CITY COUNCIL
CITY OF NEW YORK

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TRANSCRIPT OF THE MINUTES

Of the

COMMITTEE ON ENVIRONMENTAL PROTECTION

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A P P E A R A N C E S (CONTINUED)

Paul Schubert

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[background comments]

CHAIRPERSON RICHARDS: 'Kay. Good Morning.

[gavel]

The hearing is now starting. Welcome to our -- this beautiful building, actually -- I wanna thank CUNY for obviously hosting us and before I begin, I will bring up Dr. Sanjoy Banerjee to bring greetings and to bring up the Vice Chancellor, Gillian Small from CUNY, [background comments] who are hosting us at this beautiful building.

[background comments]

SANJOY BANERJEE: Thank you, Chairman Richards, Council Members; ladies and gentlemen. I'm Sanjoy Banerjee and I'm the Director of the CUNY Energy Institute, professor here, and it's a great pleasure to introduce Vice Chancellor Gillian Small, who really is the person who developed this building and had a lot of the science that's being done between the CUNY campuses taking place here.

So Vice Chancellor Small herself is a biologist, very eminent, well-known for her research, and she now has responsibilities as the vice chancellor for coordinating all research between the various campuses and for various outreach efforts and efforts by CUNY to address some of the key issues that we are facing such as in the energy and the environment. So I'm gonna hand this over to her to just make a few welcoming remarks, keeping it really brief, of course, since we don't want to cut into your time.

[applause]

GILLIAN SMALL: Thank you, Sanjoy, Council Member Richards and fellow Council Members and audience members. I'm really pleased to welcome you to CUNY and to the CUNY Advanced Science Research Center. As Sanjoy mentioned, this building is just opening its doors and the vision really started many years ago when at CUNY clearly we have expertise and a reputation in sciences for many years, but to tackle the challenges of the 21st century, really we needed to have first-class science and first-class science facilities. We really started the vision by thinking of what areas would be critical going forward and actually started with the CUNY Energy Institute and we managed to attract Dr. Banerjee to CUNY from his warmer climate in California and he has been running the CUNY Energy Institute since that time very, very successfully and the model is really being reproduced in this building in five key areas of research; that's nanoscience, photonics, structural biology, neuroscience and environmental sciences, and the model is, we're attracting high-level scientists to come and lead each of those initiatives, to hire a few more faculty in those, to bring faculty together from both across CUNY and other institutions in the area to tackle really pressing issues -- we all know climate change, renewable energy, the subject of this hearing and many others -- and to ask the scientists to not only work together within their area, but to work across areas in an interdisciplinary way, which is really the way science of the future is taking place. If you think about traditional universities, when the chemistry department is on one side of the campus and the engineering department may be on another side of the campus and so this building brings people together in a collaborative way; there's many, many areas for them to meet, there's a big sweeping staircase going up the building to encourage people to interact and I encourage you, if you have any time or if you want to slip out of the hearing for a few minutes to try and look around, we would love you to see it. The other thing that we've put in the building is some very high-end core facilities to support that research, so we have a state-of-the-art NanoFab facility being created on the ground floor and many other core facilities, a rooftop observatory for the sensing and LIDAR. This really is something that CUNY is very proud of and in addition, always our mission is to create the next pipeline of scientists, so we're very committed to the stem pipeline; we have a center that's no open yet in the building on the first floor that we're calling the Science and Education Center; we have subcontracted with Liberty Science Center to create that and it's a hands-on, interactive experience that we'll bringing in classes of middle school and high school students to really get exposed to the science of the future and then meet some of the scientists and hopefully attract them to carry on the work and address these important subjects of the 21st century.

So again, I welcome you; I am sure you will have a good meeting and hearing and please come back and visit us again. Thank you.

[applause]

CHAIRPERSON RICHARDS: Thank you so much.

Alrighty, before I begin I just want to acknowledge we've been joined by my -- I guess we're like Batman and Robin, Council Member Costa Constantinides from Queens and also committee to my Counsel, Samara Swanston, who got us all here today. Thank you for your hard work. And Bill Murray, our Policy Analyst. [applause] Thank you for your hard work.

Good morning. I am Council Member Donovan Richards; Chair of the Environmental Protection Committee and today the Committee will hear from academics experts and visionaries on how we can generate energy and grow as a city without polluting the air and destroying the troposphere.

The United States, with just 5 percent of the world's population, emits 22 percent of worldwide greenhouse gas emissions. While we currently rank second in emitting the most greenhouse gases, historically our contribution has been significantly higher than China, India and other nations. There is a scientific consensus that the global increases in greenhouse gases and the associated current extremes in climate are primarily due to fossil fuel use. New

York City set an ambitious goal for addressing climate change in 2008, Local Law 22 of 2008, the New York Climate Protection Act, required New York City to reduce its greenhouse gas emissions due to City operations by 3 percent per year over 10 years from a baseline of 2005, and required the City to reduce overall citywide gas emissions by 1 percent per year over the next 30 years. However, just 6 years later, based upon information developed from the Fifth Assessment of the Intergovernmental Panel on Climate Change, it was clear that this mandate had to be strengthened.

To strengthen the mandate, New York City passed Local Law 66 of 2014 which will require the City to reduce citywide greenhouses gas emissions by 80 percent by 2050.

New York City has already reduced its greenhouse gas emissions by 19 percent since 2005 and is almost two-thirds of the way towards achieving a 30 percent reduction by 2030. Cleaner generation of electricity and steam were responsible for the majority of emission reductions and New Yorkers are using electricity and heating fuel more efficiently in buildings.

Despite this progress, the New York City Panel on Climate Change recently came out with its 2015 report on local climate and they concluded that between now and 2050 mean annual temperatures in New York City will rise between 4 and 6 degrees Fahrenheit. From 2050 to 2080, mean annual temperature will rise between 5 and 8.8 degrees Fahrenheit. Mean annual precipitation will also rise between 5 and 13 percent by the 2080s. Sea level is also projected to rise from 11 to 21 inches by the 2050s, from 18 to 39 inches by the 2080s and as much as 6 feet by 2100.

According to the United Nations, only an aggressive push over the next 14 years will be sufficient to bring greenhouse gas emissions under control, and if greater efforts to cut emissions are not implemented soon, future generations that are seeking to limit or reverse the effects of climate change will have to depend on technology that currently do not exist in order to permanently remove greenhouse gases from the atmosphere; they may not be able to limit or reverse greenhouse gas emissions at all. Unfortunately, until now, international efforts and treaties to address climate change have fallen short; that is why cities in action at this local level are crucial.

Moving forward to significantly cut global emissions we have to transition away from the use of fossil fuels. Oil and natural gas cannot be expected to generate clean energy and help us grow as a city without polluting the air or polluting the troposphere into the 22nd century.

One important but often overlooked way to reduce the use of fossil fuels is just that, to use less through conservation. A bill that I introduced, Int. No. 0578, would help New York City do this by requiring merchants and businesses to turn off their lights, including advertising at night when they are not being used and when the last person leaves the building. Furthermore, we are going to lead by example with another bill that I introduced, No. 0693, which will require that illumination in City-owned and City-controlled spaces have occupancy sensors so that 100 percent of all City buildings would not have their lights on when their spaces are not being used. Sounds like common sense to me.

However, with conservation we still need to reduce and transition away from our fossil fuel use. Only the use of renewable energy generated on-site in battery storage will enable us to improve air quality, grow our city, reduce morbidity and mortality from air pollution and reduce and ultimately eliminate New York City's greenhouse gas emissions.

Now I have the fun of introducing our first presenter from the Urban Green Council, Miss Laurie Kerr.

[applause]

[background comments]

LAURIE KERR: Thank you, Chair Richards, City Council Members and staff and distinguished fellow presenters and audience today.

The Urban Green Council is honored to open today's presentation on this incredibly urgent and important topic. My colleague Richard Lee and I are going to be discussing some big picture items; this is kind of appropriate for opening a day's event. Some of our major themes are going to be that while new sources of energy are extremely important, one of our cheapest and most readily available resources is in fact energy efficiency, using less energy than we are right now.

We have a lot to do and as Chair Richards said, but we've done a lot so far, we're reduced by 19 percent and I wanna talk for a minute about some of the policies that we've done already. But we still have a lot to do and I'm gonna discuss a few things that we could do right away and then Dick Lee is going to talk about how we have to gear up for a much vaster, longer term effort.

So this is probably familiar to almost everyone here, but New York City's carbon emissions are dominated by the building sector; over 70 percent of our emissions come from energy used in buildings and at our anticipated growth rates, we think that roughly 80 percent of the buildings we'll have in 2050 are buildings that we have today. So making this existing building stock more efficient and making all of our new buildings more efficient is one of the most critical things that we have to address going forward.

Looking back at what we've done in the last 10 years or so, we started with a Local Law that required all City buildings to be lead; we followed with the Greener, Greater Buildings Plan that required all large existing buildings to measure their energy use and do some energy efficiency improvements and then City government buildings were required to become more efficient; we challenged universities and hospitals and major tenants to reduce energy; every important member of those communities has signed up; we had a Green Codes Task Force; 60 proposals relating to energy efficiency. So a lot has been done, but we're 19 percent of 80. So we have a lot more to do.

So looking at the short-term, here's what our energy looks like. So we measured the energy use in our largest buildings and here's what we found out. The worst performing buildings in every sector used dramatically more energy than the best performing buildings, so this compares the 95th percentile which are light-colored to the dark-colored 5th percentile and you can see, sometimes they are 3 times more; sometimes 8 times more energy in these sectors. So that's not 80 percent more; it's 800 percent more energy. So there's a lot that we could be doing by making these poor performers perform more efficiently.

How much? Analytically we looked across the City's profile and this shows the deciles of energy use. So a decile is 10 percent, the tall bars are the poorest performing 10 percent; the short bars the best performing and the red is multi-family; the blue is commercial office building. And then we just did a thought experiment; what if everybody had the average; how much energy could we save? It turned out that that was about 18 percent and if everybody came to the top core tile, we could save 31 percent. Why is this interesting? Well because 50 percent or 25 percent of the buildings are already performing that well, so we know that we could be achieving this. What would this mean to New Yorkers? Just in monetary terms, $400 to $600 per year saved for each New Yorker.

So how can we achieve these savings? A lot has to be done in terms of, you know, new windows, better insulation and so on and so on, but there's a whole lot of energy efficiency that we can get at just by running our buildings better. How much is that? So this is an analysis by First Fuel, one of the leading analytic companies in energy efficiency and they found -- the green bars are just operational savings in different buildings -- and they found that half of our savings that we could get right now of that say 30 percent would come from just making sure that buildings are running better. So that's a big savings; City has already passed a law that requires buildings to be tuned or "retro commissioned" every 10 years; that's a great first step; [background comments] I think there's another idea on the table to require building operators to be trained; I think that, you know, that the idea that a building operator should now how to run their building efficiently is something we could do right away and makes incredible sense. [background comments]

Another thing that we need to think about are deep energy retrofits. So the less expensive end, just operations and then there are some examples of -- Fashion Institute of Technology over the last 6 years has reduced by 39 percent across its whole portfolio; you probably know about the Empire State Building. But those are just a few buildings; we need to do more, so how can we ramp up these deep energy retrofits?

One idea is that the City should be leading with its own portfolio; perhaps all new City buildings should be doing 30 percent better, maybe some should actually be passive house, which is the standard that requires buildings to be incredibly well-insulated and to use their waste heat and waste cooling or to save that waste heat and waste cooling, and they can reduce energy by like 60-80 percent by using those techniques. So maybe some of the City's portfolio should be striking new ground and training the New York industry on how to do these things. Existing buildings, likewise; maybe we need to push a little bit harder, we're committed to 35 percent reduction by 2025; what about the out years; where should we be in 2030, 40 and 50?

And then, what about requiring that some of the City's building stock do deep energy retrofits? If we did those sorts of things, I think that we would start to build expertise so that the entire city can go to scale. So right now these things are sort of exotic, only a few people know how to do them; we need to broaden the knowledge base before we can really go broad throughout the whole city.

And the third thing; this slide ended up being a lot more abstract, it had a -- [laughter] but I think -- [laugh] I think it says what it should say. Essentially there's a proposal afoot to allow neighboring brownstones to share the Fire Department access routes so that every single one doesn't have to use all that space but every other one could do that. But I think this is perhaps more eloquent.

So now, Richard.

RICHARD LEIGH: I'm Richard Leigh; I'm from Urban Green Council also. [background comments] And several years ago we undertook a… [interpose, background comments] Yeah. Several years ago we undertook a… [interpose, background comments] Hello; is the mic on? [laughter, background comments] Yeah. Yeah. Okay. We undertook at study called "90 by 50," which came out a few months before the City's first "80 by 50" study did and what we were trying to do was establish not where New York ought to go, but to show that it was possible to decarbonizes the city, and so this is -- what I'm gonna show you is quick results from that study and it is not, again, a prescription; we're not saying you have to do this anymore than we're saying that we have to go to 90 percent reductions; I'll take 80 percent very happily. But what we are showing you is that this is one way to get there and if we can find other ways that are better, so much the better.

So the core of this is energy efficiency in buildings, that if we wanna reduce the energy that's used in our buildings; we broke the buildings of New York down into a set of eight different building types which we could construct computer models of and then we made energy efficiency improvements in them. First, air seal, so that air doesn't leak in and our, carrying heat out; then that makes them stuffy inside, so you have to add in ventilation, so we add ventilation, but we add heat-recovery ventilation so that in winter the warm going out warms up the cool air coming in and that lowers heating loads dramatically; add insulation, either on the outside where the building is not so good-looking or on the inside if you've got a nice façade; convert to triple-glazed windows. All of these are off-the-shelf technologies that you can purchase today and that are in use today, especially in Europe, but to some extent in progressive construction practices here. And then, because -- I was put here on Earth to tell people you have to stop burning stuff and that means you have to stop burning fossil fuels and that means we have to basically electrify our buildings. I'm not insisting a 100 percent, but in this model we assumed a 100 percent and we did it by bringing in heat pumps of different kinds -- air to air heat pumps, ground source heat pumps -- and used them both to provide space heat and cooling in the summer and hot water year-round. All the details on this are -- much more details are in the study that's available for download on our website.

So all of this is fairly straight-forward stuff and it results in substantial energy savings; these are the 8 buildings that we have in New York City today tuned to match energy use in New York City today. So that's showing you in eight different kinds of buildings; three commercials in blue and five residentials in some color or other -- [sneeze] excuse me -- and so that's what average buildings use today in New York and the result is a bunch of grid electricity and a whole lot of fuel being burned.

These are some typical buildings that exist today, including the Empire State Building and showing -- the lowest bar is a passive house, which we, as you'll see, are not trying to get to, but there are certified passive houses in New York, so this can be done.

So these are the buildings as modeled after our improvements, the ones that I just showed you on the previous slide and you can see these dramatic reductions in energy use; that assumes the same electricity mix we have today; that is, electricity produced with substantial carbon generation, as well as some carbon-free generation. If we go to carbon-free generation, that happens and that's the resulting fuel use.

So is this all pie in the sky stuff? Well first, a quick summary. Notice we can do all this on about the same electric energy that we are using today; we've taken and reduced electric use for electric purposes and we've replaced all of the fuel we were burning and we're doing it all on about the same electric energy. There is a catch here and that is the peak demand is 60 percent higher in 2050 than it is today and that comes because we're now providing heat with electricity, so we get a peak demand at 3 a.m. on a January night because that's when it's really cold and that is far greater than today's air conditioning peaks in July. So that is an issue that has to be dealt with, it cries out for storage, either thermal storage, electric storage; some mix, but it is an issue we will be facing.

But would this cost a lot? Well sure, it's not cheap, but the prices you see there, compare them to the sale price of residences in New York and commercial space in New York and it's not crazy, it's not astronomical; it is something doable. To put that into slightly better scale, break it down by the City and it's about 7 percent of the municipal budget in 2011 or about $580 apiece, but we're not gonna ask everyone for that money because it will pay for itself through fuel savings. And so we assert that this is essentially cost neutral, not to today's building owner, but to the city as a whole. The reason I make that distinction is that these measures do not pay for themselves in three weeks or even three years; some of them are long-term, like windows and they will take 25 years to pay for themselves. But everything will pay for itself; from the point of view of the City, of society at large, we have to plan the way electric utilities used to plan and look at a long-term future over the life of the investment and in those terms, these savings that I just showed you pay for themselves. But as it stands, a building owner will not make these choices because they are not looking for 20-year paybacks, they're looking for 3 and 4 and 5-year paybacks. So that's an economic issue of great importance.

So how much electricity do we need? And the answer is about the same amount of energy, but isn't that an awful lot of carbon-free energy to make? And this chart here is an indicator that in fact it is completely doable; we need about 19 terawatt hours and we can get 11 of that from the roofs of our buildings. I didn't mention that before, but on that slide showing the measures, I also showed photovoltaics on the roof, and the photovoltaics, first we assume that half the buildings of New York had roofs that were not in shadow; half of them were in shadow, so we can't use them; then of those roofs that are not in shadow, we said half of that roof is available for photovoltaics, the other half is taken up by the Fire Department that Laurie mentioned, by elevator houses; by other stuff that's on the roof, so you get half of half the roofs, a quarter of the roofs of New York will give us 11 terawatt hours; that number is completely consistent with studies done by other groups, both at CUNY and other places. So it's not a controversial number, and it doesn't rely on super-high efficiency research grade photovoltaics.

So where do we get the remaining 27 terawatt hours? And the simple answer is, 2600 4 megabyte wind turbines, which is something like 10 gigawatts of wind turbine. Isn't 10 gigawatts an awful lot of wind turbine? In 2014, China put in 40 gigawatts of wind turbines, the equivalent of about 4 nukes and you know, their building spree is continuing unabated.

So it's certainly a totally reasonable number of wind turbines, but we don't have to do it all with wind turbines; we can put photovoltaics over parking lots, over the Long Island Expressway, over any number of things where people could use some shade. We could put photovoltaic farms Upstate, but that makes less sense in our climate, but if you can get it right here in the city and provide something useful like shade or protection; it does make a lot of sense. Nuclear power exists; I'm not advocating it, but I'm pointing out that it provides about a gigawatt of fairly carbon-free power and so it's there to show you how many nukes we would need if we were doing it. And then down in the corner I show that there's a mix we could do also.

I should mention that everything I've mentioned does have a carbon footprint; hydropower and wind have the lowest carbon footprints, nukes and photovoltaics are about the same. All of them have much less of a carbon footprint than of course, than fossil fuels, but they're not zero.

So that's the big picture; here's that peak demand issue that I mentioned; this is a rehash of the energy use, the electric energy use and then showing you just graphically how the peak demand shows up on a January night and it'll be something like 13 gigawatts instead of today's 8. So that's a serious challenge; I understand some of the speakers here will be talking about storage; I encourage people to think about both electrical storage and thermal storage, because this peak is brought about by a need for heat in the middle of the night, so if you could have sheetrock, gypsum wallboard that had a phase-change material in it that would charge up when the temperature was over 70 and let heat out when the temperature went below 70; you could put a lot of heat away there.

But that's the major issue, so here's the summary situation; the first and best and most important place to go is energy efficiency and I showed you our graphs and what we think we can reduce, Laurie showed you a previous set and that is absolutely the place to start and to get half of our savings and then we can get the rest of it out of assorted carbon-free or nearly carbon-free sources.

So I'd like to thank Chairman Richards, Council Members and the audience; this is my presentation.

CHAIRPERSON RICHARDS: Thank you so much.

[applause]

[background comment]

Alrighty. Next we will hear from Micah Kotch, the Director of NY Prize and Strategic Adviser for Innovation for NYSERDA.

MICAH KOTCH: Okay. Good morning, members of the Committee; thanks to CUNY for hosting us; thank you for the opportunity to testify before you today.

My name is Micah Kotch, I'm a New York City native; I also serve as the Director of NY Prize as well as Strategic Advisor for Innovation for the New York State Energy and Research 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 consumer energy via the State's overarching plan known as "Reforming the Energy Vision" of 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're 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, so free of subsidies. But importantly, as we change, we're even more committed to using our resources to support low- to moderate-income residents to ensure that these populations are not left out of the clean energy economy as we support the growth of this industry. NYSERDA will indeed continue to support our work with low- to moderate-income communities, offering end user incentives to increase energy efficiency in 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. Hurricane Sandy, which hit New York 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's 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 -- you and me and every one else here -- will need to be spent over the next decade to maintain current generation and distribution capabilities, compared with $17 billion that we spent over the last decade. Further, as extreme weather events continue to affect communities across the State, it's becoming increasingly clear that meaningful action to mitigate climate change is necessary.

These are some of the reasons why we've launched NY Prize, which 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, which is usually a combination of gas, turbines and renewable resources, like solar or wind, as well as energy storage. The purpose is to provide power more efficiently than the grid, as well as providing islanding capability in the case of a power outage. In New York City this famously took place at Co-Op City, the largest affordable housing development in the country, as well as New York University during and after Sandy, thanks to the campus microgrid systems that they had in place, which was supported by NYSERDA in both places.

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 what I like to call at least five REV labs across New York where community microgrids show a path to a stronger bulk power system by 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. I'll say that one more time just in case there's anyone in the audience who's considering submitting an application for feasibility, 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. 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-party and customers.

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

The challenges that we face collectively from the power grid are daunting; huge portions of the grid are aging and increasingly stressed during periods of peak demand, as you heard from Dick, as well as extreme weather. An estimated 43 percent of the State's 11,000 miles of transmission lines are gonna need to be replaced in the next 30 years and currently about 7 percent of our energy is wasted via line losses across both transmission and distributions systems. It's these improvements that will cost an additional $30 billion on upgrades over the next decades and so rather than patch an antiquated system, what we propose is building a system that's smarter.

One of the biggest expenses in maintaining the grid is ensuring that the system has enough power to handle peak load; the largest demand placed on the system usually today, on a hot and 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've really thrown down the gauntlet for community microgrid projects to test new services and business models and provide the investor on 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 primarily energy efficiency.

NY Prize is not about installing more diesel-fired backup standby generators, we are purposely technology agnostic; we will fund generation; we will not fund single-customer microgrids that benefit one load behind the meter; we're really about extending today's provide microgrid model to the next level. In other words, we wanna see multiple customers, including at least one critical facility with an ability to island as well as to benefit the bulk power system during normal blue sky operating conditions.

I just wanna spend a minute on the critical facility element because I think that's really important.

Any qualifying microgrid is gonna have to include a hospital or a critical care center or police or a fire station, a wastewater or treatment plant, a school or a university or shelters and facilities of refuge. On the NY Prize website; again, prize.ny.gov, we've actually shown where these critical facilities exist across New York City, as well as 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 of this 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 roughly 25 of these awards, depending on the proposals, and there's no cost-share 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 through February of next year, we expect to make 8-10 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 state is going to address those concerns and help us to discover the most technically and economically feasible projects.

The third stage will begin in July and run through the end of 2017. We'll award up to $7 million to 5-7 projects and we will be expecting considerable cost-share for the completion of these systems.

So what's the benefit of funding these microgrids? Well aside from helping the communities involved become more resilient, more efficient, cleaner 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, as well as around the country.

As I mentioned earlier, there are several elements to a microgrid that can be used to provide on-site power; all of these have actually been used to great success around New York City. One element is a combined heat and power unit, which is also referred to as a cogen or a cogeneration system or just CHP for short. CHP replaces a typical building combination of grid power and a hot water boiler by going through a combined system which generates power from natural gas or sometimes a fuel cell and then capturing and reusing the waste heat; buildings can raise their efficiency from about 50-75 percent.

NYSERDA has been supporting CHP since 2000 and has helped in the installation of dozens of these units here in New York City as well as around the State. In the City, CHP systems can be found at such diverse locations as Fox News, New York Presbyterian Hospital, the New York Marriott Downtown, the Sheraton 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've significant growth in this renewable resource. Governor Cuomo launched New York Sun in 2012, a program that will bring up to 3,000 megawatts of solar power to the State by 2023. This billion dollar 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, the Whole Foods in Brooklyn, FedEx 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. New York 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 costs. And there's another program called 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, which is now known as herecomessolar.nyc, which reached over 400 of our neighbors in Kensington and Windsor Terrace through neighbor to neighbor outreach and resulted in the installation of 23 rooftop solar and solar thermal systems for Brooklyn residents.

The last element to bring energy efficiency improvements to a microgrid can be storage. Electricity is not consumed at a constant level, demand is constantly rising and falling based on the needs for the day and the 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 demands;

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 more 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, lead acid batteries, flow batteries that are being developed here at CUNY, as well as emerging solutions including advance 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 megawatts of peak demand, 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 example, Con Edison is investing $50 million in utility-scale storage within its territory, which is part of a $500 million program in demand-side management in order to avoid building a billion dollar 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, our large solar installer and manufacturer, 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-a-dozen energy storage projects, including a demonstration project right here at CUNY, a 2 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 Voltaic, Block Power and other innovative startups that 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 project 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 that's ready to meet the challenges of a changing climate. Thank you.

CHAIRPERSON RICHARDS: Thank you so much.

[applause]

Sounds like a great program. David Manning from Brookhaven National Lab, the role of Brookhaven National Lab in advancing renewable energy technology.

[background comments]

DAVID MANNING: Thank you very much, Mr. Chairman and ladies and gentleman, and first, a quick comment on NYSERDA, my partner Micah. I was speaking last year at the Wall Street Green Summit and at that time, this was a couple years ago, I was running the Smart Grid Consortium and there was a list of those states that are leading the country in development of the smart grid; New York wasn't on it. [background comment] And then there was a list of the states that have the most potential to advance and the first one on the list was New York. So I said to the headline speaker, I said, "Okay, so how do I get from list number two to list number one and why did you put us on list number two?" And he said, "Well number one is NYSERDA, number two is the City of New York and the way people live here and number, it's the fact that people in New York are pretty committed and we're pretty much engaged, and of course we have fairly high-cost power." So that, by way of introduction, is it's really valuable and helpful that we're doing this today and I wanna thank you. Can you set us up? [background comment] Thanks very much. [background comment]

So my agenda, sir; just quickly -- oh I'm sorry, I'll do this first one. Yeah, [background comment] here we go.

The best laboratory arguable in the country for renewable energy in cities is New York City and Brookhaven National Lab, we're early in the food chain in term -- I'm not here to talk about deployment, you have an entire room full of people who know how to do this; I just wanted you to be aware and those in the room to be aware that we are there as partners and that Brookhaven's interest is in working more closely; we have a wonderful relationship with CUNY and I want to congratulate CUNY on this facility and the programs that will be developed within this, because this is a wonderful opportunity for STEM education and for engaging students, but not many people are really aware that we have just an hour east of here one of the major national laboratories in the U.S., the only one in the northeast. Brookhaven is operated by Stony Brook and the Battelle Corporation; they manage it, but the advisory council is directed by Harvard, Princeton, Yale, MIT, Columbia and Cornell and we have partnerships in our work, as you might imagine, with CUNY and the City… **00:50:14 [audio cuts off, resumes at 00:55:18]** there and we're partnering with NYSERDA and others in that world. [background comment] Oh sorry. Okay.

So what I wanna do though just quickly, if could. Can I just pop to the other one? [background comments] So I wasn't going to get into a lot of detail on the science; happy to do that when people ask questions for us; mostly I want you to know that we're here and what we do and Martin Schoonen heads up the bio area and the chemistry area and Martin just did this presentation very recently, but just a few stunning slides, and we've all seen stunning slides, but I was struck by a few of these.

There is a rate of warming in the United States by region and what we're really trying to address here today is; I wanna discuss the urban heat island effect. A lot of the research that we're doing is the impact of cities on the climate. Brookhaven's of the view that about 70 percent of the CO2 emissions in the world are coming from urban centers, so as we address all these issues, there is no better laboratory than right here and that's why… candidly, why I'm here. Sorry… Can you pull that back up; I'm sorry? [background comment] I don't wanna mess with your machine.

So the DOE funds our laboratory, so you might say well why is the Department of Energy focused on all these issues? Well, they are deeply concerned about the sustainability of our power supply; there is a perfect example, there is a Connecticut power plant that shut down in 2012 because the Long Island Sound was just simply too warm to cool it, so it had to shut. There's another one; this is temperature range change, and it's not hard to find us on the map, but again, major graphics demonstrating -- and this is what we do at the National Laboratory; we travel all over the world and we're really good trackers; we're actually trying to measure and bring a higher level of certainty to the measurements, 'cause as we debate the impact of climate change and whatnot -- we don't, but others do -- what we need is the best available science, the best available understanding of these issues.

So once again, projected changes in precipitation, you can see how dramatic those changes are and that just, as you can see, takes us all through these regions and then of course, you look at these very strategic power supply sources and everybody in this room will say they shouldn't be our strategic sources, but they are at the moment. So how vulnerable our power system is, that's an extreme interest to the Department of Energy, but we're also here, especially after this winter; if you're sitting in Boston right now, you're fascinated by these extreme events. So just to have a look at that 67 percent increase in precipitation in our major storms and that takes us up to 2007; that's not today's chart; that just shows you the dramatic increases that are going on in our climate and we believe that the most important thing we could look at here and the opportunity here is to look at this urban heat island. So as we look at the Hudson River and the interaction of energy and water, what we really wanna do also is look at the impact of the City on precipitation; on heat and that's a lot of the analysis that we're doing.

So that's just a quick snapshot, an overview of what we do at the Laboratory and why we're here and our obvious message is that we wanna contribute to the solution.

Just a couple more quick slides. You probably are familiar with Opower; I've thrown that in, just because Opower have -- I call it the schmuck factor, which maybe is a little unfair, [laughter] but Opower has the ability, as you can imagine, to give you a message such as you're using 77 percent more energy than your neighbor and that's costing you money and you're wasting a lot of energy and that technology has served them very well and it's been very successful as they partner with utilities around the country.

But what we really need to do is to bend the future of cities and we can do that -- the three major components generate more energy within the city; solar, wind and of course, geothermal should be there 'cause you're gonna hear a lot about geothermal today, more energy-efficient buildings; we've talked about that already and then finally of course, we have to rethink transportation. So those are your three big buckets and we're very engaged in all three of those, 'cause the real goal is what do you need to bend; what do we need to do to bend the future of cities; how do we change that curve?

So Mr. Chairman, thank you; that's our snapshot.

CHAIRPERSON RICHARDS: We've been joined by Council Member Steve Levin from Brooklyn and he has a question.

COUNCIL MEMBER LEVIN: Thank you, Mr. Chairman.

Well thank you; that's an excellent presentation and very interesting and I'd love to learn more about Brookhaven, but this is a fantastic snapshot.

My question is; so -- and I am a political person by nature, because that's what I do, and you're funded by the Federal Department of Energy; correct?

DAVID MANNING: Exactly.

COUNCIL MEMBER LEVIN: That's not administration to administration; that's a longstanding relationship; correct?

DAVID MANNING: Absolutely, the Lab is run, as I indicated, it's led by a group of universities, including Columbia, MIT, Harvard; that's sort of the oversight panel; the day-to-day management is an entity called Battelle in Stony Brook University, so they operate the Lab on a day-to-day, but my email address is dot gov, so we are… [crosstalk]

COUNCIL MEMBER LEVIN: Okay.

DAVID MANNING: fully funded by the Department of Energy.

COUNCIL MEMBER LEVIN: So my question is, 'cause I'm concerned, right, so we're in the -- we're in the last two years of an administration that recognizes climate change, right; recognizes the human impact to climate change; but there are candidates for president out there right now that well say… [crosstalk]

DAVID MANNING: With other views.

COUNCIL MEMBER LEVIN: the jury is still out, or something like that and I mean, how does that… how do you as a research institution who's collecting data that's showing these impacts, and you're using that data to guide your policy into the future, you know what you wanna be looking at; I mean all of this is looking at how are we can use cities, like New York City, to reduce our carbon footprint nationally, internationally -- if you're looking at ahead, can you be confident right now that you'll be able to continue your research if an administration comes in that says the jury's still out on climate change?

DAVID MANNING: The role of our laboratory is not to make policy; the role of the laboratory is to provide the best available information, the best available science to provide the basis for policy decisions. So we are not a policy shop. We do science and we do analysis and that information feeds the users of the facility; we don't just provide the Department of Energy with this information, we are what's called a user facility. So any number of scientists, universities from around the world come and use our facility because of the scale of these machines. So they're walking away with greater information and that quest for information we're confident will continue and will survive and it is not a political pursuit at all; it is a science pursuit. So we will continue to generate information; we have no position in the policy world, that information will be used by others. And the beauty of this facility because it's funded by the Department of Energy, is that researchers from around the country; obviously, SUNY universities are a big user of our facility; we are a user facility, so scientists can come in and do research with us that they can't otherwise do. Where they take it; what they achieve it with, that's what builds the host of knowledge that we can generate.

COUNCIL MEMBER LEVIN: If you don't mind me asking; how much funding do you receive from the Department of Energy?

DAVID MANNING: The lab's budget is about $700 million per year, so that's our operating cost. As I indicated, we have 3,000 direct employees, 400 graduate students; we have about 4,000 research visitors a year; we have about 37,000 visits a year, including a tremendous number of students and school children, so that's… and as I said, we have 350 buildings on 5,000 acres… [crosstalk]

COUNCIL MEMBER LEVIN: So your DOE funding covers your operating expenses annually…? [crosstalk]

DAVID MANNING: Yes. Yeah.

COUNCIL MEMBER LEVIN: Okay, so essential component.

DAVID MANNING: Yeah.

COUNCIL MEMBER LEVIN: Thank you.

DAVID MANNING: Okay. Thank you. [background comment]

[applause]

CHAIRPERSON RICHARDS: Alrighty. Thank you. [background comments] We're not gonna take questions… we'll take questions after lunch.

So we're gonna hear now from Scott Duncan from Pertamina Energy Tower and they're going to discuss zero carbon buildings. He's going to discuss zero carbon buildings.

[background comments]

SCOTT DUNCAN: Can everyone hear me? [background comments] A little louder? Okay. So uhm… is that better?

Thank you to the New York City Council for inviting us to speak today. I'm Scott Duncan, Design Director, Architect from Skidmore, Owings & Merrill (SOM) and I'm joined by my colleague here in the audience, who is an engineering. We're an architecture and engineering firm working on a variety of scales of buildings and urban design projects around the world.

I was asked today to come talk about this project, the Pertamina Energy Tower, which is to be located in Jakarta, Indonesia, about as far on the planet as you could get from New York, but when completed will be the world's first net zero supertall. So it on-site generates as much energy as it consumes and in fact there's a surplus of energy, as designed to date.

So when we started this project -- and I should say that Pertamina is the oil and gas company, the state-owned oil and gas company of Indonesia, so there's an enormous paradox here, but a big statement about the future. In approaching this project we made energy the central focus of the design, the main driver and it was suggested that we shape the building footprint something like what's on the screen here, with a long face facing the south and north and the short faces looking to the east and west, to cut down on the solar radiation. What we found, by running a series of models, was that compactness actually won out over orientation in the first part of designing a net zero building, which is reducing the loads that go into that building. So a smaller form with the same area, like a square, performs better than a long thin rectangle. Starting with that base case of a square, so imagine this is the building footprint; could be similar in size to a major office building here in New York, rotating that form on a 45-degree angle like this reduces, just by that rotation, 8 percent of the design loads for cooling, which if you don't know, Jakarta is like Florida but with no winters, it's a tropical, very hot environment, no heating. We found that by rounding the corners and making that floor plan more compact there's a further reduction in the annual cooling, in peak cooling loads and annual cooling loads are slightly different; some of the engineers in the room will understand that.

So Jakarta itself is almost on the equator, which means that its north and south exposures for buildings get virtually equal solar radiation, which is a different design problem than we have to deal with in New York. So in thinking of this tower, we designed it to respond to that kind of symmetrical north-south orientation. So going from that rounded plan form to a shaded plan form that has north and south louver bands, so to cut that solar radiation we see a 49 percent reduction in the peak cooling load, which is what's used to design the mechanical system, so almost cut in half just by shaping the building; we haven't done anything yet, except for really reduce the problem. And that plan form evolved to be what you see on the screen, which looks like something that might've come out of a wind tunnel, a piece of a car or what have you, but it's actually been through a sort of solar tunnel, an optimization process that helps to really provide the best thermal performance from that shape. So these, as we call them, shading leaves are on the north and south exposures where they can easily be shaded by horizontal louvers by the high angle sun and looks something like this when seen in detail on a typical floor level, those horizontal louvers providing, again, protection from the high angle sun on the north and south.

We studied around 600 different variations of that fin profile in order to solve for optimal shading, but providing maximum day lighting, reflected light inside of the office spaces and the kind of section cuts through all of those shapes are on the left. The best performer was the one on the right; obviously at a different scale.

Lighting loads are huge contributors to building energy consumption, so you want to keep out the direct sunlight but you wanna draw in that bounced reflected light on the interior. So that louver band is quite effective when seen from outside, but quite open when seen from inside and you can see the kind of effect of the reflected day lighting on the inside.

So on the east and west exposures of the building there's a very different problem, a very different sun geometry which was used to drive the design of this façade, so while the north and south are shown on the bottom and the upper of the screen here is horizontal louvers, there are vertical louvers here which intercept those low-angle east and west sun rays, but still provide about two feet of viewing glass in-between those louvers and that gives the building its kind of distinctive appearance that you see in the handouts and here on the screen, with that kind of bifurcated, that slot that goes on the east and west orientation.

You'll notice at the top there's a special feature which is developed to begin to harvest the energy. I talked about reduction, which is the first important step; the second phase is of course energy generation. So in our case, fortunately, the east and west -- the winds in Jakarta are on an east and west access, so that allowed that east-west cleft, that slot to be a kind of funnel for wind and remember, the wind moves faster at the height of a tall building; this is as tall as the Empire State Building, to give you a sense of scale. We at that topmost point introduced an aperture in the building that acted like a funnel to accelerate those breezes, which are shown in this CFD analysis. Within that funnel we locate 8 vertical axis wind turbines, which are able to rotate and generate energy for the building. At the top of the building is also an observation deck, and remember, this is a public state-owned company, so there's a kind of agenda to educate the public and invite the public to the building, so at the top is this observation deck which from inside has panoramic views of the city, but also a view into that funnel that I was talking about, and on the right side of the image you see visitors to the observation deck will be able to witness the generation of energy, the turning of the turbines at the same time.

So the wind turbines, you're probably wondering, how much energy does that generate for the building? Between 1 and 2 percent of its annual load. The real story for energy here is geothermal. Indonesia is a volcanic archipelago, it's a volcanic island chain that has an outstanding -- you can see these red dots indicate seismic activity and actually volcano location -- has an outstanding resource for geothermal. So the way this deep geothermal system works is that super-heated water is brought to an energy plant at the surface; you can see our building and the energy plant there to its left, on the right side of the slide, where it drives a turbine; that turbine creates energy. So it's essentially an unexpendable source of energy, deep geothermal as opposed to many other geothermal technologies.

So all of this may sound very exotic and perhaps irrelevant to New York, but you know in talking with Samara in advance of the talk, we asked ourselves this question -- How could we do a net zero supertall like this in New York City? So Luke and I and our group thought to projects that we know, which on the left is a tower designed for net zero that's built in Guangzhou, China by SOM and more locally, here on the right, PS 62 in Staten Island, which is under construction now; you may know about it through the School Construction Authority; it's a net zero public school.

But if we look to again, the Pertamina problem and Manhattan and what would we do to create a net zero supertall in Manhattan, let's take a hypothetical site in Midtown, the red square there on the left. If we were to integrate photovoltaics within the building we might get to 10 percent of energy generation, if we're lucky; if we integrate wind turbines, may be able to get something like 2 percent of the demand that a building like that would require on an annual basis. But if we look outside of the footprint of this hypothetical site in Midtown, that green rectangle would be the size of a solar field that would be required to power that building, so roughly, the footprint of the Metropolitan Museum of Art as a solar field would get you your free energy for the year; an array of vertical axis wind turbines over by Umpire Rock or you know a few baseball fields there on the west corner would allow you to meet that energy need. So it's a smaller footprint; in some ways more invasive in the landscape; you're probably familiar with these vertical axis wind turbines; they need to be spaced apart from one another. Looking to the large-scale horizontal axis wind turbines, so the windmills that we see, you'd need two. Or looking to a technology -- hydro turbines, that in the case here, as shown in the image on the bottom of the screen, is a product that's been developed with Boeing and is in use in the Saint Lawrence River, we'd need three of those, with a total spacing of about 250 meters. So three turbines like that and you're on your way to net zero in Manhattan.

The least let's say space-intensive application is very similar to what we did on Pertamina; the deep geothermal well, which with all of its pumps and housing would probably be smaller than a two-car garage when it came down to it, but it goes very deep. In our case, based on our calculations, available kind of geothermal resources, we estimated -- we're talking about a well at 3.5 miles deep, which is in the area of twice as deep as Pertamina's well, but much shallower than the kinds of wells that we're digging to extract oil from you know offshore.

So I'm missing an image here and the final…

CHAIRPERSON RICHARDS: What type… is it open loop or a closed loop, the geothermal… [crosstalk]

SCOTT DUNCAN: Ours is an open loop.

CHAIRPERSON RICHARDS: Open. Okay.

SCOTT DUNCAN: Yeah, which is why we get such high efficiency. So we should have a map of the five boroughs here, because Central Park may be the wrong place to do something like this, [laughter] although you know we do need to think about our city's infrastructure; Central Park is a piece of cultural infrastructure; we need to think about this infrastructure differently, but I have to believe that somewhere in the five boroughs we can find an opportunity to explore a project like this and want to today offer our assistance to the Council to do any kind of feasibility study that you'd like, you know, to pursue any opportunities for sites or collaborating with the development community on a study for this kind of thing. Thank you very much.

[applause]

CHAIRPERSON RICHARDS: The future. Alrighty, next we have Dr. Sanjoy Banerjee --

[background comment] oh no -- Oh, am I wrong? [background comment] Oh, I'm sorry… Oh…

FEMALE VOICE: Washington Square Park House… [crosstalk]

CHAIRPERSON RICHARDS: Oh, sorry…

FEMALE VOICE: J. Preston.

CHAIRPERSON RICHARDS: Okay. [background comments]

While we're getting this up, let me just introduce myself… [background comment] ourselves. My name is George Schieferdecker; I'm with BKSK Architects; I have with me Jennifer Preston, our Director of Sustainability, who's gonna get the presentation up and running and Mike McGough from BuroHappold, who was our engineer on this particular project and whose firm is active on many sustainability projects; really internationally, so a good resource for thinking outside of architecture project. [background comments] Just a second. [background comments]

We are honored to present or to be able to present our very modest project; [laughter] I think we present a sort of fitting contrast to what we've just seen, [laughter] we've got the big and the small here, so. But we did a project in Washington Square Park and we think it's a model of sustainability in New York City and certainly a model for low-carbon design. Our project is a -- let me just see if this goes ahead -- alright, we're gonna see two slides in one, on the left-hand side. Our project is a modest building, we're about 3,000 square feet; it is at the southern side of Washington Square Park and it houses the park's offices, the park's changing rooms for the staff in the park, maintenance equipment, public bathrooms and the equipment for the iconic fountain at the center of the park.

What we tried to do with the design was have really a minimal impact on the park; I would say that the whole point was to have a minimal footprint. And so we took as our sort of design impetus, our design theme; the notion of a basic garden structure, prototypical pergola or trellis and put our building sort of within that. Eventually we're gonna have vines growing out of the top and over the edges of the trellis to give it further shading on its edges, and it's meant to be that blend of building and greener for the park.

The major architectural elements of Washington Square Park are the arch and the fountain, you see them on the top right there; as you come 5th Avenue you see the arch and then on axis slightly is the fountain itself and that's a formal axial arrangement that wants to take precedence in the park and any other structure like ours really wants to recede in the background. So we are not part of that formal axial organization at all, we are at the edges on the sinuous curving pathways around the park. Our building is curved so that its mass is somewhat hidden and it sort of flows with the pedestrian as he walks by it.

I think the point of talking a little bit about that architectural impetus is to say that the same quiet presence that we sought for the architecture is what we sought for the environmental footprint of the building.

So on the bottom right you have the plan of our building and as I'm sure you know, it utilizes a ground source heat pump system to do heating and cooling. Those wells are in orange, above the plan and they are about 20-25 feet outside the building.

And I understand one of the topics of today is the kinds of hurdles that we face with this sort of implementation and we had an odd one in this particular project because we are on the site of a burial ground, so we have archaeological issues that we had to deal with. Our building, as you can see by the shaded elements that are underneath the plan, sit on top of the foundation of former buildings so that the footprint is lessened and we've utilized in the one case, on the bottom right, the cellar of an older building as we conformed to the plans for the renovation of the park. Originally we had the wells in that portion of the cellar that was outside of our building as a way to access them over time but simultaneously have them within our building; that did not work out because of issues with foundations and footings, everything was too close, and so they did have to move outside the building; still within former footprints of other buildings that were on the site. Oops, I went backwards, didn't I?

So we'll get into the specifics and I'll let Jen and Mike take over. The thing that I wanted to simply mention here is on the left-hand side. We do have photovoltaics on the roof of our building;

they have a limited efficiency because of some of the buildings to the south, but they're -- we also have a dog run to the south, which opens us in that direction, but that makes a good companion, or a symbiotic relationship with the ground source heat pump system, whose only energy usage is electrical and the photovoltaics, obviously provide some of that. So Jen, do you wanna… or Mike? [background comment]

MIKE MCGOUGH: I wanna talk very briefly about some of the opportunities that we had; some of the challenges that we ran into on this project as well. The first thing is, we've been using or I've been hearing the phrase geothermal; I prefer to use the phrase geoexchange; we are not extracting hot water from the Earth. So for this project we are two geoexchange wells, they're closed loop bore holes; while I would've loved to have gone three-and-a-half miles down, we went [laughter] 500 feet for each of them. Our little building has a load of nominally 4 tons, so some of the challenges that we ran into, as George said, was obviously location for the wells, the drilling of it; obviously the initial cost, but given the nature of the building, our geoexchange wells effectively replace either an external condensing unit or a more traditional cooling power that we would see for this type of building. So continuing with the vernacular of the building, keeping anything off the roof, keeping it very simple, it was obviously a very appropriate choice, in our opinion, for this project. We effectively have three geothermal systems inside the building; two water to air systems which are serving the offices; the locker room areas, and then we have a radiant system which is serving the bathrooms as well. We didn't want to be providing air conditioning to an area which was an open resource for the public and make it an attractive nuisance, if you will.

So for the radiant system we utilized a water to water heat pump; we have a buffered tank so that we operate the geothermal heat pump doing water to water only on an as-needed basis, increase the temperature to a suction tank and let that sit pretty dormant throughout most of the operation.

The rest of the system on the air side is fairly traditional. Some of the other challenges that we ran into was obviously one of controls, getting the integration between the photovoltaics and the geothermal system as well and being able to take some of the photovoltaic energy and reduce some of our energy in particular for the pumps. The geothermal pumps or geoexchange pumps are only about 6 horsepower each for this project.

There are two primary types of geoexchange which are utilized in New York City proper itself and you'll see the reference on the bottom for both the Washington Square as well as the Front Street Project, either an open standing column well or the closed loop well. Historically in New York City some of the open wells have experienced some issues with regards to their performance and their operation, which becomes a challenge as it relates for a closed or an open loop and being able to do large-scale buildings, as you can see from the previous installation.

This project was well-suited to a geoexchange because of the public visibility of the building, trying to keep something off of the roof, as well as a very small load and being a very boutique building to support a public enterprise.

JENNIFER PRESTON: So I'm gonna take a tiny step back, which is really the first thing we should all be talking about first, which is reduction and to make the point that daylight is the first source of renewable energy, so this building really tries to capture that first and that's important because when you're reducing your loads you can reduce the cost of those upfront high technology items like geoexchange and photovoltaics.

Our photovoltaic array provides about 34 percent of our electrical load of our building; that includes the pumps on the geothermal system, lighting, plug loads, etc. When we were looking at the PV array, we did careful studies of both the solar insolation on the roof over the course of a year and the overshadow studies of the trees and the buildings to our south. You can see on the slide on the left in the three rows are our shadow studies; the top being summer months, the middle being winter months and the bottom being the shoulder seasons of spring and fall. We do take a little bit of a hit in the winter when the low horizontal sun is casting shadows from the southern buildings over our roof.

In total, the carbon savings on this project is the equivalent of 2.2 cars in terms of greenhouse emissions, or over 11,000 pounds of coal burning over the course of a year. It's a tiny little building, but it actually has a bigger impact than buildings 10 times our size, so we're quite proud of it.

Just to make the point that geoexchange is quite possible in New York City, if it's appropriate in terms of cost and value to the community; there are a number of projects that are using both open and closed wells up into the 100s and these are a few of those examples. Thank you all.

[applause]

CHAIRPERSON RICHARDS: So geothermal is possible in New York City. Alrighty, Dr. Sanjoy Banerjee on battery storage. [background comments] Alrighty. If you are driving a dark [background comment] Caravan with New Jersey plates W81BM2, you got a ticket; [laughter, background comments] for parking on the wrong side of the street?

FEMALE VOICE: Yeah.

CHAIRPERSON RICHARDS: So I would suggest you move your vehicle so you don't get another one.

FEMALE VOICE: You should've taken the subway to get here.

CHAIRPERSON RICHARDS: That's true. That is true, or the ferry. Well, that's New Jersey, Staten Island. [background comment] Alrighty, Dr. Banerjee.

SANJOY BANERJEE: Thank you. Chairman Richards, members of the Council; ladies and gentlemen. My testimony will be… [interpose, background comment] Oh, so… maybe I should use this. Can you hear on this? [background comment] Can you hear me now?

CHAIRPERSON RICHARDS: Yes, Professor.

SANJOY BANERJEE: Alright. So again, Chairman Richards, members of the Council; ladies and gentlemen, I'm Sanjoy Banerjee; I'm the Director of the CUNY Energy Institute and I suppose in many ways your host here today. I hope you're enjoying the building and it's great that the conference and hearing is going so well and so many very interesting presentations have been made. In any case, I'm going to give you some testimony which is going to be divided into two parts. The first part will be essentially related to what we see the role of energy storage, which is one of the major areas for the Energy Institute here to be, and second, related to a spin-out that has come from the technology that was developed at the Energy Institute, which is now located 10 blocks south, on 127th Street in Harlem, which is investor funded and making 20 jobs in Harlem right now; that company is called Urban Electric Power and I'll tell you a little bit about -- they wanted some testimony given, their CEO is away; I was one of the founders and so I'm going to present it.

So related to the first topic, which is the Energy Institute's views on energy storage, I have no slides; being a professor, I don't use any slides. [laughter] Okay. So we start with that. We really were formed about -- what was it -- 2008 when I came from the University of California and our mission was really to enhance our nation's energy independence. So much of our work, like Brookhaven's, is funded by the Department of Energy and some of it by NYSERDA; a lot of it by Con Edison, various people like that. In any case, why were we interested in energy storage? There are really four reasons, and I'll go into them and one I won't go into any detail about, but that will be part of an Urban Electric Power's testimony which I will give.

So the first reason was clearly that we wanted to develop an enabling technology for a low-carbon renewable future. We understood right away, and I think all of you do, that the key to this is to keep the cost of energy storage low enough that solar and wind power, for example, could become truly economical, and that is really the key reason for storage. What we can do is we can store near urban centers where it's most efficient to store energy and generate wind or solar power wherever we like; it can be away from urban centers, but because you're putting the storage near its point of use, that's the most efficient place to put it. So that was the main reason and there is no existing technology today that can do this and that's why you really need to be able to improve the technology in this way. And DOE had, for example, through ARPA-E, invested about $300 million in storage for this reason. Also of course you can think of cars, electric cars possibly being a way to store energy when it's not needed. So that's also part of, if you like, programs like DOE's, but now taken up by companies like Tesla and so on. So I won't go into that any more.

The second reason why energy storage was very interesting to New York, because it's a dense urban environment, is that it can defer the construction of transmission lines and maybe also new substations, distribution networks, because those have to be planned for really peak use. So if you can store energy, let's say in a substation, and distribute it, then you can significantly defer the cost of construction of a new substation. Now this is really of interest to people like Con Edison, which is why they're so involved with us. If they can put the storage right at the substation; what happens is, they are able then to say we don't need to put a $1 billion new substation maybe for 5 or 10 years, so that was the second reason; let's call it T&D defer, and this really also a business model that can be monetized so that the taxpayer or whoever doesn't have to subsidize it. Con Edison, if it puts in a prudent investment and putting it in a substation, they can recover funds from it, so that is a good business model to make it work. Okay, that's the second reason.

The third reason for this is that in a dense urban environment like us, it's related to the other reason, which I call ahead of the meter storage; it is behind the meter storage, which is in residences, in homes and so on; they may have local renewables which can be stored there, but they also can be used to defer or shave peaks so that you reduce the peak loads and this is by something called demand charge reduction. Okay, so that's the third reason for a dense urban environment.

The fourth reason, which I'll get into more, is resiliency. As was pointed out by the speaker from Brookhaven, it's clear that we are going to see rising temperatures, rising levels and so on, and we may expect that in the future we will have more occurrences like Superstorm Sandy and so on. No, as you know, one of the problems that occurred during the Superstorm was the backup diesel generators which were located on the roof of some buildings, were not operative because the diesel which was stored in the basement got flooded, okay. So at the end of the day it could be that if you could have energy dense solutions so that it didn't take up much building space where energy could be stored, then you could make a building resilient to a wide variety of conditions by either local storage or secondly, by having portable storage which could be deployed. So these batteries could be kept to let's say be sent to an area where you needed to have energy, okay. So that's the fourth reason, which is resiliency.

So at the Energy Institute we have installed a fairly large system, 200 kWh hours, 100 kWh, and it's in the basement of the Engineering Building and it works, it shaves off the load from the building; that demonstrated to us a quality which an energy storage system must have, safety. The permitting for this took almost as much money as building the system, [laughter] okay. Now, there was no way we could have put a lithium ion battery or something like that there; I'd shoot myself three times before doing that, okay. [laughter] It was really, really hard to get permitted and today we are actually working with Con Edison to let them know all the steps we went through, because they are looking at other installations of this type and we were sort of a pioneer in getting this done. So safety becomes an enormous issue and the advantage for energy storage technology, which is nonflammable, which doesn't pose a fire hazard; all these things are absolutely key. So when you talk about let's say lithium ion batteries being a solution; maybe it's a solution for a car, but you're not going to put massive lithium ion in a building or in a substation, I just don't see it. So we need much safer solutions in this way.

So what are we looking for in energy storage? We're looking first for low cost; ideally your batteries must be lower cost than lead acid batteries, but it must also be more energy dense in order to be located in an urban environment, because we just don't have the space to put these things. So that's number two, low cost, highly energy dense; third attribute, safe; go to be safe, and that actually is probably the most important thing that Con Edison worries about. I don't know if anybody's here from Con Edison, but we've had discussions with them and they worry about that all the time. Okay, so that's really my first part of my testimony, okay.

The second part now relates to spin-out, which is from Urban Electric Power; this I'm going to read because it's not my own. Okay. So this is from spin-out from technology that was developed at the CUNY Energy Institute, which we have licensed to a company which is investor funded; CUNY had, you know, made the agreement, and they say:

Solar plus storage for improving the resiliency of the City's infrastructure. When an emergency strikes the City it 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 an hour's notice. These facilities need to be able to provide energy sometimes for up to 4-5 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 New York City 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 be charged 10-plus years without any risk of fire hazard and these storage systems can be reused several hundred times and they are very compact for tight buildings and easily transportable; in fact, they hold more energy per unit volume than the batteries in our phones.

For example, a 1 megawatt-hour system, enough to run emergency systems of a large building for one day will take a 100 cubic feet -- that's I guess 10' x 10' -- no, less than that -- 4' by 4', alright, not that big anyway -- 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 -- here it is, 6' x 6' x 3' -- and weighs less than 2 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 nighttime use, for extended use; c. to extend the life of diesel generators when working diesel is available. One or more such energy storage systems connected to the solar system of a building can provide around the clock energy, virtually making the glo… I'm not sure… and Urban Electric is installing two such solar-tied systems this year at a college and high school within the five 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 New York faces today with regard to its energy future.

Thank you very much.

CHAIRPERSON RICHARDS: Thank you.

[applause]

Alrighty and right before lunch we will hear from Philippe Bouchard, from Eos Energy Storage, on battery storage as well.

PHILIPPE BOUCHARD: I'll try to keep my presentation short. I've learned at conferences you don't wanna stand in-between an audience and lunch. [laughter]

Alright. And many of comments today -- By the way, to introduce myself; I'm Philippe Bouchard, Vice President of Business Development at Eos Energy Storage. We are a developer and manufacturer of grid-scale battery storage solutions, based out of Edison, New Jersey where we have our R&D headquarters and we now have our manufacturing capability in Upstate New York, outside of Ithaca, New York, and we have a small commercial office in New York City in fact.

So thank you to the New York City Council Committee on Environmental Protection for bringing us in to discuss the important issue of energy storage.

And I wanna first start by understanding and discussing why -- why do we care about energy storage; what's the significance? And I wanna point out a lesser-known fact which is that the electricity grid is the only commodity supply chain in the world that does not use a significant amount of storage of the commodity produced. So less than .01 percent of electricity that is generated today is stored and as a result, we need effective solutions that can buffer inconsistencies in supply and demand to deliver that commodity at lower cost the end user, such as every other supply chain has.

So this slide is very telling of the value proposition that storage can provide. Essentially in today's environment, our electricity grid is massively overbuilt and underutilized. So if you look at all of the generation, transmission and distribution infrastructure in the United States, we use it on average less than 40 percent of the time. That represents over $1.4 trillion dollars of money that we'll spend on infrastructure in the next 20 years that will go underutilized. So storage is a means by which we can improve the efficiency and the utilization of that infrastructure, again, to deliver electricity at lower cost to our consumers.

This challenge is especially pointed in New York City, where you have such power density, and you can see, this is data provided by Con Ed and their electric system long-range plan. Currently their peak demand is at about 13,000 megawatts or 13 gigawatts and it's projected to increase, it's gonna get peakier. So I believe rate payers in 2012 spent about $1.2 billion upgrading that infrastructure to support peak load and again, this is all infrastructure that can be used more efficiently with cost-effective storage.

I think everyone is aware of the challenges that were confronted when Hurricane Sandy hit the east coast region; this is a nice visual graphic of outages, areas that were hit hardest in the five boroughs; this was data again provided by Con Edison and published by The Huffington Post.

So by combining energy storage and distributed generation, we can provide a means of power reliability and resiliency that will make our great system more effective for the end consumer.

I apologize; some of these graphs seem to have gotten distorted. But this graph is essentially showing the growing demand for storage integrated solar solutions and if you pay attention to the graphs on the far right, you can see why storage is needed to integrate renewable energy. At the top you have the typical solar output of a solar generation facility in Arizona and this is looking at second-level granularity of the output of that solar farm and you can see the sharp breaks in the production of that solar generation which correspond to passing clouds; right? So that represents a real challenge for utilities who are tasked with the job of providing safe, reliable electricity; every time that cloud passes, the utility has to ramp a thermal generator somewhere to make up for that mismatch in supply and demand; storage can fix that, essentially we can smooth and firm and shift that solar energy so that it is a dispatchable resource that's available when we need it most and thus of greatest value to the consumer.

The same challenge is illustrated in the graph to the bottom right; that's looking at wind generation profiles in ERCOT, which is essentially the Texas independent system operator. You can see the actual demand is shown in green; it fluctuates day by day, and the output of the wind farm is shown in blue. You can see they don't exactly overlap; in fact, they're countercyclical; most of the wind produced in Texas is produced at night when you don't need it, so energy storage represents a means by which we can store that off-peak generation low-cost; in the case of wind it's almost free, and shift it to periods of demand when it's most needed.

So all of these drivers -- aging infrastructure, extreme weather, rising electricity costs, intermittency issues associated with renewable energy resources, and customers and utilities struggling with increasing define the common requirements for energy storage, which I think Sanjoy articulated quite well, so I won't elaborate on that. But cost and longevity is of key importance, 'cause that's gonna drive the economics.

This is an image, a rendering of our Aurora 1000, 4000; this is a containerized 1 megawatt, 4 megawatt-hour DC battery system; here depicted is integrated with a solar photovoltaic facility in an urban area. The key differentiator for our technology is that we believe we can sell energy storage systems at a lower cost than incumbent solutions, so not just other battery technologies, but in fact for gas-peaking turbines and copper wires also shortly.

This is some more of the detail on our technology that we've developed in New Jersey and are now manufacturing Upstate New York. We're taking these batteries, as shown on the far left, aggregating them into battery systems of increasing size, we've developed a software platform so that we can manage the operation of that battery according to the requirements of your application; in effect, our technology works and looks and feels a lot like a zinc plating bath, so we're plating and dissolving zinc as we charge and discharge the system and we're able to do that reversibly for many thousands of cycles. So this is an extremely inexpensive means of storing electricity and a robust and long-lasting means of storing electricity.

So as I mentioned, the true metric for the viability and cost-effectiveness of storage or any electricity delivered to the customer is levelized cost of energy; essentially that takes into account all considerations -- upfront capital cost, long life, efficiency, operating costs -- and that's shown here. We believe Eos, which is somewhere in the middle, is essentially able to now compete with gas-peaking turbines on an LCOE basis. So with an energy storage system installed and integrated to the electricity grid can provide four hours of energy at a levelized cost of between 12 and 17 cents per kilowatt hour, while gas-peaking plants will cost you somewhere between 20 and 27 cents per kilowatt hour.

That's an important issue because really market transformation is ultimately gonna be driven by economics and we want to evaluate and implement solutions that can help our City Council achieve their policy objectives and their mandates while not creating a huge cost burden on the taxpayer and again, energy storage is a way that we can do that.

This chart is just to say -- we've actually worked very closely with a small group of utilities, including Con Ed, among others, who have helped us to design and optimize our product offering for applications of value.

And I wanted to focus on one such application, which is essentially similar to what CUNY and Urban Electric Power have done, which is to install batteries in the basements of buildings, distributing them amongst the load where they can create the most value and reducing demand charges for the end use customer. So there's really two value streams here; right? We can reduce the building owner's electricity bill, which is great, they'd save money; we can also reduce system peak for the utility, Con Edison, so both parties win when we're installing this capacity on a distributed basis, and this just shows an actual load profile of a commercial office building in Manhattan, it's roughly

8,000 kilowatts or 8 megawatts in demand and you can see it fluctuates over the day. With the battery and by combining it with energy efficiency and demand response technologies, we can level off that peak and thus reduce their electricity bill.

This is a chart showing the actual net present value of the cost of that installed energy storage system relative to the benefits of the energy storage system, which typically include demand charge management, energy arbitrage; essentially buying and storing electricity at periods of low-cost and dispatching or generating electricity in periods of high-cost, so you're able to monetize that difference and then deliver a compelling return on investment for the end use customer, so this is a technology that has value for the utility and the customer.

This -- I won't bore you the details of the business case here in New York City, but Con Edison is certainly on the leading edge of supporting and deploying these technologies; they've rolled out a demand management program where energy storage, among other solutions, can qualify for a $2.1 dollar per watt incentive to encourage customers to install these systems. Now that incentive, let me clarify, is not a subsidy, this is a payment for value that's monetized by the utility and it comes with requirements that you dispatch this energy storage resource during, you know the four-hour peak period as to reduce their system demand. That whole program has been designed to address locational capacity requirements resulting from the closure of Indian Point. So if you're aware, there's a large 2-gigawatt nuclear plant within a 30-mile or so radius of Manhattan that is anticipated it will be shut down; that creates a challenge for the utility because they need to make up that gap in supply and demand.

Sir; did you have a question, or we're saving questions? [background comment] Okay, we'll come back to that. [background comment]

So just a brief statement on the combination of energy storage and solar photovoltaic energy; how is one plus one in this case? Greater than two, and I'll tackle that discussion from a couple of angles. One, the two basic value streams for the customer are bill impacts or reducing your electricity bill and providing backup power.

To address this first issue, and this is really a policy recommendation to the Council and relevant agencies; currently today most of our rooftop solar photovoltaics are being developed under a net energy metering tariff structure, which is essentially saying, when you over-generate, when your generation exceeds your load, the utility is gonna pay you the retail price of electricity, whereas in fact, the electricity that you're generating is worth less than what the utility could procure in the wholesale market. Furthermore, in areas of high penetration, you have an uncontrollable intermittent energy resource that is now kind of wreaking havoc on the edge of the utility's distribution network. So there's some problems in how that policy and tariff structure is designed; those issues can be resolved when moving towards a more market-based infrastructure where lets envision a world -- and this is already happening in California -- where net energy metering, which is a subsidy for solar photovoltaics, will be phased out and will be replaced by more market-based tariff structures. So essentially we can say Mr. End User, if you're gonna over-generate electricity, we'll pay you the fair price, the wholesale price of electricity. What that does is it creates an incentive for the customer to use energy storage and to self-consume that over-generation to avoid more costly retail electricity, right? So there is the economic value proposition and that's where this industry is headed and you know, all of our renewable energy resources at some point need to stand up on their own feet, from an economic point of view.

The other value is backup power. I'm sure as Hurricane Sandy really illustrated, everyone that had solar PV on their rooftops was very surprised and disappointed that they're not able to use that resource when the utility grid went down; there's IEEE standards that essentially require inverters to switch off and to isolate those generation resources so that you don't risk energizing a utility line that will then pose a safety risk to a utility employee, right? With energy storage we can now integrate that renewable energy resource and make it available to the customer during a period of utility outage and thus, you know, enhance the reliability and resiliency of the grid.

This is just a small chart that we did an analysis looking at energy storage combined with solar photovoltaics in a post NEM world, so this again describes a market structure where consumers are paid the wholesale market price of electricity and you can see that the storage actually improves the net present value of that combined installation.

Finally I'll end by just talking about a project that we've been working on with Con Edison and NYSERDA; we are the proud recipients of $1.25 million of grant funding support from NYSERDA, and one of our initiatives has been to take a prototype battery system and install it in a manufacturing facility owned and operated by Con Ed in the Bronx, and this would be a typical behind the meter peak-load-shaving application. This battery system has been on test for three months now and we've been working with the New York City Department of Buildings and the Fire Department to get the permitting and approvals, which has taken at least six months and will probably take another three months. And not to discredit those agencies, because they are tasked with ensuring the safety of inhabitants of buildings in New York City, but clearly there's a lot that we can do to break down those barriers and to streamline adoption by working with the DOB and the FDNY to develop more expedient processes for permitting of energy storage installation in buildings and that's perhaps something that the New York City Council can help with.

We can also improve the resiliency of our grid here in New York by working with the Council to dedicate municipal facilities as community-accessible microgrids and perhaps performing a market-based solicitation, an RFP of sorts, that will identify those specific facilities and then ask the market to come to the City Council with proposals of how to most cost-effectively build out those reliable energy-storage-enabled microgrids.

Another thing worth noting is that the utility business model is transforming before our very eyes through the Public Service Commission's reforming the energy vision; this is becoming a huge deal for the utility and for market participants; I would strongly recommend that the learnings and suggestions and recommendations of this Council and of this conference be integrated into that proceeding so that we're all aligned and working toward the same goal. And then of course, I would end by encouraging New York City to lead by example, which it has in many cases and we've seen some great examples of that today. But the City can partner with the private city to make these municipal facilities green, resilient and cost-effective through the deployment of storage and other technologies. So that's the conclusion and we'll get on to lunch and thanks for listening.

[applause]

[background comment]

CHAIRPERSON RICHARDS: 'Kay, thank you so much. And I wanna thank all of the panelists; I think we should give them all a round of applause.

[applause]

Very good information. Before we break out for lunch, we have a special treat for you, so be sure to stay around through lunch, if you can, because we have former U.S. Congresswoman Claudine Schneider, who is the author of the first and only revenue-neutral Global Warming Prevention Act and she will be our keynote speaker. She provided the roadmap back in 1988 to reduce our carbon footprint and create jobs and save money and she's eager to share with us her vision on moving forward and she's done a lot of good stuff and it's gonna be a delight to have her speak, so welcome. Alrighty, we're gonna break out for lunch and lunch will be for…

FEMALE VOICE: Twenty minutes.

CHAIRPERSON RICHARDS: Twenty minutes. [laughter] Eat fast. Thank you.

MALE VOICE: Ladies and gentlemen, just so you do know, there is no food or drinks allowed back in the hearing room.

[background comments]

Once again, no drink or food back in the hearing room. Thank you. [background comments] And the owner of a Dodge Caravan, please move your car. Owner of a Dodge Caravan, please move your car.

[background comments]

[break for lunch]

[gavel]

CHAIRPERSON RICHARDS: Okay. Okay. [background comment] We are ready to start again and I have the honor of reintroducing, and I spoke of her a little earlier, of former U.S. Congresswoman Claudine Schneider, and I just wanna give a little bit more background on her before she comes up and gives a keynote.

Former Congresswoman Claudine Schneider served in the U.S. Congress from 1980-1990 and was on the Science, Research and Technology Committee. She authored and passed the first appliance efficiency standards in the world, resulting in the Energy Star ratings we see on our televisions and refrigerators. Anybody see those stars? Okay. [cheers, applause]

She also got Ronald Reagan to sign her International Treaty on Biodiversity, [applause] she briefed Margaret Thatcher on climate change and made a film with Prince Charles for the BBC on the same topic, taught leadership at Harvard University, co-founded Energia Global, an international energy efficiency and renewable energy business, which she sold, enlisted 50 Fortune 500 corporations to agree to reduce their carbon footprint; many of them who are right here in New York. For this work, the EPA nominated her for the EPA Climate Award, and today she continues to work with governments and industry on cost-effective strategies to reduce greenhouse gases. Without further ado, my friend and New York

City's new friend, former U.S. Congresswoman Claudine Schneider.

CLAUDINE SCHNEIDER: Thank you.

[applause, cheers]

Thank you very much, Councilman and I want to particularly thank Samara Swanston for helping to pull all of this together and Jarrell [sp?] and Bill Murray and the whole team; [applause] what a great job to pull together such a grand audience.

So I am thrilled to be here today to be part of this, what I hope will be an electric stimulation of the whole City of New York to move much more rapidly toward reducing your greenhouse gases. Now as was mentioned, some of you probably have been paying attention to the fact that there is a very steep goal to be achieved, 80 percent reduction of carbon by 2050; I hope you change that target date, because it's gotta be in the next 5-10 years, so that's why I do believe we really need to get moving. But [applause] the good news is; is that we've got a highly motivated Council leader in our midst here today and he's got a team of other Councilmen who are very eager and prepared to start moving the agenda forward. However, it takes a lot of folks to make a difference and you know I certainly commend the New York City Partnership and the Once City Built to Last; I think is a very admirable program and the Mayor introduced his 40 members of his Technical Working Group, I guess it was a couple of weeks ago, so they're getting rolling. But this is not just one person's job, the Mayor or Councilman Richards or whomever; each and every person in this room and each person outside of this room does have a role to play in reducing our carbon footprint. And one of the arenas that I think is really primed and moving swiftly is the whole commercial real estate, which is New York's largest industry, contributing $14 billion to New York's economy. Well imagine the number of jobs that are going to be created as a result of retrofitting, those 990,000 jobs and the people who will have for perhaps the first time in their lives employment opportunities that really match their skill level. And then not to mention, we've got the 3,000 schools and public housing opportunity there too.

So when you look just at the corporate sector, which I believe should be providing much of the lead also, 45 of the 500 corporations with the largest revenues are in New York City, so no one can argue economics here, you know; it's many opportunities to involve the corporations. As a matter of fact, quite a number of years ago EPA started a voluntary program recruiting corporations to reduce their greenhouse gases and I was telling the Councilman a little bit earlier, over lunch that I put up my strategic plan of what corporations I was going to go after, so first I went after the financial sector because as we all know, money talks. So happily I enlisted Citicorp, I enlisted Bank of America, and I will say, they are doing a stellar job, but when I first called them and I said, "Hi, this is Claudine Schneider and I'm calling on behalf of EPA; what are you doing with your greenhouse gases?" There was a long silent pause and they said, "Well, well what do you mean; we're not a coal plant, we're not dirty, we don't…" [laugh] I said, "Well don't you have heating and cooling in your buildings and you have lights there, don't you?" And they said, "Yes." And I said, "Well then you are generating greenhouse gases." So Bank of America has come a long way and I just read yesterday they received another award from the EPA for their leadership in carbon reduction, so we've got a number of leaders among the team. And Google has the second largest building in New York City and what's interesting is that Google, as well as Apple, are now partnering with the auto industry and they're making great strides in the whole mobility sector; we're not calling it transportation anymore, we're calling it personal mobility; this is the wave of the future.

So we've got the great example, the Empire State Building; I mean how phenomenal is that that this great icon has been retrofitted and in the first year it beat the predictions of energy savings by 5 percent and in the second year it beat the energy savings by 4 percent. So we have good examples to point to of success.

In addition to that -- are there any corporate people in the room, by the way? I'm curious; any corporate leaders? We've got two I know… [background comment] [laughter] oh come on. What about utilities; is National Grid here? Now, now, I will tell you -- and Con Ed in the room? No? Well I had the good pleasure of working as an adviser to the Board of National Grid and I will tell you that they decided that they wanted to know the future and provide a progressive approach to climate change and they have been working very arduously toward that end also.

In addition to that, we've got the universities and so hopefully all of the universities in the City of New York and the State of New York are signatories to what's called the President's Climate Challenge; these are presidents of universities who sign a commitment to reduce their greenhouse gases. And many of the universities now are divesting from fossil fuels and this effort of course is being led by the Rockefeller Foundation who is committed to helping transfer investments from those areas.

And one of my former business partners has a company now that he started not too long ago called Greener U and they only focus on retrofitting universities, so they're also concentrating on New England first, but if you're lucky, maybe they'll come down to New York.

We've got another huge sector that is a big energy drain and those are hospitals. [background comment] I don't know; who's leading charge the on hospitals? We've got the insurance industry, which is huge in New York City and they have the most to lose, needless to say. And one of the biggest energy users are data centers, so wherever you can identify data centers and cement factories, those two contribute the most to our carbon footprint. And so I've heard -- you know, this was a new thing for me to hear that parts of New York City referred to as Silicon Alley because of all the telecommunication and internet companies that are here, but those two are entities that are already looking at being more energy efficient, but can do so much more.

And then we've got the hotels; hotels are the face of New York City. We have visitors not only from all around the United States, but from all around the world who come here and imagine how exciting it would be for them to say, oh, I came to America and I see that they've got these changes using energy efficiency; we should do this in our country. So huge potential there. And if the hotels are the face of the City, then clearly Madison Avenue is the voice of New York City and they have a huge role to play, along with all the different television networks and media channels; the media should be covering your meetings regularly to let the public know that progress is being made and that change is possible and change is happening.

So we have a lot of opportunities also to do public service ads and I'd love to sit down with the Ad Counsel to share a few ideas that I have of how we can communicate each individual taking action.

One of the things that I did a number of years ago as the solar industry was whining, and I have very little patience for whining, and they were saying, oh, you know, we're trying to grow market share and I suggested that you know, there is so much opportunity in the United States for PV, for solar, that what you guys need to do is speak with one voice and make it real clear to policymakers what you need; if you need net metering, don't just tell a councilman you need net metering and walk away, you have to tell -- and then they pass it and then what; you come back the following week and you say, oh well, we need interconnection or we need tax credits; you don't do that with policymakers; you give them the big package; you tell 'em look, if we have all of this, our industry can zoom forward. And that's precisely what we did; started the Solar Alliance and we put together the four pillars of solar, those four policies that a state must have. I met with former Governor Crist of Florida and he said, oh we're the Sunshine State, we're gonna have photovoltaics all over the place. And I said, no; I said industry won't come here because you don't have the policies in place. So it is essential to be doing what you're doing to get the foundational framework of how we move forward.

And last but not least, foundations also play a critical role, because they provide the funding for a whole broad spectrum of nonprofit organizations and initiatives that would not otherwise be happening.

So it seems to me that, you know, when I first put together my legislative agenda, back in 1988; I know, I was merely a teenager then, but that's beside the point, [laughter] those weren't my ideas; I mean a few of 'em were, but I pulled together the best and the brightest from around the country and I said look, I've been listening to scientists year after year after year makes these predictions, thinking that it's not looking very good and I thought, I am blessed with being in a position of power and I have got to use that power for the public good, and I said let's devise a plan that is comprehensive. So as we speak of climate change, today here we focus primarily on the least-cost approach everyone knows is energy efficiency and New York has already been making great strides in that direction, but renewables are the second step to that end. But the bottom line is to remember there's no silver bullet, we need an agenda for transportation, we need an agenda for energy efficiency, we need a whole broad spectrum of different policy initiatives and the Global Warming Prevention Act had those 12 different sectors in it and basically you can go on the internet and check it out, because many of the policies there, you know, did not pass and they're still applicable today. I'm happy to say the President Obama took one piece of the transportation proposal that I had, what my piece was, gas-guzzler rebates, and he called it cash for clunkers and I didn't care what he called it, but you know, it was a way to get all of the big polluting gas-guzzlers off the roads and quite frankly, I was pretty enthused with the auto industry was on the ropes and the President said look, if you want to be bailed out, you're gonna have to meet fuel efficiency standards, because for decades we were trying to pass fuel efficiency standards and we could not get them through the Congress; it wasn't until there was a crisis management situation where the President had the power to say okay, if you do this, then you know, we'll help bail you out. So to me, I think that was critical.

Also, I think that if we look at some of the different studies that are being put together for New York City -- is anyone here from HDR? No? It sounds like a roadmap to me and it does provide, supposedly, what the energy patterns are of New York City and some performance patterns and a whole series of different secondary targets for existing and for new buildings, so it's my way of thinking that with that kind of data and analysis looking at the infrastructure, which is three-fourths of the City's challenge of 990,000 buildings, that that's a substantial challenge that lies ahead.

So it is important for the government to lead by example and the fact that the City is going after their public buildings is definitely a step in the right direction, but it's not just policies and regulations and standards and codes; actually, I think that it should be part of a national criteria that the minimization of energy use be the primary design requirement for any building in the United States; I wish somebody would just introduce that on a national level. Net zero energy buildings are achievable, they're here today and we can do it. And voluntary is very good, but at some point we're going to need strong leadership with targets and timetables that provide incentives and mandates and that old carrot and stick approach. So the key is to sort out what are the market barriers right now and get the plans rolling ASAP.

Of course, with that game plan we know that energy efficiency has to be first and that's where huge job opportunities exist, but it also requires education and training. And a couple of years ago I taught leadership at Harvard and when I was doing that, it was real interesting to me because I thought -- the first class, I was trying to figure out, well how do you teach, you know I know how to do it; I don't know if I know how to teach it. So I asked the students to come into the room, but I wanted the optimists to sit on one side of the room and the pessimists on the other side of the room, just so I could take a little visual snapshot to see, you know, if my theory proves out and it did, but those students who considered themselves optimists were the ones that were able to achieve the most and I do believe if all of you are optimistic and collaborative and work together; New York City can go very, very far; it is my deepest hope and expectation that we will be a world leader in a city that everybody is talking about.

So another criteria that was also mentioned earlier this morning, is that we have reliable and safe and suitable options and that there be community-based decision making; it is really [applause] critical that we involve the community in what we're doing. [background comment] Well that's what moved me first to become an activist and that was -- they wanted to build a nuclear power plant down the road from me and I didn't even know anything about nuclear power, but I knew that no one asked me my opinion and I lived there, so be careful what you ask for; look what happened. At any rate, when I learned that two-thirds of New York's rooftops are suitable for solar I was blown away and I think it's important for you to know that there is this myth; since I worked with the solar industry I learned a great deal; there's this myth that you have to have sun all the time; that's not true, as long as you have daylight you are generating power; maybe not as much or as intensely, but you are. And when I've also mentioned that for years New Jersey, along with California, but New Jersey led the nation in terms of installed solar power, people were like, what, 'cause you don't think of it as a sunshine state; had nothing to do with sunshine; they had the right policies in place years ago and as a result of those policies the industry swarmed into New Jersey and they started putting solar on various rooftops. So the potential is really significant and I think -- I was pretty excited to read that the City University of New York and DOE created a map where you can just type in your address and then you can find out, you know, what your carbon reduction would be if you were to use PV and how much money you would save and I thought, what a fabulous tool that is. So if you could provide half of New York City's needs during peak demand; that's a pretty significant accomplishment, and if you estimate that about 67,000 of all City buildings are suitable for solar; huge potential for jobs and for everything else.

So as long as you can get rid of that lengthy review process, then I think [laughter] that, you know, we'll see some really significant progress. And you'll be hearing more about, you know the other technologies that are available for the City, but one of the things that I have to share with everybody is a new technology -- well not so new, actually -- when I was on the Science Research and Technology Committee we had jurisdiction over the National Laboratories; we held their, you know, purse strings or whatever, and where I'm living now in Colorado, I work closely with the National Renewable Energy Lab and NOAA, the National Oceanic and Atmospheric Administration and NCAR, the National Center for Atmospheric Research, all of those guys, but there is a technology referred to as HOMER and it stands for Hybrid Optimization of Multiple Energy Resources, write that down, because the value of this particular piece of software is that if you want a rapid assessment of your least-cost solutions for renewable energy, this software will analyze all of those different cost benefits. It also compares thousands of different possible combinations of solar, wind storage, load management, combined heat and power as either stand-alone or grid connected, and it also optimizes variables like interest rates or what if the price of fuel changes; then what's that gonna mean, you know, to my power of choice, and what about emission goals and what are the CO_2 levels, so all of these variables are taken into consideration and I think that the HOME software really ought to be mandatory before you invest one dollar in any type of renewable technology. And that software came out of the National Renewable Energy Lab and they have 120,000 users in about 193 countries and I'm wondering, why isn't this mandatory in the United States; I mean NYSERDA, City Council, you know, everyone, I think, should use that because you get the cost benefit analysis and you get the broader analysis, so I think it's a grand idea.

And the last but not least question is; maybe this all costs money, Claudine; what do we do; where do we get the funds? There is more money than you know what to do with out there; we just have to figure out what to do with it and where to focus it and quite frankly, there are all different kinds of options; many utilities right now are doing on-bill financing for energy efficiency and renewables, so if you're talking to Con Ed or to National Grid, ask them about on-bill financing. There's also Property Assessed Clean Energy Financing, there are municipal bonds for energy efficiency and renewables, there are property tax surcharges and of course, there are commercial loans too and I spoke not too long ago with somebody from Wells Fargo; I don't know if they're doing this nationwide, but they did say they wanted to get into doing the financing for renewables. So many of those commercial banks now should be tapped and asked, you know, will you provide some low-interest loans. Then there are also the green bonds and one of the most underutilized pools of money right now is the HUD and FHA; they have a great deal of funding but they don't do a lot of advertising for it, so I think that those are two entities that some of you may wanna tap into. And also, on DOE's website they have the Guide to Financing Energy Efficiency and Renewable Energy, so there too you will find a variety of different options. The foundations have a lot of mission-related investments and some of you may be familiar with ACORE, the American Council on Renewable Energy and Efficiency; they have a meeting every year on Wall Street, so you know, Wall Street is well tuned in to all of this. And quite frankly, I don't think I would invest in any renewable energy unless I were guaranteed a power purchase agreement, because that guarantees that you're going to get the exact power that you are promised, and when I was running the Solar Alliance I was thinking, oh my gosh, here I am the president of this PV assemblage; I should have solar on my house, so I had somebody come in to do an analysis and the guy looked at me and he looked at my bills and then he looked at me again; he says, "What, are you kidding me?" And I said, "What?" I said, "So what do you think it will cost me to put solar on my roof?" He said, "Well, the problem is it'll take you about 50 years to do the payback because you don't use any power at all," and it's like, well of course not; I mega retrofitted my home with new windows, new insulation and so I squeezed as much, you know energy efficiency into that place as I possibly could.

So when you look at the big picture here for New York City, what do we need? Well, we've got plenty of different sectors that are involved in this process, we're all in this together and we've got a game plan, there are a bunch of different roadmaps out there to follow, and we've got the technology, check; you know, we'll hear more about that, and we've got financing and we've got the political will, so all we have to do is remember that no one size fits all and that there is no silver bullet; one technology is not, you know a cookie cutter approach for every problem that exists. I mean of course there are few things, like occupancy sensors and LED lighting; I mean those do suit everyplace, but we do have criteria and it is that it be affordable and that we're saving more money than we're spending; in other words, the operating costs are taken into consideration rather than just focusing on upfront cost. And we have to make sure that it's suitable, gotta make sure it's reliable, and that's where HOMER comes in because they can check out all those variables and quite frankly, the World Bank now is requiring HOMER before projects are approved and the military, well the Marines are now using HOMER also for resiliency purposes, so that they can have all of the backup opportunities that are available. We also have to make sure that the technology and the path forward is a safe one, that the decision making, as I mentioned earlier, is community-based and it needs to be on a systems approach of a whole portfolio of the variety of options.

So the bottom line is; I mean, I happen to watch David Letterman every once in a while and he is relentless about New York City being the greatest city on Earth and I must admit, when I hear that song, New York New York by Frank Sinatra, you know I get into the American Can-Can mode and just wanna kick my legs in the air, but this a great city to be celebrated; it's a city that is on the brink of being one of the most outstanding cities in the world when it comes to being a model for the world. And so I wish you all the best of luck, the hard work and the strong commitment to really make New York realize its full potential. Thanks very much.

[applause]

CHAIRPERSON RICHARDS: Thank you, Congresswoman. [background comment] Alrighty. Very well put. Professor Vijay Modi, who is a Professor of Mechanical Engineering at Columbia University and an Earth Institute faculty member, will speak on geothermal and understanding building energy use in New York City.

VIJAY MODI: So first of all, that's gonna be a tough act to follow; [laughter] we have a couple of other colleagues who are gonna talk more about geothermal, so I'm gonna just show one slide about that towards the end and I think John Rhyner, you are speaking afterwards; right, a couple of -- oh sorry; Bob. So… the computer has gone to sleep after lunch. [background comment][laughter] So while it gets restarted; just to keep up with the time issue, I'll sort of introduce some of the things I want to talk about and you know first, how we got involved, and I think -- I have to thank the National Science Foundation, which gave a grant to allow Columbia to create an entire sort of cadre of graduate students to work on the topic of urbanization and sustainability, and my group focused on the energy issues. And we are in the last year of the grant and you know, while the formal announcement has not been made, we will have another larger sustainability research network at Columbia, again allowing urban issues to be focused. So I think I just wanna thank the National Science Foundation for allowing that kind of sort of forward thinking, long-term thinking, but applying it to the City; not just purely basic science. [background comments] And thank you.

So the Chair of the Council, the Chair of the session, City Council and ladies and gentlemen, it's a privilege to be here; million points of energy used; that's 990,000 buildings, so I want to give a little bit of insight into that. So 70 percent or more that -- a little bit cut off -- 70 percent or more of emissions are from buildings in New York City. Now that is not to put down the building sector; that's actually because we are very good with other stuff, you know we are much better with transportation, public transit, all the; right? And so because or that, you know, the buildings now represent the opportunity to act on.

Now, you know we initially started with really understanding an estimate for every building, okay; we did not have data at that point; this is not through Local Law 84 or 87; we did statistical technique-based estimates of how much energy and all that, and what it does show is no different from what we would have expected is that space heating and water heating actually consumes 68 percent of the end use. So this is why a lot of the focus on electricity sometimes. Just want to highlight that domestic hot water and space heating at the end use 68 percent, okay, citywide. Now individual building-wise it's very different; okay, so if I… you know and just, it was key to have the City Mayor's Office of Long-Term Planning help with some of the data and various City agencies, so I just want to acknowledge that. You know, just want to highlight two buildings; The Empire State Building was mentioned, it's an office building and therefore more of its consumption is for electricity, for non-cooling use event [sic], whereas across the street there's a residential building and more of it is for space heating and domestic hot water. So while we give those average numbers, right, you know, building by building things can be very dramatically different; office buildings, commercial buildings way different from residential buildings. And I think what I wanted to highlight with this just one statement here is, that many -- while immediately, while immediately many opportunities may be at the individual building level, when I'm looking at the medium term, we've got to think multi-building block community neighborhood.

So that's to highlight that, because they actually can complement each other, etc.

Okay. Now I wanna talk about heat pumps. Any plan today that you see, the 80/20 plan, 90/10 plan; whatever, is making a very important point is that we will need to displace heating and that will have to come from electricity, so why… you know is that… just want to give a little bit of a one-sentence thing on that. A heat pump can take one unit of electricity and convert it into three units of heat on most days. Okay. Now, first of all, this is not some magic or something, that's just engineering, but that unit of electricity has to come from a carbon-free or emission-free source for that to help us, and so most long-term plans say that as we go towards the, you know emission-free, carbon-free electricity then we can take advantage, except on really cold days. So I, by the way, my home, Harlem, actually you know, I'm five minutes from here, walking; not by car; everything is monitored, all the loads, all the heating, everything; this year we have had a few days when it would have been actually more cost-effective and emission-effective to run the boiler on gas and then on the heat pump, given the background emission, but that's just on a few days of the year and that's where the gentleman who opened this morning, Laurie from Urban Green Council said the peak loads, due to heat pump use on some days, can exceed the current peak generation of electricity. So I want to address that issue very briefly, turns out I [sic] exactly intended to talk about that.

So what I wanted to point out, first of all is an interesting fact about New York. The blue curve is the electricity demand through the years, and I'm not going hour by hour, so I'm just giving you a rough -- we of course use most electricity in the summer for air conditioning. Green is if you used more wind; you can see that the wind actually does not blow in the summer; blows more in the winter. The heating demand, red, peaks in the winter. So I wanna show you just how system integration issues can actually help us.

So if you went towards more use of wind, it actually works well if we had in parallel integrating heat pumps. So I think it's not about one or the other always; both working together. So I want to show you that bit -- and you know, this is a complicated slide for this kind of setting, but I just wanna show you one thing; that if you went from point A, which only uses wind for current electricity needs, to point B, where you also use some of the electricity for 20 percent heat pump penetration in the city; not the entire, just 20 percent; it allows you to double the wind power capacity while maintaining high capacity factors. In other words, because those heat pumps are synergized with the wind, you actually can get a lot higher. So this just shows you -- I'm just pointing out one little factor; I am not promoting one technology or another, I'm just trying to show you that if you actually did 20 percent heat pump penetration it could close to double the rated wind power capacity that would work in the city, right, with high utilization. Okay, so that's one.

Second point I wanted to make was, we frequently in our reports; our plans, talk about let's replace everything. Reality is that if you try to replace everything, which is, if you try to replace all the heat pumps, you create a huge need for additional capacity, but what I wanted to point out was, if you replaced 95 -- so if you replace 90-

95 percent and not 100 percent, you dramatically reduce the requirement. In other words, leaving aside and taking it one bit [sic] of existing gas infrastructure but not using it all the time or using it for a fewer buildings has a big bang for the buck. So you know, I think what I want to here say again is, it's going to be that symphony; it will need some gas; this may provide also a transition in the following way; I'm not talking about gas as a bridge fuel, I'm talking about simply a fast [sic] way to get from point A to point B while innovation, technology; new developments are taking place.

So first of all, tiny percentage of on-site gas or storage -- and sorry this got cut out -- helps bought [sic] transition to renewables as well as resiliency, because there will be days when if the electric grid fails and if Hurricane Sandy occurred a month later than the day it occurred, you'd have all had a lot of heating problems which would have been bigger than charging your cell phone problem. [laughter] So I think -- you know, just want to point out that we've gotta [sic] worry about that.

Now, it turns out that that transition can also help the utility because it actually improves the capacity factors or load factors of the electric system, because as you noticed, now you are using high electricity in the summer but also higher in the winter. Now we need to understand this well so that the utility, the Public Service Commission and the consumer; I see these three pillars, they need to go into the details of this to properly understand where changes are gonna be needed, who's gonna pay what; how is it gonna be costed out? And I think that that dialogue is what the political leadership can help enable so that we can move towards this transition without creating kind of log jams and institutional sort of issues.

So the capacity factor actually improves, so this means it should be good for the utility, except this is an average picture; the nuanced picture will show that some places will be bottlenecks; some places not, etc.

And the last bit on that topic is that leaving boiler capacity in place but not fully using it is of value if you may still use occasionally half the boiler capacity. So that's on the transition using heat pumps.

Okay. So how will we get there -- the word "get" is missing. Okay, so the shorter term, of course, within building conservation. Building level shifts will already happen, they are happening -- by the way, at my home, right here, I have both gas and split heat pumps and interestingly, a political mechanism I think would be very interesting, Harlem today looks, from a building structure, very different from what it was 20 years ago and it was made possible through a tax abatement -- a tax abatement was at a neighborhood level. Imagine along with the tax abatement there was a ballotable [sic] measure to also enable community-level efficiency and long-term reduction in the cost of energy. If those went together, you could have done the engineering at scale at potentially lower cost. So that I see, at the medium term, how to get multi-buildings and community to do it at scale. And I give you all a simple example, is the sticker shock issue, which a lot of ways it's being addressed, but anything I do with my car, after I bought the car, is never a four-digit figure, it ends at 9.99 [laughter]. Anything I try to do with my building is four-digit figure, [laughter] it ends at 9,000. I want my audit done for less than $1,000; I want my insulation, my ceiling, ventila… and it's possible. See from an engineering perspective it's possible, it needs scale, it needs trained workforce, it needs a market push.

So then in the longer term, I think I want to end by saying that one needs to deconstruct what the utility, what the independent system operator, what the BSC [sic], what the customer… what are the new technologies that are coming online -- in my laboratory we have doubled up the meter, the lower right version; it can manage 10 loads or 10 customers on one single block of hardware; right, 10 loads, you can measure them, you can control them, you can turn them on or off, you can manage them and there's a small computer onboard which is of the kind of computer that's on your cell phone, right. So things are gonna happen which are gonna make some of this easier; the ability to model the isogrid, reach power plant -- these are all the 400 power plants that come on and off at any hour; how is the background transmission and this system gonna play out as you make those changes. You may just remodel; for example, cogen with gas-fired, you can model geothermal, you can model other things; on a hot day in July even every hour what the savings are are different, and year on average there are tremendous savings. There might be -- sorry -- every day of July and it might be a day when things get worse too, right.

So I think… and then I'm gonna end with sort of idea for the geothermal work. The geothermal work -- again, technologies in different part of the city are like little bit different because of the underground geology. New York City is fascinating; all the way from the Hudson River to the border of Long Island things are different and that may pose different opportunities across the board, etc. And this would not have been possible without the students, so I'm gonna stop there.

[applause]

CHAIRPERSON RICHARDS: Thank you, Professor. Alrighty, next we'll have Jack DiEnna, Executive Director of Geothermal National and International Initiative. [background comment]

JACK DIENNA: Thank you. [background comment] I typically don't use a microphone, so everybody can hear me, but I'll stand in front of it 'cause they're recording it.

Okay, that was a good segue, Professor. The one thing that I lack that you took care of, and that is, I don't one graph. Geothermal heat pumps, the energy under our feet -- I'm gonna backtrack, 'cause there have been some statements made that I wanna clear up.

The statement was made earlier by -- you know, let's call it geoexchange; let's call it geothermal; let's call it ground source -- they're all the same, but the federal government calls it geothermal heat pumps, so I'm gonna call it geothermal heat pumps.

Geothermal heat pumps take the thermal properties of the Earth and use it to heat and cool your building and give you hot water; it's caveman technology, it's pretty simple. [laughter]

Why geothermal heat pumps? Well I think you've heard this all day long; 36 percent of primary energy used in the U.S. is from energy used in buildings. Has anybody ever seen that on a commercial? Has anyone seen a car commercial saying, we can save energy, we can save gas? Right now, hopefully, my car isn't using one ounce of energy unless someone stole it. [laughter] We're talking about energy here and we're talking about the fact is that my home, because my wife and I both work, it's still using the same amount of energy as if I was there; my refrigerator's still there, my heating system is still there; 40 percent of that total energy is heating, cooling and water heating. So this pretty simple; how can we deal with 40 percent of the energy; what can we do about it?

U.S. Environmental Protection Agency states that geothermal heat pumps use 40 percent less carbon emissions than conventionalized VAC systems. This technology, by the way, is not new; it was developed in 1954, so if that's new, I'm almost new… [laughter] almost new. But what's happened? There are 2 million -- we're estimating 2 million systems in the United States right now -- and by the way, there's more geothermal heat pumps in New York, New Jersey and Pennsylvania than anywhere else in the United States; that may surprise everyone. We've got a developed infrastructure here, thanks to NYSERDA, we've got a developed infrastructure here, thanks to New York Geo, which is a brand new organization that's moving forward, which there is a couple founding members, along with myself, here today. Those 2 million are only 2 percent of the total HVAC systems, 2 percent, but it's conserved over 42 million barrels of crude, and but here's the big deal, it's eliminated 12 million tons of CO2; that's like taking 2.6 million cars off the road so we don't have anymore of those commercials and plant over 995 million trees. 'Cause I chuckled when they gave me that number, 995 million trees, because I was just dealing with a forest fire in Idaho that burnt down 4 acres of trees. So if we're depending on those trees, we're sort of out of luck.

Here's what's happening -- and Claudine, you talked about NREAL and I've worked with NREAL for about 20 years -- by the way, I started this industry when I was 2, just so everybody's clear on that. [laughter] They did a study way back when of a .55 to .88 kW reduction for every ton of installed capacity, but that was a study; recently Western Farmers Cooperative, based in Oklahoma and New Mexico, in a program that's been running since 2013, and they did this not because they were very well adept at keeping their customers happy, they did it for an altruistic reason of not wanting to build more generation. They found that a peak demand reduction for their HVAC systems dropped 38 percent or a reduction of .55 kW per ton of installed capacity. So that means that for every 3-ton unit that was installed in their program they reduced the kW peak demand by 1.5 kW.

Western Farmers also did a study that for every kW saved it's $2,000 of energy generation resources that they won't have to build. Now does everyone -- EPA's 111(d), which is their new ruling -- Clean Fuel -- I think it's called Clean Fuel, Clean Generation… [background comment] Clean Power -- thank you -- they're planning on closing 60 coal plants I believe it is across the United States. Now that's good, but we've gotta have some way to replace what we're losing there; it's not gonna be with nuclear and probably not gonna be with fossil. So we're gonna have to come up with more creative ways to do this; this is one way to do it. I'm not saying that everybody's gonna run out and put geothermal heat pumps in their house; that's not gonna happen. But let me tell you some of the -- I don't know whether I have a slide or not -- going back -- and I think Claudine, you said you were in Colorado? One of the reasons why this is becoming very popular in Colorado -- we've always talked about energy reduction; we've never thought about water savings; these are closed-loop systems that we're talking about. So you fill a tube, high-density polyethylene, which by the way, is guaranteed for 50 years, guaranteed for 50 years; in 50 years I'm going to be geothermal, by the way; just so everybody knows that; [laughter] we never thought about the water savings and the water savings in 26 states that are under water deprivation is dramatic; which was done in Florida, study done in Florida, a geothermal system vs. a 300-ton water-cooled chiller; if you look at the water savings alone, 4,730,000 gallons of water, that doesn't include all the cost for that; that's dramatic. But here's the thing; I wanna get to 30 percent. I know that sounds ambitious; I wanna get to 30 percent and it's not only the energy savings; it's not only the climate issues; if we were to go to 30 percent we would have to create or retain 5 million jobs, 5 million; that's almost real jobs; okay? And what's happening now is, we're getting governments like in New York, and by the way, we're getting more play in New York, we're getting more cooperation in New York from folks like Samara and Commissioner [sic] Richards and Bill Murray, we've worked together for a long time; we now have the Public Service Commission under Audrey Zibelman and Pat Acampora; they're both geo advocates. So we're looking at this as things we can do; we can do this here.

Once again, a commercial project touches 22 different job classifications, 22 different job classifications. Now, if this is so good, why in the world hasn't it been used? It's 40 years old, over 40 years old… [interpose, background comment] Pardon me? [background comment] I'm glad you're doing that math; I've been sitting here too long, yeah, 61 years old. [background comments, laughter] I told you it was almost as old as I am. [laughter] I'm gonna be 69 next month. Goddamn, why did I say that? [clapping] Oh my god; that's horrible saying that out loud. [laughter] Here's the thing, here's the reason why it hasn't been very well used; it's high-front cost, it's high-front cost. Right now I've got, as you saw with Western Farmers, we've got utilities, we've got third-party investors that wanna own that loop; now do you really care whether you own the loop or not? You shouldn't, because you don't own the gas line, you don't own the electric line; what you want is the benefit of it, the benefit of energy independence, environmental security and economic prosperity, that's what you get. So with utilities like Con Ed or some of the co-ops, when they own that loop, they're gonna give you all the benefits of that; you will have lower utility bills. We're doing a couple right now in market-ready multi-family housing in Colorado, as a matter of fact, and the developer is owning that whole loop and the reason why he's doing it is because he can stabilize his rents. So he rented out his entire property before it was even built, because he can guarantee what the energy costs are.

I am also the Marketing Chairman of the International Ground Source Heat Pump Association; we are the group that trains everyone. So one of my jobs -- I'm on the road about 220 days a year; one of my jobs is also dealing with jobs that are done wrong, okay? And as new… as new things -- as technologies become more, I guess popular, everyone becomes an expert, everyone. Now that's nice if you're doing windows or doors, because you can come back and fix it, but if you're burying something 300 feet in the ground and covering it up, why could that have a problem? Okay. Once it's buried, you're done. Okay? So I will say to you, if you're looking to do geothermal heat pumps for your house and for your buildings, go to New York Geo; they've got a website, go to the International Ground Source Heat Pump Association, there are accreditations that people should have, whether you be a well driller, whether you be an installer; whether you be a designer.

I just wanna show you something real quick. This was done in Philadelphia, it's in an at-risk school, it's 900,000 square feet; you see the life -- I don't read these, but you see the 20-year lifecycle; it's a plus 2,632,000; that's not the big story though; this is the big story. With Kensington Capa High School, school incidents, crime and violence dropped 66 percent, truancy dropped 25 percent, test scores quadrupled, graduation went from 30-67 percent and this young girl said this to me, "I'm poor now, but I'm no longer without hope." Now I can see a prison before I can sell a school; is there something wrong with that picture? Right? So it's up to us to demand that we do something for our kids. The average school here is 49 years old here, the average school across the United States is 42 years old; the school built in 1970, their system's already worn out. Now what's the difference between school now and when I went to school, or even Bob Wyman went to school, who's a long younger than I am; what's the difference? Well I used an abacus, okay, so nobody had these and nobody had these, so this little machine here is one human, so if you have 25 kids in a school and you've got 10 computers, you've got 35 kids in that schoolroom. So what happens; they get overheated. With geothermal technology, geothermal heat pumps, you're not only gonna reduce the cost of energy, which is the only thing that school can control, you won't have to five any teachers or get rid of the after-school programs, you'll show kids that you can use renewable energy and all you're providing is comfort, that's all you're providing. Forget the rebastats [sp?] and hemagladdens [sp?], I really don't care. I don't wanna take a machine apart, I'm not gonna tell you how it works, okay; I'm gonna tell you it will work.

Here's the other thing; 55,000-square-foot; it's a data center; there's more data centers going up in the United States than anything else right now. This is in Philadelphia, 60 tons -- if you look, the simple payback without any grants or rebates was 8.6 years, 8.6 years. So that's pretty fast, so I wanna thank the Chairman, Samara; thanks for inviting me and it's a pleasure being here; I'm glad to hear the term geothermal heat pumps in practically everybody's talk. Like I said, Professor, I didn't have any graphs, so. This is my favorite saying -- we can't solve our problems with the same thinking we used when we created them -- Albert Einstein said that. What I'm saying is; start asking questions, start looking to get involved and having more meetings like this is gonna make us move forward. Thank you.

CHAIRPERSON RICHARDS: Thank you, Jack.

[applause]

Alright, next we'll hear from Jay Egg [sic], whose daughter's celebrating her sweet 16 this week and [background comment] with us here today. [background comment] Yeah. She's enjoying her birthday.

JAY EGG: Well I just have to say what a pleasure and a privilege it is to be here; I am so grateful to all of the people in the geothermal industry, which this room is full of wonderful advocates and I am especially grateful to Chairman Richards and Samara and Bill Murray over there and just really privileged to be here today.

I pointed this presentation not so much on the geothermal side of things, though it's completely geothermal, but I've done quite a bit of work with larger applications where geothermal is applied as the base and this artwork that was done kind of gives an idea of where this presentation is going to go, because it involves mini grids, thermal grids, load-sharings that are all geothermal or Earth or ground source based and as you see, as you think about this, and I understand that these will be available online afterwards or something like that, Samara; is that correct? [background comment] You can look at all of the renewable energies that are available to us, you've got the wind power, you've got the solar, but in some of the work I've done you're able to apply the energy syncs of canals, of waste, of sewers, of energy piles of the bay and inland waters, even subways and this is something that's being implemented around the world, and you have all of this here, and this is what's so amazing about this technology because it's a water-based technology; water is a great carrier of energy, you can perpetually use energy when you're doing a geothermal or a water source system; you can share energy. So without too much more ado, we'll go into it.

We have several people covering geothermal applications, but here it is; I'm gonna say it like it is, geothermal is solar energy; the sun beats down and 50 percent of the energy from the sun goes into the Earth and all we're doing is extracting that energy when we need it. So here you have the Earth, the Earth is a solar battery, it's one kind of solar battery; we certainly need every kind; we had a great testimonial earlier on battery technology, gotta have it, but the Earth is also a battery for solar energy that lasts through the entire winter season, because the earth absorbs that solar energy and with a geothermal heat pump we can use that energy to heat our homes, to heat our buildings, to heat our domestic hot water; to heat our swimming pools. This is all of the different types of geothermal that might be applicable here, but I want you to focus -- this is at Cornell, done by Dr. Tester, Jefferson Tester; this is an actual system that's implemented there; notice the little power plant on the bottom left using the body of water as a heat sync; there's a lot of bodies of water around here, and I'm not gonna go into a lot of detail on that, but just think about this; in just one city block in New York City -- we had a slide earlier, it was magnificent, it showed the Empire State Building cooling dominant, even in the winter time -- Why? Because you have internal heat gains. So what's it doing? Have you ever sat at there and watched those cooling towers steam in the middle of the winter? It's because it's a cooling dominant building; meanwhile, you've got the apartment buildings and the residential on the same block that are needing heat; this is energy that is going into the air and as Jack said, wasting millions, billions of gallons a year of fresh water going through cooling towers, being evaporated and blown down into the sewers that can be eliminated in with geothermal heating and cooling. And there's more to it along the line of cooling towers that we'll cover.

This is a very simple schematic of how a thermal advantage loop works or how a thermal mini grid works. You've got cooling heat pumps for your cooling dominant buildings in the top left, you've got space-heating heat pumps; they nab the waste heat from having cooled a building before it goes back down into the ground and they use it for space heating, for water heating; even for pool or spas, and down below you have whatever -- this is the source energy, whether it's a geothermal close-loop; open loop; there are several different kinds and I think Mr. Rhyner's gonna cover that later.

Now, elimination of CO2 emissions or going CO2 neutral, we know, and this… I stole this from Bob Wyman; we know that CO2 emissions come from burning fossil fuels to heat domestic hot water and to heat homes and buildings. Here's something along the lines of what Jack talked about; all I'm gonna do is focus on one figure here -- if you have a cooling tower, which every building that has cooling, as commercial does, if you use 1,000 tons of cooling you're going to use 34,500 gallons of fresh water on a summer day, and that is not that big of a system, there are many systems in the city that need 4-6,000 tons of cooling; can you imagine the amount of fresh water a day?

Now here is a winter picture -- this actually happens to be, in the bottom left, a picture from my hotel window; my wife and I are staying near Times Square; you see that cooling tower; that was yesterday morning, just blowing off steam because it's a cooling-dominant building; this is just a stock photo showing all the cooling towers blowing off steam on a winter day, and that's a Google satellite photo; every building is just littered with these. Not only are cooling towers able to be eliminated by going geothermal or going with a thermal grid that's geothermal-sourced, but you also eliminate very high profile equipment on the roof that is prone to wind damage, it's prone to aging because of the severe weather; you take all your equipment inside when you go geothermal; there's no outside equipment, everything is where it should be, tapped into the Earth and renewable. Isn't that beautiful? I mean just amazing. Look at -- that's right outside my window right there, bottom right; I mean I didn't plan on doing this; I just said hey, look out there, wow; is that -- all that equipment literally, quite honestly, would be gone if that building was geothermal-sourced. And this, up top left, was a building across the way and the others are just stock photos of different…

Now this is my lovely 16-year-old daughter and she's standing in a geothermal cooling and heating plant that was finished in Clearwater recently on which I was consulting; this room here to the right is the size of a couple or three basketball gymnasiums; it was the hurricane-hardened enclosure for cooling towers that was required to be built that is now vacant because there are no cooling towers in there. See the abandoned connections for the chiller plant? That's all there is now, it's inside. Wouldn't that be beautiful to be stubbing up ground source piping from the earth for cooling and heating? Gets better, infrastructure and resilience.

This is a place in 2009, it's called Schooner Bay and it's in the Bahamas, it's in Abaco. They started right; they said, Jay -- I happened to have a website and they happened to stumble across it and they called me and I was like, what are you calling me for? But anyway, I knew just enough to be dangerous and so we flew down there and we built a completely geothermal community. If I had the time, I'd tell you a fascinating story about the billionaire who developed this community. He just didn't like outside noise, that's all, he says, "Jay, I want something that doesn't have anything outside to meddle with my peace. This community, complete with hospitals, schools; downtown district, is 100 percent on a geothermal plant, 100 percent; there's the equipment room and there it is as it's being developed. It's doable. This was made by a friend of mine, a co-writer of my last book, Greg Cunniff, who works for Taco up in Providence, Rhode Island; this is exactly how a block in New York would be designed to use the different heating and cooling elements -- buildings, apartment buildings, commercial buildings; manufacturing -- you could sync and sap some of the heat from subway canals from sewers; I understand it's a little bit difficult, but who was it in here that said there are a lot of people out there with money, and those people with money would love -- second bullet point here -- legislation to encourage the sale of waste heat; how 'bout that? You've got a commercial building, a great big tall building here in New York City and it's cooling-dominant; if you go to that person, that owner, that group and say hey, how would you like to sell some of that waste heat that's going out your cooling tower all winter long? They're gonna go, sign me up; how much -- you'd say, well you've gotta get this thermal grid run around this whole block so you can sell it and then we'll let you do it; how 'bout that? It would work. And then, the residential apartment buildings and the people that need heating would be able to pull that in at a far reduced rate; everybody would be happy and hopefully no tax dollars would be spent. I'm not opposed to that, but I'm not here to say how it happens; it just makes sense to me.

So promotion of geothermal source mini grids; if you do like Bob told me, about the London thermal, the heat map, if you can do thermal mapping, you can get a good idea of which parts of the blocks and which buildings are cooling-dominant, 'cause most people don't know if they're cooling-dominant or whatever, but you can figure this out, so there needs to be studies done; we've done a lot of feasibility studies in different parts of the world.

This is the most amazing part and the paper that Bob Wyman's gonna present is where I tapped this from -- in New York City geothermal in the heating mode is 78.9 percent renewable energy, 73 percent of what a heat pump brings into a building of the finished energy is straight from the earth. The other 27 percent comes from the electric grid. New York electric grid right now is 21.7 percent renewable energy and guess what; you think that's gonna get better? Electricity is the way to go; it is going to get better, better and better; I wouldn't be surprised if it doesn't hit 30, 40 and 50 percent renewable energy before long.

Here are the big bullet points -- if you go with geothermal heating and cooling you have reduced reliance on fossil booms; boom, reduced price risk; we all know about fossil fuel price risk; easier planning due to stability of fuel sources -- I love this term -- eco immunity -- if you're not relying on fossil fuels, you have eco immunity; I love that terminology; increased likelihood -- I'm a consultant for some big companies that I can't really name, but they're very interested in being the vendor of choice -- increased attractiveness to valuable talent; the kids comin' out of school these days wanna deal with the green companies, the green cities; New York City is a green city, but the more you do, they go hey, I wanna go to New York; I bet my daughter wants to go here eventually; public relations, employment factors, expenditures on electricity-sourced technologies like ground source heat pumps tend to stay in-state; when you buy fossil fuels, all that employment's out-of-state -- Table 3 of NYSERDA, employment goes way up.

This is something I put together, but I want everybody to know my feelings on this; when ground source heat pump technology couples with thermal load-sharing, which is like a thermal grid like we're talking about, the result begins to come close to perpetual use of energy, because you're reusing and reusing the energy until you have a surplus, one way or another and then it goes either into the earth or you pull more from the earth; the earth is your thermal battery; you can put it in; you can take it out. And loads of the buildings and systems linked to a geothermal source thermal grid become hyperefficient. The efficiencies we're talking about don't even include the factors of reusing heat; when you do that it goes to a degree that's -- you can't really say until you use all the dynamic calculations. So thank you very much; I appreciate your time.

[applause]

CHAIRPERSON RICHARDS: Alrighty, for our next panel, we're staying on geothermal it looks like… oh no; what are we doing? [background comment] Yeah, geothermal and geothermal mini grids and storage. So we'll have… I'm gonna call three panelists up -- Bob Wyman, Geothermal Expert, Factors for Evaluating Heating Alternatives in New York City; John Rhyner, my good friend, Geology of New York City and Geothermal; Gaylord Olson, Industrial Advisory Committee for Mechanical Engineering at Temple University, mini grids.

BOB WYMAN: They really need to make that thing taller. [laughter] Either that or make me shorter. 'Kay. I submitted something like 47; 48 pages of stuff; I will spare you the agony and I will not present it to you; just a few selections from it. What I wanna do is talk a little bit more about geothermal, but really, in context of the alternatives to it and provide I think a few notes that others have not mentioned. I do wanna first go to just one slide; doesn't have a lot of information on it, but I think it's a really important slide for people in the city to really get their heads around. We don't -- my apologizes to Professor Modi, but it is the million points of energy in the City; we have 3 million fossil fuel burners in this city at any time; at least those are the permanent ones here. We've got -- everybody says 990,000; to me that's one million buildings; almost every one of them has at least one fossil fuel furnace in it and many of them have more and we've got a bit over two million registered vehicles in this city and just about every one of those is a fossil fuel burner. And so when we ask the question, you know how are we going to reduce the consumption of fossil fuels within the city, the real answer is there are three million different ways that we are going to go about doing it and given that we do have three million different little projects that have to be addressed here, we'd better get started soon and we'd better be working together and have the full support of the government. But fundamentally, our goal I think needs to be to remove the three million fossil fuel burners from the city as soon as possible and frankly, what we need to move from here too is essentially what I call the second grade electrification of our society.

Where the first grade electrification essentially dealt with lighting; things like radio, entertainment, appliances and such, the second grade electrification, which will be actually larger in terms of energy than the first, will focus on transportation and heating applications, these three million fossil fuel burners.

To, you know, put some more color on it, I think -- let's look at this graph; it's a little old, but it's still very close to reality, from 2008 that Enro [sic] puts out, and what they do here is they show you, on the left side, the very sources of energy, okay, as they're being delivered -- this particular graph is focused on carbon dioxide emissions, so it showed you on the left the sources of energy and on the right, you know, where the emissions are coming from, and I think one of the things that I think we really need to sort of understand here is that although there's a tremendous amount of discussion today about things like the EPA Clean Energy Plan for power plants, the 111(d) process, the PSC is constantly working on the issue of emissions from power production, etc.; it turns out that electricity, an entire electrical system, the electrical production system, actually doesn't produce that much carbon emissions, okay, and in part that probably isn't surprising because in New York State, as in most of the country, electricity only accounts for less than one-third of all the energy that is delivered to end use applications. Okay. Over two-thirds of the energy turns out to be consumed really by two applications and those are the applications you see on the bottom of this chart here; it's transportation and it's the use of fossil fuels, direct combustion of fossil fuels in buildings, which is of course primarily for heating and for hot water. So when you think about the size of the electrical industry, you think about the size of all these issues that people are constantly talking about with electricity, just remember that that's really only -- that's less than one-third of the power we consume. And interestingly enough, if you look at New York; the numbers are a little small here on the slide, but if you look at the amount of carbon dioxide emissions that are coming out of the electrical generation industry there, it's about 45 million metric tons; that's a lot, okay, but it turns out that's only about 23 percent of the total carbon emissions for the state. About 40 percent of the carbon emissions for the state as a whole are coming from transportation applications and about 30 percent of the emissions are coming from heating space and hot water. Space and hot water and cars produce much more emissions today than does the entire electrical system. It's important we understand this so that we get the priorities right.

Now if we go on -- you know, this isn't just me you know saying this; just yesterday, by chance, the Public Service Commission issued an order adopting the regulatory framework and implementation plan for renewing the energy vision; this was just filed on their site yesterday, and they say that achieving the long-range carbon goals will likely require a transition away from fossil fuels in building heating systems as well as transportation. They also acknowledge, as they have before, the ground source heat pumps powered by electricity are commercially available and are economically feasible for many customers today. So this is something that a lot of people don't believe, but in fact it is the case.

It's also important to reflect back on previous statements by the PSC; the PSC recently, in their comments on the EPA's 111(d) process, the clean power plan, pointed out to the EPA that they were somewhat concerned because if really the EPA's intention was to reduce emissions, at least in New York State, it might not be most effective to put all of our resources and our money into reducing emissions and electrical generation business; the Public Service Commission made clear that they were of the opinion that it was quite possible that the most cost-effective way to reduce emissions in New York State would be to focus on the emissions that come from the building heating space, because it is primarily powered by point of use direct combustion of fossil fuels.

Now in this city I think we've got a number of people who've been able to look at the issues long enough and closely enough and compact enough so that we don't get that confused by these things and I think we're beginning to recognize these kinds of priorities and understanding the tremendous impact that the buildings are having on our emissions.

But nonetheless, we still need to move forward and one of the things we need is efficiency, because as we always say in this space, efficiency is the first thing you should focus on.

What I've done here and I think it's great that we have or had Miss Schneider, who had worked on the Energy Star regulations some years ago, I list here the Energy Star minimum criteria for the efficiency of heating equipment, okay. And what you see here are essentially heating equipment comes in two flavors and really only two flavors that are available in any scale of scale; you've got your oil and gas furnaces down at the bottom and then you've got a variety of kinds of heat pumps, either ground source heat pumps or air source heat pumps. It's important to really recognize that while a lot of people talk about alternatives, like the various biomass alternatives, you know, solar passive heating, etc.; these are all great technologies, but they're probably not the kind of technologies that we can scale to the challenge of doing something like trying to figure out how to heat one million buildings in New York City anytime soon. On the other hand, the practical technology for doing that are probably the technologies that we have here, either the heat pumps or the fossil fuel furnaces.

But it's interesting to look at the efficiency ratings for these things; they come in all sorts of different numbers; there's AFUE and HSPF and SEER and EER, etc., which is great for keeping people confused, because it makes it very hard to compare between one and another to see what's going on; I convert them all over to something called coefficient of performance, and coefficient of performance is simply a ratio of the amount of energy that you put into a system, be it electricity, be it fuel or whatever, compared to the amount of energy that you get out of the system, and if you get exactly as much out as you put in, you've got a COP of one. If on the other hand you put in say one unit of energy and you get three units of energy out, you've got COP of three. So let's look at how these various technologies rank in terms of Energy Star ratings.

And we'll see over there on the right your gas furnaces, either in the north or south -- I won't talk about why there's a difference between north and south; we're interested in the north -- the best you can do is a COP of .95, which really translates into an efficiency of 95 percent. Sounds pretty good, 95 percent; that's pretty close to 100 percent, you know all the way through -- almost every time in life you know you're told a 100 percent; that's as good as you can get; actually, that's really pretty bad, it's really, really sad and if we're stuck using technology that is only approximately a 100 percent efficient, then we're gonna have some real issues here.

If you go on to the least efficient air source heat pump -- actually both of them are about the same; the least efficient air source heat pumps are gonna give you a COP of 1.9-2, okay, and understand, these are minimum federal standards, so actual systems have much better COPs than this. The minimum standards here on these things are gonna give you two; that means for every unit of energy you put in you get two units out.

Now look at the ground source heat pumps; the ground source heat pumps in this case, the minimum federal standards will get you a COP as high as 4.1, although I must admit that normally the kinds of systems you would be implementing would be these closed-loop water to water ones that get you the 3.1; essentially 3.1 units of energy in terms of heat out of those systems for every one unit of energy that you put in; that's 310 percent efficiency. It sounds crazy, it sounds like totally wrong; if you were paying attention in physics class in high school you were sitting there saying this is BS, well it is actually; it's kind of an unfair comparison; it has to do with the say COP is computed; it's the amount of energy you put in in terms of the input compared to what's coming out. What's missing here is the fact that a heat pump is unlike a fossil fuel system; a heat pump isn't a question of changing one kind of energy to another, a transformation from say chemical energy to thermal energy; a heat pump really is a pump; it's not producing energy; what it's doing is it's taking energy that's in the ground and it's just moving it along and that's where you get the appearance of these 300, 400, 500; even 600 percent efficiencies in real systems in the field, because you're just taking the existing heat and you're moving it, either from the ground into a building or from that tremendous solar collector, which is called a building and you take the heat from the building and you put it in the ground during the summer so that basically you'll be able to suck it back out of the ground in the winter to heat your house, which is a very different process than taking dead dinosaurs and burning them, you know. And the thing that's kinda cool is that, as Jay points out, the thing that's sort of neat about this approach is you can take the heat out of your house in the summer; you pump it down into the ground in the winter; you'll pull it back out of the ground in the winter to heat the house and you sort of end up with this cycle where you're constantly cycling the energy back and forth; in fact, if you've got one building which is heating-dominant; the next building over or say on the other side of the block is cooling-dominant, you can be just sloshing the heat and back and forth sort to perpetually, but you know, you can only burn a dinosaur once, only one time and that should give you some sense of the difference in approach here.

Something I really wanna point out and clarify here is that I constantly hear people say, this heat pump, it's a great idea, but you know, if you're using a heat pump you're still using electricity that's coming from the grid, so you're still using fossil fuel, so it still is not a good idea; what we really need to do is, we need to figure out how to get totally fossil fuel free heating and cooling. It's like, god what a concept; that would be great, if only we could do this. But the point is, at least in New York State, the claim that using electricity to run a ground source heat pump or an air source heat pump is not a good idea because after all you're still burning fossil fuel; it just isn't true. And I'll show you here, if you look at this chart, once again our nice and confusing list of all these different alternatives, if you look on here at sort of how much fossil source energy is reduced by replacing old equipment, either electric, oil or gas furnace, by the new equipment -- I give you the listings here -- if you look up there in that block which is the ground source heat pumps, you're talking about a 78 percent reduction in fossil fuel use if you're replacing electric heat, 69, 64, 58 percent reductions in fossil fuel consumption and this is systems that are powered by grid power, okay, grid power in New York State, which is being produced in part by fossil fuels; it's important to remember in New York State that about 50 percent of the power statewide, which we consume, is in fact fossil fuel free. So when you take power which is 50 percent fossil fuel free, you then put that into a system which has effective efficiencies of 310 percent, it turns out and then compared that to say an oil furnace, which is a 100 percent fossil fuel; it turns out that you are able to demonstrate very significant reductions in fossil fuel energy consumption by switching to ground source heat pumps without doing anything else in your building for efficiency or whatever simply by changing the technology.

It's also important to understand; the reason ground source heat pumps end up being so efficient and being able to so reduce the amount of fossil fuel energy consumed is in fact because they are in fact what the subject of this conference is about; they very much rely on sight-sourced and stored renewable energy. What these things are doing essentially is taking the grid power -- actually, ideally they would take clean power that came off a local PV system or something like that so they'd be a 100 percent clean, but we'll assume the worse case, they're taking power from the grid; they take a small amount of power from the grid and then essentially amplify that into a large amount of power by pulling energy out of the ground.

The amount of site-sourced energy, okay, which is produced by any of these systems, as you see would be listed here; let's look at our sort of slow performer ground source heat pump there, the water to water, your worse case here is that about 67 percent of the energy that is actually output from the ground source heat pump will have been pulled out of the ground right there on your site, okay. Now, we dilute that a little bit to get an overall number, dilute that a little by taking into account the amount of renewable energy, which I think is about 21.7 percent for the state, in our mix and we come up with, on average, say for that water to water system, 39.2 percent is essentially the overall amount of renewable energy that you're using in your house the moment you switch from your fossil fuel system or anything else to a ground source heat pump. You get smaller numbers for the air source heat pumps -- I don't like talking about them because they aren't very efficient that the rest; there are some strange places due to architectural constraints where you might have to use them in the city, so include them there.

The general idea here is that basically the heat of the summer makes it possible to -- you know those hot summer days are what make it possible for you to have sort of warm winter evenings and that's the promise of the ground source heat pumps, 'cause essentially efficiently moving the thermal energy into a place where it can be stored, as a thermal battery, essentially; then brought back later.

And it's a lot cheaper than most people think it is. Here what I've done, and by the way, these are all… this should be 20… the dates on the bottom; that should be 2005-2006; 2006-2007; these are basically the price -- if you take the price of the various fuels, convert them to how much you would pay in terms of pennies per kilowatt using the Energy Star efficiency ratings for the different equipment types over time where each of these years is essentially that winter, so the last date is really the 2013-2014 winter season; what you see here is, that although natural gas, because of all the fracking and stuff we've been doing and the overproduction, is very much price competitive for the first time really with the ground source heat pumps; oil is nowhere close. Anybody in the state I think who is still burning fuel oil, and that's about 30-35 percent of the citizens of the state and I think it's higher for here in the city, much higher in the city; anybody who's actually burning oil is not only polluting the air and being an absolute -- well I can't say those words probably on a City Council recording -- yeah, anyway, he's being, shall we say, exceptionally unwise to be burning oil, there just seems to be no excuse for it; you should either be shut down because you're poisoning the air; and fortunately we're shutting down the people that are doing No. 6 and No. 4 oil, but even the people that are doing No. 2, they're just stupid, because it's costing them way more than it should. If they were using ground source heat pumps they'd be saving a lot of money while being able to use renewable energy.

Just wanna sort of summarize some of the points here again. Heat pumps are, as far as we know they're most efficient way to heat and cool buildings; we don't have any alternatives that anybody has that are practical on the scale that we need to be able to work in New York City; if you've got a place in the country and you can build into a side of a hill or you can get your frontages right and you're able to do passive and you can have 6-foot-wide walls and all that sort of stuff; cool, but it's just not gonna happen in New York City. Of the systems today, even without any modifications to make a building more efficient, which for goodness sakes you should make your building more efficient, but even if you just swap out the heating systems, these systems today will produce fewer emissions, use less fossil fuels and save you money and most importantly, they will eliminate, for every building we shut down or for every building we retrofit we will have one fewer of the one million fossil fuel furnaces that are spewing carbon dioxide and poisons into our air today.

My personal feeling is, is that we need to acknowledge that heat pumps are in essence inevitable; everything points in the direction of, you know over time, the petroleum prices are gonna go higher, gas prices are gonna go higher, our willingness to tolerate the poisons that are coming out of those systems; our willingness to tolerate the carbon emissions of those systems is decreasing every day; we are going to get to the point where we're going to either stop using the oil because it's too expensive or we're gonna stop using it because we're not given a choice; we're made to stop using it. The only alternative we have is in fact heat pumps; we may have an interesting argument over ground source vs. air source, but that is the only known alternative for heating a house, other than wood stoves, but let's not go there.

What I would like to suggest is that the City Council do something which has been done in England to great effect, and that is to adopt what is now called a Merton Rule, and the interesting thing about a Merton Rule; it's named after the town where it was first done in England, which oddly enough was called Merton, and what they did was, they simply said that all new construction in that town must come with or must be designed to produce at least 10 percent of its energy on-site. Now it turns out that's really not hard for people to do; you tell 'em you gotta do it, they'll do it. But it turns out that any decent architect, once he's told he's gotta go produce 10 percent of energy on-site, he starts looking at it and realizes, you know, yeah, I can do 10 percent, but you know I could just as well do like 40 or 50 or 60 or 70 percent as well. The point is essentially to get people to understand that they're expected when they build a building not to be relying on the rest of society to provide them with electricity, fuel or whatever, but for them to understand that part of the responsibility of building a building is to provide for the energy, from site-specific sources is to provide for the energy that's necessary to power that building.

So I would hope that you all would consider, if there's any way that we could get it in New York City, we could get a Merton Rule; there are some places in the U.S., out in the west, where there are towns that have required that you can't build a new building without putting solar on top; I think it should be more general than that; we should be just talking about energy as opposed to any particular technology. But I think one of the best things that we could do and one of the best ways we could set an example is to have a Merton Rule here that essentially says you build a building; you're responsibility it to provide at least some of your own energy from your own site's resources. Thank you.

[applause]

[background comments]

JOHN RHYNER: Good afternoon; my name is John Rhyner; I'm with P.W. Grosser Consulting engineers on Long Island and I'm also the Director of the Sustainable Energy Group there and I'm also a founding board member of the Long Island Geothermal Energy organization on Long Island. Thank you, Chairman Richards and Committee and guests for having me here; it's late in the day.

I'm a geologist by training and hydrogeologist and I've been working in the geothermal business here in New York City for about 15 years, looking at the viability of geothermal in the City for various types of properties and clients and I'm here to talk a little bit about geology; the question comes up a lot, there's a big mystery about geothermal, it's not like solar and wind, you can see the resource, you can measure it easily; the geothermal resource is down below us; you can't see it and it's not a black box, okay; so I have to tell people that all the time; the Earth is not a black box; you really have to know it's down there to tap into the resource and take advantage of it and know if it's viable for your particular property. So I'm just gonna touch on that and I'm gonna touch on the fact that the geothermal resource beneath the City has been studied, there are people that are interested in trying to characterize it and quantify it for the benefit of the residents of the City, so I'm gonna touch on that and then some creative applications on how to do it in New York City; doing anything in New York City is hard and it can cost a lot of money, a lot more than elsewhere, so there's a lot of creative solutions out there on how to tap into the Earth and I'm glad I don't have to talk about the thermodynamics or anything like that, because… [background comments] what's that? [background comments] Okay. Should I start over? [background comments] Somebody should've waived their hands earlier. Okay, I'm gonna break my back.

So anyway… [background comment] okay, that works good; how do we advance the slides? This thing? [background comment] Okay. So as I said, I'm a geologist; did everybody hear that? [background comments] So I wanna show a couple of nice pictures, just to kinda lay the groundwork for the geology in New York City, when geologists had a lot of time on their hands a long time ago; now they don't 'cause they're in consulting and they have families and it's such a fast-paced world. But this is the projected extent of the glacial ice sheets many, many years ago when none of us were around here and it's like the powers that be conspired to converge all this activity right in New York City to make my job difficult, you know 30,000 years later, but the glaciers actually came down from the north and you know parked right in New York City for a while and they dumped a bunch of stuff right -- all over New York City, which is very difficult for us to get through to build buildings, to build piles and to drill for geothermal, so that's one picture. This is another nice picture; this is a cross-section through the Hudson River by the Verrazano Bridge; that's the one on the right. Actually, the one on the left is a more modern, updated version of that, but it just kinda shows you; you know once you get through all this glacial debris that the glaciers dumped, the geology beneath New York City is very varied; it's a lot of rock, mostly rock; it's limestone, it's all warped and contorted and largely below a depth of, you know a thousand feet or so; it's largely unknown; it's kind of unchartered territory. So this is a resource that's beneath us; the different rock and soil materials all has a different thermal capacity, a thermal exchange capacity. So this is, quickly, Staten Island, a vertical slice through Staten Island, the high point in the middle of Staten Island is all rock and down in the flanks on either side to the east and south there is some unconsolidated sand and gravel. So these are the type of the resources we have beneath us and it's all different. There's been some reference today to standing column wells, open loop wells; closed loop wells; these geothermal systems we tap the building into the Earth; we're dumping heat in or pulling heat out, and someone mentioned; I think Jay mentioned it, that water -- they all involve circulating water; the water is the messenger, we're moving heat around, from the building to the ground and from the ground to the building seasonally. So some of them, the two on the left, you're circulating ground water; those are called the open loop systems or the standing column well systems. The closed loop systems, you don't circulate ground water, you circulate just city water, so you have a network of plastic piping and vertical bore holes or horizontally and it's all charged with city water, so you're just circulating that water and piping; not ground water. And they're all different, they're all -- they depend on the geology -- standing column wells on the left, they like a lot of rock, they're installed predominantly in solid bedrock, so Manhattan and the Bronx are suited for standing column wells -- open loop in the middle; you're pumping ground water, you need prolific aquifers; Brooklyn and Queens -- closed loop you can anywhere you want.

This is just a cross-section through Brooklyn and Queens, just showing the variety of geologic materials; the brown wedge is bedrock, the yellow, blue and orange and red, that's all sand and gravel, unconsolidated materials beneath Brooklyn and Queens, and then you've got gray layer on the top;

that's the debris that the glacier dumped. So this is what you're up against; a lot of options and you really need to have a good idea of what's down there to plan a system. Plan view -- I'll just go through this; I know that it's late in the day.

So anyway, this resource that we have, there have been attempts to characterize it; the New York City Department of Design and Construction, the City, they're the pioneers with geothermal technology; back in early 2000 or so they published the Geothermal Heat Pump manual on the left and they wanted to, to the best of their ability, give a guidance document for City agencies and the private sector how to do geothermal -- how to go about evaluating and doing geothermal in the city. A few years ago that manual was updated and I had the pleasure of working with the DDC to update the manual on the right -- and here's a copy of it right here; it's available through the City, or if you wanna invite me into your office, I'll bring a copy. But really, it's a good resource, it's how to do geothermal in the city and some of those geologic maps I have are presented in that manual in a little better quality; the manual goes through and kinda presents where these different types of systems are viable based on the geology -- closed loop, as you can see, are viable in all five boroughs; standing column wells, as I mentioned, where rock is shallow here in Manhattan and in parts of Staten Island, and then open loop, where you have the really good sand and gravel aquifers.

And this Dr. Modi already talked about, but this was an attempt that I worked with Columbia grad students on characterizing the feasibility of geothermal, based on not only geology, but also the building stock, the heating/cooling loads. So I just was somehow put in touch with Dr. Modi and his grad students, whom are all brilliant; I really enjoyed working with them. But they determined the heating demand, cooling demand, electric demand and domestic hot water demand for every building in the city, so that was the basis of their model, heating and cooling demand; they converted it to tons per acre. I helped them convert it to determine the ground thermal capacity, depending on the geology there and what kind of geothermal capacity existed and we compared the two, and this was the illustration that Dr. Modi flipped up there before; the difference between the two determines the geothermal feasibility. And it also takes into consideration open areas that you could actually access to drill a well, because the other limiting factor, or the dependency with geothermal is you have to be able to pull up a drill rig, boom up a 35-foot mast and drill, so that's factored into this. So as you can see, a lot of Manhattan shows like it's not really feasible, but keep in mind that this map is based on a block by block basis too, so there's a lot of individual lots and facilities in the city that have geothermal, so don't let that sway you, but the green is feasible, so that means there's enough land to drill; the buildings aren't so large that you can't put in enough wells or loops to meet the demand, so basically the potential is huge, it's enormous.

So some creative solutions -- 'cause a lot of people say, it's hard doing geothermal in the city, it's expensive, etc., etc.; what if there was an outside source of water available to you? You know you need water; what if your building's built out and you have no room to drill wells or loops; what if somebody came along and said, I've got the water for you; you could run it through your heat pumps? Well there is. Okay, New York City Transit has two subway stations at Pitkin Avenue and Nostrand Avenue that were constructed when the water table was depressed, when the city was pumping ground water for drinking water from that area; they build these subway stations and then the city stopped pumping and kept moving out east and the water table rose, and now these subway systems are flooded out, so on a daily basis the City has to pump down the water table around these subway stations to keep them from flooding and we're talking 8-11 million gallons per day they're continuously pumping to keep the water table depressed so that water doesn't infiltrate into the subway and they're dumping it into the sewer system. So if you live in the area of either of those places, they even engage a consultant to look at a feasibility study -- what type of water users were in the vicinity that could conveniently tap into this source of water for non-potable uses, geothermal; they looked at all that and they came up with all types of building types and public and private facilities; hospitals that could potentially take advantage of that water source. So I think it would take something like a utility scale or a third-party investor to build a plant near that area to, you know, filter the water, clean it and make it available to folks. Anyway, that's something that -- thinking outside of the loop here. And then energy piles, someone mentioned it; New York City is the land of big buildings that have to be supported with piles sitting on rock, so every big building has dozens and dozens of piles and caissons that have to be drilled and seated into rock and the building gets built on that; most of these things get filled up with concrete and that's it. Well if you're in Europe, the norm is to -- if a building's gonna have piles, put a bunch of plastic piping in them as a heat source or heat sinker or heat source. So I'm aware of one building in New York City that's using that; that's the Trevor Day School that just went in in the Upper East Side a few years ago. Why this is not more widely adopted in the city or the states I don't know, but it's very big in Europe and Asia. Not only the piles, but the foundations, if you're gonna have a big foundation slab and the walls down in the cool soil, it's pretty standard in Europe to put pipes between the foundation and the soil or actually embed them in the concrete, again for heat exchange.

And that's one of my favorite pictures; that's one thing, if you're gonna do geothermal in the city, you have to be aware of the water tunnels that are anywhere from 500-700 feet down in the city; this allows you to drill closer than 200 feet on either side of a water tunnel. So about 10 percent of Manhattan is off limits to drilling deep geothermal wells because of the city water tunnels.

So I don't have any requests or recommendations of the Council, except just keep doing the good work you're doing and we've got Local Law… [interpose, background comment] Huh?

CHAIRPERSON RICHARDS: And use geothermal.

JOHN RHYNER: Yes, we did Local Law 32 and geothermal bill too, we hope to see that get through. So thank you.

CHAIRPERSON RICHARDS: Okay, great. Thank you so much.

[applause]

Alrighty, our last presentation on, I believe geothermal -- oh is this on mini grids, [background comment] Gaylord Olson and then we're going into solar and sustainable districts and wind. [background comments]

GAYLORD OLSON: Okay, well thank you, Samara for inviting me here. Can everybody hear me, first of all? [background comments] It's okay? Alright, I can talk pretty loud, so -- wow, it really feeds back to me a lot here.

So I'd like to talk about what are called multi-source heat pumps and seasonal thermal storage; it kinda ties into what you've heard already, but it takes a little bit different tack on things and some of this is a little bit futuristic and it kinda ties into architecture as well -- [clearing throat] pardon me.

So multi-source heat pump, also known as hybrid heat pump -- basically you're looking at taking advantage of not only one type of access to thermal energy or thermal exchange underground, but maybe two types of thermal exchange or thermal input. So moving along, here is a very simple example of a hybrid or multi-source heat pump system; you'll see that it has two things that we've already heard a lot about -- the green box, standard water source heat pump; it has an underground heat exchange block on the bottom left; could be bore holes, could be standing column well; could be trenches with a slinky -- oh slinky; does anybody know what slinky means? Some of you may, but whatever. By the way, this is about a 40-minute talk, but I have to compress it by about a factor of two, and so if anybody wants more detail or wants the full treatment, just jot my phone number down; I'd be happy to oblige whenever it's convenient for anyone.

Okay, so I have two slides on this particular example, which comes from a couple of articles published in 2011 by people in Canada and France, and you'll see that these three blocks; that is, on the right; I should've mentioned, unglazed solar collectors; these are typically used for swimming pool heating; there are just pieces of black plastic that have small tubes embedded in them so you can transfer water from one side to the other and when the sun is out they get warm, just like a black plastic hose sitting on your lawn, gathers heat from the sun. And so this example is for heating only, although it could be used for cooling as well, but let's just talk about heating. So you'll see there's a valve in the middle, a three-port valve, which can control the flow of the fluid either on the left, which is the example of a standard grown source heat pump where the water flows only through the ground exchanger and the heat pump. On a sunny day you can gather heat from the sun with the unglazed collectors that gives a significant benefit beyond what you can do with only the ground. So this system has a significant higher coefficient of performance than you would have with a standard approach, using only what's underground.

You ask, how much better is it? Well that's on the next slide. This slide shows the situation if you vary the amount of area of the unglazed solar panels. On the left is what you have with a standard ground source heat pump system and this has been simulated for a 20-year time period; it's an example for an office building in the north of France; pretty much heating only in that case. So what you see here in the red is the cost to build this system, to do exactly what's needed for this office building for a 20-year time period. It shows that the cost to build it is $900,000 Euros. If you start adding in solar area, you see that there is a significant reduction in the cost to build this system; you're gathering heat from two different places, the sun and underground. So if you get up to 750-1000 square meters of solar collector, and these are very inexpensive items, they're mass-produced in many different countries; you're saving almost $200,000 Euros for this kind of a system; pretty significant -- [cough] Pardon me. If you go too far in that direction, of course you have more than the optimum quantity of solar collection and the sun is not always out, so you actually need some minimum quantity of ground exchange.

The information on these two slides comes from these two articles and you don't need to write them down -- [clearing throat] pardon me -- I can put this up when the talk is done if you wanna write them down then or you can call me; I'll tell you as much as I can.

Okay, so now; can we do even better than what we're showing on that first slide? The answer is yes, I believe we can do even somewhat better than that. This example shows the addition of five more valves; these valves just control the flow of water one way or another through the same three blocks --

the heat pump, what I call here a solar air heat exchanger; that's kind of equivalent to the unglazed solar panels, and then there's a ground heat exchanger. So this allows us to have about nine different modes of operation and some of them are very significant. If we go back here, suppose we have an example where we want to preheat the water with the unglazed collectors and after it's preheated we wanna send that water into the ground exchanger; that will very likely happen many days of the year, many hours of the year, but this design does not allow you to do that. Incidentally, there's only one direction of flow for the water in the system; in this case it's counterclockwise. So by the addition of some additional valves you can control which of these blocks is first or second in the series sequence; you can make the ground exchanger first or second.

Now how many other modes are there? It turns out there are at least 10 different modes and this is kind of a quick overview of what they are. The top left mode is again, simply a ground heat exchanger mode of operation -- [clearing throat] pardon me. Mode number three at the top right was exactly the same mode as shown on the first slide; the one on the right is the same thing as mode number three, right here; however, mode number two was not allowed by the previous system. Also, mode numbers four and five are simply using the air or solar collector block to provide what's needed for the heat pump; you don't always have to use the ground, keep the heat or the cold in the ground for a later time.

There are some parallel modes of operation and notice modes eight and nine; nine being at the bottom right, those modes are used to precondition the ground temperature. If you don't need the heat pump you can make the ground either warmer or colder by using the air and solar heat exchanger.

Now suppose we want to have two regions underground and keep one permanently hotter than the other one; this allows you to do that. So in this case, the heat pump in the summertime will likely be putting out very warm water. Assume that the flow of direction is clockwise, and this shows only part of the operation of the heat pump, not the full; it's just what's called the ground loop side of the heat pump. So suppose we have the condition where the solar air exchanger is not in use, we block that off by closing valves three, four, one and six, so now what we can do, if we want to optimize the operation of this, and as I say, it's in the summer; we take the very hot water coming out of the heat pump, we put it underground in one of those two regions, the one that we wanna purposely keep hot and after that it goes through the other region underground, and these underground regions could be one or more bore holes with closed-loop pipe; I believe they could also be standing column wells, two or more for each block, so what you'd end up with then is two regions underground -- as I said, one you keep warm all year long, the other you keep cool all year long; that allows you to have a significantly higher efficiency for the heat pump than merely using the ground as a heat exchanger. Also, this design allows you to change the sequence, so let's say in the wintertime the water from the heat pump is gonna be very cold, so what you do then is you change the sequence for the bottom two blocks and you put that cold water into the region underground that you purposely want to keep cold before it goes to the other region. Does that make sense? Okay. Here is kind of a side view of a system like this that would be possible to do. In this case there is something called a flow control module which would contain all of the valves and pumps shown in this design. In other words, each of these four blocks has just two pipes attached to it, so each of those two pipes feed into the thing called flow control module here, and of course I'm assuming, which I didn't state, but I should have stated, the little blocks with the letter T are temperature sensors, so there will be a computer and a control system to change the valve conditions based on all of those temperature sensors that are in use. So there's a systems controller here, basically computer and control block.

Now I've added one more item here which was not previously shown or mentioned -- electrical generator. If you have two sources of fluid, one being hot; one being cold, anybody who's in mechanical engineering realizes you can generate electricity. I see Jay nodding his head; you get what I'm talking about, right? Okay. So now this is what you might call a tri-generation system without the need for fossil fuel. Now the electricity might not be possible or cost-effective on a continuous basis, but I believe it could be very possible to have this as an emergency electricity source for a mission-critical facility -- hospital, police station, data center; whatever -- if you absolutely, positively need to have electricity 24/7, all year long and the grid goes down and you have no fossil fuel; this is another backup approach.

Oh you notice there is a spiral shape shown here for the two underground exchange regions; I think that's kind of important because to have the optimum long-term storage in the ground you wanna have a spherical or hemispherical shape for the region that you're storing. A sphere has the maximum possible ratio between the volume and the area; no other shape has that. And you can make the shape into a quasi-rectangle if you need to; typically this put under a building.

Now we have some simulation work that's been done on this type of underground storage, so we pretty much know how big it has to be to store on a seasonal basis. So this shows some simulation data points; on the bottom right it indicates what the parameters were; we're assuming for this example that we're heating up the ground for a time of 60 days, like two months; let's say July and August or whatever; now we're gonna let that ground cool down for some arbitrary time, in this case 150 days, about five months, so we wanna store heat from middle of the summer into the middle of the winter and have that heat be there. What this graph shows is that if you have a small area that you're trying to do this with, it does not work; with a 4-meter radius you're losing about 80 percent of the heat, so that's not so good. As you get larger with this system, at about a 15-meter radius, you're retaining 80 percent; you're losing 20 percent of that heat, so that's much more effective.

Incidentally, the data points on the right have been corroborated with yet a third approach to doing this, and so we're pretty confident that the data points toward the right are correct, and we've done a lot more sophisticated simulation beyond what is shown here, but I don't really have time to expand on any of that for now.

Now you might ask; is there anything close to this that's already in existence in the real world, and I have four somewhat close examples that are being done and tested and used with multiple installations today. One of them is just for simple homes, residences; what's shown here has been done with multiple homes in New Zealand and Australia and you can see the website on the bottom right, the digitalsolarheat.com website; a lot more detail. But basically, this involves evacuated tubes, solar thermal collectors on the roof of the building and what you might calla horizontal heat exchanger below the building with insulation in-between the concrete slab of the building and the dirt below; it's pretty simple, and in some cases there will be a heat pump required with this; in other cases the heat pump is actually not needed, because there's enough heat from the solar collectors and the underground storage to take care of comfort for the building. So check that out.

Here's another closer-to-home example and a number of these systems sketched out here have been built in the state of Maine. The principal developer who did this work is Jeffrey Harrison, who some of you probably know, but he'll be speaking actually in a couple of weeks at an event up in Upstate New York, Skidmore College, which is put on by the New York Geo

Association. So I'd recommend, if you have a chance, check that out.

Anyway, what I'd like to show here is the comparison between the top left-hand example and the top right-hand example. The top left-hand example is what you've heard numerous times already today, a standard bore hole with closed-loop liquid flow. Now these are all -- at the top you see they're all 6-ton system examples; what is interesting, at least to me, is that you can get the 6-tons of heat exchange with the horizontal array of pipe at the top right. So now you'll see it's about 4,000 square feet, 5,400 linear feet of tubing. Down below are the cost comparisons; notice specifically the standard closed-loop bore hole approach cost per ton, $3,400; the very bottom, where it says horizontal slinky bed -- and you can eliminate the word slinky from this; that's kind of an option -- $1,100, so you'll see that it's about a factor of three less expensive to do the horizontal approach rather than the closed-loop bore hole. Also, if you work out the numbers here, it comes out to be, for the upper right example, it's $1.70 per square foot to put that horizontal bed into the system.

Okay, here's another example that's being built in London and I should've put the website on here, but it's pretty simple; goes by the designation icax, so if anybody wants to check that out, put that into Google; it's almost always the first thing that pops us, icax -- if you want the full website, icax.co.uk. And what they're doing is, they're collecting solar thermal energy from an asphalt either parking or playground on the left, putting that thermal energy in pipes under the building; again, just as we showed on the previous example -- actually, this is the third example, one here, two here; three here. Many of these types of buildings and installations have been done and I recommend you can check their website. If you wanna store cold, you can do that; that's what this slide shows. So the asphalt on the left is kind of equivalent to the unglazed solar collectors; it could be on the roof; doesn't have to be on the surface, like shown here.

Here's a picture of the partial installation of one of these systems beneath a school building. You notice they do not have a connection at the center, so I believe it could be improved somewhat if they use the quasi-spiral approach rather than what is shown here.

Some of you may have heard of a place in Canada called Drake Landing Solar Community; anybody? Okay, Bob has. Bob, are you and I the only ones? I guess so. Anyway, I'd recommend that you check this out also. [background comment] Say again. [background comment] Jay, you have, yeah. Okay, three of us. [background comment] Drake Landing Solar Community; it's at the very top. [background comments] Canada. [background comment] Alberta, near Calgary, cold climate. Website is dlsc.ca, very simple. Anyway, this is an overview of what they're doing there; it's about 7 years old now and the people in these 52 homes are getting essentially 100 percent of their heating from the previous summertime sunshine being stored in the ground. You notice that in this case they are using bore holes; they've got 144 bore holes that are drilled about 120 feet deep, then they've got insulation on the top and that's really all they -- well, they of course, they have to transfer the water into each of the homes and they have solar collectors, shown here in the dark gray; these are glazed flat panel solar thermal collectors, no photovoltaic. Alright, so this works. Here's a cross-section view, drawn somewhat to scale, showing the individual bore holes that are about 7 feet apart, in this case; you can see the dimensions there. Now if you really wanna store a lot of energy and you don't have much surface area, then you might have to use bore holes or standing column wells or something of that sort. But if you have enough area, at least with a minimum of about a 100 feet across, you can get seasonal storage -- in this case I would guess you might only have one-third the energy in the hemisphere as compared to the vertical wells; let's say one-third.

Anyway, the next slide has some dollar cost items. If we concentrate just on the bore hole field, $620,000 Canadian dollars and we convert over to dollars per square foot, based on the approximate area of that system, about 10,000 square feet; we have a cost for that bore hole array which is $62 per square foot and you remember the previous number we had from back here is $1.70 per square foot. Which would you prefer? Now that's not quite fair, because the bore holes might give you three times as much energy, but still, we're talking about an order of magnitude approximate difference in cost to do each of these approaches.

Finally, this I think could be of interest to architects in some future year, and again, this involves solar thermal collection, but I'll do a quick explanation of this and you'll see the website at the bottom right; this is a fairly new development; they're still perfecting it, and it's a consortium of seven different European countries; it's sponsored by the European Union. You've heard of triple pane windows -- okay, this is a quadruple pane window, but it's not only a window for looking out to the outside; this is a window which allows for fluid to flow in-between the panes. So what they're doing is, they're gonna have one or two hollow regions with fluid flowing in; that's the blue, and then some of the other hollow regions could have gas; that's the yellow. Now they're showing only one example here of where the three hollow spaces have two, region blue; one yellow. This shows that they can collect solar thermal energy from the outside surface and use the inside surface as kind of a radiant panel for making the temperature either higher or lower in the room where this window is faced. Now I believe this could be improved beyond what is shown here; imagine, for example, that you interchange what is yellow from what is blue; imagine that you have two regions of gas which are the outermost hollow regions and the most inner region, the one that's now yellow, you make blue with fluid, water; what you have there will be equivalent to a fully glazed flat panel solar collector, so a very efficient solar thermal collection from every window in the building. To me that seems pretty interesting and that's where I'm gonna end. So thank you very much for your attention.

CHAIRPERSON RICHARDS: Thank you. [applause] Alright, we're moving to solar now. So we're gonna have two presenters… [interpose, background comment] oh so just one, Tria Case, the New York City Solar Partnership and Distributor Generation Hub.

TRIA CASE: Does everybody need to stand up and shake their arms or something? [background comments] Do you wanna -- while we're… while… there's a lot of very intense technical -- there you go, especially after lunch. [background comment] I got to walk down here, so it was helpful to me. [background comments]

TRIA CASE: Okay, everybody. So we're gonna change speeds a little bit. Everybody ready? [background comment] Okay. Okay. That was your two minutes, guys; everybody hear me okay? [background comments] Okay. [background comment] Absolutely. [background comments] Okay. [background comment] Okay. [background comment] So it was good timing for me to let everybody stretch, just not long enough, is that… While he's changing his tape, I'll give you a little heads up here.

So we've been hearing a lot about different technologies, but when you think about deploying each one of these technologies, there's a whole process on the other side, so while our researchers, like Sanjoy Banerjee that you heard earlier, are developing great batteries and we're thinking about how to deploy geothermal, when you go to put that into a city like New York City, you have to go through a major process to get there; you have to go through the Department of Buildings, sometimes you have to go through the Fire Department; sometimes you want an incentive from NYSERDA, so there's actually a whole process that you have to understand and you have to go through [laughter] in order to actually get any technology into New York City. So [background comment] it has changed and it's been massaged, but it's a little bit more transparent than it used to be when we started this effort in 2006, so I wanted to sort of set that stage for all of you. Are we good up there with the… [background comment] okay, super. Okay.

So you know, when we sat down and took a look at solar, and actually, I'm sort of happy to find out that there aren't a slew of solar installers here, because to me that says we've probably come a long way in the solar industry in New York City and I think some of the numbers that I'm gonna show you are gonna make you realize that in fact we have, but these other technologies, like batteries and the concepts of resiliency are now flowing together with the idea of deploying solar, because the way we design our solar today, the way we permit our solar today, the way Con Ed is permitting our interconnection, it's shutting down when the grid goes down and you heard that a little bit earlier this morning. So much of what I'll talk about today is the progress that we've made over the years in trying to move traditional solar into the marketplace, but some of the things that we have to do going forward in order to make solar now meet some of the new needs that we realize that we have.

We've doing this, as I said, since really 2006 and the Department of Energy has been a great driver; somebody earlier was thanking NSF; NYSERDA and the Department of Energy and the City have been great supporters of CUNY in really trying to spearhead the movement of solar into the marketplace.

One project -- just to sort of you know keep it on ground in terms of the implementation, and again, you know that's really what we're about implementing these projects, is something called New York City Grid Ready. When you go to deploy solar in New York City, it's not just what's -- the potential is on your rooftop, but it's also what the grid can handle; whether or not you're could cause a problem in feeding back to the grid. So one of the efforts that CUNY has taken on in partnership with Con Edison is to take a look at not only the solar potential of our rooftops, but also what's happening on the grid side so that we can tell installers and developers whether or not there might be an issue on the grid side before they get too far down the path. So these are each projects that we've taken on over the years, but I call your attention to Grid Ready, because that's something you'll see launching very soon.

Events like this are really important, bringing stakeholders together are real important; I thank you for pulling this together and inviting me to speak. We've been working with stakeholders in New York City and one of the things that's happened is that New York City's really been a leader and now municipalities across the state have asked us to work with them to put in place a program similar to what we've put in place in New York City so that they too can realize the growth of solar.

In 2006 we had a little over a megawatt of solar, a little over a megawatt; now we've got over 40 megawatts of solar. So clearly it's been exponential and it's been exponential both in terms of the installed capacity each year and the cumulative installed capacity; you can see how that growth has taken place. It's been truly in credible and we think that by next year we'll double again.

Oh, we seem to have a glitch in our -- okay. Well what this slide should tell you [laughter] is that when we started there were 45 installations in New York City and today there are over 2500 and again, we're looking at that doubling. But going along with that is the installation companies, the businesses, the economic development. When we brought all the stakeholders together to develop a roadmap for New York City, there were six installers sitting around the table; it was pretty easy to develop that roadmap together; there are over 60 now doing business in New York City; there's over a 100 that are looking to do business in New York City and work with us on a New York City installer roundtable. This number of installations, little over 40 megawatts; almost 42, represents about $285 million in economic development in New York City. So we started at probably about $10 million and today we're over $285 million, so it also -- it's not only about clean energy, it's not only about the fact that we're reducing our carbon footprint, but it's also about jobs and it's also about economic development.

So our strategy has really been twofold; we've really been working on the balance of systems cost, so again, you've been hearing about the technologies; the cost of solar has come down greatly, the cost of geothermal has come down greatly, but in New York City over half the cost of putting solar on your rooftop is what's known as your balance of systems cost; that's customer acquisition, that's your financing; it's your permitting and your inspections processes; it's your interconnection with Con Edison and it's your operations and maintenance on those systems, 64 percent.

Our strategy also includes, you know trying to find ways as we reduce that balance of systems cost to find ways to allow solar to reach grid parity; how do we actually make solar cost the same as paying your Con Ed bill, or in our case, our NYPA bill -- little harder on the NYPA side, but getting darn close on the Con Ed side. And you can see that the costs have been coming down and they've been coming down exponentially and New York City is coming close to New York State.

Oh that is a bummer. Okay. I guess the graphics are not happening here. Okay. So our implementation platform -- at least you can get the four pillars of our platform -- they really revolve around human capital, so at CUNY there are solar ombudsmen, New York City solar ombudsmen that are looking at the policies and the programs in New York City, working with installers and trying to make sure that folks are trained. One of the complaints that we get from Con Edison or the Department of Buildings is that when folks are putting in their applications they may not be filling out those forms correctly; they may not know exactly what it is they need to do. So we work hard to make sure that the installers know what it is the Department Buildings is requiring; that they understand why they're being required; there's some 19 forms that the Department of Buildings requires, 22 signatures; 5 different inspections. So there's a lot to understand and one of the things we'll talk about is that there are probably some ways we could streamline some of those forms and some of those inspections. But our ombudsmen are really there to help make sure that folks know what needs to be done and to also try to come up with some resolutions to make sure that the program is as streamlined as possible, and in that regard, really working on policy and analysis.

There are over a 100 jurisdictions across the State of New York that adopted or are in the process of adopting a streamline solar permit that was developed by our program. Again, I think that there is a version of that that New York City could adopt.

We've also looked at the City to try to determine where do we have our peak load problems; where is there daytime peaking across New York City where solar could play a role in reducing that daytime peaking? So it's you know, taking away batteries, taking away other technology; solar is producing at its best in places around the City where we're realizing our peaks. So we've identified solar empowerment zones across the City of New York and again, sort of you know, when policy is good, the rest of the State has now adopted that, so NYSERDA offers an adder to solar installations that are in these zones that have been identified across the State of New York, all started here in New York City

You heard earlier about the solar map; the solar map is one of our technical platforms -- I'll show you… if graphics works, I can show you some more analytics that we've developed based on data that we get from NYSERDA, from the Department of Buildings and Con Edison. So CUNY actually developed an agreement with each of those entities so that we get a daily upload of all the information about the permits that are being pulled at the Department of Buildings or the incentives that are being applied for at NYSERDA and at Con Edison, so we can see who's working where; how much it costs; what the balance of systems costs really are; what the technology costs are, and we can begin to track what's happening in the marketplace.

What the solar map does is it actually allows the public to see what's possible on rooftops, and one of the things that we found early on, is people came to us and said solar? Well there's only a megawatt of solar in New York City because, well you know, where are you gonna put solar in New York City, you know, and nobody thinks about the rooftops. Well as you've heard a couple times today, there's almost a million buildings in New York City and there's a lot of potential for solar on a rooftop. So to combination of solar can provide when we're at our peaks and we have these rooftops that are available, makes solar a really great technology to be looking at for the city. And so we've identified the key players in New York City who really impact permitting, who impact financing, who impact all the key areas that determine whether or not solar can be successful in New York City, and I say again as I mention growing from 1-42, I think that's one of the reasons why you know you don't see a ton of solar installers here because the issues now have gotten very particular, they are very real and they require very specific responses, as opposed to other technologies like batteries, where our issues are, we've gotta figure out how to permit them, we have to figure out how to permit them. Right now, if you wanna put a battery in a building in New York City, I can't show you the pathway; we have to figure that out.

So here we can sit down with the key players; we've created working groups around permitting, planning and zoning, net metering in connection with financing, and the folks who are the decision-makers around these -- Economic Development, Con Edison, Department of Buildings -- are leading those working groups with us and helping us to create the solutions to the problems that exist across the city, and that has been an incredible process and I think incredibly successful process.

So I'm gonna talk about the solar map for a second as one of the key tools. How many of you have seen the New York City solar map? Not bad. Okay. So for those of you that haven't, it allows you to plug in any address across the City of New York; it'll take you to that rooftop and it will tell you what the solar potential is. When you first land it'll actually tell you about installations that currently exist, and I will say that we've gotten as much feedback about that component of the map as the solar potential component of the map. Because people can't see rooftops, they can't see those solar installations, they don't know that their neighbor put solar on the rooftop, they don't know that a business that they respect put solar on their rooftop, so this is a way that we can allow for folks to put their solar installation up there, give a little testimonial and allow people to see why they put solar on the rooftop and that it's there.

For those that wanna see what the potential is on their own rooftop, we have 15 billion points of data across the city; we've had planes flown over New York City in order to create a 3D map of the city so that you can see the shading from one building to the next, so that you can see what the actual solar potential is; even taking into consideration, for example, fire code setbacks. Now you're able to not only see what that potential is, what your bills savings are, but, as somebody said, the same as planting trees, your carbon footprint reduction, you're able to see what the generation is month to month and you're able to get a financial payback analysis.

So this map is hit from people all over the world, by the way and we were recently asked -- folks in Australia built a map and they based it on the way we built our map, so it's also become a platform that others around the world are looking at, so as somebody said, New York City leading the way.

One of the big projects that we've taken on recently is to expand the solar map; it's not gonna be the New York State solar map; we have LIDAR data for Westchester County, so we are in the process of creating that 3D map, that 3D imaging of Westchester County, so you'll be able to also get solar potential for any rooftop in Westchester, including the consideration of the shadowing and we will hopefully be able to build that across the State of New York.

For New York City this expansion is going to be very important because it's gonna also allow us to make it a portal for other information about solar, so it won't just be what your solar potential is, but a guide for permitting, for example. There will be an interactive guide so that you can build for yourself your permitting process and take that with you so you understand what it is that's required of you.

Right now we've done some things, like we have a single checklist of all the forms that are required from any entity for permitting across the city. So some of that information is out there, but this will be an interactive guide so that you can see what's happening.

Also, one of the things that's happening across the city is something called solarize; are you all familiar with solarize, group purchasing efforts that are happening across the city? We'll be able to show you where those solarize efforts are happening, connect you to them and hopefully connect you to installers. Right now, again, we can give you list; this'll be a little bit more robust, it'll allow you to get to installers who might be interested in your installation.

So today New York State is fourth in the country for solar jobs; there are some 7,000 jobs across the state and it's growing faster than in most of the other areas of employment. One of the things I like about it is that a fifth of those 7,000 are women, so yay. [laughter]

You heard a couple folks talk about One City Built to Last; we worked with the Mayor's office to make sure that the Solar City Partnership and the Partnership, Mayor's Office of Sustainability, New York City Economic Development Corporation and CUNY is the coordinator housing the solar ombudsmen our not codified in one city, so we'll continue to reduce the cost of installing solar; we'll continue to create these group purchasing programs; soon you'll hear about one that's launched in Community Board 6 in Brooklyn and then we'll also start looking at community-shared solar where it's resilient. Again, folks that haven't to this point been able to adopt solar, maybe because they don't own their rooftop, for example, are gonna be able to all work together to be able to invest in solar installations, either together on their own rooftop or on another rooftop, and you heard some folks talking about the REV proceedings that are happening across the state; that's gonna make these sorts of projects much more viable and we'll work hard to try to identify the locations across the city, again, where the solar potential is there and give them a platform to be able to work together to adopt solar together.

For those of you that don't know solarize, the more folks that work together -- boy, the graphics are not working too well here. The more folks that work together to buy solar, the more the price drops. So like any group purchasing, this has become a real method for helping to move solar in communities across the country.

I'm gonna end to just talk a little bit about solar and resiliency; again, something that a lot of the speakers this morning talked about batteries and solar together as being a great source for resiliency, for reducing peak load. We've seen more and more blackouts in New York City and we're recognizing that while we have 2500 solar installations installed across the city and 42 megawatts, the predominance of those systems, if the grid goes down, they'll go down. So after Sandy, we got quite a few calls from around the country saying so, how did solar do; you guys are a leader in solar; what happened? And luckily we could say nothing flew off a rooftop that everything stayed where it was supposed to be; however, they all shut down, because that's how they're designed to operate and they do that for the safety of Con Ed workers who might be working on lines so that the power that might be generated isn't going back onto the grid. So they do that for a good reason; however, technology is there now to have smart inverts so that if the grid goes down they can shut down and those inverters can "black start" and allow you to use that solar power shut off from the grid so that on days after Sandy, when they would've been generating at 35 percent of their sunny day capacity, you could've charged your cell phone; you could've charged batteries and use them at night.

So we've brought together all of the smart inverter companies, we've introduced them to the solar installers in the city; we're looking at more and more ways that we can help bring those smart inverters into New York City and help installers to design systems that are resilient and as batteries become more and more available and more and more financially viable, this is gonna be a great source of resiliency for the city and it will also help folks with peak load. I can tell you for CUNY, more than half of our energy bill comes from our demand; not from our consumption, so if we could reduce our peaks, if we could take down our peaks, we would save a lot of money; I think that's the same for most businesses and others around the city. So half the solar installations across the city after Sandy shut down. So you can see that this could make a huge, huge difference.

So we initiated something after Sandy; this is supposed to also have four boxes that are sitting in a square -- I'm not entirely sure why that's not working -- and we brought together all the key entities that interact around an emergency, from FEMA to OEM to Homeland Security, to Con Edison, and we sat down and we said, well what can we do to make installations across the city resilient; what are the barriers to that, we were able to create a roadmap for traditional solar; can we create a roadmap for resilient solar; what are the barriers? And we were able to organize ourselves into four key areas -- hardware and technologies, software technologies, policy and legal and economics and finance. And just recently we were awarded a grant from the Department of Energy under their Solar Market Pathways program to bring together all those players over the next three years to build that roadmap and to create those working groups to be able to identify what the barriers are and the solutions and begin implementing them. So over the next year you'll hear us talk about resilient solar and creating that roadmap and we'll be looking to you for any insights and thoughts that you have about what could be done and we're already talking to the Chairman and his staff about ways that we can start to create policies and programs that will help to make that a reality; not the least, which as I said, is going to be permitting and helping to understand the different battery types that are out there and the different storage technologies that are out there, and the uses of solar and how maybe we can even begin to support them. Somebody earlier talked about a tax abatement

-- currently the price of installing solar in New York City is 7-10 percent more than it is in neighboring Westchester, for example, but the incentives from the State are the same. So if you're an installer, you're probably gonna go to Westchester 'cause you're gonna have an easier sell. So we worked with the City in order to develop the Solar Tax Abatement and that leveled the playing field and that was one of the reasons why we saw growth in solar, because the financials worked, and I think as we start to get into resilient solar we're gonna need to be creative like that and find ways to make resilient solar financially viable as well.

So with that I will end and thank you and hopefully get us back on track.

CHAIRPERSON RICHARDS: Thank you.

[applause]

Alrighty. [background comment] Now we're going to hear from Philip Skalaski from The Durst Organization. [background comments]

PHILIP SKALASKI: So I'm usually better at yelling at contractors than I am at making presentations, so I'm probably gonna read a little bit of this, so forgive me for that.

Good afternoon; my name is Philip Skalaski; I'm the Vice President of Engineering and Energy Services for The Durst Organization… [background comments] I'm sorry. [background comments] Thank you for giving me the opportunity to share our experiences with site-sourced and stored renewable energy. Just a brief overview of The Durst Organization's experience with sustainable buildings and then I'm gonna discuss some of our experiences with some of the site-sourced and stored energy technology within our buildings.

The Durst Organization is celebrating its 100th anniversary this year; we are one of New York City's largest developers and owners, with more than 13 million square feet of Class A office space and nearly 5,000 residential units, either built, under construction or currently in the development pipeline. The Durst family has been on the vanguard of sustainable construction and building operations for 25 years; we have a number of notable firsts -- One Bryant Park was the first LEED Platinum skyscraper; One World Trade Center is the largest building designed to achieve LEED Gold Certification in the Unite States; 4 Times Square was the first green skyscraper; 1155 Avenue of the Americas had the first thermal ice storage plant; the Helena is New York's first voluntary LEED-certified residential building to receive a gold rating and Manhattan's first building-wide residential composting program.

Over the course of building close to 10 million square feet of sustainable buildings we have piloted many site energy technologies; some have been very successful, others not so much. I'm gonna start with the unsuccessful ones and remember, a lot of these systems we put in close to 15 years ago -- 4 Times Square was in 1998; it was a very small system in terms of capacity, was 5 kW; the installed cost $80,000 at the time, which is probably more in these dollars today, but at the same time, we understand that solar is a lot less -- excuse me -- [cell phone ringtone] duty calls. Because it was built into the façade, it became expensive; it was very difficult to install; it was very delicate to install, so the installers had to be very careful when putting up the panels and looking at it over the past 17 years that it's been installed, it only generates about 3600 kW hours a year; again, 'cause it's on a vertical surface; not to mention when we built One Bryant Park next to it, it blocked half the solar, so that didn't help either. So that was that solar system; again, greater than a 100-year payback period, so at the time not such a great idea, but we did it anyway.

The Helena; this is 601 West 57th Street, this is next to the pyramid building that we're building over there. This we were a little smarter at; we put a little bit more capacity in, yet it definitely cost more; we did get incentives at the time; this was 2004. Annual power generated is about 25,000 kilowatt hours and we have a payback of approximately 35 years, so we were getting better, although trying to sell that to ownership now doesn't really help.

Wind -- wind actually, in this one, we are successful; we do buy 10 percent wind energy across our portfolio, annually without actually adding any cost to the energy. So the way we actually get billed, we also bill our tenants at the same rate; we're a real estate company, we're a developer; we're not an energy company, we don't wanna make money off our tenants; we make the money off the rent; not by charging them excess costs in electricity, so we sell them electricity at the same rate at which we buy it at. So for us, we worked a deal with Con Ed Solutions to give us a two mil reduction per kilowatt-hour and then we roll that back into regional wind, which is approximately 2 cents per kilowatt-hour, which equates to about 10 percent northeast regional wind, so it's not the guy in California that we're buying it from, it's the guy that's local that has it, either on his building or in his residences. And again, that equates to a total wind power purchase of about 11 million kilowatt hours per year, which is pretty significant.

This is one that actually didn't work that well and we ended up not installing; this was One Bryant Park; we had planned to put a vertical wind turbine on top and it would've been one of these types of vertical rotors; unfortunately, when we looked at it and this was again, back in 2004 when the building was being designed, the wind in New York City is not really consistent enough; normal consistent wind is usually less than 5 miles an hour or it's much greater than 15, 20; 30 miles an hour, at which point it gets hard to actually make the energy; you actually have to let the wind turbine freewheel, 'cause it'll rip itself to shreds, at least at the time; now again, technology may have changed, but at the time when we looked at it, it just was not feasible, so we didn't actually plan on doing it and ended up not putting it in; although the building still does have the supports for it and if we ever have the opportunity to make it actually work economically, we may in fact do it.

The next one was geothermal heat pumps; this was historic Front Street and this was back before, way before Sandy; we put in a geothermal heat pump system; I think this was back in 2002, unfortunately it was an open loop system; again, it was before we really knew about -- not before we knew about it, but we realized that, you know we didn't use the plastic piping; we used stainless steel piping; the blackish ground water caused it to corrode out, we had nothing but problems, it was an open loop to the apartment heat pumps, which caused all the heat pumps to corrode; not saying that it was -- it was just a bad design. it didn't work out well; it's hard to kind of go back and try and force that now on you know tall tower bosses and tell them, you know why it didn't work; we were in some litigation with the engineer as well… [interpose]

CHAIRPERSON RICHARDS: Please show some successes, instead of… [crosstalk]

PHILIP SKALASKI: We're gonna get… [interpose]

CHAIRPERSON RICHARDS: Okay.

PHILIP SKALASKI: We're gonna get to them…

CHAIRPERSON RICHARDS: Alrighty.

PHILIP SKALASKI: this is the last one; I promise. [background comments]

CHAIRPERSON RICHARDS: No, no calling out, no calling out, no calling out.

PHILIP SKALASKI: So again, we learned from that… [crosstalk]

CHAIRPERSON RICHARDS: Look at their successes.

PHILIP SKALASKI: We learned from that and we ended up replacing the system with a variable refrigerant flow heat pump system after Superstorm Sandy, which does work very well.

Now for our successes. At 4 Times Square we installed two hydrogen fuel cells, with plant to install many more at the top of the building. While the fuel cells at 4 Times Square did not really perform as well as we hoped, which the maintenance costs made them prohibitively expensive, we very much like the concept of generating on-site power, so when we designed One Bryant Park, we designed into it a 4.6 megawatt combined heat and power plant; it runs on high pressure natural gas and we used the waste heat to generate steam to heat the building in the winter and in the summer, through absorption chillers we make chilled water for air conditioning. Power from conventional utility power plants is about 45-50 percent efficient, our cogen plant approaches about 70 percent efficiency. Our cogen plant also provides more than two-thirds of the building's energy and produces half the carbon of a conventional power plant. The plant required a steep capital investment, close to $30 million -- these are some other pictures of the plant; this is when the actual unit was being installed and that's it installed in place. But it does perform brilliantly; it's challenges are economic; somebody mentioned the REV proceedings going on right now, which I'm actually a member of REBNY and I've been trying to help REBNY with the PSC to try and direct them into changing these tariffs, but Con Ed charges nearly $2 million a year in standby charges, so that if our plant goes down for any reason it's transparent [sic] to the building. But again, it's about $2 million in standby charges, about a million dollars a year on the steam side, just to have the pipe through the wall, even if I don't use an ounce of steam and it's about another million dollars in having the electrical capacity to back up the 4.6 megawatts just in case our plant goes down.

In addition, regulators are often unprepared to assess new technologies like cogen and permitting can be onerous, especially with high pressure gas; we jumped through some major hurdles with the Fire Department, dealing with greater than 15 psi gas; this system operates at about 180 psi, and it's on the 7th floor, which is below a tower which is another, you know 50 some odd stories above, with office workers in it, so it was not easy.

Of all the sustainable technologies we have installed in our buildings we are most enthusiastic about is cogeneration, but it requires the assistance of government and regulators to proliferate.

Energy storage. Thermal energy has proven itself to be extremely effective; we have 7500-ton hours of ice storage at One Bryant Park, and an additional 3200-ton hours of ice storage at 1155 Avenue of the Americas. These thermal batteries equate to approximately 700 kW of electrical demand reduction over a 10-hour period; they basically offset the peak energy load to off-peak, which saves on marginal carbon. Again, it is electrically driven, so we have to run an ice chiller at night, but again you're running it at night when the grid is lightly loaded basically, and then reusing the ice during the day for cooling purposes.

Ice storage systems are economically viable; their only downside is they require a large footprint and they require also a 24-hour watch engineer, because you have to run that chiller at night, so we've tried to look at doing this in some of our other buildings which are, you know 6 a.m. to 6 p.m. operating buildings, but we can't make it economically work out because now I have to pay a watch engineer at night or 24 hours a day to actually make that ice at night, so when you add the extra manpower in to make that ice, it actually doesn't work out from an economic standpoint, but it works out great in buildings like One Bryant Park, which have 24-hour trading; works out great in 1155, which has a law firm that operates through the evening and through the nighttime hours. This is the other ice storage facility at 1155 and pros and cons we just discussed.

'Kay, projects under development. This is our new construction project which we're not even coming out of the ground yet, it's just a site at this point, but this is Hallets Point, which is on a peninsula off Astoria, right across from 96th Street. Currently assessing the feasibility of a microgrid; right now the plan is to have three combined heat and power plants serving 2.1 million square feet over 5 residential buildings; the plants would have a total combined capacity of 6.8 megawatts, which would include N+2 redundancy on the capacity side and 2 N redundancy on the distribution side; the N+2 is based on the Con Ed requirements. Again, this would provide electricity, hot water, chilled water for the entire facility. Basically we'll have gas coming into the building and that's it, there will be no electricity coming into the building; we're gonna make our own, we'll load follow; this will be totally off the grid this plant. We estimate the incremental capital cost to be put these three plants in will be about $23 million with a 9-year payback and we expect the plant to essentially convert 6 cents worth of gas into 30 cents worth of electricity. Again, these are economic points, but they're important from a business standpoint.

This is building one, which shows the layout, it's a little tough to see, but again, this is the I guess concept plan at this point; we're still designing; we just started DDs, so still got a long ways to go. This is the electrical distribution plan, which shows the three generator plants; one in building one, one in building three and one in building four and how they'll all connect to building two and building five and again, there is pretty much no single point of failure, with the exception of if we lose gas, but that's true for heating as well, if you lose gas you're gonna be in the dark when it comes to heating as well.

Two of our other residential buildings that are currently under construction -- 855 6th Avenue and 625 West 57th Street; we're installing hybrid heat pumps with condensing boilers. This is a little different than the hybrid heat pumps that the gentleman was discussing a little earlier. This basically -- these are the CGC hybrid heat pumps and basically they act as a fan core unit when in heating mode and they act as a standard water cool base unit when in cooling mode. The beauty of this is that when you're in winter operation you get low temperature supply hot water and you get even lower temperature return water and condensing boilers love low temperature return water, to the point where we get almost a 98 percent efficiency on hot water condensing boilers. This is providing greatest efficiency, again, when using natural gas condensing boilers. Again, it also limits the internal compressor to run only in summer operation, which offsets the less efficient electric operation of numerous distributed heat pumps with more efficient central gas-fired condensing boilers. This system provides, again, the low -- excuse me, I'm repeating myself.

In addition, both buildings employ the use of energy recovery units with energy wheels to transfer heat from the spill exhaust air to temper outside makeup air without mixing or contaminating the air streams.

One additional measure of energy recovery takes place at 855 Avenue of the Americas during the winter operation -- excuse me. Basically, what we were talking about before when it comes to the thermal microgrid, we actually created one of those in 855 because it's a mixed-use residential and commercial building, so we have a 200,000-square-foot footprint for commercial operations and then we have about 380,000 square feet of residential and what we basically do is, instead of taking the heat that's always generated from the commercial and blowing it out the cooling towers, we recycle it and run it through those hybrid heat pumps that you just saw, which basically saves on gas, so we don't have to fire the condensing boilers, we can lower it. The only problem we've had with that so far is when talking to the office tenants, they don't like it because they're paying for our heat, but it's alright, we'll work that out in lease negotiations.

And that's it. Thank you for allowing me to share some of our experience with you and happy to take any questions.

[applause]

CHAIRPERSON RICHARDS: Thank you. I commend The Durst Organization for always thinking forward and I ask you not to give up on wind and geothermal.

PHILIP SKALASKI: It's… [crosstalk]

CHAIRPERSON RICHARDS: You know what; there are some experts who might help you get it right in this room.

PHILIP SKALASKI: It's always a… [crosstalk]

CHAIRPERSON RICHARDS: You should get their cards.

PHILIP SKALASKI: It's always a possibility and again, when we look at every project, we start from scratch again and we see what we can do, so… [crosstalk]

CHAIRPERSON RICHARDS: Alrighty. Great. You guys get to know… [crosstalk]

PHILIP SKALASKI: Sure. Thank you.

CHAIRPERSON RICHARDS: Thank you again; always a pleasure. Alrighty, next we'll hear from Sustainable Districts, Architecture 2050.

FEMALE VOICE: Are they here, Architecture… [crosstalk]

CHAIRPERSON RICHARDS: Are they here, Rory Christian.

FEMALE VOICE: and you said you just need a few minutes?

[background comment]

FEMALE VOICE: And… and… [crosstalk] [background comments] And who is Rory Christian?

MALE VOICE: Rory had to leave.

CHAIRPERSON RICHARDS: Okay.

FEMALE VOICE: Okay. Okay. [background comments] Okay, so…

MALE VOICE: He was going to set us up with some wonderful words, but it's so late in the afternoon that I am gonna go off script and if I knew how to sing and dance I would even do the musical version of this, just to try to keep you all awake, but you don't wanna see that. That would only be funny for about five seconds. Lesson number one for the day, do not -- I'm using -- thanks -- [background comment] well I don't wanna put it on yours. Lesson number one; don't put your reading eyeglasses in your lower pocket in a trench coat before you sit down in the subway. If these fall off, I will grab them quickly; at my age, reading without them is not an option.

So my name's Llewellyn Wells and I'm with the New York City Eco Districts team; we're partnered with Haym Gross and his 2030 District's exploratory team to try to bring district-scale sustainability and resiliency to New York City. We're currently working through NYC 2030 Districts and our group to explore neighborhoods and communities and areas that are best to this kind of work. And the Eco Districts -- to be clear, there are two different national organizations, the Eco Districts organization that started out in Portland, Oregon and now has eco districts functioning in 12 different cities around North America and 10 other cities are considering adopting them, including Washington, D.C. and Boston on the east coast that have a lot of climate and other socio economic considerations similar to what happens in New York City, and Haym will tell you about 2030 Districts; they have eight and a bunch else being considered around the North America.

So to do the quickened version of this -- What is an eco district and why is the district or neighborhood the right -- one of the many, by the way; we don't claim this to be a panacea; it's one of the many solutions; we think we all ought consider to move sustainability and resiliency forward here in the City -- why districts and what can be accomplished in a district that can't be accomplished elsewhere? Districts, neighborhoods; communities, those are words we kind of use interchangeably in different aspects of this work, but they're kind of referring to a geographical area of a certain size and space that self-identifies as a neighborhood so that there's community commitment to that area to actually do things and get things done on the ground.

Districts are of a scale that it's possible to do a lot of experimentation; we think of these districts in some ways as small urban labs where we can do certain things, many of which were spoken about today; imagine geothermal, microgrids, the solarized New York Community solar type programs all coming together in a community wherein there was actually staff on the ground that was making sure that stuff was being presented over time most effectively to those community members and most importantly, in partnership with those community members.

So we think that the district is the right scale to bring people together from all walks of community life to do this work together to get actual things done on the ground. It's not possible for a city to roll out programs across the entire city at once; you can in certain kind of policy issues, but to get implementation stuff done on the ground, we feel it's much better to do these things at an urban lab, demonstration project, district scale so we can create the models that then are replicable and can be taken to the rest of the city and elsewhere over time, and we don't mean a lot of time, 'cause this work's being done all around the world, it's not new stuff necessarily, it's just a new construct for bringing it all together.

We currently right now are working with community organizations in East Harlem, like Community Development Corporation in East Harlem, and on the Lower East Side these projects are evolving slowly, 'cause this not a fast process, but we're also [bell] -- is my time up already? Wow. I'm sorry. But can I go quickly? I'm trying my best.

In those communities, what we do is, we go in and we first and foremost identify who the community is in terms of the long-term organizations that represent that community and really are the best people to work with to try to get this kind of work done over time, so like a community development corporation. On the Lower East Side, if this works, it will be GOLES and LES Ready and Two Bridges Neighborhood Council, people like that that, you know, really represent the community. We bring in a process that looks at everything that's already been done and is being done there, figure out where the sort of gaps and moving programs for it are and how we might bring resources in from the outside so that that community can do more for itself on the ground. Of course they identify what their resiliency and sustainability to equity goals are, so all the programming that you do then is tailored to what that community wants, needs and is capable of doing with you. The Eco District of course over time becomes entirely that community's process and they own it.

We're applying, for instance, for the New York Prize community microgrid program, hopefully with some of these organizations I mentioned in those neighborhoods, plus a group in Brownsville, Brooklyn and a group in the Rockaways, if this all works out. To try to drive a model through that amazing opportunity that this REV-driven, NYSERDA-run community microgrid program offers, to really look at -- what does that mean; what's a community microgrid; what is that; who owns that; who benefits from it and how does the utility, which still has to survive and keep our lights on, work with you best to add in these distributed generation assets at the locally-sited community scale in a way that's good for the utility and provides real benefits for the community and by that we mean, what kind of cooperative entities do you create where there's actual partial ownership of these assts over time. And it's something that actually the NYSERDA RFP states they're looking to try to figure out and solve.

So that's what we do. It's late in the day, so I'm gonna step aside and let Haym come and talk for a moment; I'll be around afterwards for a minute if anyone wants to hear anything more, but stay tuned and hopefully Eco Districts coming to your neighborhood soon. Thank you very much.

[applause]

HAYM GROSS: Thank you, Llew. And I'm gonna try to make this quick; I'm gonna read a one-page statement, but let me just briefly say, what we've heard is many very dedicated people working on individual technologies and solutions and the truth is that all of these are important, but not one of them are the whole answer, as the congresswoman said, there's no silver bullet. The real challenge is gonna be to integrate these technologies in our built fabric, to integrate them with each other; there's been some talk about integrated solutions and I could talk about that for a very long time, but as an architect I can tell you that every neighborhood, every building, every project is different and we need to have the capacity to address many complex challenges and be very flexible and very creative. So a district offers, especially a diverse district, and New York City is a very diverse city, with -- you know you throw a rock from an office building and you're gonna hit a tenement or maybe even a one-story bar, who knows; the diversity is here. So in a defined area we can address many different building types, many different occupancies; many different challenges; that's what the district is about.

The New York City 2030 District Exploratory Committee, we are a group of volunteer professionals; we've been meeting for about a year-and-a-half to develop a 2030 District in New York. Architecture 2030 is a national nonprofit organization which works toward dramatic reductions in fossil fuel consumption, greenhouse gas emissions, from buildings in cities; they've issued the 2030 Challenge, which targets buildings in cities to reduce fossil fuel consumption to 50 percent in existing buildings and full carbon neutrality in new buildings and major alterations with lower transportation emissions and water consumption targets by the year 2030 -- 2030 is kind of a deadline; I think people who've been following climate science know this -- 2030 districts have been established in eight major U.S. cities, encompass -- Stanford, by the way, is the most recent, Stanford, Connecticut is the most recent addition -- encompass over 170 million square feet of real estate, cooperate in a growing network to advance sustainability energy and resource-management goals of the district scale. The proposed New York City 2030 District is structured as a private-public partnership, private sector led of property owners, civic organizations and community stakeholders to achieve broad sustainability and public health benefits to improvements in building energy performance and reductions in greenhouse gas and fossil fuels.

The partnerships will share resources and information, aggregate financing, collective action and public support, advocate for sustainable policies and collaborate to support technical innovation, adoption of best practices in environmental progress. The New York City 2030 District will deliver energy cost savings and improve property values to its members while combating climate change on an urban scale.

The Architecture 2030 organization facilitates emerging districts [bell] as the national organization -- I'll skip through all that part; you don't need to know that -- it's a voluntary collaborative action between private and public community stakeholders and it's centered on an established governance structure, such as a BID or neighborhood alliance.

The 2030 District Exploratory Committee proposes to establish a 2030 district through a process of consultation with public officials, local businesses, community organizations and we're seeking to break out of the model of the present 2030 districts which are all centered in central business districts and very much based upon large commercial buildings and institutional campuses to address the diversity of the building stock in New York and the diversity of populations and that's why we're very happy to be partnering with Llewellyn Wells and the Eco District group, because we feel there's a great complimentarity between the private sector and large real estate interests in the city and all the rest of the small and medium size commercial buildings, residential land owners of every size, complexes and types, as well as public buildings and institutions. So I think the diversity of New York and the density of New York and the creative juices and brain trust that New York represents offers a tremendous opportunity to achieve not only sustainable and resilient progress, but we feel that there's an opportunity to really create a cultural change and we don't believe that there's gonna be real progress until there is a cultural change; to do that you need a certain critical mass and a district allows that opportunity to really transform a neighborhood and to prototype and test many opportunities to integrate these technologies, solutions, communications in social and behavioral changes. We are talking to a number of community-based organizations and BIDs, we're about, because the 2030 protocol and the process is a little bit different from eco districts, it's less of a community-based process as a climate change impact driven process which is private sector led, so we're gonna go out to the Dursts and the Rudins and the Vornados and the Tishmans over the next several months and try to bring them into the process and acknowledge that they're leaders in sustainability and acknowledge that they're civic leaders and then through their heft and importance and influence, try to bring in many of the other commercial and residential real estate interests as well as the community stakeholders to really make a significant change; we've got 15 years, clock is ticking, and -- my time is up. [background comment]

[applause]

CHAIRPERSON RICHARDS: Alrighty. Tom Outerbridge to speak about wind turbines, from Sims 100. [background comments]

TOM OUTERBRIDGE: Thank you for having me; my presentation will be very short as well and not too technical; I'm not a technical person, I'm just in the recycling business, but we did at our recycling plant install a large wind turbine, first commercial wind turbine in the city, as well as a large photovoltaic solar array, so I'll talk a little bit about those and our experience with that .

This is an overlook for visitors to our education center; it is in Sunset Park, Brooklyn, that's a site plan, when we set out to build this in 2006 we wanted to incorporate as many renewable energy features as possible; we are a for-profit company, publicly traded for-profit company, so there is a financial hurdle; the renewable features have to pass and fortunately, with us being a retail buyer of energy, having a net metering arrangement with Con Ed and EDC, this is EDC property, and with the NYSERDA and federal incentive programs available, we could -- both the solar and wind were economically viable for us; somewhere between a three- and a five-year payback on both of those, which was good enough for my board to approve the capital. Really actually, for me the lesson was how hard it was to actually get it done, which I attribute really to a bureaucratic process that's gonna somehow have to correct itself if the City's gonna make a major step forward in its renewable energy installation, although I was very, very happy to hear that presentation from the Sustainability Director for CUNY; it sounds like there is a lot of that coordination happening.

That was the conceptual plan; this is what we actually built, so we have a 600 kilowatt system on that large building in the upper left corner, which is where we receive material, and in the upper right corner is a 100 kilowatt wind turbine, and collectively those provide about 20 percent of our power requirement; I now have a RFP out for additional solar on the other buildings, the balance of the buildings and another wind turbine possibly, so I think we can get well above a megawatt, assuming, again, those incentive programs stay in place, because those are critical; without those, these are not -- I will probably not get the capital that I need to put them in.

This is just a couple of the lessons learned and this is, obviously, for people more technical than me, these are nothing terribly groundbreaking here; we did build the buildings with the extra load capacity to hold the solar and that was really, in the grand scheme of our capital costs, incremental, really sort of lost in the overall noise [sic] of the capital cost; we worked with the roof provider, it's a Nucor building, to make sure that the solar bids and the installation plan didn't compromise the roof warranty. I thought the process of getting the solar system approved and Con Ed interconnection application approved and so forth was problematic or challenging until I started with the wind turbine [laughter] and it was -- I do a lot of permitting being in the recycling business, we dredge, we deal with the Army Corps of Engineers, federal, state, city, permits across a whole host of issues and I've never been through anything like this; it was a… [crosstalk]

CHAIRPERSON RICHARDS: How long did it take you to get your permits?

TOM OUTERBRIDGE: four-year process, [background comments] which is to me kind of an interesting thing, because basically we were not looking for -- the finances were there, the site was there, technology was there, we had the equipment vendor lined up; it was literally a bouncing around amongst different agencies or different bureaus within agencies to find the right entity that would actually finally give the signoff that we needed. Actually, the environmental impacts and the visual impacts were among the easiest; we went to the Department of Design Commission; no issues, went through DEC with avian and bird impacts; no issues, it was really -- I don't know what to attribute it to other than just sort of bureaucracy that really wasn't up to, let alone permitting this, let alone facilitating it. So my, again, overall -- and I tried to come up with a good analogy; I remember when the DEP decided to basically install low-flush toilets all across the city and you know, with very, very short order, all of a sudden there are thousands -- actually, the reason I know about this is because they asked us if we would dispose of the toilets that were left over right there, it's a ceramic product. But I don't think that's a perfect analogy, because obviously that's one agency; in this case you have

DOB, you have FDNY, you have Con Ed, there's a lot more safety issues involved, so it's not a simple comparison, but I think that there is the potential if the City Council sets forth this goal, it's administration and it sounds, again like from that CUNY presentation, that there are a lot of efforts to bring all the parties to the table and really, because to me, with the technology that's out there today, I know fantastic improvements still coming along, but even with what is out there today and the price of power in the city, I don't know why the city can't be really ahead leaps and bounds on the solar front. Wind is a little more challenging, it's not quite as attractive economically and it's a little more difficult to site, but that was also for us, it's not a bad return and then with the incentive programs that are available. Thank you.

CHAIRPERSON RICHARDS: Thank you.

[applause]

TOM OUTERBRIDGE: But that's actually -- we are open for business; this is the reason we have all this, we consume a lot of energy, we have a lot of machinery, a lot of equipment and we are open for tour visits. Thank you.

CHAIRPERSON RICHARDS: Thank you. Alrighty, Mateo… [background comments] oh no, we're gonna hear… [background comments] Okay. So Rinez Miramet [sp?].

FEMALE VOICE: He's been waiting for an hour and he's Scyping in from Korea.

CHAIRPERSON RICHARDS: Oh he's Scyping, oh. [background comment] Technology. [background comment] Yeah, [laughter] it's really a off-site hearing. [ringing] Maybe he went to bed. He's in Korea, actually. [background comment] Alrighty, he went to sleep. I'm not mad at him. Well we tried. You could try one more time.

FEMALE VOICE: Wanna try one more time?

CHAIRPERSON RICHARDS: We forgot he was in Korea. [background comments] Alrighty. [background comments]

Good information today? [background comments] A lot to take in in one day? [background comments, applause] But one thing that I think I heard from everyone is certainly on permitting and that's something that we're gonna look at much closer. We should not -- you know, if we're gonna meet this goal of 80 by 50, then we have to get rid of the bureaucracy, so something we're certainly gonna be looking at. [background comment] Alrighty, we're gonna bring up Mr. Mateo Chaskel; hope I said it right, from the Urban Green Energy and he will speak of renewable energy microgrids.

MATEO CHASKEL: Thank you very much for the opportunity to be here; thanks everybody for being here. Realize it's getting late, so I will go fast.

UGE, we're an engineering services company focused on distributed renewable energy and what I want to address today specifically is one specific challenge, which is how we are going to deal with energy resiliency within New York City going forward.

This map here, which we saw a version of earlier today, highlights how ill-prepared we were for Hurricane Sandy when it hit and the question we're trying to address is, we know that it's going to happen again in the future; we know that the outlook for climate change and for these events happening more often is bleak, so how can we better be prepared?

So the way we tend to address the solution is by focusing on distributed renewable energy; this is basically outside generation and outside storage brought together into a single spot. A lot of what we've heard of today, especially in the latter part of the day, has addressed new buildings and the different technologies that can be implemented there; what I'm looking at here is, how can we address this for the buildings we have in place today? What can we best do so that when this happens again we can be more energy resilient as a city and not have the same damage that we saw back then?

So how does it work or why does it work; how does it come together? The graphics, I'm having similar problems, as a few others, where they're not working perfectly, but basically we have on the right what we call a triangle sometimes with energy and we consider three basic aspects that people are looking for. At the top we have the resiliency that people want, the bottom right, the sustainability aspect; we want this to be environmentally friendly, and at the bottom left there's meant to be a dollar sign, representing the economics. Distributed renewable energy is not something… it's not a pie in the sky idea; it is what we see when solar energy systems are installed in homes; it is, according to a lot of people, including myself, the single biggest change to the electric grid since its inception.

So how can distributed renewable energy be applied in a resilient manner to New York City; what can we reasonably hope to achieve? The first thing is that we are a very energy-dense city; that's been talked here before, we consume a lot of energy per meter squared of area, or foot squared, which we cannot reasonably expect to address through renewable energy alone. So what we seek to do instead is for the critical loads that we need as a city; that means for hospitals, for emergency services, for shelters; perhaps schools, that we need to have power during these times; how can we best provide them with that energy? For secondary facilities, for facilities that may not be critical but which are required for us to maintain our usual way of life during such an event, such as banks, grocery stores and other institutions of this nature, and lastly, businesses and residential needs; if you're a business you might need to keep your computers on, your servers on so your website is running; if you are home you wanna be able to charge your phone to call your parents, telling them you're okay. Whatever is the case, we wanna make sure that those are the aspects that we are addressing.

So what is the technology that we see as putting together for these types of solutions? And there are four key aspects; the first is renewable energy; we as a company tend to be technology agnostic, look at each site individually, determine what works best, so this can be wind, solar or any of the other ideas that have been discussed here today. In second place are the advanced electronics; we're talking about how most systems installed today are basically feeding energy into the grid and that's what they do, period; when the grid goes down they cannot do anything else. So what are the other advanced electronics that can be brought into play so that we're not just powering the grids, we're providing backup to the batteries as well; if the grid goes down we want to keep powering certain loads. More complex electronics come into play there that we're looking into and we tried to integrate into these solutions. Stationary storage, more often than not it's a fancy name for batteries, but can also be a name for whatever storage capabilities we have and we've seen several more advanced and more interesting storage ideas here today. And lastly, system design; this isn't talked about nearly enough and when the congresswoman was here she mentioned it, but it's very important to make sure that we aren't just putting systems together, throwing different pieces of technology together and hoping that they work; we assess the sites, we look at them, we consider the different technologies, understand, which is very important, the needs of the customer and create a solution based off of that.

The finances are of course extremely important, we don't want something that's going to pay back for itself in a 100 years, like we saw in a presentation and not in 35 years; we want them to pay off for themselves quickly. And so we seek a positive RI [sic] from these projects which we seek to do for different ways. On the one hand there are metering initiatives, there also are incentives that are available from NYSERDA largely in New York which makes these installations more economically feasible. There is of course a question of how do you value the resiliency against a storm; how can you put into a calculator how much money am I going to save by a storm which may or may not happen two or three times or zero times in the next 10 years? So these are questions we seek to address with our customers to understand what the value of sustainability, the value of lowering their energy cost and of stabilizing their energy cost within the next 10 or 15 years as to them.

There are of course very interesting financing structures which have been developed which diminish the capital cost in essence to zero, whether it be by simply leasing out your space for renewable systems to be installed or through a power purchasing agreement.

New York itself has a very positive outlook in terms of the ability to install renewable systems that can be resilient going forward. I talked about the NYSERDA incentives, which again, the idea is not that they'll be permanent, but that they will increase adoption and help spur the technology to be in place that we need.

Permitting is an issue; it has been discussed several times and there are a few variances in place for renewable energy systems, such that if you're installing a wind turbine right now, it's a lot easier than if you were installing one five years ago.

Something that's very, very important also related to the permitting is the fact that the technology is maturing very, very quickly. For a wind turbine that was being installed 10 years ago, this was a system that had no certifications; you did not know how it would do, there was no third-party that had verified it and that's why Department of Buildings, Con Ed were rightfully concerned that the permitting had to be done properly. Nowadays I encourage the Council to bring into consideration the various certifications that are in place, not only for wind turbines, but for solar panels, for electronic components, for installers, everybody in the industry as the industry has matured has become certified according to the certifications that are being put in place and those should be brought in to streamline permitting.

And lastly, there are various initiatives; we talked earlier today about the Prize NYC initiative; there's another one called RISE NYC, which is I believe federally funded and is being guided by the New York City Economic Development Corporation, but basically the question they were asking is, if we got hit by Hurricane Sandy, or by a similar hurricane, what can we do to be better prepared and they put out bids and are taking in applications from several different companies with proposals of what can be built -- systems and individual locations -- to address this.

So everything I've talked about so far has been I guess theoretical in nature -- this is what we could do, this is what we could do -- in the next few slides I'll talk about some things that we have done in New York and some of the projects that we are planning.

So this first one here is a proposal that UGE submitted for the RISE NYC competition that's currently in the final stages; what we've done is, basically we've taken a few small businesses throughout New York City, mostly in Staten Island and Brooklyn and found ways to provide them with a microgrid such that if a hurricane happens again they will not lose power. And in doing so we talked to small business owners -- a restaurant owner or a grocery store owner -- who would say, my power went out; not only could I not serve customers, but all my inventory went back, I lost $45,000, $100,000; whatever the case is, and by installing these systems we're able to provide them with that backup energy that means that should something like that occur again they will not have the same issues; not only will they have energy stored on-site, but they will be producing energy on-site, so it can provide a permanent solution to those critical energy needs that they have.

These systems are again, combining both solar and wind, depending on the exact location, what our site assessment told us would work best at that location. This isn't the one technology fits all approach; it is a one solution fits all approach.

The Whole Foods Market in Brooklyn was also mentioned earlier today in a presentation; they have a combination of a wide solar array, which is being duly used to produce energy and to provide cover to the cars parked below, and in addition to that they have a series of off-grid street lights installed, such that if the grid were to go down, these street lights are operating entirely off the grid; there is no connection, there's no backup needed there. They use a combination of wind turbines and solar panels to operate completely independently and they have batteries at their base.

This is a project we did for a residential building also in New York City, we installed three wind turbines on the roof to power specific loads, as some of the architects that were here before explained, if you install wind turbines on the roof you can power a percentage of the site; you will never power all of it, and that was well understood by the customer in this case. So they're using these turbines to power specific common areas on the building, such as the lobby, hallways, gym and the roof lounge, in this case.

And lastly, I just wanted to finish with this small and it's a project that's meant to demonstrate the technology at a middle school; basically where we have a similar idea for wind turbines and some solar panels which are powering a battery bank that's located inside the middle school which then provides backup energy to a computer lab or a chemistry lab, actually. Such that again, this… it allows the students of course to have an educational opportunity to see the system, but it also provides them with the backup energy that they need; should a hurricane occur again, they can simply connect those batteries to their critical loads and have that powered. I'll be around afterwards if anybody has any questions, but I'll end it there.

[applause]

CHAIRPERSON RICHARDS: Thank you. Alrighty, next we'll have Donnel Baird from BlocPower. [background comment] I'm a little jealous that you're not in Rockaway though. We'll get you there. [background comment] Alrighty. [background comments]

MORRIS COX: Great. Hi guys; I know it's late; I'll keep it short, like everybody else. I'm a little different than some of the other folks that have spoken here. My name is Morris Cox; I'm Co-Founder and Chief Investment Officer at BlocPower. We're focused on financing solutions for clean energy for the financially underserved community. So we focus on neighborhoods where people can't pay for any of this stuff up front and banks aren't going to give them a loan to pay for it either.

So at a high level, you know we focus on a lot of the stuff that's been discussed already, energy efficiency is one of our top priorities, we think that's low-hanging fruit, it's easy to do. We also look at clean energy generation on-site generation. We're also looking at smart controls in some of the buildings that we can concentrate on in these underserved communities, they haven't had a whole lot of capital expenditure, so they are the least efficient buildings in the city; I think somebody mentioned a very interesting statistic, that the least efficient are four to eight times worse at consuming energy than the average population. So we focus on those buildings; we also focus on populations of people that are harder to employ -- ex-offenders, kids who've aged out of foster care, public housing residents -- we're looking to give those folks jobs in the clean energy economy, because we feel that's a crucial part of the equation that hasn't really been discussed today. And obviously we're based here in New York City, so we focus on areas where grid prices are high, you know oil prices are high here, gas prices are high here, electricity prices are high here.

Our story really starts in Brooklyn; this is a church, Mount Pisgah Baptist Church in Brooklyn; the pastor here was struggling with energy bills, they've got about 300 folks in the congregation, maybe an annual budget of around $300,000; they spent 30 percent of their budget on heating and cooling for this facility and you know there was a study done by I think the Pratt Institute on this particular building that they could make an investment of I think it was around $15-16,000 and achieve $36,000 of annual savings -- long-hanging fruit, energy efficiency -- insulation, windows, sealing the building envelope. We actually took a look at -- so you know, the customer here, the pastor, isn't really being served by any of the energy efficiency contractors or the solar industry at all because you know he's too risky, he's too small and there are just too few of them, so we really think this is a big opportunity that's being missed; we think it's a $400 billion market, sub 50,000 light commercial buildings; that comes from, you know 4.3 million buildings in the U.S. that are less than 50,000 square feet; we're focused in, again, underserved communities, we take a community-based approach, so we're looking at schools, churches, nonprofits, multi-family buildings and small businesses; there's sort of two sides to this marketplace and you know, my background is financing; I spent some years in private equity and worked for GE Capital for a while; the other half of this market that we think is unserved is, you know, impact investors and crowed funding that is interested in some sort of social or environmental return that comes along with the financial return of investing in clean energy, so our idea is to bring these two pieces of the market together. Our solution for bringing these two pieces of the market together is an online marketplace. We went and applied for a contract at the Department of Energy to build an online marketplace to bring the two sides that we believe are underserved together and that is, you know the buildings that really need this energy efficiency and clean energy and the folks who want to invest some capital into this market. We've had conversations with, you know, some 200 project finance investors, characters that you wouldn't really expect to show up at a hearing like this, a Goldman Sachs; they are interested in this type of stuff, but it really takes a creative financing solution to get them to invest in a financially underserved market.

This is a little bit of a complicated diagram here and I don't wanna get into the details, but essentially what we're doing is structuring a special purpose vehicle to hold the debt and the equity so that we can finance solutions for these schools and churches that you see. Down here at the bottom we've aggregated a group of 10 churches and schools in financially underserved communities that need you know about a $100,000 apiece of energy efficiency or clean energy and we'll do things like oil to gas boiler conversions, we'll also look at solar hot water instead of gas boilers, we'll look at solar on the roof, we'll do some low-hanging fruit, lighting, you know insulation. The problem is, a lot of these folks can't pay for this up front; no one's gonna finance it on a one off basis, so we'll aggregate them into a portfolio and structure an energy services agreement where we split the energy savings between the customer and the financing partner.

The key to the structure really is being able to provide some incentive for folks like Goldman to put debt capital into the structure at a low interest rate; we don't want these folks to end up paying double digit interest just to get their boiler financed or put some solar thermal on the roof; it would eat away all of the savings and it's not a very good value proposition for the customer. In order to attract low interest rate capital we've gotta put an equity piece into the deal and this is where BlocPower comes in; we work really hard to raise money from three different types of investors -- folks that are focused on environmental returns, folks that are focused on social impact, job creation in these communities; those folks are willing to provide an equity piece where there is very little return; they're more interested in generating environmental savings or creating some jobs. What we've found to date is that most of the folks interested in putting this equity capital to work are looking for 15 percent returns on their money, they're financial investors. And so you know, we've been talking to a few folks here in the city, financing organizations; also the City government, the City Council, about finding pools of capital, whether they are state, city or private pools of capital that are willing to be that first loss piece, that equity piece and allow us to install clean energy in these underserved communities.

Yeah, I'm having the same problem everybody else is having, so this doesn't make a whole lot of sense. This is a group of six churches that we are working with in the Northwest Bronx; the size of the portfolio here is about $900,000 total, $400,000 of energy efficiency and about $500,000 of solar; again, no one wants to lend to these guys, so we put them into a special purpose vehicle and are negotiating with three sets of lenders right now, some of whom are willing to provide up to 95 percent of the capital at low interest rate, but still we're, you know, we've gotta put in money ourselves as an early stage startup into that equity position to provide that protection that those lenders need in order to fund these projects. So this is an ongoing project right now; it's part of a group called the Northwest Bronx Community and Clergy Coalition; we work with these sort of community-based groups to try and aggregate as many as we can, there's strength in numbers; the more folks we get into a block, the easier it is for us to finance the block. There's a group of 50 churches in the Northwest Bronx; this is a pilot for the first 6.

Yeah, so there's a lot of numbers on this page, but essentially what you need to look at here is; in order for me to sell this portfolio to a finance investor, I've gotta offer them a projected equity return of between 10 and 30 percent; that's that line in the middle that you see right there, projected IRR; that's really the problem and we need to find pools of capital that prioritize social and environmental returns over financial returns.

This portfolio is gonna work, regardless of how expensive the equity is, the net savings, the second to bottom line that you see there, is how much these customers would save in the first year, even with the ridiculous returns for the equity piece. Obviously if we can find capital that lowers the required equity return, we can give more of those bill savings that you see there in the fifth line from the bottom -- the total is about $100,000 a year that they'd be saving, right. So we're looking at somewhere between a four- and eight-year payback on the money. If we can find cheaper equity capital we can give more of those savings to these financially underserved customers. So that's the goal of BlocPower, our online marketplace, the purpose of the online marketplace, it's a source for these types of debt and equity investments from social, environmental and financially oriented investors.

Yeah, this also didn't come out to well. The gentleman from UGE mentioned a great program here in the city called RISE NYC; this is also a program that we applied to; again, we focus on underserved communities, so the application we put together was looking at three communities -- Far Rockaway, Rockaway Beach and Staten Island, near the Stapleton Housing Projects; we wanted to build a wireless mesh network powered by solar and battery backup so that if another Sandy came through, not only would these guys have power and we'd be able to power some of the small businesses in the neighborhoods around the wireless mesh network, we'd also be able to give them communications capabilities and access to the internet.

So this is a situation in which the City stepped in to provide that low-cost financing; this comes in the form of a grant and we've worked with several other nonprofit organizations and governmental organizations to put together pools of capital that are free or low-cost to help those who need the help the most.

This is a shot of Brooklyn during a blackout; I noticed a couple folks presented today and showed the shot of Manhattan during a blackout. Funny story there; the headquarters of Goldman Sachs stayed up and running during Sandy because they had backup power; there's nothing like that out here in Brooklyn, these people are all alone and there's a big issue kind of around the Brooklyn grid, the Brooklyn-Queens Demand Management Zone; I'm sure a lot of you have heard about this; it's part of the PSC's initiative reforming the energy vision; there's a couple substations out in Brooklyn, in Brownsville, and area that has one of the highest concentrations of poverty, highest concentrations of public housing, HIV, unemployment in the city and in the state; Con Edison would need to spend about a billion dollars to upgrade those two substations and instead of spending that money and jacking up our electricity rates, the Governor and the PSC have ordered that they spend about $200-250 million on energy efficiency in this low-income neighborhood to try to bring the load down so that they don't have to replace those two substations.

Again, those are the types of programs that we think are really needed in the city and the state. That's it for me; happy to talk to folks afterwards; we have multiple projects ongoing. Thanks.

[applause]

CHAIRPERSON RICHARDS: Alrighty. Well let's give a round of applause for all the panelists today, once again.

[cheers, applause]

Got some valuable information today. We're gonna move into the public session now and each person will have around two minutes to give their spiel. [background comment] So the first person is Lisa DiCaprio; she's here. We're really gonna hold people to two minutes because we have to be out of here.

LISA DICAPRIO: Thank you for the opportunity to speak today; I am Professor of Social Sciences at NYU and a member of several environmental organizations, including 350 NYC. My testimony concerns New York City and New York State policy measures and financial incentives that can facilitate the realization of New York City's renewable energy potential.

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 New York City; one, the New York City Solar Property Tax Abatement and Federal and State Tax Incentives for the cost of purchasing and installing solar panels and two; net metering that provides generators of grid-connected solar power with a credit on their utility bill for generating more electricity than they consume; 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 percent 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 on Long Island and several cities.

New measures are also required to promote more sustainable methods for heating and cooling buildings, which are responsible for 71 percent of all greenhouse gas emissions on New York City. 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. The incentives for natural gas conversions are expanding New York City's natural gas infrastructure and increasing the market for fracked gas. [bell]

The alternatives are biodiesel for heating and geothermal and air source heat pumps for both heating and cooling. By combining geothermal or air source heat pumps with wind power purchasing, a building can obtain all of its electricity, heating and cooling from renewable energy sources. However, even with the most innovative technologies, financial incentives and policy measures, we will not actualize New York City's renewable energy potential without a systematic citywide public education campaign. First, the Committee on Environmental Protection could organize a hearing like this one on an annual basis; in addition, we can 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 New 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, 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… [interpose]

CHAIRPERSON RICHARDS: Alright, I'm gonna ask you to wrap up.

LISA DICAPRIO: and just one more suggestion; 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. Thank you.

CHAIRPERSON RICHARDS: Thank you. Thank you, Lisa.

[applause] [background comment]

Alrighty, Ken Gale, New York City Safe Energy Coalition. Alrighty, we're gonna ask you to really keep it to two minutes; got a lot of people to get to.

KEN GALE: If you're reading along, I'm cutting a lot out.

CHAIRPERSON RICHARDS: Alrighty.

KEN GALE: Thank you for holding this hearing and for giving us the opportunity to speak. I'm Ken Gale and since 2002 the host and producer of the environmental radio show Eco-Logic on WBAI-FM here in New York City and also the founder of the New York City Safe Energy Coalition, NYSEC. I'm also on the Advisory Board of the New York City Friends of Clearwater, a member of the Environment TB [sic] team -- recording this -- and a founding member of the New York Climate Action Group, which was instrumental in getting the commercial net metering law passed in 2008 -- I keep busy [sic].

When people save money on energy they tend to spend their money they save locally so that benefits to the local economy are greater than merely what we save on energy. Clean energy is healthier; that cuts down on health care costs and increases worker and student productivity; don't underestimate that.

These days there are a lot of studies on how to provide for New York City's electricity needs without fossil fuel or nuclear power; the Jacobson study is a good start. Right before CUNY's Solar Roofs and Solar City studies and especially SUNY Albany Solar Research, headed by Dr. Richard Perez. We can get 50 percent of our electricity from solar, more in the summer when prices are highest; less in the winter.

In doing my radio show and talking to local solar installers, one of the big complaints they have is financing; many banks don't or won't. Now my friends from Occupy Wall Street say that's because of interlocking boards of directors of banks with oil companies and utilities. I hope it's only ignorance, but it was 10 years ago that Home Improvement magazine had an article on how much solar panels increase a home's value and resale speed, so the banks should know better by now. There have been more recent studies in other magazines saying that sometimes solar panels increase the value of a house by more than the cost of the panels; with lower monthly energy bills, the borrower will find it easier paying for efficiency in solar loans than probably any other type of home improvement.

On Long Island upstate there is on-bill financing, where homeowners can pay for energy efficiency in solar [bell] and tie the cost to utilities; Con Ed does not participate in that and I think they should; the green bank only helps large installations and it's time they helped homeowners.

Buildings built to code are no better, so building codes must take energy use into account.

Andy Padian from Steve Winter Associates, one of New York City's foremost energy experts, made a presentation at a recent New York City, State Financial [sic] Coalition; the number of simple and cheap improvements that can be done to lower energy costs and our carbon footprint is more than I had realized, even with decades of energy activism. Most boilers are old and inefficient, we use more hot water than we need to and thus waste more energy heating it; most of our toilets are old and inefficient, increasing energy costs to pump replacement water and increasing waste water treatment costs, and his biggest easy energy savings is from cable boxes; they use the same amount of energy, 20 watts, when they're off as when they're on. In California, the same company that supplies our cable boxes supplies theirs and they only use 2 watts when off, a 90 percent savings. Every cable box that is replaced should be replaced with an efficient one; if the cable companies won't do it voluntarily, perhaps legislation is needed.

Energy activists like myself may know how much more economical and green Energy Star appliances are, but I think the average person does not; more education is needed. Solar panels, insulation and better windows cannot be stalled from overseas; they mean local jobs; let's stop burning our money and sending it to Texas and the Mideast; let's spend it at home. When the air and water are clean, thank an environmentalist; if not, become one. Thank you.

CHAIRPERSON RICHARDS: Thank you. [applause] Well said. Katherine Scoppi [sp?]. And I heard you've been with us for seven hours. [laughter, background comment] A lot of you have, actually.

KATHERINE SCOPPI: Thank you so much, legislative Council, Samara Swanston, Environmental Chair Donovan Richards and Bill Murray; it's good to see you here, and those of you who are remaining.

I'm just gonna make a couple comments; I'm breaking away from this 'cause time is short, but I did wanna say that this has been a very, very exciting conference; this is solution oriented and I've learned so much; raise your hand if you too have learned some things that you didn't know before. Yeah, this is the kind of stuff we have to move forward with and I'm so thrilled that you've done this. And I do think that there are a couple legislative bills in there… [laughter] like the Merton Bill we heard today… [crosstalk]

CHAIRPERSON RICHARDS: And that we are. [sic]

KATHERINE SCOPPI: and I wanna work with you on getting some of this into a bill to make it real so that we can implement it in our lives. [applause] Yes. I did go to the REV hearings… [crosstalk]

CHAIRPERSON RICHARDS: What is that; we affect the… Oh okay, alright, exac… Okay. Okay. Okay.

KATHERINE SCOPPI: Yay. I did go the REV hearings and I was very interested to learn; you probably all know this already; I did not, that the grid system has to be built to function at the peak; now that's only for about 60 hours out of the year, so they talked a lot about flattening peak, shaving off peak, having the storage batteries so that during low peak you fill them up so that you can use it during high, so I learned a lot of that and the fellow who talked about in Brooklyn avoiding having to redo the substations and I'm thinking, well instead of spending the $6 billion on updating the grid, why don't we just go to CCAs and those are community choice aggregates; we are a democracy, so why do not we have local sustainable independently owned and operated energy systems -- raise your hand if you would like to see those happening. [applause] Yes.

So the second point I'd like to make is that I heard references to two energy sources that made me cringe a little bit; the first person talked about nuclear and I am working very hard to get Indian Point closed and we have to be very careful about natural gas; it is not energy independence; energy independence is renewable energy, so we have to be very careful about that, we're living with the infrastructure of pipelines and compressor stations and they're trying to put an LNG port at Port Ambrose, but we need a wind turbine, so we have to be very careful about this myth we've been sold about natural gas, we have to be very careful.

Third point and final one and I'll just say this very quickly, when I moved into my Tribeca loft in 1973 it was kind of like open; we did whatever we wanted in our lofts and we installed kitchens, we built walls or whatever; 10 years later we had the CofO [sic]. So at that point they had to take all those laws and regulations into consideration; there was a let of laws when your building was built -- my building's a 150 years old -- there was a set of laws to the present ones, so city, state; federal, but they came together, made a code so we can get our certificate of occupancy; we can do that, we can do that here and we can -- and I'm urging the City Council -- we've heard it three or four times today -- to bring all the levels of government together to make it easier to get all of this renewable permitted. So thank you very much.

CHAIRPERSON RICHARDS: Thank you. [applause] Denise Katzman, enviro enhancement. Think she likes legislation. [background comments]

DENISE KATZMAN: Maybe we should all do some jumping jacks. [laughter] And I promise, I'm not gonna do my version of Patricia Arquette to get anymore time.

If you didn't know before this hearing, I hope you use it as a takeaway; every problem is a solutionist; every one of us is a solutionist. This hearing will flip the switch from unsustainable energy to resilient energy, transforming NYC into a vibrant energy democracy via local jobs and value capture that supports clean energy economy.

Insurances and bonds -- in 2015, this very year, the World Economic Forum Global Risk report over 900 experts declaring climate crisis as the second largest threat to global stability, February 23rd, it was a series event; the world banks -- Swiss Re America CEO, J. Eric Smith -- the cost of another Sandy will grow from $19 billion to $90 billion. The head of Global Capital Markets for Bank of America, Merrill Lynch, Lisa Carnoy is exhorting her colleagues to fund clean energy until every blue chip company in the S&P and every investment manager has a green bond. Zurich Insurance, Germany, CIO Michael Leinwand, Germany has been leagues ahead of us with enviro sustainability; that's why Passive House exists, because of German.

Practically this means investing for the next generation, what better way could we find than working with the World Bank on a customized solution to both out-perform our liabilities and tackle climate change? I am now posing this to Donovan Richards for an introduction for legislation to protect us from future Sandys; it's called KAT Bonds, also known as Catastrophe Bonds… [interpose]

CHAIRPERSON RICHARDS: You said KAT Sparns?

DENISE KATZMAN: KAT, K A T… [crosstalk]

CHAIRPERSON RICHARDS: KAT. Okay.

DENISE KATZMAN: also known as Catastrophe Bonds. The bonds will protect us from climate crisis via; [bell] NYC can get involved and you can also go to Mike Bloomberg, 'cause Bloomberg recently said he's gonna give [laughter] $48 million to meet the federal government's climate rule, and you've got financing in place; then you go to the green bank for GAP financing. And Donovan Richards also gave some points on the NYC Panel on Climate Change; I'm gonna give two others. Six heat waves per year compared with the current two annual heat waves by the 2080s, defined as three or more consecutive days over 90 degrees, and by the 2080s the 100-year flood, meaning a flood that has a one percent chance of occurring, will become a 1 in every 8-year occurrence. Microgrids, Katherine mentioned CCA; it's embarrassing because the State of New Jersey has CCA and we don't, but the REV has CCA built into it and that's what we need to support because we need communities to unite to get sustainable energy in place. And one of the big entities building microgrids is Siemens and they have stated, "Microgrids have the potential to play a significant and positive role in promoting a cleaner, more resilient energy infrastructure," and one of the most simply on-site energies is everyone in this room can produce kinetic energy by walking, by running; you can power a music concert with stationary bikes and you can MacGyver your own bike to power your own blender. We are cognizant that we are stewards of a healthy planet now and for future generations. So everybody should have a really good weekend. Thank you.

CHAIRPERSON RICHARDS: Thank you. [laughter, applause] Biking off calories. Alrighty. Next we have -- I can't read this; I think it's Hami… Okay, I'm gonna just say Global Reser… [interpose]

FEMALE VOICE: Harold Harrison.

CHAIRPERSON RICHARDS: Oh okay, Harold Harrison. Alright. [background comments] Alrighty. Stefan Nutz [sic], AIA.

FEMALE VOICE: AIA.

[background comments]

STEFAN KNUST: Good afternoon; my name is… sorry… [background comment] Yeah, I do have copies, but I'm not read anything and I'm gonna submit them to you electronically, 'cause it needs to be… [interpose, background comment] edited. Am I not… [crosstalk]

CHAIRPERSON RICHARDS: Speak loud.

STEFAN KNUST: speaking into the mic? Okay. [background comment] Okay. My name is Stefan Knust; I'm representing the Committee on the Environment from the AIA; I work with Ennead Architects and the new president of our chapter, Tomas Rossant has thrown the full weight of the AIA behind the 80 by 2050 objective. And I'm also German and I'm Passive House trained and I will let you know that the Passive House standard actually is based upon a U.S. standards that grew out here in the 70s and the Germans simply figured out how to put it into an Excel spreadsheet very efficiently.

I'd like to talk about two things; one is fundamentals and the other is pride. The numbers get worse every time we turn around, we can't get this wrong and there are some low-hanging silver fruits to gain and it gets back to the fundamentals of conversation. I think everything that we discussed here today as far as how that can get back into the building code is best represented in a YouTube video that I'd like to just give you the title of that you should look up, it's 7 minutes; it's called The Perfect Energy Code and it will describe for you how we can achieve the 80 by 2050 goal or better. One thing I would like to touch on, which is the gap that I see, after being engaged with what we're discussing here for 20 years is air leakage. We talk about it; we barely actually understand it, but I think if you look at the data about where our energy is going, I think it's leaking and the U.S. Army Corps of Engineers estimated that up to 40 percent of a building's heating energy is lost through air leakage; they have developed a very rigorous design protocol and construction protocol for limiting that; in fact I trained with Corps engineers for the past standard.

And this actually is what brings me back to pride, because every single person in this room, everybody in every district can begin to address this themselves and can learn from what's happening already.

My suggestion here, to close, is to build upon the experience of the FAR ROC Competition, which we were fortunate enough to participate in, use that framework in every district to highlight work that's already happening that's meeting this goal in this high standard and to actually promote competition with projects that you can select, existing buildings that you can select of various types; they can be the same types across district, but they can represent the majority of the infrastructure in the city we're talking about today, the million buildings and run those through the modeling process and the design process and make that a community effort; this is where I think [bell] we will all learn and benefit from what's happening and do it together.

CHAIRPERSON RICHARDS: Thank you. [applause] [background comment] Alright, Michael Bennett, Solar One Energy. [background comments] We will get to you.

MICHAEL BENNETT: Hi everybody. I'm actually the angry carpenter, the angry general kind of developer. Since 2008 me and my company have been putting up PV on commercial buildings solely in New York City and I feel sometimes that I picked the wrong area. Specifically I got certified -- I'm a NABCEP installer, I'm a certified NYSERDA installer; I know what I'm talking about; I've been trained in batteries. The topic I wanna talk about -- storage systems in New York City, multiple authorities having jurisdiction needs City Council deadlines if we're to realize behind-the-meter commercial storage. The point here is that electricity prices have been stable because of the power prices being stable, but delivery has been going up consistently and demand costs have been going up consistently. What that's driving is a market that's ready to use some of the battery power that we have now; you saw Eos before having a battery system inside of a container. Now if I were to try to put that container anywhere outside of a food store in Brooklyn, the back of it, forget it; I'd be at the Environmental Review Board in a heartbeat and with about a $30,000 fine too, because I took up a parking space. So my point here is that we've got several AHJs in New York, they act independently, but they only act if the pioneers blaze the trail. So what that means is that, one agency has no relevance to the other. The best recommendation to grow storage installations while the federal ITC is still at 30 percent seems pretty much a fantasy at this point; it took almost three-and-a-half years for CUNY to develop what they did with solar and it sort of works now; I just got done waiting four months for a permit because somebody insisted that a skylight wasn't part of a solar install, even though it's an FDNY mandate.

So I listed the details here, but fundamentally, Con Ed is an AHJ, FDNY, their FC 504, which is the code for that, that's not even addressing anything about putting these on rooftops, if that was an availability, I can't; I went through the Fire Code myself [bell] and that Fire Code says that you can put in car batteries which are sealed and then you have to ventilate it or you can put up to a 1,000 pounds of lithium-ion. Now if you go online and you spend five minutes, you're gonna see that that's about 1950s technology being left for us and as a person trying to sell this stuff -- I'm out there selling a 600 kilowatt system and I can't even put in a battery to help the guy bring the demand down by 20 percent. I have a list of over 100 companies where we've got their electric bills, we've gone through and classed them and believe it or not, food storage places with refrigerators and office buildings with HVAC, they top the list; I can't do anything about 'em because I can't put in a form for it and that's -- the details are in here, I invite you to take a look at 'em because I read each of these things; I know 504 inside and out and then to read -- the last point I wanted to say is, with any kind of battery system, right now if you put a battery system, you know, whatever, you've gotta go out and get somebody in the building to be certified as the person who's responsible for maintaining that. There's no independent certification for me or anybody else that would be doing it; I don't wanna grow a business and then have problems because somebody had a fire or a safety issue, because what's it set up for right now in New York City is not consistent with any kind of storage capacity, even if it's under sustainability it's probably being flagged as a test case. So there we stand; if we wanted to actually move ahead -- I'm ready to move ahead now; I can't even price something because I don't know how much it's gonna cost me. I could wind up having a TRA issued and that's another $3,000 just for an environmental check; I had to do that on a job. So thank you very much… [crosstalk]

CHAIRPERSON RICHARDS: 'Kay, thank you. [applause] [background comments] Daniel Harper. [background comments] Alrighty, Daniel Harper, two minutes. [background comments] You can start, sir.

DANIEL KARPEN: My name is Daniel Karpen; I'm a professional engineer, I specialize in energy conservation engineering; I do a lot of steam system retrofitting in New York City. First thing I wanna say is, I'm doing an oil to gas conversation in a small 15,000-square-foot hotel in New York City and doing all the red tape, we're three years into it and we still don't have the gas/oil conversation completed; was a mound of red tape between the Fire Department, the Buildings Department, the plumbing inspectors in the Buildings Department, the boiler inspectors in the Buildings Department, they do different things; we can't get any coordination whatsoever.

Now, I wanna talk about Local Law 87; this is the law that is supposed to require energy audits of buildings more than 50,000 square feet, do 'em every 10 years; that law is an absolute total disaster, it is not working at all. Number one, the companies that do this work are not engineering firms, they're greenies, green companies and they have someone rubberstamp the report; they're using unqualified people and I've sent a letter to the New York State Engineering Board; whether or not these companies that are not registered professional engineers, firms are allowed to do this and they said absolutely no; the problem is that Local Law 87 needs changing dramatically. I have given out to everyone here on the dais a copy of the Local Law 87 which I have marked up with some changes, including the requirement that all design professionals be New York State registered design firms, either architects or engineers, to do this work. Second of all, [background comments] there's a lot of changes required to the law itself. I have included in here a lot of the changes needed, including how the law affects steam systems. The person involved at the Department of Buildings admitted to me yesterday that the law does not [bell] attack steam systems in buildings, either low-pressure steam systems, one or two pipe steam systems; the reports that I've seen prepared by these consultants are slopping, terribly written; you'll see that in this here describing a bad report; one report that was good that followed the law's recommendations to the absolute of what the law required had almost nothing in terms of energy conservation recommendations in the building that could have been attacked because of the stuff that's asked for is very superficial work, it doesn't require for example, that it be checked to see if the boiler system's oversized or not and it doesn't address the terrible problem of steam pipes banging and it keeps everyone awake at night and that's one thing I specialize in solving, and if you have a building that has steam pipes banging and knocking, please call me and I'll speak to you afterwards and I'll solve the problem for you once and for all. [crosstalk]

CHAIRPERSON RICHARDS: No problem. I can call you three in the morning. [laughter, applause] Alrighty, got it. Thank you; well put, and we're certainly gonna look at your recommendations; well put. D. Ahearn. [background comments] Alrighty. Donovan Gordon.

FEMALE VOICE: He left. [background comments. He left.

CHAIRPERSON RICHARDS: Hey, my long lost brother. Buck Morehead. Come on Buck.

BUCK MOREHEAD: Good to see you again. Buck Morehead with New York Passive House and also with Damascus Citizens for Sustainability and NYHO2 Anti-Fracking Groups.

I'm gonna go off script, in the interest of time, but I appreciate all of the effort, actually; the time that you folks are putting in on this. I was very pleased by Chairman Richards' comments initially about energy conservation and also Urban Green Council's presentation, which I felt was excellent. The energy conservation factor is… it's all a priority, but that is the priority I think of all of them, because building energy, 75 percent of it is in buildings in New York City; you know I am specifically focused on Passive House -- Passive House, 80-90 percent energy reductions in heating and cooling in buildings, demonstrated over 20-25 years, 30,000 buildings throughout Europe, this is something that absolutely works. There are cities -- Brussels is going full-time Passive House, Luxemburg by 2017, they're doing the same thing; the European Union by 2020 -- is basically saying that new buildings, either have to be near zero or net zero and if they're not, any energy they need they have to generate on their own site. So this is completely achievable now, but the key component of all the buildings, whether they're bringing in some portion of geothermal or some portion of PV, is they have to be doing Passive House or something like it; otherwise they never get close and we'll never get to 80 by 50 without having something like this happening and the point of that; retrofitting is completely critical; I mean these buildings, we have to learn how to retrofit buildings that are occupied, because most of our existing buildings that are gonna be here in 30 years [bell] are occupied for rental or they're co-ops or condos or they're offices, so we're not gonna get all these things vacated, so we have to be very creative about incentivizing or regulating kind of the retrofitting of existing buildings that are occupied to begin to get there. So I'm gonna leave it at that. Oh one thing I'll say is that New York Passive House is having its annual conference on June 11 here in the City and we're gonna be bringing very notable people from Europe who will be able to speak to the European experience in Brussels and… I mean they do -- the fellow from Durst, I wish he was here; I mean, Passive House skyscrapers are happening -- Passive House is an unfortunate name; there are 400-unit Passive House projects; there are Passive House eco districts, Passive House districts, schools, fire stations, office buildings; it transfers across all building types. So I'll leave it there. Thank you very much.

CHAIRPERSON RICHARDS: Thank you, Buck. [applause] Raymond Figueroa, President of the New York City Community Garden Coalition.

RAYMOND FIGUEROA: Good afternoon; I was the first one to salute you, Chairman Richards, Samara Swanston and your colleague, Mr. Murray; this has been phenomenal day of education and really in the service of pushing forward sustainability and resiliency for our city. Let me go as quickly as I can.

Urban heat island mitigation, carbon sequestration, storm water runoff mitigation, air filtration and oxygenation, full production coming on top of social capital community development outcomes, such as crime reduction, economic development and positive youth development and education outcomes.

This is all being had and realized right now in the thousands of community gardens throughout the city, very actively and very cost-effectively. There are some communities that are looking to push the envelope even further and what I wanna bring to your attention, Chairman Richards, is that Community Board 3 just recently voted to support a community garden district; ala what we heard earlier, the eco district; what can we do on a district-wide level, community district-wide level that can really push the model of sustainability and resiliency in such a way that we can begin to have a model from which to project around the city. That's one example and I know it's gonna go forward, because it's already gone through the community board, so I just wanted to flag that for you, community garden district out of Community Board District 3.

In the South Bronx, where I'm based with Friends of Brook Park on an everyday basis, the community, a community-driven decision-making process known as participatory budgeting, local residents voted for a solar-powered food production greenhouse on public housing land at Millbrook Houses, and the community has really bought into sustainability and resiliency; this is a frontline community at the very southern tip of the South Bronx, it is a community that is struggling, it's an environmental justice community; the rub has been what we've heard from a couple of the speakers already around the administrative inertia, the red tape; this project was voted on and it's not moving forward and so residents are frustrated, local residents that you know, former Congresswoman Claudine Schneider said hey, if one of the pillars for really making sure that this is a successful thing, pushing sustainability, pushing resiliency is that it be community-based, and so we have that where local communities are looking to do this, but we're running with this rub. Right now we have this project, it's been officially voted on and therefore that means it's funded, but we're having a problem, in this case, with NYCHA and some related agencies in terms of moving this forward. So I just wanted to highlight that for you and that's basically, those two things I wanted to bring out.

Just wanna make an announcement very quickly; I'm also part of the People's Climate Movement Coordinating Committee, formerly known as the People's Climate March Coordinating Committee and I think outreach has already been done to you, Chairman Richards; Samara Swanston in terms of coming to the public forum on March 16th; this is open to all; it's where we're gonna be looking at the body of legislation, which is quite robust in terms of how we can better inform the local citizens and then two, how we can, if need be, refine and look for limiting toxic loopholes and really strengthening the enforcement clauses in some of this legislation that's being entertained right now. And so that all is happening March 16th at 6 p.m. at DC37 on Barclay Street; look out for it, PCMNY; you can looks up on the web.

CHAIRPERSON RICHARDS: Thank you. [applause]

RAYMOND FIGUEROA: And… and sign up, we've got… right here, we have this gentleman right here, Garrett, who is the on-the-ground organizer for this initiative. Thank you very much, Chairman Richards.

CHAIRPERSON RICHARDS: Thank you, sir. [applause] Paul Schubert. Paul Schubert, [background comment] fellow Rockaway-ite. Alrighty;

you've gotta move fast. [background comments] I know, Paul. I've known you for around 10 of those years. [background comment] Thank you for being here.

PAUL SCHUBERT: Howdy.

CHAIRPERSON RICHARDS: Howdy.

[background comment]

PAUL SCHUBERT: Howdy. Now, we are a nation of laws, we are a republic; that means that you people who are unhappy with the present state of laws -- I was just told by this great radio personality that the best green laws for business are California and New Jersey and I've heard the Solar One man state that we have some laws that are contradictory, with too many city agencies in charge. A principle of law is this; you cannot go back, but I'll tell you the words of Simon Shawnee [sic] Murphy when a man came to him with a problem -- Yes, it's America, it's not the old country, we have laws here; 2. laws can be changed, they can be written and a problem can be solved by a new law, and 3. I'll look into it. I am a big fan of Tammany Hall; Tammany got you women's right to vote, workers' compensation, housing laws; building code. Now Donovan, I would consider considering the Solar One and the other problems that the chief agency in this city is the Department of Buildings. Now we rewrite building code as necessary; there is international building code, which means that people from Sandy have to waterproof their flood flaws, that's number two, you've gotta waterproof your house; if you do not do so you would be paid nothing 'cause you violated NFIP regulations, but if we can take these California laws; the Jersey laws and put 'em in our building code, [bell] I think that would be an amaze… and then every other agency would just follow in step, but I think the building code and these gentlemen have given you some ideas and I'd like you to sit down with them in a conference and have them submit to you ideas, examine the Jersey laws; the California laws, we didn't write everything, but we have a new administration and I have confidence we're gonna go for… and also, we need to tell all the buildings, we're going to have insulation laws, boiler laws; if they don't change, well the sheriff can be empowered to seize whatever assets are necessary to enact the changes. But that's basically… yeah. And yeah. And we need to build mini grids and there is a YouTube video called The 10 Best Wind Turbines, with different 10 best wind turbines and I'm talking now with an architect to design a system. NYCHA spends two… [interpose]

CHAIRPERSON RICHARDS: Alrighty Paul, you're gonna have to wrap it up.

PAUL SCHUBERT: Okay, I'm gonna wrap it up right now. NYCHA, according to Margarita Lopez, NYCHA Green Commissioner, spends $2 million dollars per building to Con Ed; that's insane. If we captured the sewer gas in those buildings we could produce 25 percent of our power, even though it'd be methane sewer gas. I believe we could put many turbines outside every terrace and we could have the building produce maybe 90 percent of its power. Thank you.

CHAIRPERSON RICHARDS: Well put, Paul. [applause] Alright, Bruce Rosen. [background comment] Alrighty, Mercy Van Vlack, New York City Safe Energy Coalition. Alright. [background comments] Alrighty, you are the last… [background comments] person.

MERCY VAN VLACK: Well John Hall says this a lot better than I could… [crosstalk]

CHAIRPERSON RICHARDS: You're doing a poem?

MERCY VAN VLACK: but I wrote… but I wrote the second verse… [crosstalk]

CHAIRPERSON RICHARDS: Okay. Oh you wrote the second verse. Okay, interesting.

MERCY VAN VLACK: [singing] Just give me the warm power of the sun, give me the steady flow of a waterfall, give me the spirit of living things as they return to clay. Just give me the restless power of the wind, give me the comforting glow of a wood fire, but please take all their atomic poison power away. Everybody needs some power I'm told to shield them from the darkness and the cold, but some may find a way to gain control when it's bought and sold. I know that lives are at stake, yours and mine and our descendents in time, so much to gain and so much to lose, I'd say every one of us has to choose. Just give me the warm power of the sun, give me the steady flow of a waterfall, give me the spirit of living things as they return to clay. Just give me the restless power of the wind, give me the comforting glow of a wood fire, but please take all their atomic poison power away. Many people said that slavery's the way to get our cotton in by the end of the day, but there has come an end, now we can say that's gone away. Change is never easy any time, but change is here to stay and in our minds we know it can be done, we've done it before, change in the future of power [bell], just… [crosstalk]

CHAIRPERSON RICHARDS: Keep going.

MERCY VAN VLACK: give me the warm power of the sun, give me the steady flow of a waterfall, give me the spirit of living things as they return to clay. Just give me the restless power of wind, give me the comforting glow of a wood fire, but please take all your atomic poison power, take all your atomic poison power, please take all your atomic poison power away. Thank you.

[applause]

CHAIRPERSON RICHARDS: I would have closing remarks, but I think the song said it all… take all your atomic poison power away. That is the end of this hearing. Congratulations, 7 or 8 hours; thank you for all your recommendations. I wanna thank all the panelists once again; I also wanna thank Mercedes Buchanan, Jerrel Burney, [applause] and the illustrious Samara Swanston, infamous, and

Bill Murray, who makes me look good. Well I don't know if you make me look bad, 'cause you look better. I wanna thank the sergeant of arms for hanging in there for like 10 hours, 12 hours; we never give them credit, the cameramen, everybody, CUNY. Thank you all. Thank you. Thank you. [applause] [background comments]

C E R T I F I C A T E

World Wide Dictation certifies that the foregoing transcript is a true and accurate record of the proceedings. We further certify that there is no relation to any of the parties to this action by blood or marriage, and that there is interest in the outcome of this matter.

Date March 19, 2015