NRDC CASE STUDY

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Retrofitting Mahindra Towers:
How an Innovative ESCO Model Lowers Energy Bills With No Upfront Cost

Mahindra Towers post-retrofit. Photo used with permission from Mahindra & Mahindra.

"It was the first time that we could get buy-in from people in the company to show that energy efficiency pays. For us, the ESCO was an enabler to validate our claim and show that energy efficiency is a good business case. We changed the mindset at the company through this retrofit and we would recommend it [the ESCO model] to other companies."

– Ms. Beroz Gazdar, Sr. Vice President - Group Sustainability, Mahindra & Mahindra

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Prepared by: Natural Resources Defense Council
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The Indian economy has experienced unprecedented growth over the last decade. This growth led to increasing per capita income and standards of living, coupled with rapid urbanization, rising demand for housing and expanding commercial office space, all of which strain India's current energy resources. Incorporating energy efficiency measures into India's building stock is an untapped energy resource with immense potential to help meet India's rising energy needs.

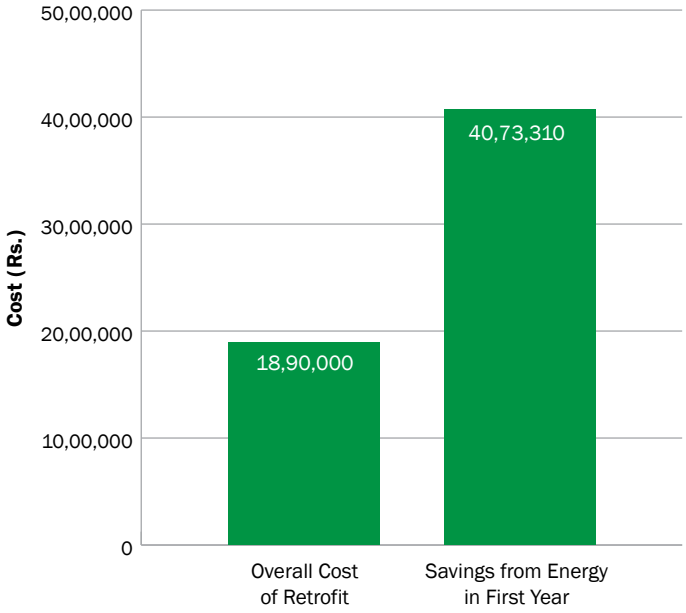
As the Mahindra Towers ESCO retrofit demonstrates, Energy Service Companies (ESCOs) are a key tool to advance India's efficient buildings market. An ESCO is a company that provides integrated energy services to its customers, including undertaking energy audits and implementing energy efficiency improvement projects on a turn-key basis. The earnings of the ESCO are contingent on the savings that accrue to the customer from the project. Therefore ESCOs secure the project risk and may cover upfront costs to ensure improved energy efficiency in a customer's facility and their payment for the services are delivered based (either in whole or at least in part) on the achievement of those energy efficiency improvements.

This case study highlights the Mahindra Towers headquarters, an office building in Mumbai, focusing on the strong business case for the ESCO model to implement energy efficiency improvement measures. As a result of the energy performance contract (EPC) taken up between the ESCO and Mahindra, Mahindra Towers reduced its power consumption by 14 percent in the first 12 months of the retrofit. The Mahindra Towers saved 543,108 kWh and Rs. 40,73,310 ($66,200) from March 2009 to February 2010.

With an overall investment of Rs. 18,90,000 ($39,375) for implementing all the energy conservation mechanisms (ECMs) that focused on improving efficiency in lighting and cooling systems, the Mahindra Towers had an impressive **payback period of less than half a year**. By working with the ESCO, Mahindra avoided making any upfront payments for the energy efficiency improvements because the ESCO model enabled the company to make payments over time through the energy savings. The corporation now continues to profit from those energy and cost savings for the life of the building.

The Mahindra Towers energy efficiency improvement project demonstrates that working with an energy servicing company to implement energy conservation mechanisms is practical and profitable in India's rapidly transforming building market and provides replicable practices for cost and energy savings.

FIGURE 1. COST OF ENERGY EFFICIENCY MEASURES COMPARED TO SAVINGS IN THE FIRST YEAR OF RETROFIT



BUILDING BASICS	
Location	Worli, Mumbai, India
Climate Zone	Hot and humid
Building Area	18,430 square meters (198,277 square feet)
Occupancy	1,380 people
Number of Wings	2
Number of Floors	6 (A Wing) and 7 (B Wing)
Building Use	Commercial
Constructed	1985
Retrofit Started	March 2009
Retrofit Completed	July 2009
Building Owner	Mahindra & Mahindra
Retrofit Financing	Provided by ESCO
ESCO	ENCON Energy Management Services Pvt. Ltd.
Utility Company (kVA)	BEST (Brihanmumbai Electric Supply and Transport) supplies 11 kilovolts (kV) of power via two transformers of 1,250 kilovolt-amperes
Pre-Retrofit Annual Energy Consumption	3,836,910 kWh/year

USING THE ESCO MODEL

An energy service company (ESCO) is a service provider offering a broad range of comprehensive energy solutions including designs and implementation of energy savings projects, retrofitting, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management. It utilizes Energy Performance Contracts (EPCs) to guarantee that the energy and cost savings produced by the energy conservation mechanisms (ECMs) will equal or exceed all ECM-associated costs over the term of the contract. The project's capital investment is either funded by the building owner, ESCO or is paid through a loan from a financial institution.[1]

An ESCO can be involved in one or several roles associated with the lifecycle of an energy efficiency project, including:

- Performing an audit to identify energy efficiency opportunities and quantify potential savings
- Developing customized recommendations on systems and equipment to upgrade based on past experience as well as specific conditions of the site
- Engineering, implementing, and commissioning the most energy efficient and suitable equipment
- Determining measurement and verification (M&V) protocol for each ECM[2]
- Maintaining equipment to ensure maximum savings are achieved
- Reporting energy savings

THE ESCO PROJECT

At the time of the retrofit, Mahindra Towers was serving as the headquarters of Mahindra & Mahindra,a company of more than 180,000 employees worldwide.[3] The company, originally founded as a steel trader in 1945, is now operating in 18 industries including the automobile, energy and real estate sectors. The Mahindra Towers building is a seven-story office that houses Mahindra & Mahindra, Mahindra Finance, Raymonds, and the Mahindra Lifespace Developers. Mahindra & Mahindra hired a Bureau of Energy Efficiency (BEE) certified ESCO, ENCON Energy Management Services Pvt. Ltd. (ENCON), to audit and implement the energy efficiency retrofit in the building.[4]

The initial motivating driver for Mahindra to undergo a retrofit was to save energy and demonstrate the benefits of energy efficiency through a pilot project without having to incur any upfront costs. Mahindra also wanted to ensure that working conditions for its employees and the tenants of the building were maintained, if not enhanced, through the proposed energy conservation mechanisms (ECMs).

Mahindra decided to move forward with the energy performance contract because the ESCO, ENCON, had deep expertise on building efficiency. By taking on full responsibility of the investment, ENCON was the "enabler" in the retrofit with minimal involvement on Mahindra's part.

The deal was structured as a three-year project based on the following key terms of agreement between the company and the ESCO:[5]

- The duration of the contract and billing period was 36 months from March 2009 to February 2012.
- Savings were calculated monthly on the basis of a pre-determined baseline.
- Monthly savings were shared 50/50 between Mahindra and ENCON throughout the duration of the project.
- ENCON initially presented a range of available ECMs to Mahindra. The two companies then collectively selected ECMs, which were implemented within a 6 month period.
- Upfront retrofitting costs were borne entirely by ENCON. ENCON entered into contractual agreements with equipment vendors allowing for deferred payments. These payments were met entirely by the energy savings that resulted from the retrofit. Hence, no initial capital expenditure was required from Mahindra for the retrofit.
- A measurement and verification (M&V) protocol was mutually determined between ENCON & Mahindra, which allowed any variations in normal electrical load or operating conditions to be accounted for in final measurement of savings.

ROLE OF THE ESCO

ENCON performed an energy audit for Mahindra Towers, reported opportunities for ECMs, calculated the baseline energy use for a comparison of savings, recommended cost-saving ECMs and ultimately, implemented the selected ECMs on behalf of Mahindra. The scope of the project included:

- **Investment Grade Energy Audit (IGEA):** ENCON conducted a comprehensive energy audit of the Mahindra Towers building, covering all equipment and systems to identify opportunities for energy savings.
- **Technical report and proposed ECMs:** Following the audit, ENCON submitted a technical report. It outlined an action plan with a calculation of investment, associated savings, payback and timelines.
- **Implementation:** ENCON completed the retrofitting of the selected ECMs. ENCON interacted with the equipment suppliers and vendors and was fully responsible for carrying out the implementation of the entire project.
- **Training & monitoring:** ENCON was further entrusted with the responsibility of carrying out appropriate training programs for the equipment and systems relevant to the retrofit. ENCON also monitored the systems through the duration of the project.

INVESTMENT, RISK AND SAVINGS

- The entire investment, and therefore the associated risk, for this project was undertaken by ENCON, the ESCO working on the retrofit.
- ENCON was entitled to receive a professional service fee at the rate of 50 percent of the savings in a particular month (including the period of implementation of ECMs).
- Invoices from suppliers/contractors for materials and labor were sent after the work was complete, paid directly by Mahindra and deducted from ENCON's 50 percent savings profit. This structure not only avoided the barrier of double taxation, but also avoided the need for upfront capital by either party.

ESTABLISHING THE BASELINE AND CONDUCTING THE ENERGY AUDIT

ENCON adopted a specific methodology to calculate the baseline to establish monthly savings. In this case, ENCON used Mahindra's utility bills for a particular month in the preceding two years to calculate the average power consumption for that particular month. For example, to calculate the baseline for March 2009, ENCON used the average consumption from March 2007 and March 2008. The previously-established baseline was utilized for all months over the duration of the project. ENCON recommended comparing energy use post-retrofit with the baseline, correcting for additional loads along with monitoring and verification to ensure energy savings. This data would further be used to calculate savings, set targets, prepare reports, and explore new ECMs.

ENCON conducted the initial energy audit based on building performance and identified efficiency opportunities for Mahindra Towers in the electrical, lighting and the heating, ventilation and air conditioning (HVAC) systems of the building. ECMs were prioritized on the basis of payback period as well as impact on worker productivity and building aesthetics. ECMs with a simple payback period of 12 months were implemented first (initial cost divided by annual energy cost savings). To maintain building occupants' productivity level, Mahindra required that the ECMs sustain the pre-retrofit comfort levels of temperature and illumination levels as well as the building's aesthetic appeal. Although ENCON financed the retrofit on a shared saving basis, Mahindra approved all purchases of equipment to ensure product quality.

ENERGY CONSERVATION MECHANISMS & COST

Energy conservation measures not only save energy, but also improve equipment reliability, increase the quality and property value of the building, enhance occupant comfort, and amplify a company's environmental commitment. The following ECMs were implemented keeping in mind the desired savings and Mahindra's conditions.

LIGHTING

Prior to the retrofit, lights were normally operated for 250 hours per month, with a connected load of 200 kW. The majority of office lights were ceiling-mounted luminaires with two 36 W linear fluorescent lamps (FTL); the utility areas had lights with one 36 watt (W) FTL; and 150 W high pressure sodium vapor lamps were used as security lights. Tube lights (e.g., FTLs) accounted for 78 percent of total lighting load and compact fluorescent lamps accounted for 10 percent of the load.

Illumination levels, or the amount of lighting reaching a surface, were measured in offices to be between 300 and 460 lux while the desirable level is between 250 and 350 lux. It was identified that desired illumination levels can be maintained and the lighting load could be reduced 40 percent by replacing FTLs with T-5 tube rods and high-frequency, low-harmonic electronic ballasts.

The retrofit replaced existing low efficiency lighting with T-5 high efficiency tube-rods with high frequency, low-harmonic electronic ballasts. Over 500 lamps were changed, resulting in savings of 5,551 kWh per month. The illumination on all surfaces was kept in the company's desired range to keep workers productive.

UPGRADED PUMP PANEL, MAHINDRA TOWERS.

Photo used with permission from Mahindra & Mahindra.

HVAC SYSTEM

Mahindra Towers has 22 air handling units (AHUs), with a total installed motor load of 209 kW. The AHUs consume an average of 30,500 kWh of energy per month. The energy audit revealed that the motors were loaded below 50 percent of rated capacity, operating less efficiently than if loaded at their full capacity. Further, electrical rooms with AHUs were poorly insulated, allowing heat to enter the space, creating a need for extra cooling load.

The building has two screw chillers with a capacity of 350 tons each to cool the water that flows to the AHUs through manually-controlled valves. Prior to the retrofit, these chillers were operating longer than required, and using 75,000 kWh per month. The cooling towers used 60 cubic meters of water a day with a pump that operated for 6 hours a day and had a capacity of 55 cubic meters per hour and a 15 horsepower (HP) motor, providing much more capacity than was needed. The pumps and cooling tower fans together used 29,060 kWh per month prior to the retrofit.

Photo used with permission from Mahindra & Mahindra.

RETROFITTED CHILLER SYSTEM, MAHINDRA TOWERS.

The air conditioning system was optimized while maintaining pre-retrofit air temperatures inside the building's rooms. The AHU motors were replaced with appropriately-sized high efficiency motors, reducing wasted energy and capacity. With appropriately-sized motors, the blower speed remained unchanged, increasing comfort and decreasing energy use. The chiller system's pump was also enhanced to reduce energy use. The pump's capacity was reduced to 15 cubic meters per hour with a 7.5 HP motor. This reduction did not compromise the chiller system's needs while saving energy.

ELECTRICAL SYSTEM

The energy audit revealed that the building electrical system did not require a retrofit. However, ENCON recommended measures to manage demand more efficiently by altering and optimizing metering, stabilizing power frequency and reducing power losses. By working with the ESCO, Mahindra was able to easily modify their electrical system with no additional cost, yielding energy savings.

COSTS

Out of the recommended ECMs, the building's retrofit team incorporated high-performing energy-efficiency measures, which pay for themselves over time by significantly saving on electricity costs. The replaced lighting cost Rs. 14,20,000 ($29,583). Optimizing the HVAC system was another major expenditure, costing Rs. 4,70,000 ($9,792). The electrical system was simply optimized with no equipment replacement and did not add to the costs of the retrofit.

COST OF INCORPORATING ENERGY EFFICIENT MEASURES

Energy Efficient Measures	Cost in Rupees (USD)
Lighting System	Rs. 14,20,000 ($29,583)
HVAC System	Rs. 4,70,050 ($9,792)
Electrical System	Rs. 0 ($0)
Total	Rs. 18,90,000 ($39,375)

RECOVERING RETROFIT INVESTMENT VIA ENERGY SAVINGS

Using the average of fiscal year (FY) 2007–08 and FY 2008–09—the two years before the upgrade—as the baseline, electricity use and electricity cost savings for FY 2009–10, 2010–11 and 2011–12 were calculated.[6] In the first year after the upgrade (FY 2009–10), the Mahindra Towers' electricity use dropped by a monthly average of 45,259 kWh per month, for a 14 percent saving in average monthly electricity use, including the period while ECMs were being implemented. In the second year after the upgrade (FY 2010–11), average monthly consumption dropped by 59,207 kWh per month, for an 18 percent saving in electricity use compared with the baseline. The third year after the retrofit, FY 2011–12, the building experienced a 12 percent saving in electricity use from the baseline with average monthly electricity consumption dropping by 38,537 kWh per month. Energy consumption increased in the third year due to a change in operating practices of the air conditioning system and its use beyond working hours.

With an overall investment of Rs. 18,90,000 ($39,375) and an average saving of Rs. 3,39,000 ($6,400) per month in the first year of the retrofit, the project's payback period for this retrofit was recouped in a little less than 6 months.

FIGURE 2. AVERAGE MONTHLY SAVINGS (KWH)

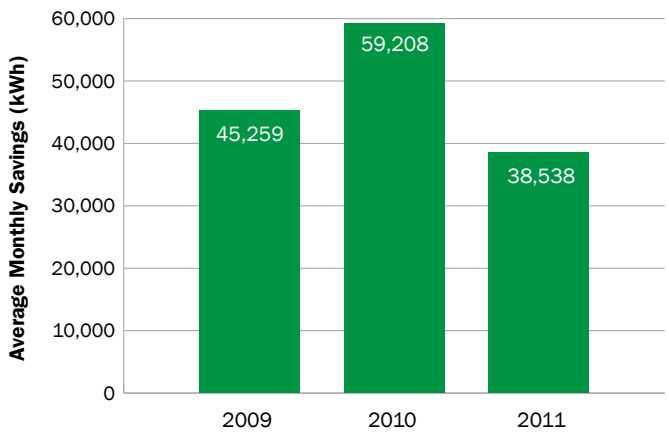
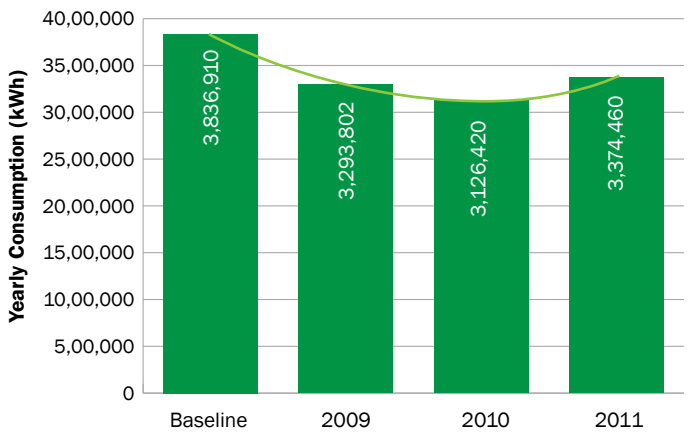


FIGURE 3. YEARLY CONSUMPTION (KWH)



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MS. BEROZ GAZDAR, SENIOR VICE PRESIDENT OF GROUP SUSTAINABILITY, SPEARHEADED MAHINDRA'S RETROFIT TO SPARK THE COMPANY'S SHIFT TOWARDS GREATER ENERGY EFFICIENCY, STARTING WITH THEIR HEADQUARTERS.

MAHINDRA TOWERS' ENERGY AND MONETARY SAVINGS FROM MARCH 2009–FEBRUARY 2010

MONTH	ENERGY SAVINGS (KWH)	COST SAVINGS
MAR 2009	30,660	Rs. 2,29,950
APRIL 2009	36,600	Rs. 2,74,500
MAY 2009	59,370	Rs. 4,45,275
JUNE 2009	26,160	Rs. 1,96,200
JULY 2009	42,840	Rs. 3,21,300
AUG 2009	30,390	Rs. 2,27,925
SEP 2009	26,370	Rs. 1,97,775
OCT 2009	46,980	Rs. 3,52,350
NOV 2009	55,770	Rs. 4,18,275
DEC 2009	53,880	Rs. 4,04,100
JAN 2010	77,160	Rs. 5,78,700
FEB 2010	56,928	Rs. 4,26,960
TOTAL	**543,108**	**Rs. 40,73,310**
AVERAGE SAVINGS	**45,259 kWh/Month**	**3.39 Lakh Rs./Month**

ENERGY EFFICIENT RETROFIT: MOTIVATIONS

MAHINDRA'S MOTIVATION

- **Saving Costs and Energy:** Mahindra's sustainability team knew energy efficiency could save energy and costs, but needed to validate this assertion through an in-house business case. This retrofit presented the opportunity to undertake energy and cost-saving measures with minimal risk and a short payback of less than a year.
- **No upfront investment needed from Mahindra:** ENCON's ability through the ESCO model to ensure electricity savings and take on the risk was a key motivator in Mahindra's decision to undergo the retrofit. ENCON was willing to invest in the retrofit fully in order to demonstrate the benefits that accrued to the company. The Mahindra team could more easily bring everyone on board with the project internally because the retrofit was handled by a third party. Further, the project was undertaken with a shared saving arrangement which allowed Mahindra to demonstrate this retrofit as a pilot project without capital expenditure (capex).
- **Simplicity and transparency of the ESCO model:** In Mahindra's experience, some ESCOs operated on agreements that were complicated with a number of deductibles and complex calculations. Further, taking on a complicated ESCO agreement as a pilot would have served to discourage the team from taking on future projects. ENCON offered an ESCO arrangement that was simple, straightforward, and easy for the team to understand.

ENCON'S MOTIVATION

- **Client's reputation:** The Mahindra Towers Project was ENCON's second project with Mahindra. As a corporation, ENCON was confident that Mahindra was committed to sustainability and savings through energy efficiency. ENCON wanted the opportunity to work with large corporations that were willing to experiment with the ESCO model. Hence, confidence in Mahindra as a client was a key motivating factor for ENCON.
- **Fair work agreement:** The agreement put in provisions that were fair to both the ESCO and Mahindra, particularly for the M&V protocol put in place that allowed for variations in the electrical load and operating conditions to be accounted for in the calculation of savings. For example, any variation in occupancy of the building would have an impact on electricity consumption that was independent of the retrofitted upgrades.
- **Flexible work agreement:** Even though the ESCO undertook the upfront investment for the upgrades, Mahindra and ENCON mutually agreed that equipment vendors and suppliers would bill Mahindra directly every month. Mahindra would pay the vendors each month from ENCON's 50 percent share of the savings. Two direct benefits for ENCON and the vendors resulted: double billing (and therefore double taxation) was avoided, as was the need for upfront capex.

OVERCOMING FOUR COMMON BARRIERS TO ESCOS

Expanding the ESCO model could be key to tapping the potential of energy efficiency in the existing buildings and facilities in India. However, given that it is a fairly new business model, the ESCO market in India presents its own challenges.

Barrier	Solution
Lack of knowledge and awareness of the ESCO model. ESCOs and energy efficiency savings concepts are relatively new to the real estate market and building owners, and a lack of awareness of this business model persists. Further, corporate motivation is traditionally rooted in profit-making and less in cost-saving.	**Case studies and pilot projects demonstrate savings through ESCOs.** Given that the ESCO market is a fairly new market, many organizations have a nascent understanding of the ESCO concept. Awareness of the benefits of the ESCO model can be increased through case studies like this one. The Mahindra Towers case study demonstrates with real numbers the high energy and cost savings achieved through secure efficiency investments implemented by ESCOs. Building owners and tenants can follow Mahindra's example to start saving money while increasing worker satisfaction.
Lack of trust in ESCO model. ESCOs and corporate teams sometimes struggle to convince management of the efficacy of the ESCO model to input efficiency measures. A perception that the ESCOs make profits at the expense of the company needs to be dispelled.	**BEE accreditation to increase trust.** The Bureau of Energy Efficiency (BEE) is actively working to expand the number of existing ESCOs, which will increase trust and familiarity with the ESCO model. An accreditation exercise for ESCOs was carried out by CRISIL and ICRA, with technical and financial support from BEE.[7] The accreditation focused on calculating baseline energy use, proper M&V procedures, technical manpower, and financial strength to invest in such projects.
Lack of financial strength and incentives. ESCOs need financial strength in order to take on the risk and execute large projects. Both ESCO revenue models—shared savings or performance guarantees—require the ESCO to either provide capital initially, or a bank guarantee (which would also requires significant collateral). Hence, for an ESCO to execute its first project, large seed capital is essential.	**Financial opportunities to support and incentivize ESCOs.** While efforts are already being made by government agencies like BEE, more can be done to incentivize industries to take up ESCO projects by providing income-tax rebates and other benefits. Banks and other financial institutions can support ESCOs by providing better access to capital. So far, BEE provides a partial risk guarantee of up to 25 percent for ESCO projects vetted by BEE. The Small Industries Development Bank of India (SIDBI) also provides an incentive for energy efficiency projects. Non-financial incentives include opportunities for client companies to avail themselves of an 80 percent depreciation on all retrofitting equipment in the first year and a 20 percent depreciation benefit in the second year of the retrofit.
Calculation of savings disputes. Even when the ESCO is employed to undertake the energy efficiency improvement project, disputes arise related to savings that do not account for changes in operating procedures on the part of the client company.	**Strong M&V protocols can eliminate disputes in calculation of savings.** If the mutual agreement between the ESCO and the client highlights a normal operating procedure, any change in the normal procedure can be considered the reason for change in savings and predetermined methods to account for these deviations should be built into the initial agreement. There should be strong dispute resolution mechanisms such as these to avoid potential conflict down the line.

LOOKING AHEAD

The ESCO provided valuable expertise to Mahindra to maximize energy savings while minimizing upfront costs. The ESCO energy audit identified efficiency measures specific to Mahindra Towers, estimated savings for each measure and created an implementation plan. A phased implementation of the ECMs, starting with energy efficiency measures with a short payback, reduced operating costs quickly. The savings from the first phase of efficiency mechanisms could be used to fund additional efforts, and furthermore, strong monitoring helped identify where these efforts should be concentrated.

Moving forward after the ESCO retrofit, Mahindra started working with the Confederation of Indian Industry (CII) and the Federation of Indian Chambers of Commerce and Industry (FICCI) Bombay Chapter to share best practices and exchange ideas.

The Mahindra Towers retrofit showcases how, with little upfront investment, great energy savings can be captured. An energy audit can help a company save money on operating costs and guide the implementation process. Not only are these investments paid back in a short time, but they continue to save money and energy for the lifetime of the building. This ESCO model is replicable and offers strong motivations for other Indian building owners to retrofit and lock in cost and energy savings.

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The Natural Resources Defense Council (NRDC) is a highly effective international environmental action group, combining the grassroots power of 1.4 million members and online activists with the courtroom clout and expertise of more than 350 lawyers, scientists and other professionals. NRDC's India Initiative works with partners in India on clean energy and climate change strategies and solutions. www.nrdc.org/international/india/

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Mahindra & Mahindra Ltd.
Mahindra & Mahindra Ltd. was founded in 1945 as a steel trading company, and it has since emerged into a conglomerate of companies whose operations span 18 different industries. No longer just an Indian company, Mahindra has turned into a $16.7 billion multinational group with more than 180,000 employees across the globe. No funds were exchanged by Mahindra to develop this case study. http://www.mahindra.com

ENCON Energy Management Services Pvt. Ltd.
ENCON Energy Management Services Pvt. Ltd. is an Indian energy services company (ESCO) with 11 years of experience providing energy efficiency services, and accredited by the Bureau of Energy Efficiency (BEE). ENCON covers all aspects of energy management with the aim of system improvement and reducing energy costs. No funds were exchanged by ENCON to develop this case study http://www.enconenergy.in

Endnotes

1 Pavan Kumar, Shalini Vaddy, *Growth of Energy Service Companies in India*, IIM Ahmedabad, http://www.mbaskool.com/business-articles/operations/7720-growth-of-energy-service-companies-escos-in-india.html (Accessed on 8 January 2014).

2 M&V Protocol refers to the suitable operating conditions determined for any component of the energy efficiency improvement project. For instance, M&V protocol for lighting could be deciding the average number of working hours. Any significant change in number of working hours would therefore have an effect on measurement of savings through improved energy efficiency lighting.

3 Mahindra & Mahindra, http://www.mahindra.com/.

4 Encon Energy Management Services, http://www.encon.co.in/.

5 Case study calculations and company insights gathered through NRDC and ASCI interviews with the implementing teams at Mahindra and ENCON between 2013 and 2014.

6 The methodology to calculate these savings included normalization to account for weather or and other changes in demand.

7 The Credit Rating Information Services of India Limited (http://crisil.com/) and Investment Information Credit Rating Agency Limited (http://www.icra.in/) are independent professional investment information and credit rating agencies.