addition, we can:

- Mandate the DEP to provide information about energy conservation, efficiency, and renewable energy in the water bills that it sends to all building owners. This will ensure that all owners are informed about the fossil fuel free options for electricity and heating and cooling.
- Call on our elected officials to create a green page on their websites with information about energy conservation, efficiency, and renewable energy.
- Encourage our City Council representatives to call Town Hall meetings in their districts on a regular basis that would include presentations on biodiesel, solar power, geothermal, and air-source heat pumps.
- Encourage all of our elected officials to widely distribute summaries of the recently released York City Panel on Climate Change 2015 report which provides projections for increases in mean annual temperatures and precipitation, sea level rise, and coastal flooding. According to this report, by 2050, annual temperatures could increase between 4.1 and 5.7 degrees, mean annual precipitation by 4 to 11%, and the sea level could rise between 11 to 21 inches.⁶
- Launch a public education campaign about climate change, sustainability, and resiliency that will include public service announcements, brochures to be

distributed in the offices of all elected officials, all appropriate government agencies, libraries, and community centers.

- Establish a sustainability information center in City Hall to provide the general public with resources about energy conservation, efficiency, and renewable energy.

All New Yorkers must be informed about the individual and collective actions that we can and must take to end our current reliance on all fossil fuels and transition as quickly as possible to a new, green economy. We are all responsible for the future of our city.

NOTES:

¹ See the NYC Solar Map: www.nycsolarmap.com

² The NYC solar property tax abatement is for 20% of expenditures over 4 years and 5% each year for a maximum of \$62,500. This property tax abatement will expire on January 1, 2017. See: <http://open.nysenate.gov/legislation/bill/S7464A-2013>

³ In 2009, Gainesville, Florida became the first U.S. city to implement a solar Feed-in-Tariff. In Germany, Feed-in-Tariffs were first implemented in municipalities and then legislated at the national level. See: <http://cleantechnica.com/2012/04/12/los-angeles-solar-feed-in-tariff>. For more information about solar power and Feed-in-Tariffs, see the website of the New York Solar Energy Society (NYSES): <http://nyses.org/Main/AboutNYSES>

⁴ See http://www.sunedison.com/sites/default/files/uploads/resources/whole_foods_fnl%20%28s%29.pdf For the location of parking lots in NYC, see the NYC Department of City Planning website on parking facilities in NYC: <http://www.nyc.gov/html/dcp/html/parking/pidpindex.shtml>

⁵ For information on air-source heat pumps, see: <http://energy.gov/energysaver/articles/air-source-heat-pumps> and <http://energy.gov/eere/energybasics/articles/air-source-heat-pump-basics>. Currently, manufacturers are developing a new design that will allow the external unit to fit into an air conditioning sleeve. This would allow the unit to be even with the façade of a building, eliminate the need to drill a hole (typically about 3 inches in diameter) for the connecting conduit, and dispense with the brackets now required to fasten the unit to the side of a building. We can encourage or require the design for new buildings to include a sleeve in which the external unit can be installed.

⁶ For the New York City Panel on Climate Change 2015 Report Executive Summary, see the January 2015, Volume 1336, Annals of the New York Academy of Sciences: <http://onlinelibrary.wiley.com/doi/10.1111/nyas.12591/full>

NYC2030District

exploratory committee

nyc2030district@gmail.com

February 27, 2015

Testimony before The NY City Council Environmental Protection Committee Hearing on Site-Sourced and Stored Renewable Energy by Haym Gross, Architect

The NYC 2030 District exploratory committee is established to form an Architecture 2030 District in New York City. Architecture 2030 is a national nonprofit organization which works toward dramatic reductions in fossil fuel consumption and greenhouse gas emissions from buildings and cities. The Architecture 2030 Challenge targets call for phased reductions in fossil fuel consumption to 50% in existing buildings and full carbon neutrality in new buildings and major alterations, with lower transportation emissions and water consumption, by the year 2030.

2030 Districts have been established in eight major US cities, encompass over 170 million square feet of real estate, and cooperate in a growing network to advance sustainable energy and resource management goals at the district scale. The proposed NYC 2030 district is structured as a private / public partnership of property owners, civic organizations and community stakeholders to achieve broad sustainability and public health benefits through improvements in building energy performance and reductions in fossil fuel consumption, carbon emissions and air pollution. The partnership will share resources and information, aggregate financing, collective action and public support, advocate for sustainable policies, and collaborate to spur technical innovation, adoption of best practices and environmental progress. The NYC 2030 District will deliver energy cost savings and improved property values to its members, while combating climate change on an urban scale.

The Architecture 2030 organization facilitates emerging districts through a variety of support services and provides an established process for monitoring building energy performance. Successful 2030 Districts have been concentrated in central business districts, are based upon the business case for energy cost savings and the value of environmental benefits, driven by the voluntary participation of property owners, civic institutions and community stakeholders in a contiguous geographic area, and are sponsored by an established governance structure such as a BID or neighborhood alliance.

The NYC 2030 District exploratory committee proposes to establish a 2030 District through a process of consultation with local businesses, community organizations, civic institutions, and elected officials to be located in an area comprising a portion of a dense NYC commercial district with adjacent residential, institutional or industrial zones. We propose to include affiliated areas as satellites to the 2030 District in order to reach a diversity of populations and income groups; to engage community-based non profits; and to promote broad impact of innovation and wide implementation of both sustainability and resilience goals. We believe that the NYC 2030 District can provide a platform for advancing the objectives of Mayor DiBlasio's 'One City Built to Last', including adoption of positive behaviors and best practices through community engagement and constructively competitive interaction between stakeholders. The district will offer a living laboratory to demonstrate and test innovative approaches to aggregated energy efficiency projects, cooperative renewable and distributed energy generation, accessible off-grid emergency power, integration of sustainable energy technologies and design strategies and silo-busting pilot projects to achieve common solutions to the challenges of sustainability, resilience and equity.

The NYC 2030 District exploratory committee and the allied NYC Eco District working group are working to initiate a NYC sustainability district program . The technical and market-oriented strengths of the 2030 District structure will be combined with the Eco District model's community-oriented focus to compose a flexible program to address the sustainability challenges faced by all of NYC's communities.

NYC2030District

exploratory committee

nyc2030district@gmail.com

October 31, 2014

NYC 2030 District Outline

The NYC 2030 District exploratory committee is established to form an Architecture 2030 District in New York City. Architecture 2030 is a national nonprofit organization which works toward dramatic reductions in fossil fuel consumption and greenhouse gas emissions from buildings and cities.

2030 Districts have been established in seven major US cities, encompass over 100 million square feet of real estate, and cooperate in a growing network to advance sustainable energy and resource management goals at the district scale. <http://architecture2030.org/>

The proposed NYC 2030 district is structured as a private / public partnership of property owners, civic organizations and community stakeholders to achieve broad sustainability and public health benefits through improvements in building energy performance and reductions in fossil fuel consumption, carbon emissions and air pollution. The partnership will share resources and information, leverage financing and public support, advocate for sustainable policies, and collaborate to spur technical innovation, adoption of best practices and environmental progress. The NYC 2030 District will deliver energy cost savings and improved property values to its members, while combating climate change on an urban scale.

The Architecture 2030 organization provides free assistance to facilitate emerging districts through consultation and technical assistance, organizational and marketing materials, and access to a variety of support services. The organization serves 2030 District management with key resources such as contract document templates and an established process for monitoring building energy performance. Successful 2030 Districts have been concentrated in central business districts, are based upon voluntary participation by property owners, civic institutions and community members in a contiguous geographic area, and are sponsored by an established governance structure such as a BID, community planning board or neighborhood alliance. <http://www.2030districts.org/>

The NYC 2030 District exploratory committee proposes to establish a 2030 District through a process of consultation with local residents, institutions, businesses and elected officials. The district will be located in an area comprising a portion of a dense NYC commercial district with adjacent residential, institutional or industrial zones. We propose to include affiliated areas as satellites to the 2030 District in order to reach a diversity of populations and income groups; to engage community-based non profits; and to promote broad impact of innovation and wide implementation of both sustainability and resilience goals. We believe that the NYC 2030 District can provide a platform for advancing the objectives of PlaNYC, including overcoming obstacles to adoption of positive behaviors and practices through community engagement and constructively competitive interaction between stakeholders. The district can offer a stage to demonstrate and test innovative approaches to aggregated energy efficiency projects, cooperative renewable and distributed energy generation, accessible off-grid emergency power, and integration of sustainable energy technologies and design strategies.

The NYC 2030 District is proposed as a central element of a sustainability district program to be developed in conjunction with a complementary Eco District model, toward the establishment of an expanded citywide process of energy and resource management policy implementation. The focused technical and market-oriented strengths of the 2030 District structure may be combined with other frameworks to compose a flexible sustainability program to address the challenges faced by all of New York City's diverse communities and neighborhoods.

NYC 2030 District Six Month Project Development Phase

Month 1 & 2:

1. Initiation of District Formation Process with Assistance of Architecture 2030 Organization
2. Completed Interactive Group Website
3. Established Outreach Strategy & Implementation Plan
4. Hiring and Commencement of Administrative Assistant Activities
5. Initiation of Outreach Plan for Solicitation of District Partners and Sponsors
6. Development of District Management Infrastructure with Architecture 2030 Organization
7. Preliminary Solicitation of NYC District Board of Directors and Board of Advisors

Month 3 & 4:

1. Continuation of Outreach Plan with Target of Signing First Property Owner / Area Alliance / Civic Organization Partner
2. Preliminary Framework of District Management Infrastructure Complete (Financing, Energy Monitoring, Stakeholder Communication)
3. Continuation of Outreach Plan with Target of Signing of Additional Two Property Owner / Area Alliance / Civic Organization Partners
4. Review of Potential District Site Selection with Architecture 2030 Organization

Month 5 & 6:

1. Completion of Outreach Plan with Target of Signing Total of Five Property Owner Members plus Securing Area Alliances as Governance Partners
2. Consultations with NYC Agencies to Prepare District Establishment Process and Discuss Schedule of Project Rollout
3. Completion of District Site Selection Process
4. Establishment of Board of Directors and Board of Advisors
5. Signing of 2030 District Charter between Stakeholders with Architecture 2030 Organization
6. Publication of NYC 2030 District Planning Report including Budget and Action Plan
7. Project Rollout in Coordination with NYC Agencies & Architecture 2030 Organization

NYC 2030 District Exploratory Committee:

Alan J. Gerson, former NYC Council Member, Sierra Club NYC Executive Committee

Rick Bell, FAIA, Executive Director of AIANY

Nancy Anderson Ph.D, Executive Director, Sallan Foundation

Wendy Brawer, Designer, Founding Director of Green Map System

Vincent Martinez, Director of Research & Operations, 2030 Inc./Architecture 2030

Christine Condit, VP, GPS-Environmental, Markit

Neil Weisbard, Counsel, Pryor Cashman LLP

David Bergman, Architect, Sustainable strategist, Adjunct faculty at Parsons School

Matthew Ferguson PE, LEED AP BD+C, CEM

Ting Chin, AIA, LEED BD+C, NCARB, Lincarscape Architecture, Asst. Professor, CUNY CityTech

William Schacht, Architect, Faculty Member of Newman Institute at Baruch College

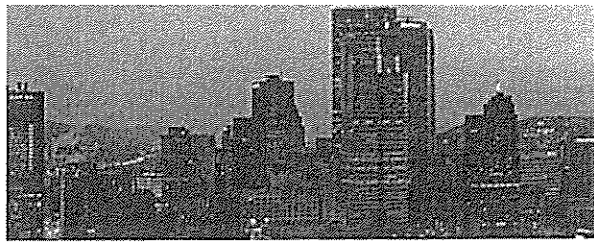
Ben Rosenblum, Principal, Ben Rosenblum Studio, Environmental Designer and Sustainability Consultant

Rory Christian, New York Director, Clean Energy, Environmental Defense Fund

Max Driscoll, AIA, LEED AP BD+C, Director of Sustainability, Croxton Collaborative Architects, P.C.

Honey Berk, Director of Technology, CUNY Building Performance Lab

Haym Gross, Architect



2030 DISTRICTS®

2030 Districts

Unique private/public partnerships that bring property owners and managers together with local governments, businesses, and community stakeholders to provide a business model for urban sustainability through collaboration, leveraged financing, and shared resources.



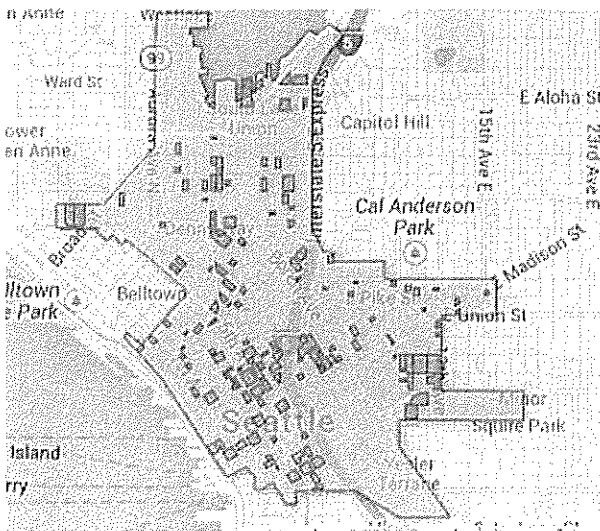
Introduction

Across the United States, 2030 Districts® are forming to meet the energy, water and vehicle emissions reduction targets for existing buildings and new construction called for by Architecture 2030 in the 2030 Challenge for Planning.

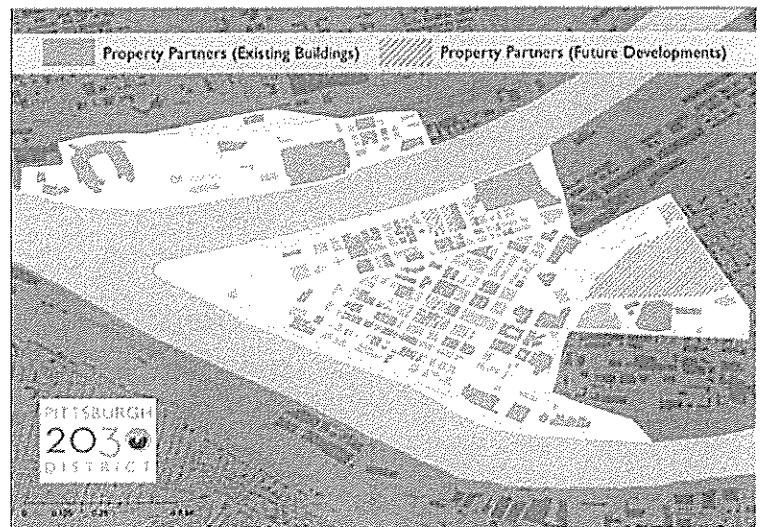
First established in Seattle, 2030 Districts® are in the vanguard of the national grassroots effort to create long-term partnerships, coalitions, and collaboration around achievable and measurable goals for renovating hundreds of millions of square feet of existing urban and suburban areas and infrastructure, as well as for infill development and redevelopment. 2030 Districts® are unique private/public partnerships that bring property owners and managers together with local governments, businesses, and community stakeholders to provide a business model for urban sustainability through collaboration, leveraged financing, and shared resources. Together they benchmark, develop and implement creative strategies, best practices and verification methods for measuring progress towards a common goal.

Established 2030 Districts

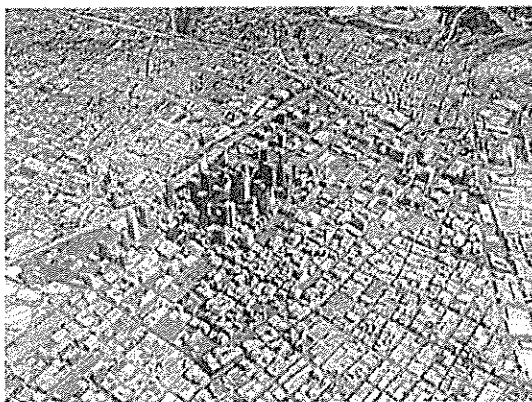
2030 Districts, currently representing over 100 million of square feet, have been formed in Seattle, Cleveland, Los Angeles, Denver and Pittsburgh. These Districts demonstrate that energy, transportation emissions, and water reductions can be achieved through collaboration, leveraged financing, and shared District Member Resources.



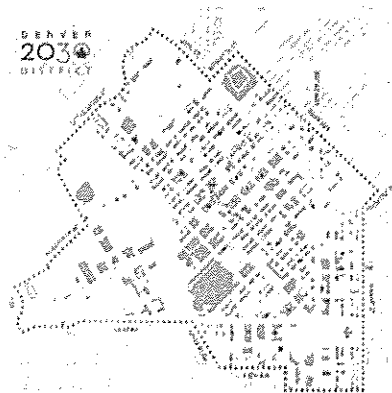
Seattle 2030 District



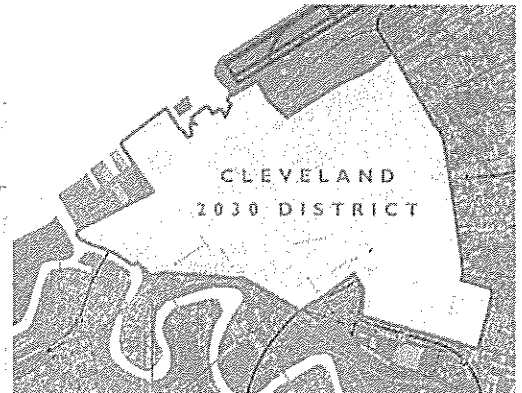
Pittsburgh 2030 District



Los Angeles 2030 District



Denver 2030 District



Cleveland 2030 District

2030 District Goals: The 2030 Challenge For Planners

NEW BUILDINGS, MAJOR RENOVATIONS, AND NEW INFRASTRUCTURE:

- ② Energy Use: an immediate 60% reduction below the National average, with incremental targets, reaching carbon neutral by 2030.
- ② Water Use: An immediate 50% reduction below the current District average.
- ② CO₂e of Auto and Freight: An immediate 50% reduction below the current District average.

EXISTING BUILDINGS AND INFRASTRUCTURE OPERATIONS:

- ② Energy Use: A minimum 10% reduction below the National average by 2015 with incremental targets, reaching a 50% reduction by 2030.
- ② Water Use: A minimum 10% reduction below the District average by 2015, with incremental targets, reaching a 50% reduction by 2030.
- ② CO₂e of Auto and Freight: A minimum 10% reduction below the current District average by 2015 with incremental targets, reaching a 50% reduction by 2030.

2030 District Member/ Partner Types:

2030 Districts are as naturally diverse as the communities they represent. Private sector leadership is key, keeping groups well connected to market realities and solutions. Support from the public sector is also needed. A successful 2030 District is a public-private partnership.

PROPERTY OWNER/PROPERTY MANAGER OR DEVELOPER:

An individual or entity that owns, manages and/or develops real estate within a 2030 District boundary.

SERVICES STAKEHOLDER:

An individual or entity that provides services within a 2030 District boundary. Examples include architects, engineers, energy services companies (ESCOs), utilities, and contractors.

COMMUNITY STAKEHOLDER:

A non-profit, government entity or community organization. Examples of a Community Stakeholder include, industry and/or professional organizations, local green building councils/USGBC chapters, city, county and state agencies, and community groups. An individual or entity that provides services within a 2030 District boundary. Examples include architects, engineers, energy services companies (ESCOs), utilities, and contractors.

2030 District Benefits:

2030 Districts leverage strategic partnerships with professional and community stakeholders to provide building owners, property managers, developers and professional service providers with the education, services, tools and support needed to accomplish the performance goals of the District.

PROPERTY OWNER AND MANAGERS

Through District membership, building owners, property managers, and developers are given access to a suite of resources, tools and opportunities to improve and add value to their assets. Member are granted access to:

- ④ Assessment of current building performance relative to 2030 District goals
- ④ Anonymous benchmarking against local peer buildings
- ④ Guidance for moving towards 2030 District goals
- ④ Training and ongoing support through educational workshops on tools and best practices
- ④ Innovative software platforms to track and analyze performance
- ④ In-kind member professional services and contributions, including project scoping and feasibility
- ④ Influence on District-related policy issues, including incentives



PROFESSIONAL STAKEHOLDERS

Through District membership, professional stakeholders have opportunities to reach an engaged audience of developers, property owners and property managers as they assess efficiency upgrades for their properties. They also gain access to the most up-to-date information regarding potential new and renovation projects within the 2030 District. Professional stakeholder can also provide guidance and influence to permitting and policy revisions that are considered to incentivize 2030 Challenge projects.

COMMUNITY STAKEHOLDERS

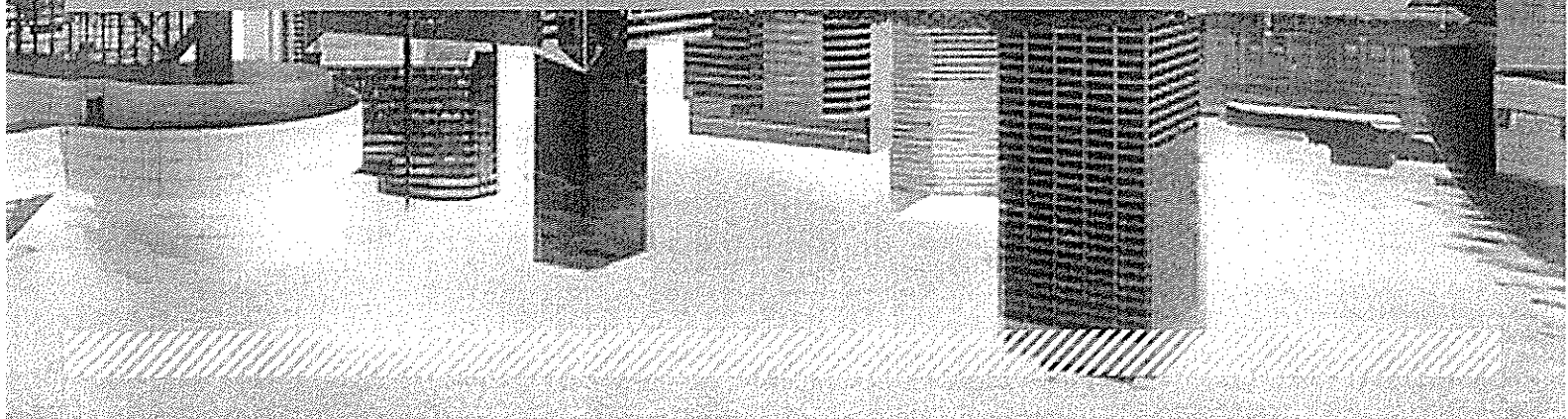
Through District membership, community stakeholders can expand their reach and network to better fulfill their mission. 2030 Districts are not meant to replace or compete with existing programs, but rather to leverage and expand programs and initiatives of community stakeholder to reach an eager market of potential implementers.

The 2030 Districts Network

To expand its support for 2030 Districts, Architecture 2030 is establishing the 2030 Districts Network, leading the effort to create and help newly forming Districts and coordinate District resources and collaborations in cities across the United States. Architecture 2030's objective is for 2030 District national collaborators and partners to have equal access to the support and resources needed to achieve the *2030 Challenge for Planning* targets.

Architecture 2030's on-going network management system for growing the 2030 District Network includes the following elements:

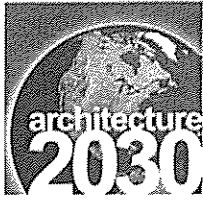
- ⊙ A process for on boarding new network members and orienting them to the protocols of the network;
- ⊙ Processes for member-to-member relationship building and communication;
- ⊙ Development of sub-networks between different stakeholder groups, including district staff, building owners and managers, professional support partners, etc.;
- ⊙ A description of different types of network transactions, and protocols for those transactions;
- ⊙ Best practices for facilitating network meetings, conference calls, webinars, etc.;
- ⊙ A system for evaluating network health and assessing its value to its members.



The 2030 Districts Network Benefits

All 2030 Districts will benefit from the following partnerships, support, and services from 2030 District Network:

- ④ Technical support and related services;
- ④ Strategies for cost-effective reductions in energy and water consumption, and commuter transportation approaches to reduce CO2 emissions;
- ④ A 2030 District website interface;
- ④ A 2030 District Owner/Manager Database;
- ④ Participation in 2030 District conference calls, summits, webinars and capacity building workshops;
- ④ 2030 District publications and other available information;
- ④ Strategies and funding mechanisms for 2030 District staff;
- ④ A list of “Best Practices for Property Owners and Managers Outreach” and the creation of written and/or video content that covers the significance of the 2030 District approach and “Benefits of, and Needs Met, by 2030 Districts”;
- ④ Assistance with data evaluation and the design of actual District-specific support services;
- ④ A comparison of similar efforts and potential collaborations;
- ④ A standardized “tool kit” to help cities create new Districts;
- ④ A process for establishing District and building benchmarks;
- ④ A benchmarking study of similar efforts and potential collaboration;
- ④ Access to NationalField software to share best practices and increase collaboration



EcoDistricts

The 2030 Districts + EcoDistricts Collaboration

A Shared Vision

There is recognition among urban sustainability leaders that the district or precinct is an important scale for addressing sustainability performance and outcomes, whether it be reducing carbon emissions, improving our natural systems, creating green jobs, or building community action.

Progressing sustainability at a district scale is now critical for cities to transform into places of opportunity and prosperity, as it is a scale small enough to facilitate rapid innovation, yet large enough to have a significant impact beyond district boundaries.

The efforts of 2030 Districts help reduce greenhouse gas emissions from buildings at a district scale, realizing the benefits of multiple building owners, operators, and occupants working together to share resources, leverage financing, and implement collective strategies. Guided by targets set within the 2030 Challenge for Planning, deep reductions are being sought across building energy and water use, and transportation emissions. The work of 2030 Districts is:

- Focused on High Performance Buildings and Building Retrofits;
- Engaging with individual building owners and managers, building sector professionals, and community representatives, and is private sector led;
- Tracking metrics and performance in the following areas: building energy and water use, and transportation emissions; and
- Reporting on aggregated building and district wide performance against set metrics and performance goals with incremental milestones.

EcoDistricts is an organization seeking to accelerate sustainability at a district level, using a model based upon strong stakeholder engagement and district governance and creating a pipeline of projects that reduce ecological footprint, promote community action and civic entrepreneurship, generate green jobs, promote equity, and identify and embrace place-making. The work of EcoDistricts is:

- Focused on place-based development typologies, including brownfield and major redevelopment, campus and neighborhood revitalization projects;
- Engaging with plan makers and policy makers, community representatives, financiers, and developers;
- Uses eight "Performance Areas" across the full sustainability spectrum to inspire and guide sustainability project opportunities; and
- Uses a performance tool called the "EcoDistricts Framework" to allow projects to develop a roadmap for planning, designing, financing, delivering, and monitoring EcoDistrict projects.

There are a range of areas where 2030 Districts and EcoDistricts can work together to further create shared value from a collective vision on district development and transformation, including:

- Project and Resource Development
- Training
- Marketing and Communications
- Funding Opportunities

Local 2030 Districts and EcoDistricts are encouraged to partner and work together to leverage and enhance the work of both initiatives and recognize that their efforts are complimentary.

Testimony

COMMITTEE ON ENVIRONMENTAL PROTECTION
Site-Sourced and Stored Renewable Energy Conference

Presented by Rory Christian
Environmental Defense Fund

February 27, 2015 Public Hearing
New York, NY

My name is Rory Christian and I am with the Environment Defense Fund (EDF), a non-partisan environmental organization with more than 750,000 members nationwide. EDF is dedicated to working towards innovative, cost-effective solutions to environmental problems, building on a foundation of rigorous science, economics, and law.

Thank you for the opportunity to testify today to discuss how densely populated cities like New York can generate energy without polluting the air or destroying the troposphere. The New York State Public Service Commission (PSC) is in the midst of an initiative that will usher in a new era of choices for energy users throughout the state of New York. This initiative, known as “Reforming the Energy Vision” has been heralded as a revolutionary reimagining of the relationship between utilities and energy customers that will lead to a future where consumers can produce their own power

In this proposed future, distributed generation in the form of solar and wind power as well as battery storage will play a central role in reshaping the average consumers relationship with energy. But fossil fuel based distributed generation will also play a role and have the potential to exacerbate local environmental conditions in communities throughout NYC. As the state moves forward with these initiatives, NYC must take steps in preparing for a future where all sources – both renewable and fossil fueled - can be effectively integrated into the city while managing the impact on the health and welfare of New Yorkers. With that in mind, EDF recommends:

1. the City of New York place an emphasis on energy efficiency for all building types
2. review permitting requirements should for adjustments that will accommodate clean energy and battery storage options
3. establishing platforms through which all New Yorkers can benefit

Background

Climate change presents a clear and present danger to the U.S. and to the world. The World Meteorological Organization confirmed that 2014 was the warmest year in recorded history. This meant that fourteen of the fifteen warmest years on record have all occurred in the 21st century. The costs of climate disasters continue to increase and severe weather events continue unabated. Our friends in the City of Boston are still digging out of an unprecedented series of storms.

The U.S. Global Change Research Program has determined that if carbon pollution is not reduced, it is likely that American communities will experience increasingly severe climate impacts, including: rising levels of dangerous smog in some of our cities—which will lead to an increased risk of respiratory infections, more asthma attacks, and more premature deaths; increased risk of illness and death due to extreme heat; more-intense hurricanes and storm surges; increased frequency and severity of flooding; increases in insect pests and in the prevalence of diseases transmitted by food, water, and insects; reduced precipitation and runoff in the arid West; reduced crop yields and livestock productivity; and more wildfires and increasingly frequent and severe droughts in some regions.

U.S. Secretary of Defense, Chuck Hagel, said in November that “Climate change does not directly cause conflict, but it can add to the challenges of global instability, hunger, poverty, and conflict. Food and water shortages, pandemic disease, disputes over refugees and resources, more severe natural disasters – all place additional burdens on economies, societies and institutions around the world.”

Energy Efficiency as a Primary Solution

In light of the clear and present danger climate change represents, The New York City Council is wise to take steps to understand how site-sourced and stored renewable energy can play a role in improving both the environment and the ability of New York City to be resilient in the face of future extreme weather events. Before addressing site-sourced and stored options, it is important to address energy efficiency.

The International Energy Agency views energy efficiency as “a way to increase the productivity and sustainability of society, primarily through the delivery of energy savings. The impact of energy efficiency measures can go far beyond energy savings, and energy efficiency improvements can be an important contributor to economic growth and social development.” The benefits from energy efficiency affect both the end users and society writ large. Local benefits include lower energy bills, improved health, well-being and social development, reduced air pollution. These are benefits that can accrue to all New Yorkers, particularly low income New Yorkers where energy costs represent a proportionately higher percent of monthly expenses when compared to other income levels. The societal benefits include enhanced property values, lower greenhouse gas (GHG) emissions and higher productivity, to name a few.

Addressing energy efficiency reduces the energy needed to perform everyday functions deemed necessary for our modern life, and reduces the need for site-sourced and stored renewable energy source. Developing programs which promote energy efficiency for all building types will reduce the need for energy supplied through traditional sources, while increasing the effectiveness of site sourced and stored options to be deployed in the future.

Streamline Permitting Requirements

The wide array of buildings in the city, coupled with various technologies and applications create an environment where no one solution is likely to dominate. To foster the expansion of these new

technologies in the variety of options will require of solutions, to foster the expansion of these sources in NYC, flexibility and transparency will be key.

A recent example is the New York City Department of Buildings efforts to accommodate the 100 kilowatt wind turbine at the Sims Metal Management recycling plant in Subsidy Park. When the permits for the turbine were submitted in 2010, the Department of Buildings didn't have a process for commercial-scale turbines – though it does have a process for building-mounted wind turbines. A protocol was subsequently developed in 2011, and the Department of Buildings should be commended for quickly addressing this need, but as we hurdle towards a future where large portions of the city could be positioned to deploy a wide array of clean energy solutions, steps should be taken to ensure that the permitting process and other City regulations are developed to keep pace with change, lest they stifle innovation and delay progress.

Uniting all New Yorkers

New York is a city of renters. With roughly 50% of building inventory dedicated to affordable or rent controlled housing, a significant portion of the city may experience obstacles in pursuing site sourced and stored renewable energy solutions. As with many things in life, pursuing opportunities as a group can be far more effective than when pursued as an individual, and the City Council can help facilitate the process by helping to establish a framework through which communities can come together and in the pursuit of these new options.

Two existing platforms come to mind that have proven their value in other cities throughout the country. The EcoDistrict and Architecture 2030 district models. With established, functioning districts in Seattle, San Francisco, Los Angeles, Boston and Atlanta, these two programs have helped revitalize communities and put them on the path towards greater energy efficiency, increased sustainability, improved resiliency and improving overall quality of life of the inhabitants.

■ AWM (Proto-Type)

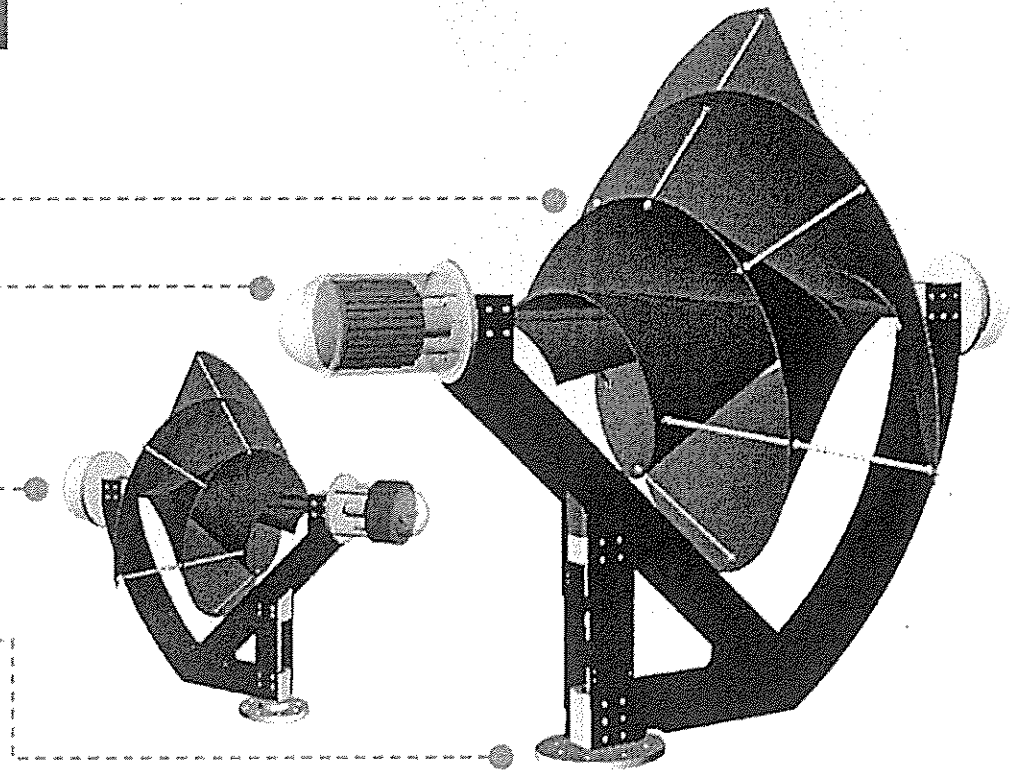
Part Description

01 Spiral Blade

02 Generator

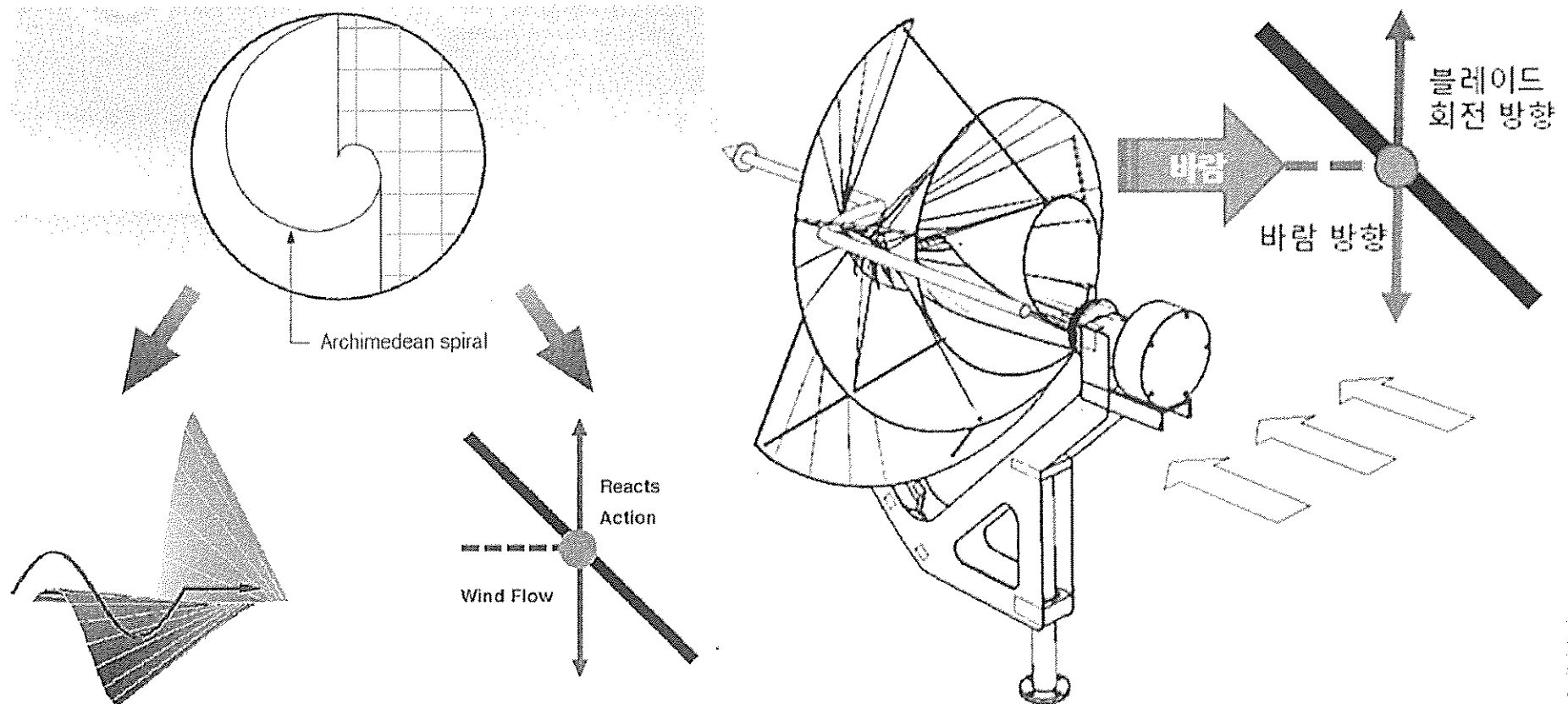
03 Magnetic Brake

04 Frame with Yawing System



- AWM-1500D-1000W → Blade diameter: 1.50m / rated power: 1.00kW
- AWM-0750D-0200W → Blade diameter: 0.75m / rated power: 0.20kW

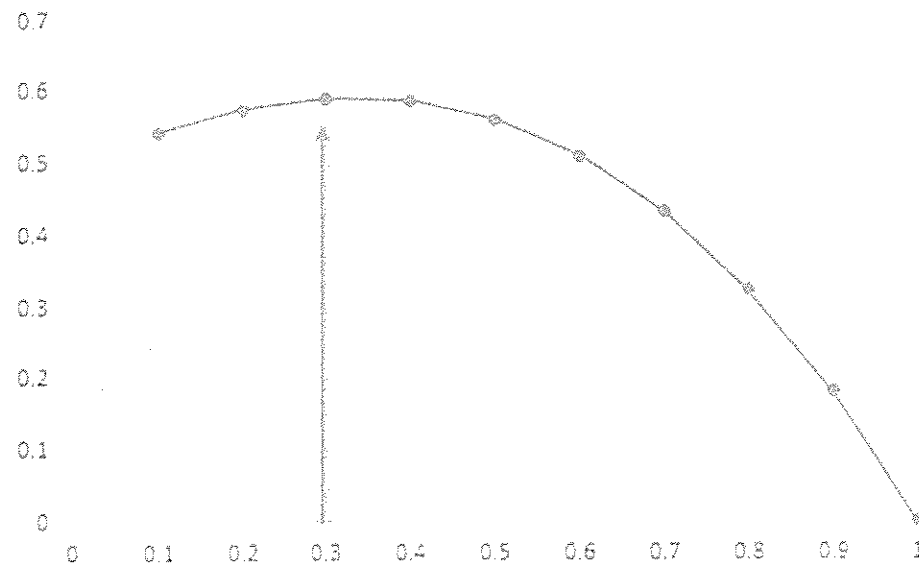
AWM Principle



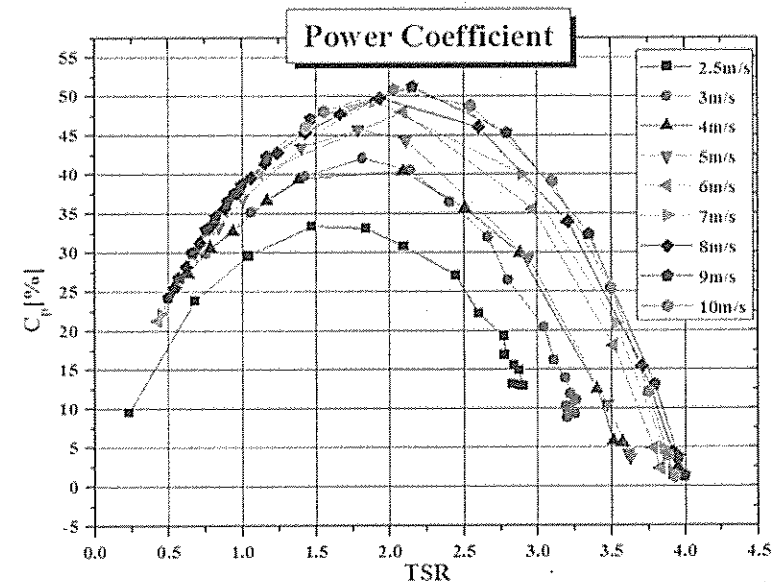
- Spiral blade – all advantages of Lift and drag-type
→ Airflow direction is changed

AWM Performance - Efficiency -

Theoretical maximum Efficiency



AWM Rotor efficiency

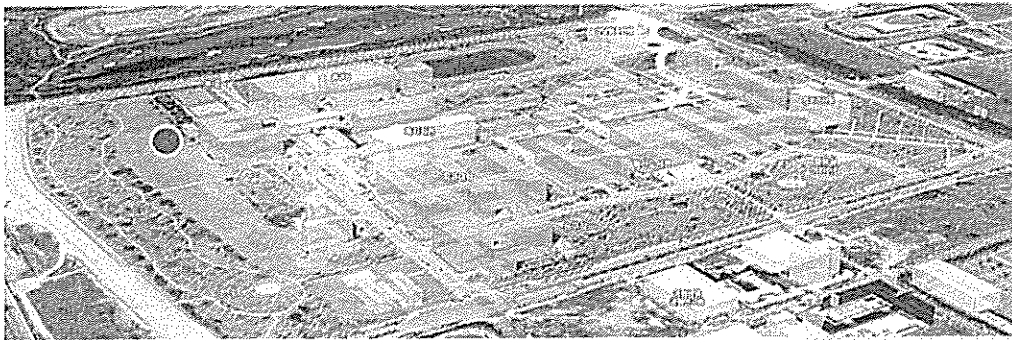


AWM rotor efficiency is maximum 52%
Even at low wind speeds a high efficiency

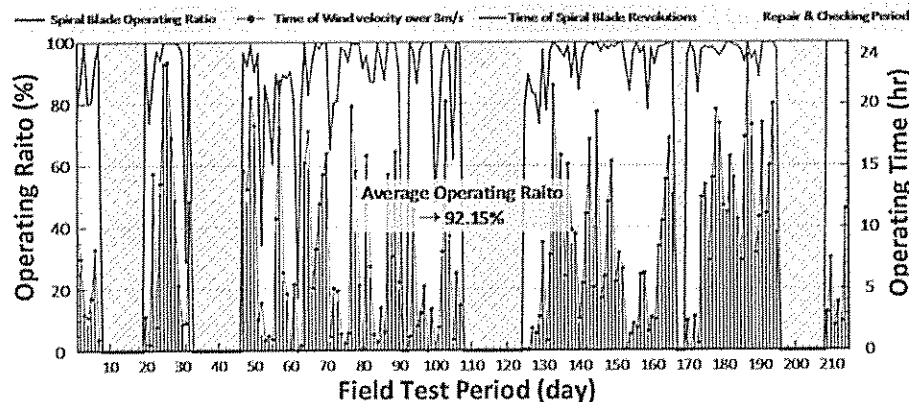
Start-up at 2.5 m/s
1 kW Rated Power at 12 m/s

AWM Performance Verification – Field testing –

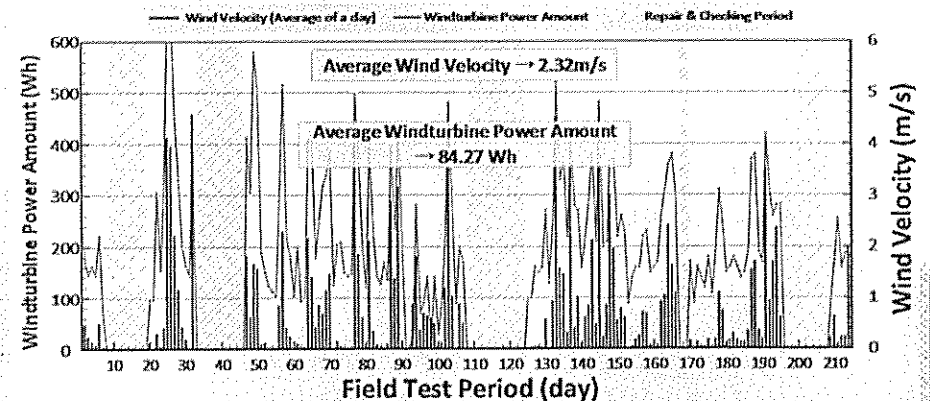
► Field test site (Incheon University)



► Utilization

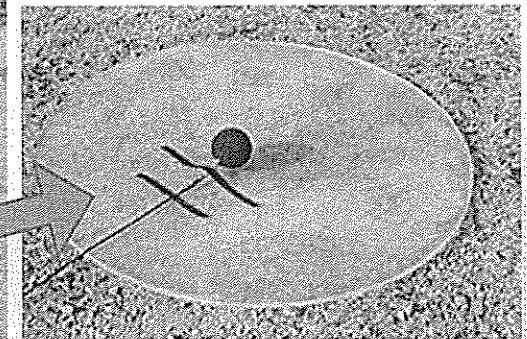
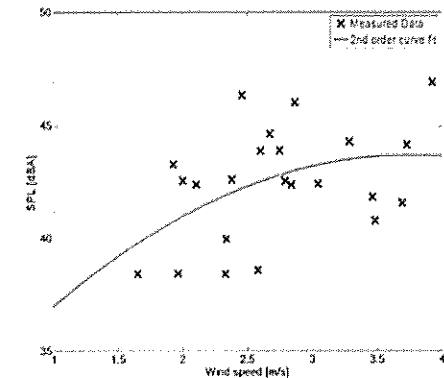
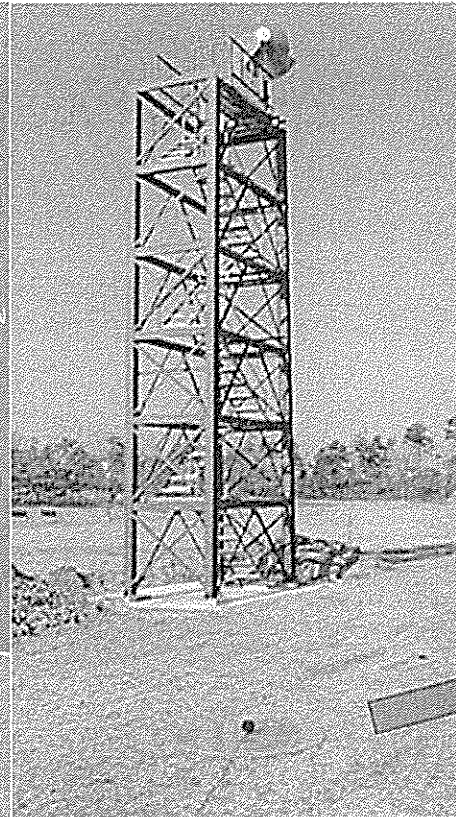
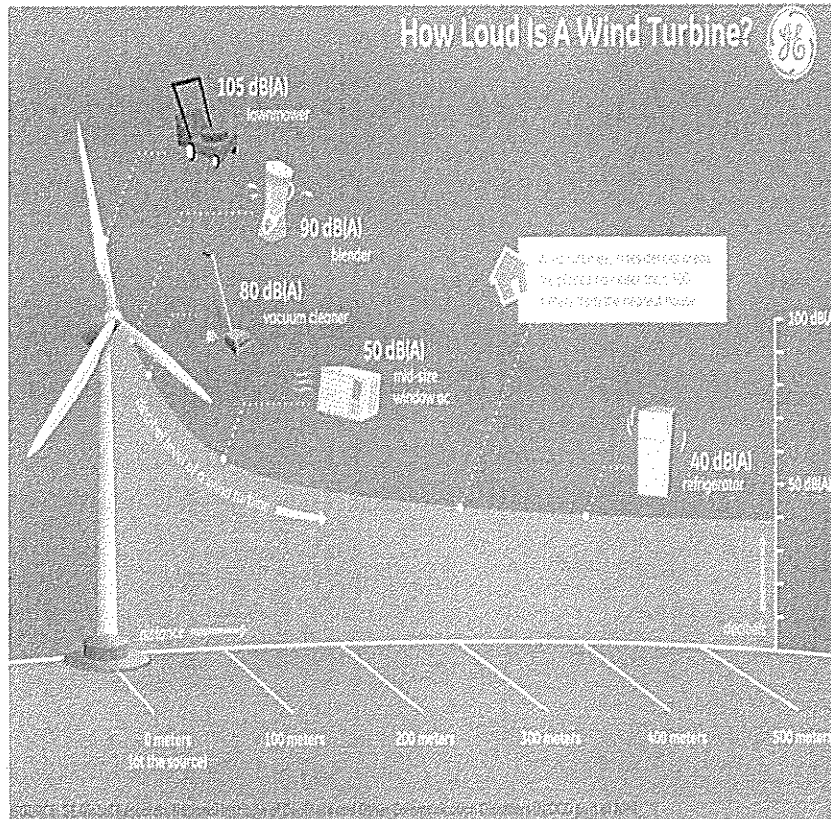


► Power Generation



- University of Incheon (Songdo campus) → 2013-oct ~ 2014- Aug
- Utilization: 92% / Average power generation 84Wh at 2.32m/s

Sound levels

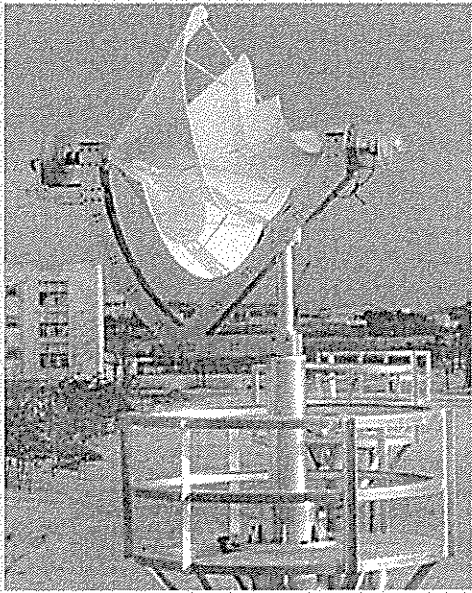

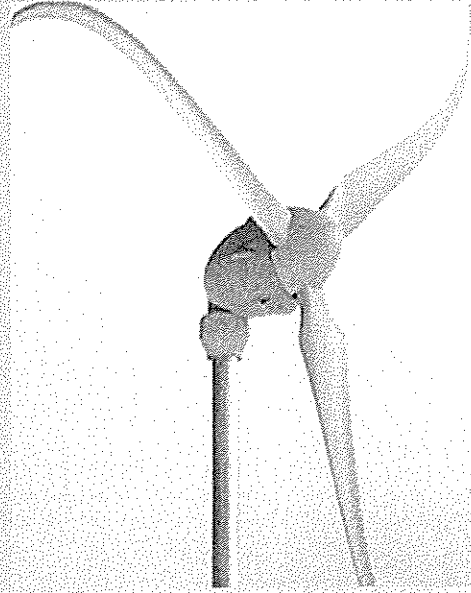


Sound level < 45 dB(a)

Below day- and nighttime sound-regulations

AWM Comparison

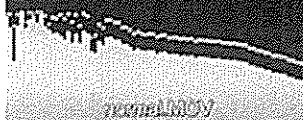
► Micro Wind Turbine Comparison

	Spiral Blade	Propeller Blade	Former Best
Type			
Blade Cp	48%	15~30%	35%
Sound	45dBA	60dBA	57dBA
Start speed	2.5m/s	2~3m/s	2.7m/s
Cut in speed	3.0m/s	4.0m/s	3.0m/s

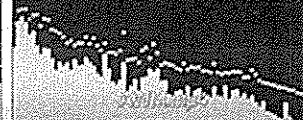
■ AWM Performance – Sound –



60 dB(a)



40 dB(a)



■ AWM in the American Press

The Washington Post

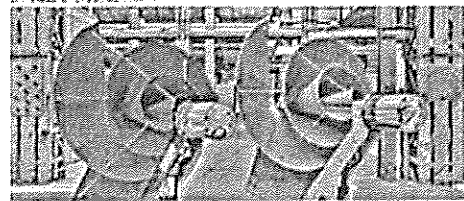
Columns

The Washington Post

Is this odd-looking wind turbine the most efficient you can buy?

Is this odd-looking wind turbine the most efficient you can buy?

By Tom C. Bruneau

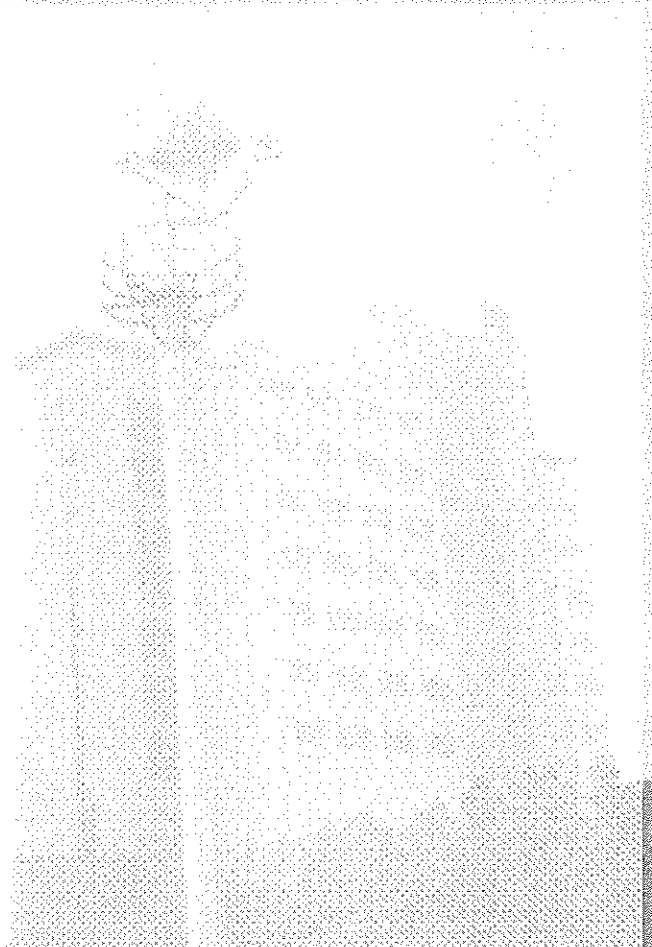


This isn't your father's wind turbine. (The A. Archimedes)

When it comes to producing wind energy, three-blade propeller turbine systems have been the gold standard for so long, they've become boring. Sure, engineers have put forth their fair share of alternate designs, but nothing has proven to be quite as efficient.

They aren't perfect either, however. Despite unmatched rotational speeds upwards of up to 200 mph, taking full advantage of the elements requires that the turbines be positioned directly into the face of the current. So while such systems generally make sense for offshore wind farms, they're not as practical in surroundings where winds are far less predictable.

The Archimedes, a Dutch-based tech firm, says that its Diam B Urban Wind Turbine can do for your home what these towering structures have done for the electric grid and turn as much as 80 percent of harness-able energy from wind into electricity, a

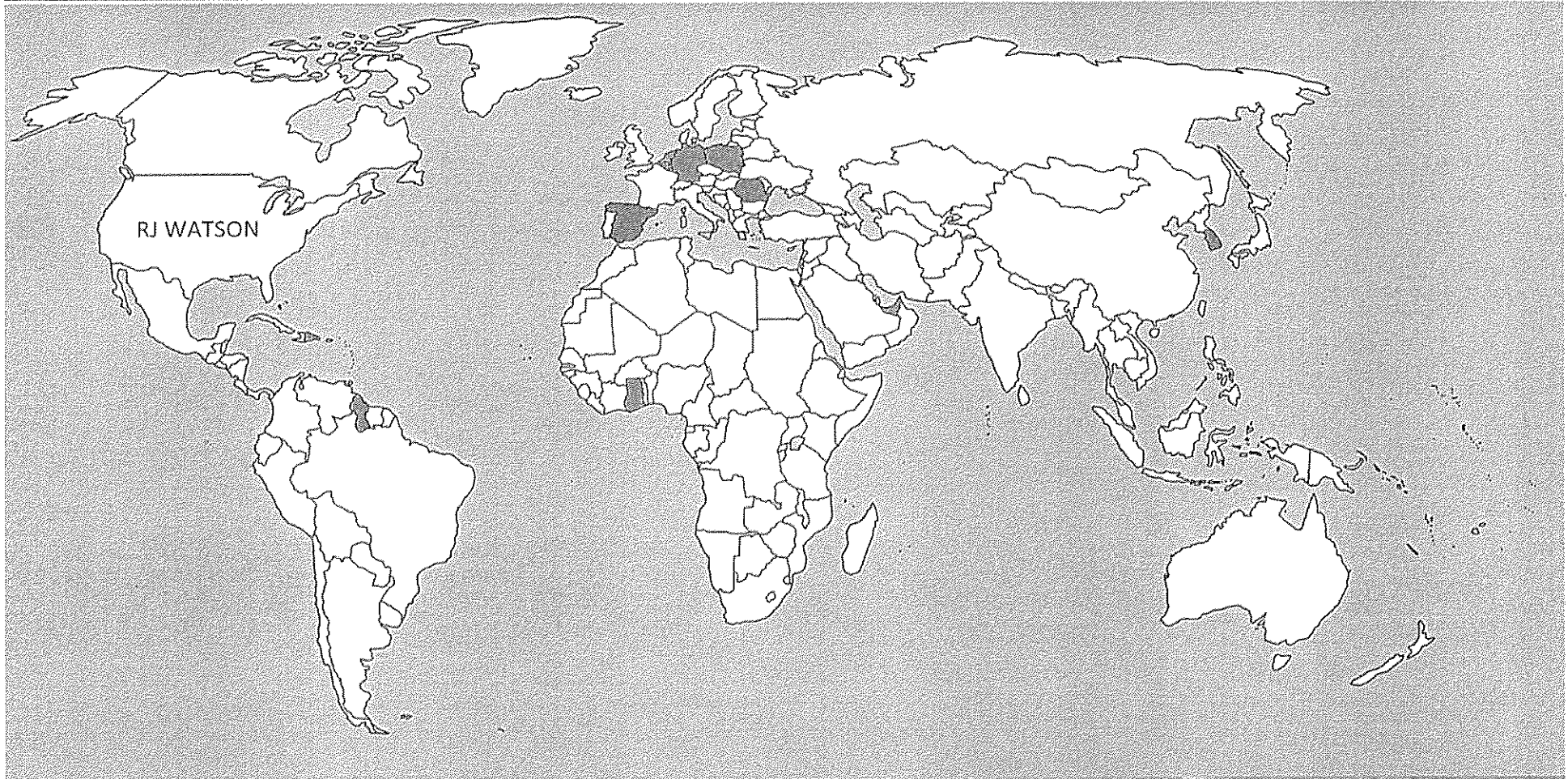


- Washington Post 2014-june-10

- <http://www.washingtonpost.com/blogs/innovations/wp/2014/06/10/is-this-odd-looking-wind-turbine-the-most-efficient-you-can-buy/#comments>

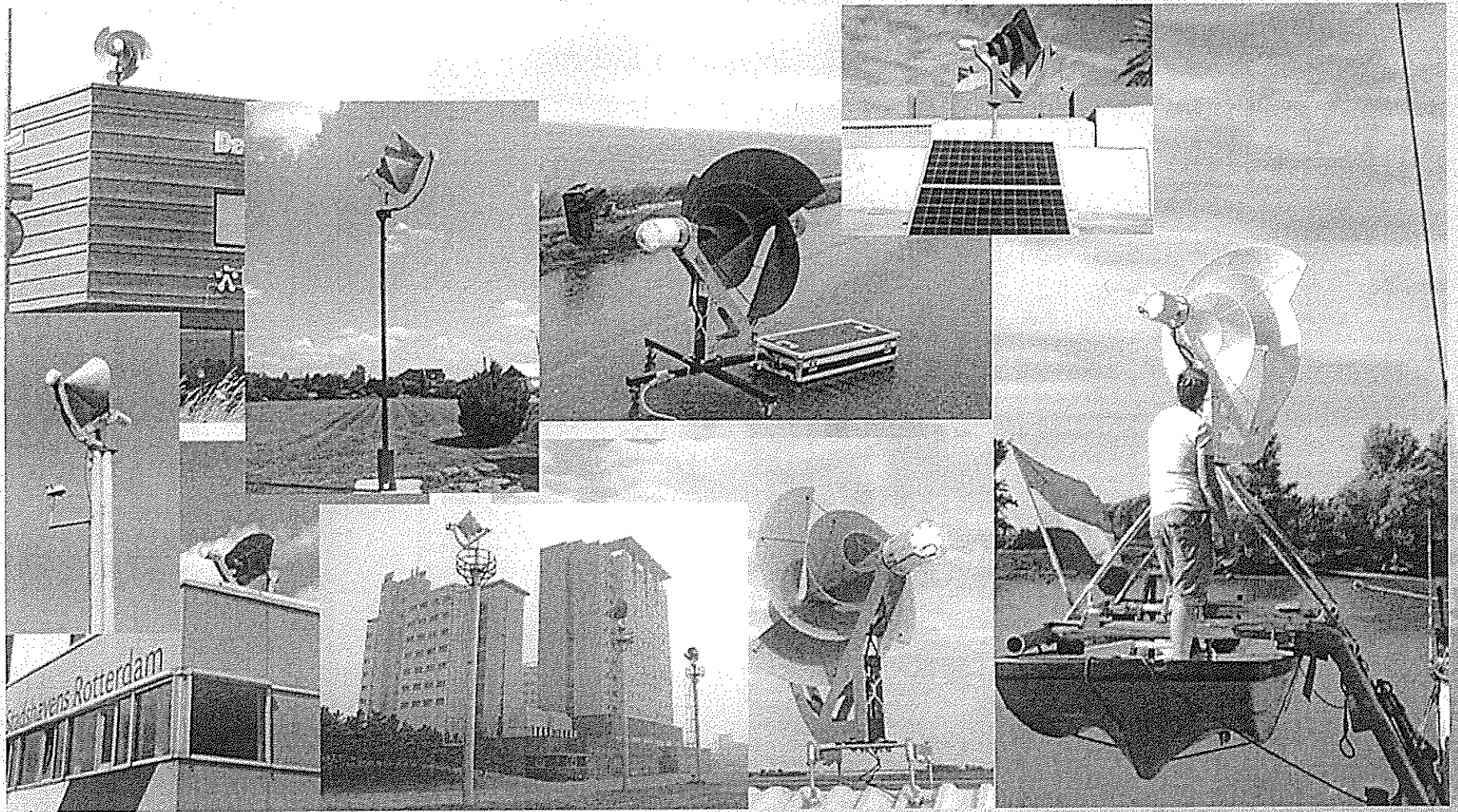
■ AWM Field Tests

Next



- 23 independent test-sites in 9 countries

■ AWM Installation examples





A black and white photograph of a large industrial facility, likely a power plant or refinery. The image shows several tall, dark smokestacks rising from a complex of buildings and piping. In the foreground, there are large, light-colored storage tanks or silos. The facility is surrounded by a fence, and the background shows a clear sky. The overall scene depicts a major industrial operation.

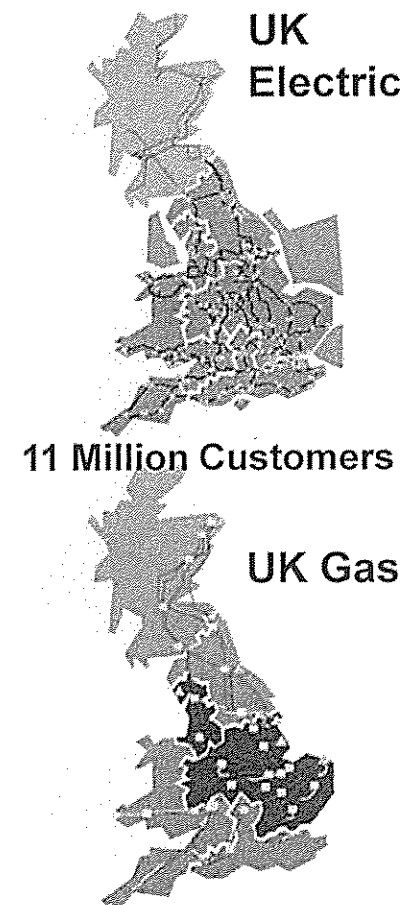
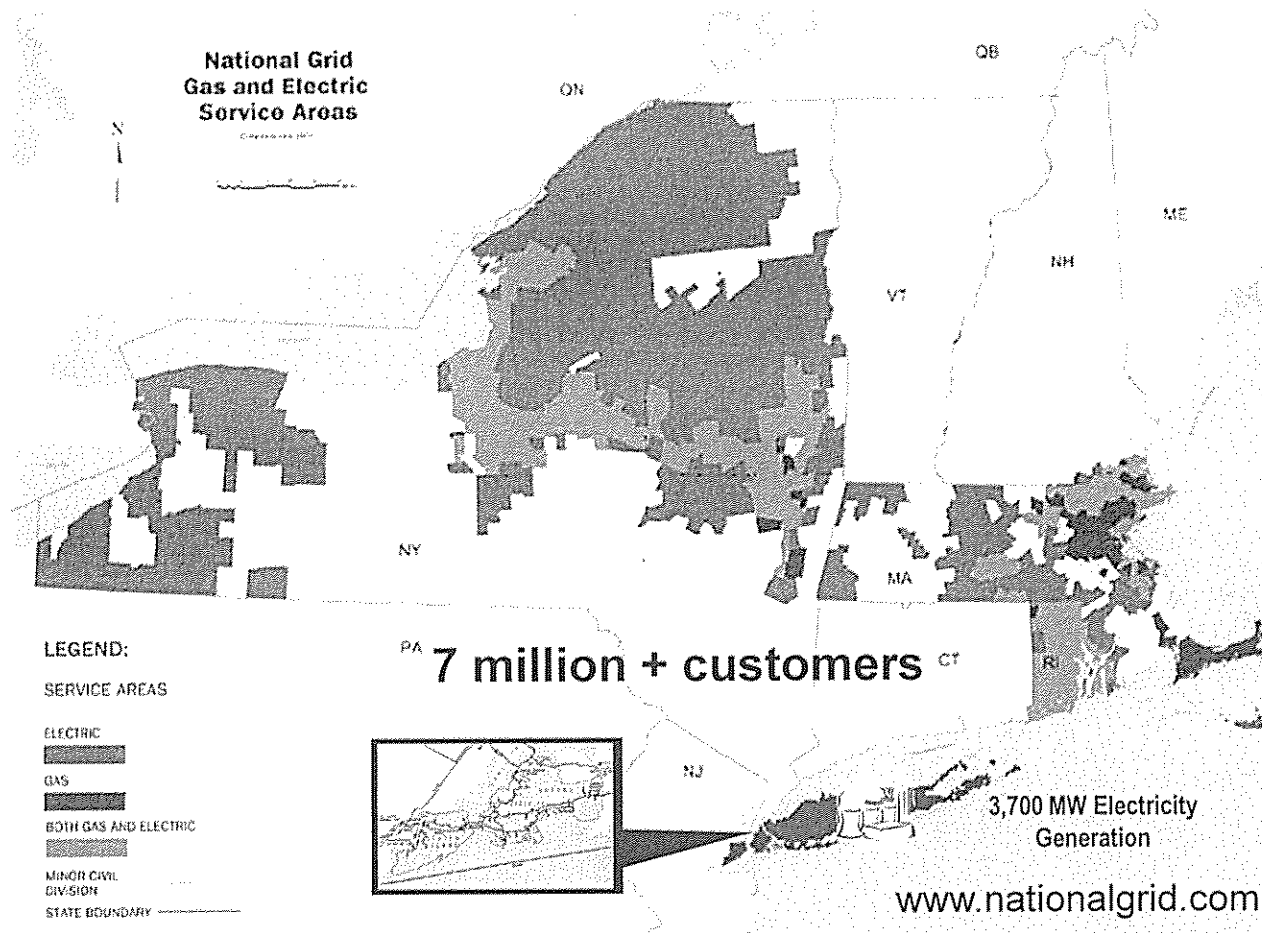


New York City Council
February 27, 2015

An International Energy Company

nationalgrid

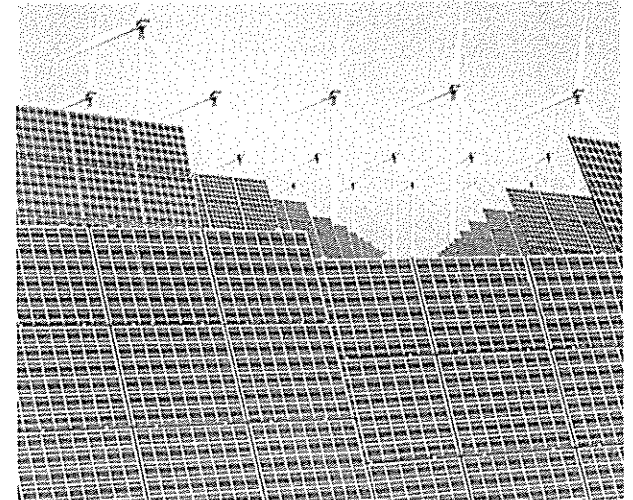
HERE WITH YOU. HERE FOR YOU.



The Way Forward: Connect21

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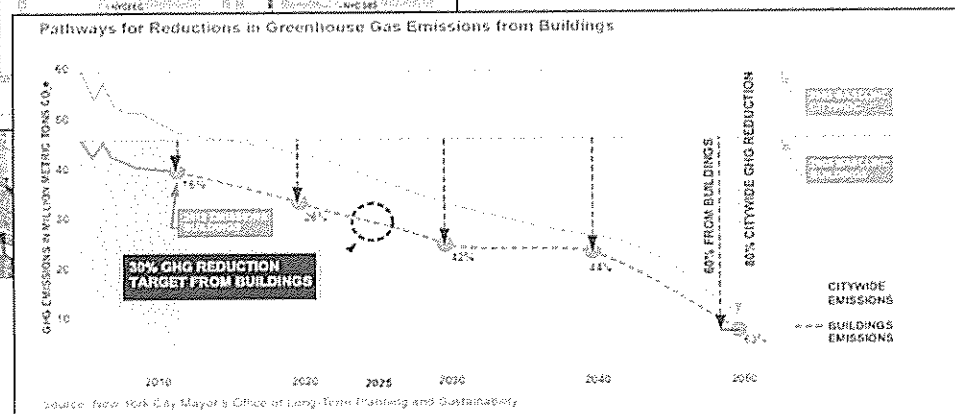
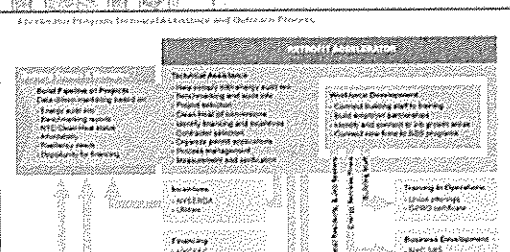
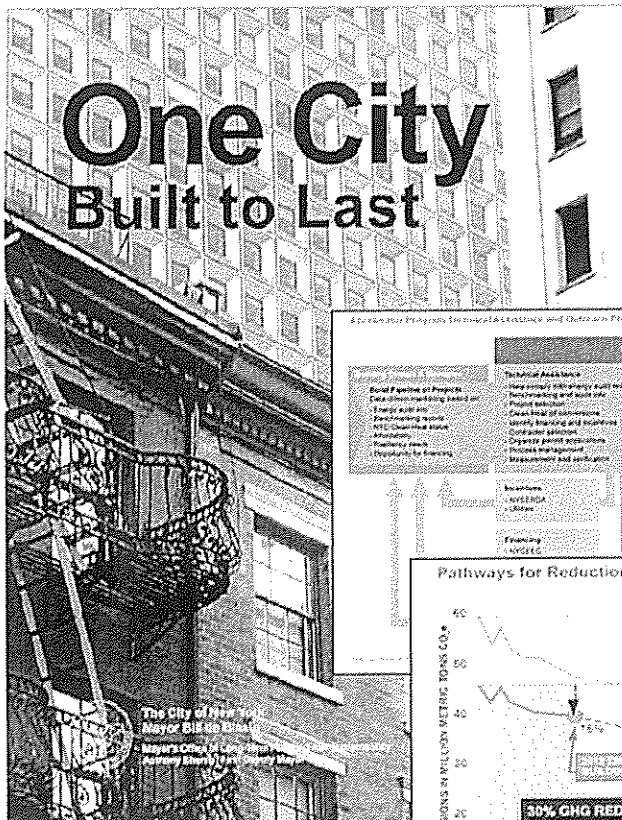
- ◆ Set clear and compelling policy goals
- ◆ Modernize the Grid
- ◆ Incent Infrastructure Investment
- ◆ Focus on Energy Efficiency and place renewables where it makes most sense
- ◆ Manage customized energy solutions for diverse customer needs
- ◆ Drive technology and innovation
- ◆ Developing Tomorrow's Workforce



• <http://us.nationalgridconnecting.com/connect21>

National Grid is actively supporting NYC's commitment to cut Greenhouse Gas Emissions (GHG) *80 Percent by 2050 and 30 Percent by 2025*

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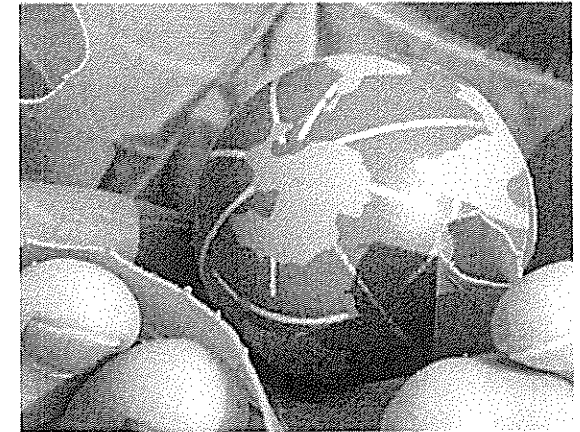


- Member of the Mayor's *Green Buildings Technical Working Group*
- Committed to ensuring the success of reducing GHG emissions *from the energy used to heat, cool, and power our city's buildings by 30 percent over the next decade*

Agenda

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- ◆ Gas Distribution
 - ◆ Oil-to Gas
 - ◆ Pipe Replacement
- ◆ Energy Efficiency
- ◆ Natural Gas and Hydrogen Vehicles
- ◆ Renewable Natural Gas
- ◆ Distributed Generation and Fuel Cells
- ◆ The Future
 - ◆ Holonic Energy Grids
 - ◆ Capturing Carbon from Air and CO2 Pipelines)



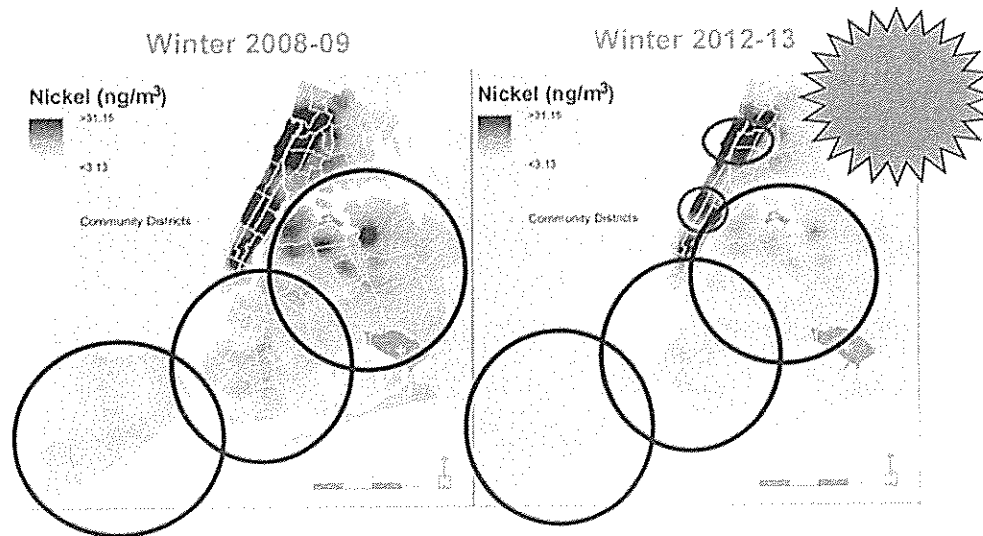
*In October 2011,
Newsweek listed
National Grid as the top
green utility in its 2011
Green rankings report.*

NYC CLEAN HEAT: *Nearly 3/4 Complete less than 1/4th To Go*
National Grid's remaining share of #6 and #4 Oil burning buildings
continues to steadily decrease

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NYC cleanheat



- ◆ National Grid officially crossed the “*Half Way Mark*” for CLEAN HEAT Program completion as of July 2013
- ◆ As of December 2014 National Grid has converted 498 #6 & #4 oil buildings to Natural Gas *with an additional 82 converted* (in Progress): for a total of 580 since the launch in late April of 2011 – *leaving slightly over 1/4 to go*
- ◆ In addition, National Grid continues to its efforts to aggressively convert the few remaining Clean Heat eligible on Staten Island to help create “*NYC's First Green Borough*”
- ◆ We continue to actively work to help convert all eligible customers from all grades of Oil *including #4 & #6* to Natural Gas wherever adequate infrastructure exists

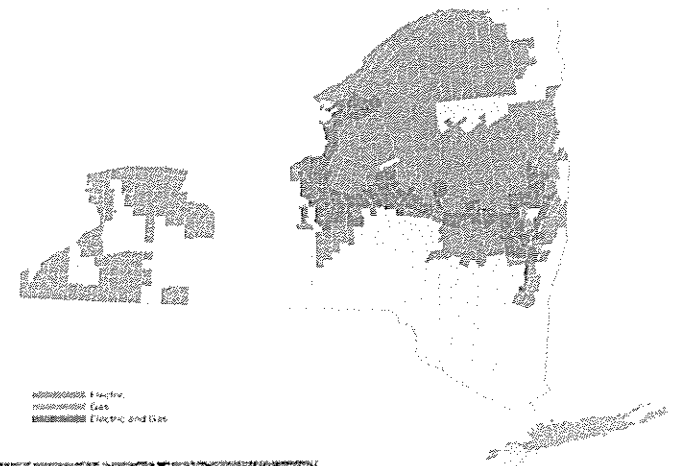
Already Underway in Queens

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Queens Natural Gas Reliability Project

\$100M investment will modernize our gas infrastructure and provide:

- ◆ **\$100M+** Energy costs savings **over 15 years**
- ◆ Environmental benefits of **reduced CO₂ emissions by 9,000 tons / year**
- ◆ Enhanced reliability and availability of natural gas
- ◆ Supports NYC Clean Heat Initiative
- ◆ **900 jobs** sustained
- ◆ Adds add \$77.6 million to local GDP.
- ◆ Project expected to be **completed by Spring 2016**



Environmental Defense Fund and National Grid- Small Methane Emissions Study S.I.

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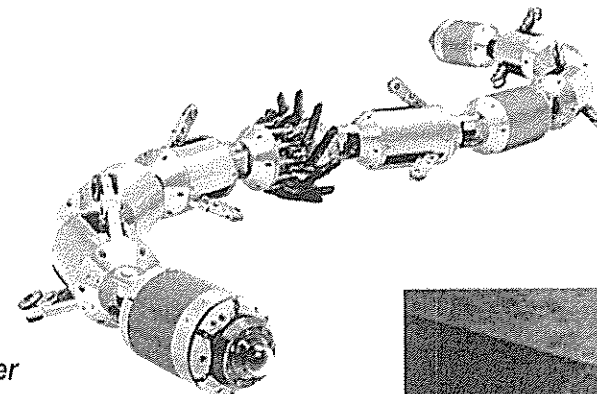
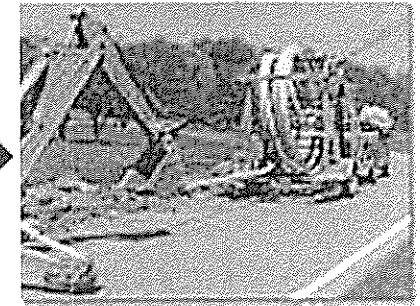
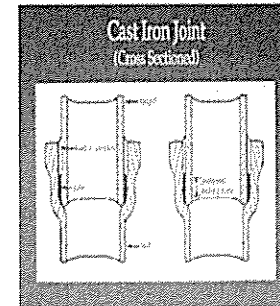
Methane is a greenhouse gas, and National Grid is investing in our infrastructure to reduce methane emissions. Overall in the United States, emissions from natural gas distribution networks have dropped 22% since 1990, even as the number of customers served has increased by 32%.



Modern Infrastructure: Piping

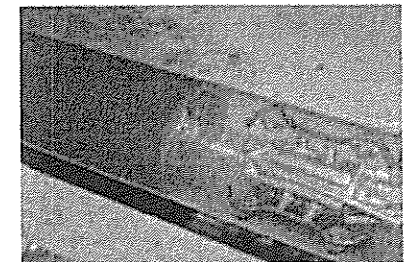
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- ◆ Needs
 - ◆ Varied gas composition
 - ◆ Higher pressures and flows
- ◆ New Materials
- ◆ Retention
 - ◆ Robotic Inspection
- ◆ Re-habilitation and Upgrading
 - ◆ Pipe-in Pipe
 - ◆ Internal Spray Liner



Explorer
NYSEARCH

 TOKYO GAS



Energy Efficiency - The Alliance Commission: Energy 2030

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- ◆ Summary: Policy recommendations to double U.S. economic productivity of energy by 2030

ALLIANCE
TO SAVE ENERGY
Using less. Doing more.



- ◆ Scope: All sectors of the economy – buildings, transportation, industry, power generation, and connections between these sectors.



Invest in energy productivity in all sectors of the economy.

- ◆ Recommendations →

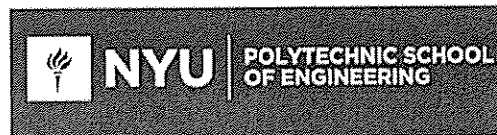


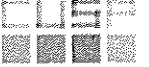
Modernize U.S. infrastructure, buildings, transportation, and equipment.

- ◆ National Grid's 2015 Gas Energy Efficiency Incentive Budget: \$51 Million in NYC.



Educate consumers, business leaders and policy makers to encourage smarter energy use.



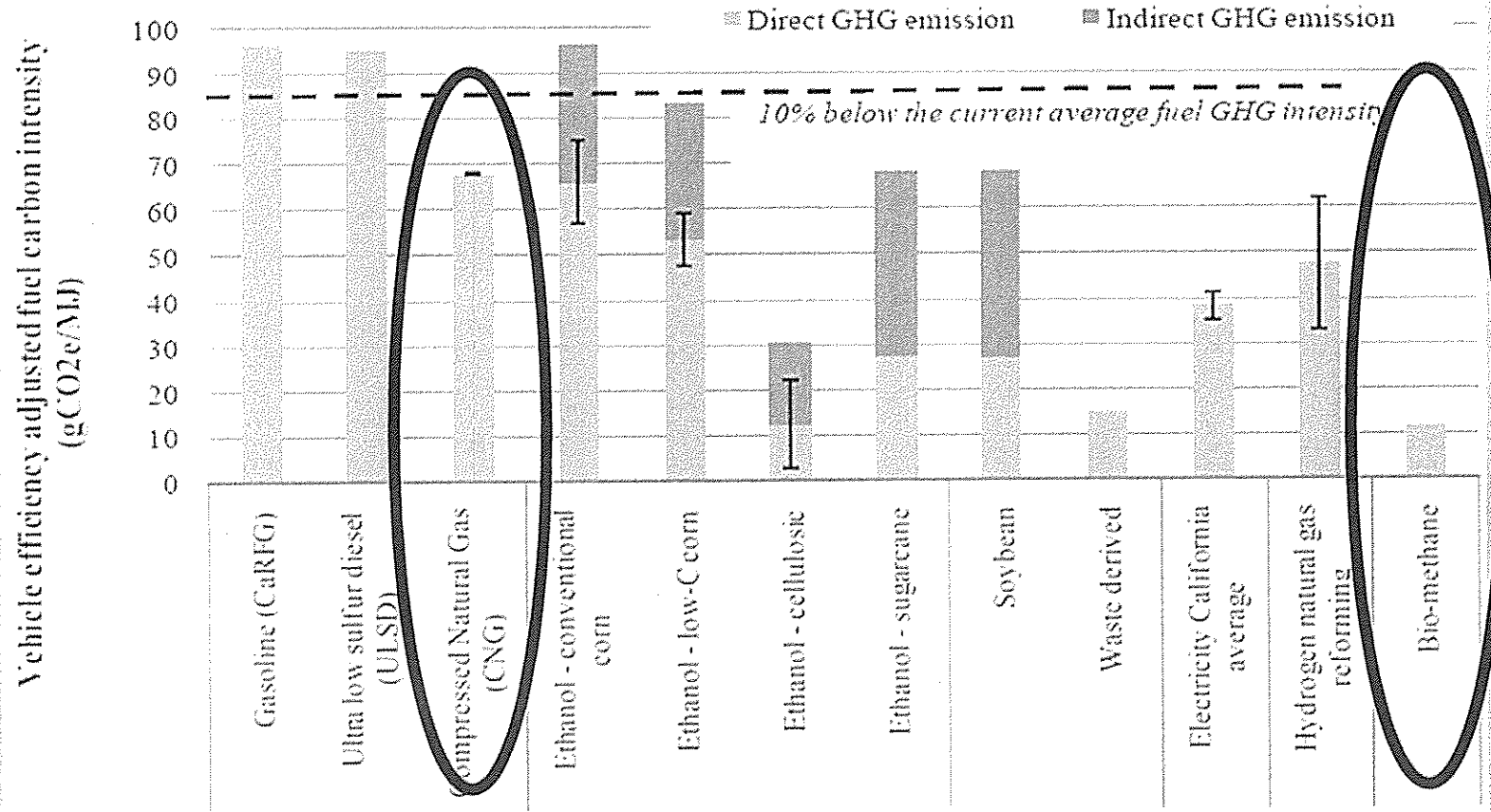
Support for
 & the
Urban Future Lab

Transportation

The Other Half of Climate Change

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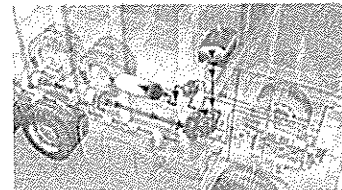
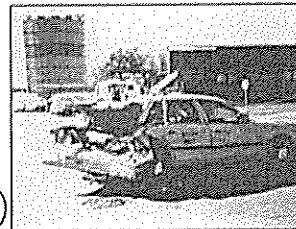
gti.



Natural Gas and Fuel Cell Electric Vehicles

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- ◆ A series of US firsts for NYC
 - ◆ First Commercial Transit Bus (Queens)
 - ◆ First Original Equipment Taxi (Ford Crown Victoria) Safe!
 - ◆ Largest fueling station in US when built in 1997
- ◆ Jackie Gleason Depot (Bklyn)
 - ◆ 4,800 scfm, fills a transit bus in 3½ min.
- ◆ Local Law #6 stimulated a new industry in NYC.
- ◆ Bronx Community College; one of first US technician training programs.
- ◆ Several R&D projects (e.g. hydraulic hybrid truck).
- ◆ Fuel Cell Electric (Renewable Hydrogen) Vehicle Potential



TOYOTA



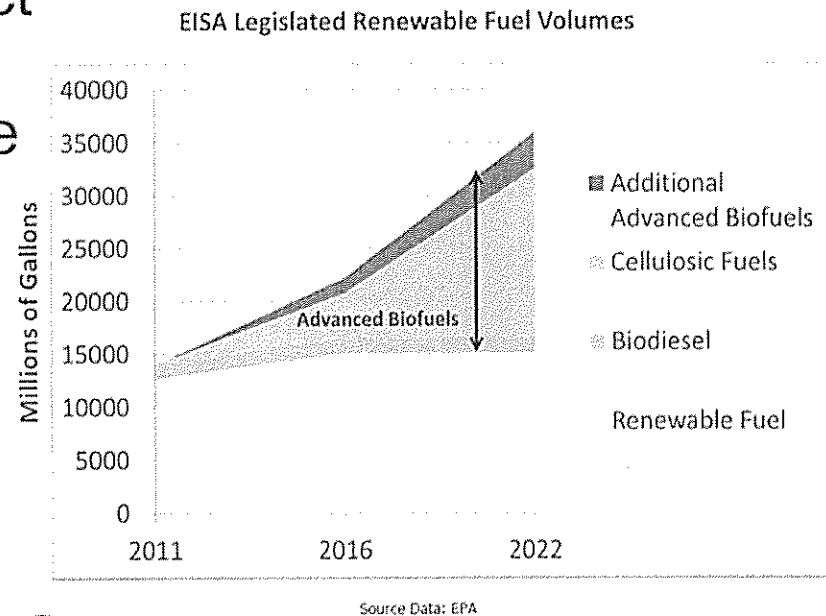
USEPA Renewable Transportation Fuel Standard (RFS-2)

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- ◆ Renewable Natural Gas is an “Cellulosic Bio-fuel” as produced from landfills, wastewater facilities, food waste, etc.
- ◆ NGV customers that contract for independent supplies of renewable gas can generate credits called RINs.
(1 RIN = 77,000 Btu_{LHV})
- ◆ Gas RINs traded for \$0.89 = \$1.32/ GGE = \$1.03/therm
- ◆ SI Landfill (1988) New RFQ
 - ◆ 3-4 MMcf/day Pipeline Quality Gas



CLINTON
CLIMATE
INITIATIVE



Newtown Creek Demonstration Project

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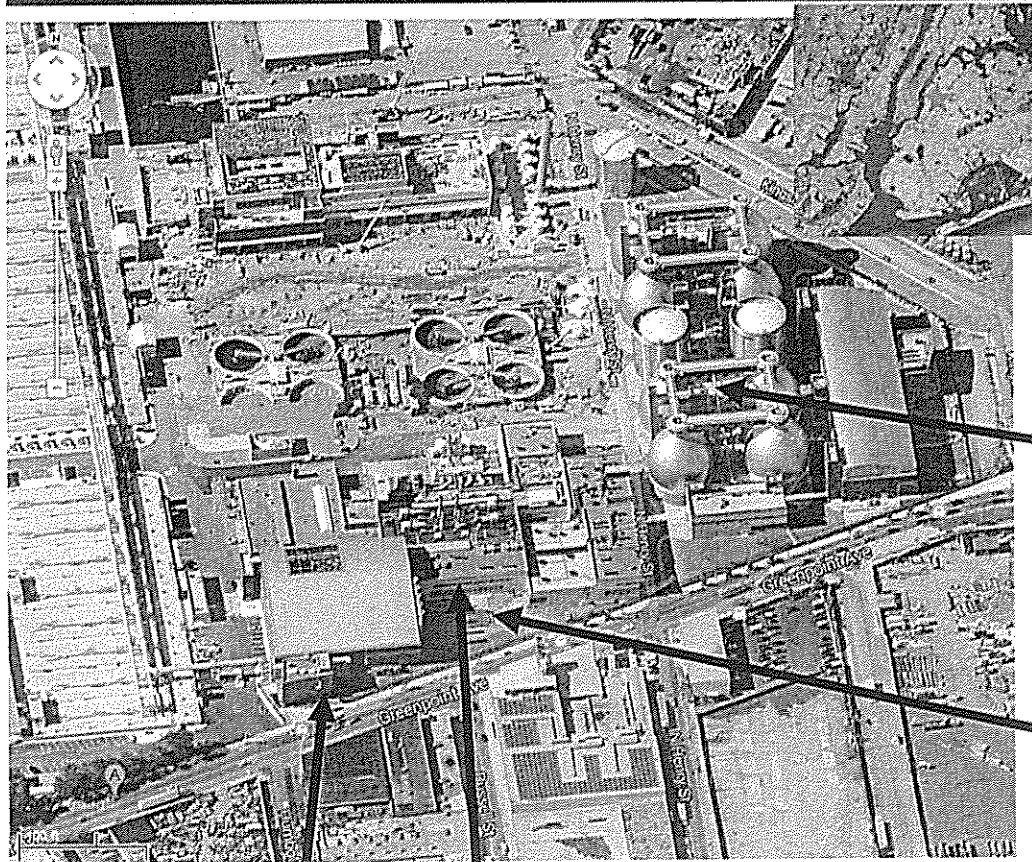
- ◆ National Grid and the New York City Department of Environmental Protection are working together to deliver renewable gas from the largest wastewater treatment plant in New York City which will be supplemented by food waste.
- ◆ Once operational, the project will inject enough gas to provide heat to approximately 2,500 homes and reduce CO₂ emissions by about 16,000 tons annually (equal to CO₂ emissions of approximately 3,000 cars)



Picture of Newtown Creek wastewater treatment plant in Brooklyn, NY.
Source: New York City Department of Environmental Protection

Newtown Creek Demonstration Project

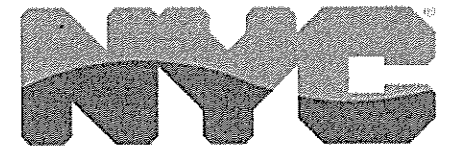
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Control Room

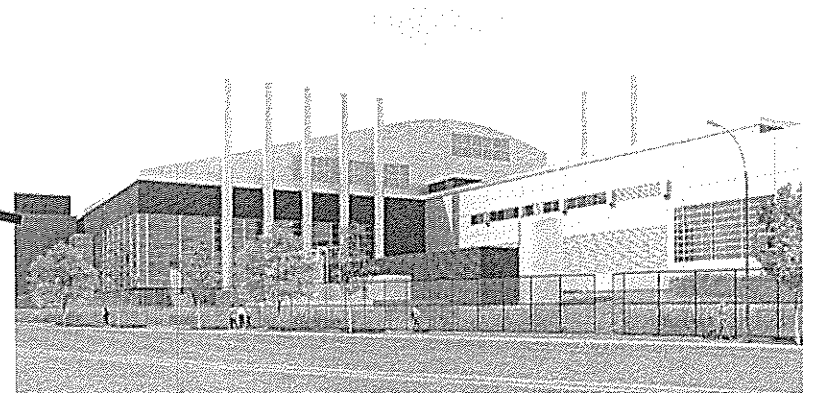
Boilers

Digesters



Environmental
Protection

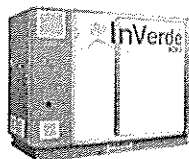
Newtown Creek – National Grid Beneficial Use of ADG Project



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Clean Distributed Generation and Fuel Cells

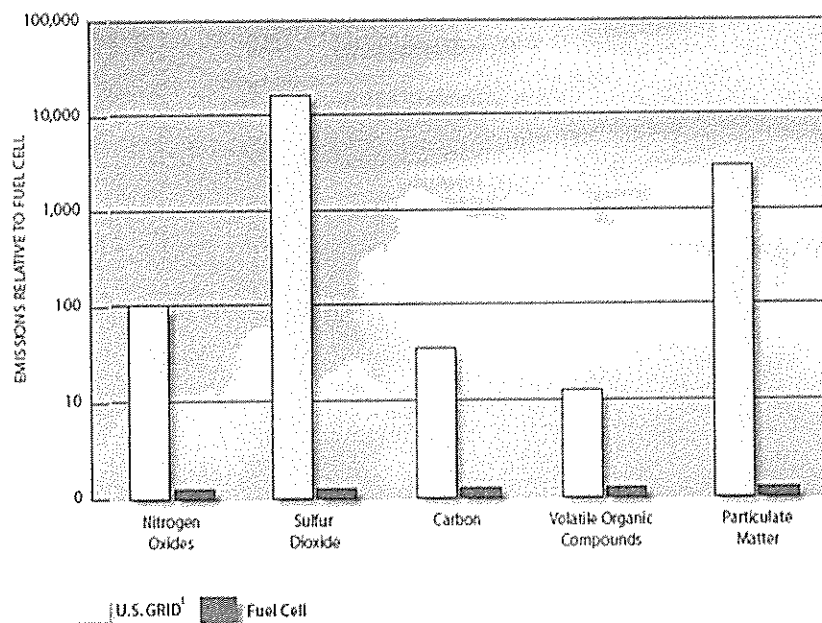
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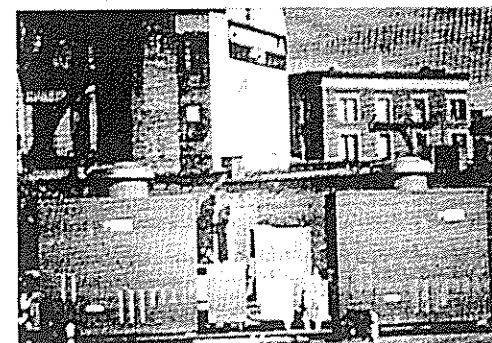
◆ Combined Heat & Power Served by NGrid in NYC

- ◆ 90 MW at 130 customer sites
- ◆ New Options for Resiliency

FUEL CELL EMISSIONS vs. U.S. GRID EMISSIONS



12.5 kW Fuel Cells: Cinderella Project
Brooklyn, 1968



More news

1993

St. Vincent's using revolutionary 'fuel cells'

Among first in country to get electricity from natural gas

Elements of the fuel cell powerplant

VERDANT POWER

Verdant Power, East River

Future: Holistic Energy Systems

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◆ Micro-Grid and Holistic Energy

◆ Dynamic Energy Cost and Volatility Management

◆ Source Flexibility/Reliability

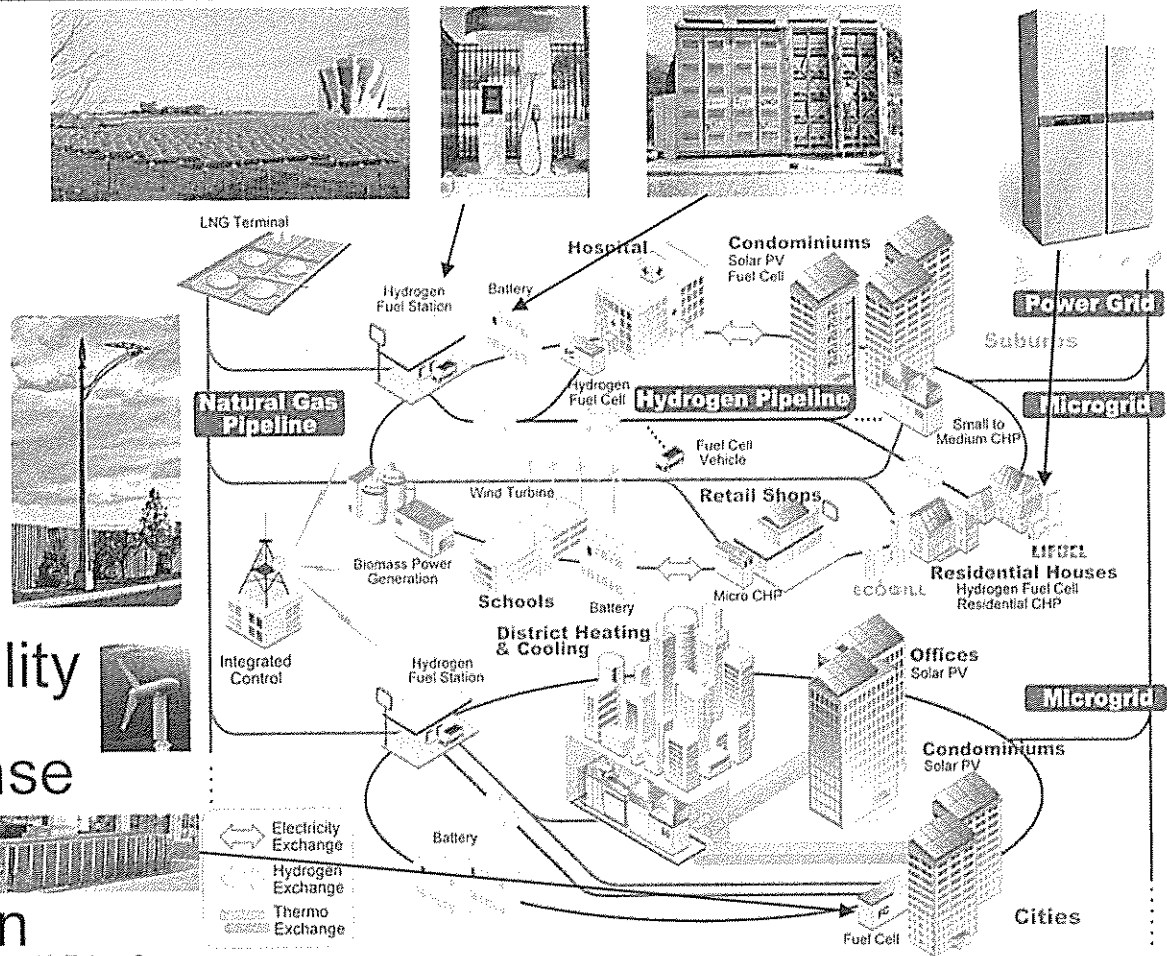
◆ Demand Response

◆ Clean Generation

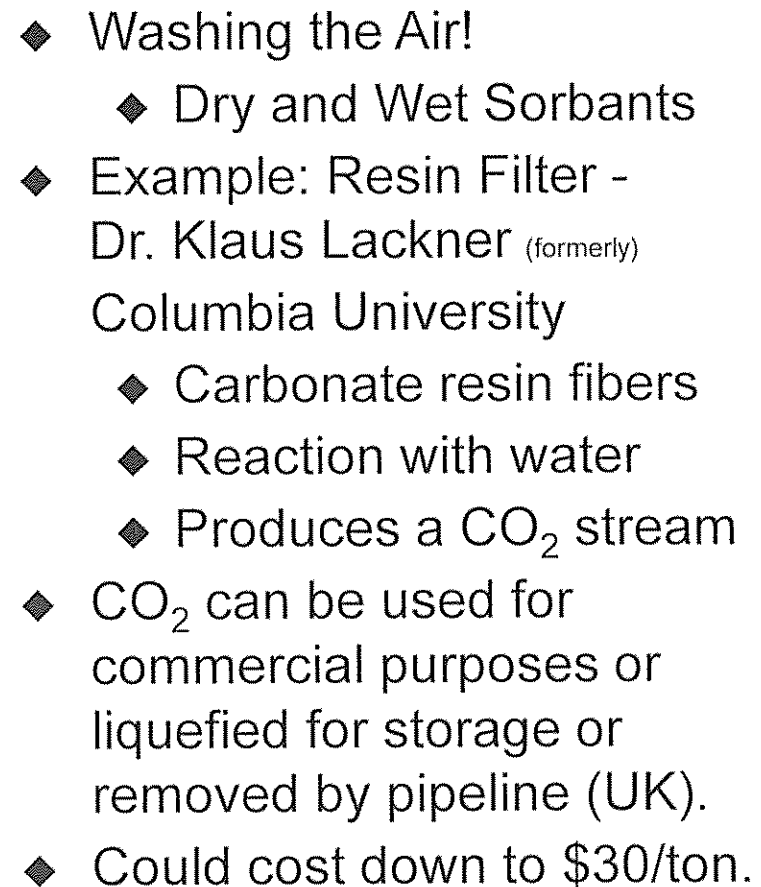
*Lumisolar, manuf.
Brooklyn Navy Yard*

e.g. Bloom Energy

"Sam" Muraki, Tokyo Gas



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"Scientific American June 2010