Is it commercially viable to provide a distributed generation and storage solution to Higher Education Institutions in New York?

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Key Findings

Among a selection of the most promising markets in the United States and Europe, our research outlined that the New York ISO (NYISO) ranks as the most attractive for the formation of new Energy Service Companies (ESCOs) seeking to engage clients in renewable energy projects. In particular, within that market, the Higher Education Institutions (HEI) segment emerged as having the most potential, for the following reasons:

1. **Scale**: HEIs account for ~3-5% of all electricity consumption in New York state over the course of the year\(^1\). Given their locations and their primary consumption patterns, their actual share of electricity expenditure is likely to be even higher.

2. **Customer engagement**: There is a growing awareness of the need to act on emissions and energy efficiency from HEI’s in New York, with ~ 30% of HEI’s having drafted an climate action or sustainability report since 2007\(^2\).

3. **Low barriers to entry**: The HEI market is significantly under-examined as a customer segment by ESCOs, yet these customers rely heavily on external technical expertise. For companies that invest in building relationships and providing technical guidance, there is considerable scope for new business.

The research also identified some of the barriers that hinder development in this segment. The ability to overcome these barriers may help an ESCO to achieve a significant competitive advantage:

1. There are **no proven commercially viable solutions** that offer solar PV, storage, energy management software and a financing component, as an integrated bundled product to Higher Education Institutions (HEIs) in New York State.

2. Without relying on the economies of an integrated solution and the smartest combination of low-cost suppliers, the **current utility and state level financial incentives alone may be insufficient** to overcome the cost of the technology at this point in time.

3. The **inability to deploy lithium ion storage into the most attractive locations** in New York City, due to fire safety constraints, prevents storage providers from capturing financial gains at the most attractive Locational Marginal Price points (LMPs).

Beyond this specific product offering, the research finds more broadly that there is significant scope to provide alternative distributed generation, demand response, and green energy procurement products and solutions to HEIs in New York.

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\(^1\) Own research  
\(^2\) Ibid
1. Introduction

In September 2016, the SAIS ERE “Project Bologna” Practicum team (“the Team”) were tasked with assessing the commercial viability of a new energy service company (ESCO), across six different geographies. The client was a UK based Energy consultancy called Power Capital (“the Client”), who are analysing the use of Distributed Energy Resources (DERs) within developed economies. It was the client’s hypothesis that a critical transformation was underway within the electricity markets of major G7 economies. This was due to the rapid decline in the cost of renewable energy resources over the last ten years and the rapid expansion of regulatory incentives to support renewable and clean energy system deployments.

For the fact-finding component, the team was tasked with researching four US and two European jurisdictions. The four US markets were New York state (NYISO), the east coast grid system (PJM), the California state grid (CAISO) and the Texas state energy grid (Ercot). The two European markets were the United Kingdom and Germany. Through multiple levels of analysis (see section 2 and appendices for details), the team determined that NYISO presented the most attractive target market for a new ESCO offering a DER solution. Given the clients desire to initially focus on a solar PV driven solution, the C&I customer segment was immediately refined to organisations that possessed sufficient roof space to generate a material level of MW/h per annum.

After researching and directly approaching potential clients across four customer segments (shopping malls, supermarkets, hospitals and universities), the team decided that the Higher Education customer segment represented the most attractive starting point. This decision was primarily driven by three key factors: firstly, a strong customer commitment to sustainability, secondly a high engagement rate with initial email requests for interviews, and thirdly the customer segment was large enough to support the business case for an ESCO.

Update:

Since this report was finalised, it has been confirmed that the first residential scale deployment of Lithium Ion batteries has been approved inside buildings in NYC. However, no utility scale deployment has been approved. Demand Energy Networks, in partnership with leading battery maker EnerSys, completed the first of five storage projects to be enrolled in Con Edison’s Demand Management Program (DMP) earlier in 2017. The five systems contracted with Con Edison are sized 100KW/400KWh and are installed in separate properties across Manhattan owned by Glenwood, one of New York’s largest owners and builders of luxury rental apartments. These represent the first major behind-the-meter smart battery deployment project in NY.

2. Research Methodology Overview

In order to assess the viability of the different markets, the team identified 16 variables as essential for scoring the attractiveness of these territories. These variables included electricity prices, price volatility, market size, electricity storage, operating reserve, competitive landscape, smart meter penetration, intermittent resources, and DER metrics and incentives (See Appendix 1). From these

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3 The details of these variables, their respective scored and points allocation can be seen in Appendix 1.
16 variables, the team was able to group the variables into 11 items split across two groups: Primary variables and secondary variables. The primary variables were assigned a total of 80 points out of a possible 100, while the secondary variables were assigned 20 points out of a possible 100. From this analysis, the team determined that the CAISO market was the most attractive, followed by NYISO.

Following the initial analysis, the client refined the research down to four markets, discounting ERCOT and Germany. The client also made suggested revisions to the weighting of points for the scoring matrix and asked the team to re-run the analysis with those adjustments. Accordingly, the team re-ran the analysis and adjusted the weightings. In this second assessment, CAISO and NYISO remained the top two markets, with NYISO taking the top spot.

**NYISO SWOT Analysis:**

<table>
<thead>
<tr>
<th>Strengths:</th>
<th>Opportunities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Supportive political mandate for DER deployment,</td>
<td>• No ESCO is currently offering an integrated storage, software and distributed generation solution,</td>
</tr>
<tr>
<td>• High average wholesale electricity price,</td>
<td>• HEIs have been largely ignored by developers, in favour of other C&amp;I customers,</td>
</tr>
<tr>
<td>• Large price volatility, especially at certain LMPs in NYC,</td>
<td>• Under-developed market allows ESCOs a chance to establish a niche brand in the HEI space.</td>
</tr>
<tr>
<td>• Large market size for expansion.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Weaknesses:</th>
<th>Threats:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• HEIs do face significant financial constraints and challenges in accessing debt,</td>
<td>• Regulatory shifts may occur faster than anticipated, giving an edge to larger companies who can move quickly. E.g. NextEra Energy and STEM,</td>
</tr>
<tr>
<td>• NY does have several well-known ESCOs providing DER services, such as ENERNOC,</td>
<td>• Changes to the ITC, combined with low price of natural gas, may promote use of microgeneration over Solar PV,</td>
</tr>
<tr>
<td>• Current regulation prevents utility scale deployment of lithium-ion in key LMPs and there is no timeline for when this could change.</td>
<td>• Policy may shift away from DER support.</td>
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</tbody>
</table>

With the regional analysis complete, the team were tasked with researching four customer segments. These included supermarkets, shopping malls, higher education institutions and

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4 The details of these variables, their respective scored and points allocation can be seen in Appendices 2 and 3.
5 The details of these variables, their respective scored and points allocation can be seen in appendix four and five.
hospitals. All of these organisations have significant energy needs, large untapped roof space potential and have typically not been as commercially savvy about deploying cost efficient electricity solutions as other C&I customers have been, e.g. manufacturers. After identifying and researching 200 clients in each customer segment, the team concluded that HEIs were the most attractive client segment for three factors:

1. This customer segment broadly displays a high awareness of sustainability issues and a desire to reduce their carbon footprint. About 30% of all universities and colleges surveyed have climate action or campus sustainability plans.
2. The customer segment was numerous and covered the whole state geographically, whilst also demonstrating the requisite profile to support a commercial scale DER deployment.
3. The customer segment was very responsive to the team’s research inquiries, with a favourable response rate of 15% within a week of the initial email.\textsuperscript{6}

\textsuperscript{6} This figure is based on a response rate of 12 out of 80.
3. Territorial Market Analysis: NYISO

The New York State electricity grid is managed by an Independent System Operator (ISO) called NYISO, an agency that was authorised by the Federal Energy Regulatory Commission (FERC) in 1998 and established in 1999. NYISO is responsible for one of the most challenging grid systems in the US. While the state has ample space for its population, it is sparsely populated throughout most of the territory, with the overwhelming majority of people concentrated around New York City.

New York State has one of the most dynamic electricity markets in the USA. Since the election of Governor Andrew Cuomo, the state has adopted a new strategy called “Reforming the Energy Vision (REV)”. REV was pioneered by the New York State Energy Research and Development Agency (NYSERDA) and focused on promoting the transition towards a clean, resilient, and more affordable energy system.

The followings are characteristics of the NY power system:

a) A small but fast-growing distributed solar network

At present New York relies heavily on nuclear, hydro and gas for the majority of its energy needs. The combined installed capacity of wind and solar PV is <5% of the states total capacity. However, deployed distributed solar capacity has grown from 100MW in 2012 to 500MW in 2015, registering an annual growth rate of 50%.

b) High and volatile wholesale prices:

The average wholesale price in NYISO for 2016 was ~$53.4/MWh, slightly lower than the nation’s highest average wholesale price state, California. The historic highest peak annual wholesale price occurred 2014, when prices in New York state averaged $69/MWh for the year.

In addition to high prices, the NYISO market also has the greatest price volatility across the states and in the winter of 2015 the LMP wholesale price spiked 1000 times in a week due to extreme weather and congestion. In New York City, where transmission is a major concern, LMP price spikes are even more extreme.

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8 Ibid.
9 Ibid.
10 Ibid.
One of the challenges that NYISO faces is the transmission constraints that exist in and around the south-eastern portion of the state, namely NYC. Energy largely flows from the west and the north toward the southeast, NY city and the Long Island. As a result of transmission constraints there are regularly higher LMPS in the New York City and Long Island. Furthermore, the aged transmission infrastructure (mostly built in pre-1970s) has exacerbated the congestion problem.\textsuperscript{11}

\begin{itemize}
  \item Pre 1980's: 84%
  \item 1980 to 1989: 13%
  \item 1990 to 1999: 1%
  \item 2000 to Present: 2%
\end{itemize}

c) High Consumption Growth Without Distributed Energy

The energy consumption of NY is forecasted to grow substantially in the next 10 years, adding huge stress to the existing generation and transmission capacity. However, research shows that NY state energy consumption can be reduced through effective use of distributed energy and energy efficiency measures (see Appendix 7).

Part of the challenge lies in the need to have capacity available to provide peak demand of more than 31GW during winter, while the summer peak is considerably lower (see Appendix 8). As a result of these features we believe that NYISO has great market potential for developing distributed energy resource to dampen consumption, alleviate stress in the generation and transmission infrastructure, and save energy bill for the customers.

The Higher Education market in the US is big. According to Second Nature, a higher education NGO, the operational budgets for US Higher Education institutions (HEIs) total around $350bn a year, or 2.5% of US GDP\textsuperscript{12}. In states like New York, specifically the electricity sector, the market share is even bigger. The CUNY school network accounts for 1% of all New York City’s electricity consumption\textsuperscript{13}, while the University of Buffalo purchases 212 GWh of RECs per year and produces 674 MWh of green energy on-site\textsuperscript{14}. In total, we believe that HEIs in New York may account for between 2-5% of all electricity consumed within the state\textsuperscript{15}.

Higher Education institutions are interesting for several reasons:

1. **They are big:** Most higher educations in our review of 148 have a student population of between 5,000-10,000, with large air-conditioned offices and computer banks. For example: Stonybrook College has a peak time demand of about 25MW, while other colleges like the University of Buffalo are an order multiple magnitudes larger.

2. **They plan for the long term:** The overwhelming majority of HEI’s have campus strategy plans with a 10-year horizon or longer.

3. **They have a high level of awareness:** Whether the HEI has an active climate action plan or not, all universities are engaged in some form of sustainable activity. These include water conservation, recycling and energy efficiency measures such as ensuring that new buildings meet LEED standards\textsuperscript{16}.

In 2007, the American College & University Presidents’ Climate Commitment (ACUPCC) was signed. This agreement committed US colleges to ensuring that sustainability became an important part of their future planning. Following this commitment, a significant number of HEI’s developed

\textsuperscript{12} Second Nature citing the National Center of Education Statistics (NCES)
\textsuperscript{13} CUNY website
\textsuperscript{14} University of Buffalo website
\textsuperscript{15} Own research
sustainability plans. Of the 80+ HEIs researched to-date, 23 have sustainability plans available to the public, the most recent versions of which range from 2007 to 2016. In total, 12 are older than 2012. Following an initial period of interest, it now appears that many HEIs have not updated their plans and that many strategies are coming to the end of their original timeline.

To support the work of the ACUPCC in regards to sustainability for HEIs, the Association for the Advancement of Sustainability in Higher Education (AASHE) was founded. AASHE helps HEI’s by providing scoring metrics to benchmark their performance against peers. Using a STARS (Sustainability Tracking Assessment & Rating System) approach, AASHE helps HEI’s in New York to ensure they can learn from other best practises.

From our research, it is clear that the overwhelming focus for HEI’s has been on energy efficiency because many HEIs have limited technical resources to implement broader energy reform programmes. As a result, the upgrading of HVAC units, replacing oil boilers with gas/biofuel and using new LEED lights has been an extremely common theme. These activities fall within the normal remit of activities for facilities managers and are the most commonly reported measures on AASHE. We also note that initiatives, such as the REV Campus Challenge has been an important mechanism to catalyse support for projects and to help secure additional financing streams for HEIs. However, the special situation of each HEI is important. For example, Colgate University is ineligible for grant funding from NYSERDA because they are a customer of a municipal utility and do not pay the System Benefits Charge (SBC). This is only one example of the extremely diverse landscape of HEIs that have to be analysed individually.

The next most common approach for HEIs is to acquire Renewable Energy Credits (RECs) instead of generating renewable energy on-site. While exact numbers can be challenging to find, the Princeton review does provide indications of how much “Green Energy” HEI’s purchase. In general, we find that there is a wide gap between HEI’s who purchase green energy, with some purchasing only 5% and others purchasing 135% of their electricity supply in the form of RECs. Where these RECs are purchased, the chosen technology is overwhelmingly wind energy due to its low cost.

For HEI’s that are more advanced, distributed generation takes on a variety of forms. From our research over 24 HEIs have Solar PV units installed, that range from 5KW to 2MW in size. We also note geothermal heating and ground pumps are a very popular solution, with 13% of HEIs making active use of them for heating and cooling of their buildings. Co-Generation plants and gas/bioenergy turbines are also present in 13% of HEIs and range in size and capacity. At one end of the spectrum is NYU’s 13.4MW multi-turbine plant that provides heating and cooling to 40 NYU buildings and electricity to 26 buildings, saving the university $5–8 million per year\(^\text{17}\). On the other end, Adelphi University has a 1.99 MW combined heat and power plant. Colgate University uses a wood-fired boiler to satisfy 75% of the campus's heat and hot water needs\(^\text{18}\).


\(^{18}\) Adelphi University, 2017
Energy storage is not present at any HEI we have researched to date. Part of this is linked to cost, part is regulation and part is licensing. At present, there are no commercially approved utility scale lithium ion storage batteries allowed inside buildings in NYC. This is because of significant fire risks created by lithium ion, concerns about accessibility to the fire, re-ignition risks and lack of fire department training. As such, the deployment of these technologies has been, and is likely to remain, limited for the next years. This has significantly affected the commercial ability to capitalise on the high LMPs found inside NYC, where the large property holdings that HEIs have, could feasibly support battery deployment. Outside of NYC the lack of explicit mandates for utilities to use storage, unlike in the CAISO market, has restricted the incentives to deploy batteries.

We find that there is a growing interest in demand response measures from HEIs. The utility service provider NORSECO serves Columbia; while Con Edison works with Barnard College and the Fashion School of NY; and the New York Power Authority collaborates with Hunter College. Other solutions are being piloted by a range of HEIs, many of which revolve around controlling HVAC units and lighting.

Despite the wide range of federal campaigns to finance and deploy renewable energy, we find that HEIs in NY are largely focused on distributed resources, if they deploy any generation assets at all. Initiatives such as the Billion Dollar Green Challenge and the Green Gigawatt Partnership are working across the USA to catalyse the deployment and financing of large scale renewables projects. However, only Cornell University and Vassar College feature on the Green Gigawatt Partnerships list of HEIs to have invested in or deployed significant projects.
4. Competitive Landscape Overview

Most ESCOs in the NYISO market provide demand response aggregating services. This is a logical reaction to the unique features of the NYISO market, where demand response resources are considered critical in mitigating stress on the system. Moreover, they have been heavily incentivized by a range of programs from NYISO and various NY utilities. The demand response services are usually bundled smart software for real-time energy monitoring and management, either at the equipment level for customers or at the system level for utilities.

There are lots of battery storage manufacturers and vendors in NY and a couple of battery management software providers\(^\text{19}\). However, the “smart battery” (battery that has control software attached) is a rare case in NY. The three leading smart battery providers in the USA, namely Stem, Green Charge Network and Sharp, are not actively operating in NY, (Although Green Charge Network does have a demonstration project with a NY utility). Nonetheless, other companies are working with NY utilities and have recently made some progresses on deploying dispatchable DER and storage.

In addition to demand-side services, ESCOs in NY are also engaged in providing supply-side diversification options. Some are providing consulting services for the customer to procure energy in the wholesale market or to install on-site distributed energy projects, while others are directly supplying tailored energy options to the customers as retailers. But the supply-side services are less common than demand-side service in NYISO.

While at this time we do not believe that there are any ESCOs in New York that are offering a fully integrated distributed generation, storage and smart software management system, there are a number of companies in the CAISO market who do offer such services. Should they decide to enter the market in NY, then we would expect them to retain or adjust their existing business models.

<table>
<thead>
<tr>
<th>Company</th>
<th>Target Customer</th>
<th>DG</th>
<th>Software</th>
<th>Storage</th>
<th>Cost</th>
<th>Contract Length</th>
<th>Leasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>ViZn</td>
<td>Commercial &amp; Industrial</td>
<td>Solar PV</td>
<td>No</td>
<td>Lithium Ion</td>
<td>Est. $10,120 per month for a 250-kWh system</td>
<td>5 - 7 years</td>
<td>Yes</td>
</tr>
<tr>
<td>JLM Energy</td>
<td>Residential, Commercial, Utility</td>
<td>Yes</td>
<td>Yes</td>
<td>Lithium Ion</td>
<td>Unknown</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Stem</td>
<td>Commercial &amp; Industrial</td>
<td>No</td>
<td>Yes</td>
<td>Lithium Ion</td>
<td>No upfront costs, then pay monthly</td>
<td>3 years</td>
<td>Yes</td>
</tr>
<tr>
<td>Green Charge Networks &amp; REC Solar</td>
<td>Commercial &amp; Industrial</td>
<td>Yes</td>
<td>Yes</td>
<td>Lithium Ion</td>
<td>No upfront costs, then pay monthly</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Sharp &amp; Sunworks</td>
<td>Commercial &amp; Industrial</td>
<td>Yes</td>
<td>Yes</td>
<td>Lithium Ion</td>
<td>Unknown</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

\(^\text{19}\) For a full list of ESCOs in New York, please see Appendices 9 and 10
Currently the four companies are actively operating in California, largely driven by California’s storage mandate on utilities and the Supply Side Pilot (SPP) project of PG&E that allows storage to bid into wholesale market. In contrast, none of those companies are actively operating in NYISO.
5. Regulatory Environment and System Design

Companies that operate within the NYISO market are affected by incentives, regulations and market opportunities that are generated at three separate levels: The Federal Level, the State Level and the Utility level.

**Federal Level Regulation**

The primary federal mechanism for stimulating the deployment of new renewable technologies is the Investment Tax Credit (ITC). The tax credit operates differently depending on the technology deployed. For Solar PV, the ITC provides project financiers with a tax credit valued at 30% of the cost of the total systems value. For Micro-turbines the ITC provides the equivalent of $200/Kw, while for Fuel cell technology, the ITC provides $1500/0.5 Kw. The system however is not available for Lithium Ion storage and this has a notable impact of the relative cost-competitiveness of this technology in contrast to fuel cells and micro-turbines.

**State Level Regulation**

At the state level, transformations in the NY electricity market have been driven by Governor Andrew Cuomo’s Reforming the Energy Vision (REV)\(^{20}\). The aim of the policy is to incentivise the deployment and integration of new DR, DER and EE solutions.

In New York the ISO, NYISO, sets the regulatory framework and market pricing structures that incentivise the deployment of DER, DR and EE. NYISO works alongside several other state level agencies, including the New York Power Authority (NYPA), the Long Island Power Authority (LIPA) and the New York State Energy Research and Development Authority (NYSERDA).

To support Demand response, NYISO has developed several programs which pay program participants who can meet the appropriate qualifications to reduce their electricity consumption ("load") for discrete periods of time. NYISO Demand Response programs include:

- Reliability-based Demand Response programs
- Installed Capacity - Special Case Resource (ICAP-SCR) program
- Emergency Demand Response Program (EDRP)

During periods of increased demand, or when the grid is affected by unplanned events like inclement weather, the NYISO’s market pays participants in Reliability-based Demand Response programs for load reductions that lessen stress on the electric grid. Program rules unique to the ICAP-SCR program also enable participants to receive monthly payments (called “capacity payments”) based on the obligated level of load reduction (i.e., the committed level of load reduction at the facility when the NYISO requests that participants reduce load).

- Economic-based Demand Response programs
- Day-Ahead Demand Response Program (DADRP)
- Demand Side Ancillary Services Program (DSASP)
Economic-based Demand Response programs provide participants the opportunity to offer load reduction into New York’s electricity markets in response to high electricity prices. DADRP participants submit to the NYISO an “energy offer” to reduce consumption at the price the participants determine. Similarly, DSASP participants submit “reserves” and/or “regulation” service offers to the NYISO. If the offer is accepted and scheduled by the NYISO, DSASP participants are eligible to receive market payments based upon actual performance.

To further support the deployment of DERs, New York has a net metering policy that is offered to many technologies including non-residential solar with capacity of no more than 2MW. Net excess generation credit should be carried forward from one year to the next for non-residential solar. To participate in the EDRP, ICAP-SCR program, or the DADRP program, load reduction performance is measured using hourly interval electric meters that meet NYISO’s requirements for accuracy.

In order to incentivise Energy Efficiency (EE) measures, the Clean Energy Fund (CEF) was approved by the New York Public Service Commission after the expiration of the New York’s Energy Efficiency Portfolio Standard (EEPS) and Renewable Portfolio Standard (RPS) fund. It is intended to continue the provision of energy incentive programs and to focus on market development including energy storage. CEF reduces the uncertainty associated with the expiration of financial incentives in NY state. It is effective until 2025. Investment plans have been proposed by the CEF on energy storage to reduce the soft cost of energy storage, improve safety and install pilot projects.

However, HEIs are not eligible for many programs funded by the CEF, because they do not pay the System Benefits Charge (SBC). Despite this current challenge, the New York State Energy Research and Development Authority (NYSERDA), which is in charge of the CEF, is in the midst some changes under the Clean Energy Fund program and paying the SBC may no longer be an eligibility requirement for some NYSERDA programs21.

**Utility**

Consolidated Edison provides an incentive program for demand response measure. It compensates demand response providers $1/kWh and $18/kW/ per month for Tier 1 customers or $25/kW/ per month for Tier 2 customers.

The Brooklyn Queens Demand Management Program is a scheme that demonstrates the significant potential that Utilities see for DER deployment in urban Environments. In order to avoid a $1.1bn substation upgrade, ConEd held an auction to consider alternative solutions. Multiple bids were submitted and eventually ConEd confirmed that it will invest $200mn in DERs to investment in a blend of solutions including EE upgrades, Solar PV, demand response, storage, microgrids.22 23

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21 This is informed by interviews with Cornell University
Con Ed is also working on a second project with SunPower, and Sunverge to develop a multipurpose “virtual power plant” from 300 homes in Brooklyn and Queens. Each home will have a rooftop PV system and a lithium-ion battery system to explore providing services such as peak shaving, frequency regulation, capacity and wholesale market participation, and deferring investment in transmission and distribution²⁵.

Due to the challenges of providing electricity to Long Island, LIPA offers Feed-in Tariffs which offer market participants a fixed price for generation ($/kWh) that will be paid for a period of 20 years based on a Clearing Price determined through the Clearing Price Auction. The bid price cap is set at $0.1688/kWh. Applications with price greater than the bid cap will not be considered for auction. The system size eligible for the FiT is from 200 kW to 1MW.

Challenges:

Specific challenges faced by higher education institutions in implementing demand response and distributed generation

Higher education institutions are non-profit organizations, which are not eligible for some incentive programs such as ITC and many programs funded by the CEF. This may be a barrier for implementing demand response and distributed energy projects, at least one of our interviewers pointed it out. This barrier might not be difficult to overcome, because higher education institutions can engage with private investors to design a financial structure that makes projects qualified for policy incentives. However, a deeper problem might be reflected by the barrier: higher education institutions may often have different motivation and interest from private investors in developing projects on distributed energy plus battery storage. The former focuses on education and research whereas the latter focuses on profitability. The different incentives might reduce the responsiveness to financial incentives.

Technical Challenges for Lithium Ion

Strong financial incentives have not targeting/extended to battery storage

²⁴ BQDM map is from the ConEdison auction results page:  https://conedbqdmauction.com/
Although the cost of battery storage has decreased significantly, it is still too expensive. The levelized cost of energy storage for lithium-ion battery, which is one of the most economical battery storage technologies, ranges from $285 to $581/MWh when it is used to shave peaks in electricity demand (Lazard 2016). In contrast, the levelized cost of energy for microturbines ranges from $66 to $101/MWh by including fuel price changes. The number for fuel cells spans from $98 to $174/MWh (Lazard 2016). Since battery storage technologies are much more expensive than its alternatives, battery storage needs strong incentives to be deployed in market.

Based on the policy incentives presented in the previous section, microturbines and fuel cells are eligible for ITC whereas energy storage is not. This will make microturbines and fuel cells more attractive to demand response providers than does battery storage. Adding to the problem is that battery storage is not eligible for net metering policy but fuel cells and micro-CHP, both of which are alternatives of battery storage under many circumstances, are eligible for net metering.

**Regulatory framework on battery storage lags behind**

In New York City today the Buildings Department of NYC is responsible for issuing permits for the inclusion of new systems, such as energy storage modules, within commercial and residential properties. However, it is the obligation of the Buildings Department of NYC to receive a “Letter of no objection” from the Fire Department of New York (FDNY) before it approves such a deployment. To date legacy systems, like lead acid batteries, are well known to the FDNY but lithium ion is not.

Lithium ion fires have not been handled by many fire officers in the US to date and a number of challenges have occurred due to lack of training and educational opportunities between manufacturers and fire departments. In certain instances, fire officers have treated fires from lithium ion batteries as comparable to elemental lithium fires. In one instance, fire officers waited for an hour for specialist foam equipment to arrive on the scene, only to find it was not effective. In other cases, the risk of re-ignition and the need for large volumes of water inside a potentially sealed container (housing the battery) have led to risks of how to remove the unit after a fire safely.

As a consequence of these issues, no utility scale lithium ion solution has been approved for deployment inside properties in NYC. This therefore limits the cost effectiveness of batteries to provide power nearest to the most attractive LMP spots. While these challenges are not insurmountable, they will take time. The first residential scale lithium ion solutions were approved in NYC in April of 2017 and as fire officers become more comfortable with the process, we expect to see the regulation become more accommodating as fire safety procedures are established.
6. Conclusion

The New York market provides an extensive range of attractive criteria for new ESCOs to consider. The high regional and local electricity prices, the volatility of pricing, the challenges with new transmission and the extensive level of financial support available at the state, federal and utility level, all make the provision of demand response and distributed generation attractive. Given the unique demand profile of universities and the fact that many are located inside attractive LMP areas, there is a clear need for a tailored set of consumer solutions which a new ESCO could provide.

Technology at this time appears to have moved faster than local regulation and policies. It is important to acknowledge that NYC has some of the toughest restrictions in the world for deploying new innovations that pose a fire safety concern. Nor should this be surprising. In one of the densest urban environments in the USA, fire risks are a major concern and have a political sensitivity. In particular, fire fighters have an extremely strong level of public support and it is crucially important to get their buy in early. Many battery companies are currently working with the Fire Department of New York (FDNY) and it is likely that lithium ion will become deployable inside commercial properties in NYC. The only question is time. As one insider noted “If you can deploy it in New York, you can deploy it anywhere”, providing an additional incentive for companies to work on deploying a lithium ion solution in NYC.

Given the rise of new social movements to promote climate change and increasing student level mobilisation for sustainability on campus, we believe that HEIs will come under growing pressure to do more. Those HEIs with existing Climate Action Plans (CAP) and sustainability reports will be encouraged to act on implementing their strategies, while nearly expired policies will need to be reviewed and a new strategic plan drafted. Additionally, HEIs without CAPs or sustainability reports will come under increasing pressure to do so.

Given the increasing demand that HEIs will have for advisory services and project development guidance, we believe that there is a unique market opportunity in the next few years for an ESCO to develop a competitive niche in this sector. In order for NY to reach the ambitions goals set by Governor Cuomo, we expect that NYSERDA, NYPA, NYISO and leading utilities like ConEdison, will continue to grow their range of incentives and support mechanisms. In particular, we believe that DERs which contribute to grid resiliency will be favourable reviewed, as well as software solutions that help manage demand during peak periods. As a result, we judge the regulatory environment as highly favourable for ESCOs and we anticipate that the regulatory framework will remain favourable for the foreseeable future.
Glossary:

- ACUPCC = American College & University Presidents’ Climate Commitment
- AASHE = Association for the Advancement of Sustainability in Higher Education
- CAISO = California Independent System Operator
- DER = Distributed Energy Resources
- DG = Distributed Generation
- DR = Demand Response
- EE = Energy Efficiency
- ESCO = Energy Service Company
- HEI = Higher Education Institution
- ITC = Investment Tax Credit
- LCOE = Levelised Cost Of Energy
- LEED = Leadership in Energy & Environmental Design
- LIPA = Long Island Power Authority
- MWh = MegaWatt Hour
- NY = New York State
- NYC = New York City
- NYISO = New York Independent System Operator
- NYSERDA = New York State Energy Research & Development Agency
- NYPA = New York Power Authority
- PACE = Property Assesed Clean Energy
- PPA = Power Purchase Agreement
- PV = Photo Voltaic
- REC = Renewable Energy Credit
- REV = Reforming the Energy Vision (NY Strategy)
## Appendix 1

### DECISION-MAKING METRICS FOR COUNTRIES / REGIONS

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Variable</th>
<th>Logic</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Market Size</td>
<td>The market size determines the attractivity and ability to scale up.</td>
<td>in TWh used per year</td>
</tr>
<tr>
<td>2</td>
<td>Electricity from Intermittent Sources</td>
<td>IS = Solar PV and Wind Turbines</td>
<td>in % of total production</td>
</tr>
<tr>
<td>3</td>
<td>Growth Rate of Intermittent Sources</td>
<td>Describes how dynamic and disrupted the market is and will be in the future.</td>
<td>in % per year of capacity</td>
</tr>
<tr>
<td>4</td>
<td>Electricity Storage Capacity in MW</td>
<td>Storage enhances the flexibility to respond. It can help shifting the load.</td>
<td>in total MW capacity (all storage options)</td>
</tr>
<tr>
<td>5</td>
<td>Wholesale Electricity Price per MWh</td>
<td>Especially high prices can open up market opportunities for us.</td>
<td>$ per MWh</td>
</tr>
<tr>
<td>6</td>
<td>Volatility of Wholesale Electricity Price</td>
<td>High volatility allows for wider margins depending on savings.</td>
<td>Statistical Variance (Standard Deviation)</td>
</tr>
<tr>
<td>7</td>
<td>ESCO Competitor Landscape</td>
<td>We would prefer to start in a fairly novel market and be a first-mover.</td>
<td>Rough Estimate of ESCOs</td>
</tr>
<tr>
<td>8</td>
<td>Smartmeter-Penetration Rate</td>
<td>We need information about the load curve for each house. Therefore smartmeters are essential.</td>
<td>in % of total</td>
</tr>
<tr>
<td>9</td>
<td>Data Protection Legislation</td>
<td>Our business model will mainly focus on processing data and information.</td>
<td>Score depends on feel</td>
</tr>
<tr>
<td>10</td>
<td>Budget for Demand Side Response Incentives</td>
<td>This determines the attractivity of the market.</td>
<td>in million $</td>
</tr>
<tr>
<td>11</td>
<td>Market Structure according to Global Electricity Markets Model</td>
<td>See below for the four models.</td>
<td>See Slide</td>
</tr>
<tr>
<td>12</td>
<td>Operating Reserve for the Electricity Grid (spinning and non-spinning)</td>
<td>STOR figure, i.e. how much can be &quot;turned on&quot; within the operators agreed time frame</td>
<td>Additional % capacity</td>
</tr>
<tr>
<td>13</td>
<td>DERs</td>
<td>Summarise resources, size of market, policies to incentivise development (types - i.e. subsidies, &quot;small&quot; - less than 50MW capacity.</td>
<td>&quot;small&quot; - less than 50MW capacity.</td>
</tr>
<tr>
<td>14</td>
<td>Behind the meter Solar</td>
<td>Utility vs behind-the-meter is different because the former sells into (and thus influences) the wholesale</td>
<td>in total deployed MW capacity</td>
</tr>
<tr>
<td>15</td>
<td>Solar Insolation</td>
<td>Global Horizontal Irradiance kWh/m^2/day</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Subsidies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2:

![Image of Total Score Matrix]

**Primary Variables**
- Price: max. 25 Points
- Volatility: max. 25 Points
- Electricity Storage: max. 10 Points
- Operating Reserve: max. 10 Points
- Competitive Landscape: max. 5 Points
- DERs Metric: max. 5 Points

**Secondary Variables**
- Market Size: max. 4 Points
- Smart Meter Penetration: max. 4 Points
- Intermittent Electricity: max. 4 Points
- Growth Rate Intermittent Points: max. 4 Points
- DSR Incentives: max. 4 Points

**Maximum:** 100 Points

**Maximum:** 80 Points

**Maximum:** 20 Points

---

Appendix 3:

**Scoring Matrix**

<table>
<thead>
<tr>
<th></th>
<th>1st Scorer</th>
<th>2nd Scorer</th>
<th>Average</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>56.5</td>
<td>58.5</td>
<td>57.5</td>
<td>3rd</td>
</tr>
<tr>
<td>Germany</td>
<td>27</td>
<td>28</td>
<td>26.5</td>
<td>6th</td>
</tr>
<tr>
<td>Texas</td>
<td>38</td>
<td>47</td>
<td>42.5</td>
<td>5th</td>
</tr>
<tr>
<td>CAISO</td>
<td>69.3</td>
<td>70.5</td>
<td>69.9</td>
<td>1st</td>
</tr>
<tr>
<td>PJM</td>
<td>49</td>
<td>44</td>
<td>46.5</td>
<td>4th</td>
</tr>
<tr>
<td>NYISO</td>
<td>65</td>
<td>74</td>
<td>69.5</td>
<td>2nd</td>
</tr>
</tbody>
</table>

Appendix 4:
Methodology Overview

<table>
<thead>
<tr>
<th>Total Score</th>
<th>Maximum: 100 Points</th>
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</thead>
<tbody>
<tr>
<td>1 Price</td>
<td>max. 18 Points</td>
</tr>
<tr>
<td>2 Volatility</td>
<td>max. 18 Points</td>
</tr>
<tr>
<td>3 Electricity Storage</td>
<td>max. 18 Points</td>
</tr>
<tr>
<td>4 Competitive Landscape</td>
<td>max. 18 Points</td>
</tr>
<tr>
<td>5 Subsidization</td>
<td>max. 18 Points</td>
</tr>
<tr>
<td>6 Intermittent Electricity</td>
<td>max. 4 Points</td>
</tr>
<tr>
<td>7 DERs Metric</td>
<td>max. 3 Points</td>
</tr>
<tr>
<td>8 Isolation</td>
<td>max. 3 Points</td>
</tr>
</tbody>
</table>

Appendix 5:

Scoring Matrix

<table>
<thead>
<tr>
<th></th>
<th>1st Scorer</th>
<th>2nd Scorer</th>
<th>Average</th>
<th>Rank</th>
</tr>
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<tbody>
<tr>
<td>UK</td>
<td>51.5</td>
<td>55.5</td>
<td>53.5</td>
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<tr>
<td>CAISO</td>
<td>69</td>
<td>64</td>
<td>66.5</td>
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<tr>
<td>PJM</td>
<td>47</td>
<td>55</td>
<td>51</td>
<td>4</td>
</tr>
<tr>
<td>NYISO</td>
<td>75</td>
<td>69</td>
<td>72</td>
<td>1</td>
</tr>
</tbody>
</table>

Appendix 6:

Source: NYISO Power Trends 2016. P24
Appendix 7

![Graph](http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Power_Trends/Power_Trends/2016-power-trends-FINAL-070516.pdf)

Source: NYISO Power Trends 2016. P9

Appendix 8 – NYISO Distributed Energy resources Roadmap, 2016
Appendix 9:

**Business Models of ESCOs in NY**

<table>
<thead>
<tr>
<th>Business Model</th>
<th>DR</th>
<th>Software</th>
<th>Retail</th>
<th>Procurement Consulting</th>
<th>Project Dev</th>
<th>Battery</th>
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</thead>
<tbody>
<tr>
<td>Adara energy</td>
<td>✓</td>
<td>✓ (battery)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
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<tr>
<td>Altenex</td>
<td>✓</td>
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<tr>
<td>Converge</td>
<td>✓</td>
<td>✓ (utility)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demand Energy networks</td>
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<td>✓ (battery)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Direct energy</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EDF</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Enbala</td>
<td>✓</td>
<td>✓ (utility)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EnCoop</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EnSpectrum</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ETS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EnerNoc</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Green charge Network</td>
<td>✓</td>
<td>✓ (battery)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Galt</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Note: NERC defines “On-peak” as 7am to 11pm (HB 7 to HB 22) for the Eastern Interconnection

*Figure 12 – Example of Summer Load*
Appendix 10
Integrated business model

Retail + DER project + DR + software  Direct Energy
Procurement + DER project + software  ETS, Nuenergen
Procurement/DER + DR + software  Johnson controls, Nuenergen
Battery + Battery control software  Novele, Adara energy

Appendix 11

<table>
<thead>
<tr>
<th>Utilities</th>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Hudson Gas &amp; Electric Corp.</td>
<td>Diane</td>
<td><a href="mailto:seltz@centralhfd.com">seltz@centralhfd.com</a></td>
<td>646-455-4897</td>
</tr>
<tr>
<td>Concord Energy Co. of New York, Inc.</td>
<td>Sim</td>
<td><a href="mailto:zahiej@concordenergy.com">zahiej@concordenergy.com</a></td>
<td>914-408-3282</td>
</tr>
<tr>
<td>Long Island Power Authority</td>
<td>Michael</td>
<td><a href="mailto:michael@lpe.com">michael@lpe.com</a></td>
<td>631-648-3864</td>
</tr>
<tr>
<td>National Grid</td>
<td>Stacey</td>
<td><a href="mailto:shughes@nationalgrid.com">shughes@nationalgrid.com</a></td>
<td>518-432-3550</td>
</tr>
<tr>
<td>New York Power Authority</td>
<td>Dan</td>
<td><a href="mailto:smilowitz@nypa.gov">smilowitz@nypa.gov</a></td>
<td>914-207-3118</td>
</tr>
<tr>
<td>New York State Electric &amp; Gas Corp.</td>
<td>Eric</td>
<td><a href="mailto:rahdg@nyseg.com">rahdg@nyseg.com</a></td>
<td>605-750-4725</td>
</tr>
<tr>
<td>Orange &amp; Rockland Utilities, Inc.</td>
<td>Eric</td>
<td><a href="mailto:rahdg@nyseg.com">rahdg@nyseg.com</a></td>
<td>605-750-4725</td>
</tr>
<tr>
<td>Rochester Gas &amp; Electric Corp.</td>
<td>Eric</td>
<td><a href="mailto:rahdg@nyseg.com">rahdg@nyseg.com</a></td>
<td>605-750-4725</td>
</tr>
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</table>

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