SCALING SUCCESS

Recent Trends in Organizational Energy Management

EDF ENVIRONMENTAL DEFENSE FUND | CLIMATE CORPS

MEISTER CONSULTANTS GROUP

FOREWORD

THOMAS MURRAY

Vice President, Corporate Partnerships
Environmental Defense Fund

Energy efficiency has long been recognized as a win for both business and the environment. All too often, however, the practice of implementing cost-effective energy efficiency measures is fraught with internal organizational barriers. In an effort to overcome these barriers, EDF has engaged with hundreds of leading institutions in the U.S. and China to drive new investment in energy efficiency and clean energy projects. Despite the many challenges associated with strategic energy management, we have observed significant advancement in organizational performance over the years. While many opportunities for improvement remain, we are encouraged by the progress that organizations have made in turning energy management from a one-off investment into a strategic priority.

Photo: EDF Climate Corps fellow Wendy Yu evaluating energy-efficiency opportunities for HGST.

Photo: EDF Climate Corps fellow Jay Stone identifying energy efficiency opportunities for News Corporation.

ABOUT ENVIRONMENTAL DEFENSE FUND

Environmental Defense Fund (EDF) is one of the world's largest environmental nonprofit organizations, with more than one million members and a staff of 500 scientists, economists, policy experts, and other professionals around the world. EDF finds practical and lasting solutions to the world's most serious environmental problems. Working with leading businesses, scientists and academics, EDF is taking a leading role in minimizing the environmental, economic and human health risks associated with rising greenhouse gas emissions.

ACKNOWLEDGMENTS

The authors would like to thank the many companies, institutions and fellows who have contributed to the success of the EDF Climate Corps program since 2008.

Environmental Defense Fund and Meister Consulting Group co-authored this report. Lead authors include Jon Crowe, Kathryn Wright and Suveer Bahirwani at Meister Consulting Group, as well as Liz Delaney and Ellen Shenette at EDF.

CONTENTS

Table of ***FIGURES***

EXECUTIVE SUMMARY

EDF Climate Corps host organizations are engaging in more high-level and strategic energy management activities, considering energy investments with larger initial investment and of larger scale and reaping significant financial and environmental benefits.

Investment in commercial and industrial building energy efficiency has risen dramatically in recent years, more than doubling between 2006 and 2014 from $7 billion to $16 billion.[1] This growth has been fueled by a mix of organizational sustainability commitments, the availability of enabling incentive programs, the proliferation of cost-effective technologies, and the promise of significant financial savings.

Since 2008 the EDF Climate Corps program has played a significant supporting role in this growth, helping over 350 "host organizations" jumpstart energy management solutions by matching them with trained graduate student fellows who work onsite over the summer to identify actionable energy reduction strategies. The work of EDF Climate Corps fellows has also yielded valuable insights into successful energy management practices. EDF staff has tracked information on each project opportunity evaluated by a EDF Climate Corps fellow since the program's inception in 2008 and now maintains a detailed database (The "EDF Climate Corps Project Database") of more than 3,200 energy project opportunities.[2]

This report presents the results of a new analysis of this database designed to offer insights on strategic energy management in more than 350 companies, non-profits and government agencies across the U.S. In particular, the analysis focused on identifying meaningful trends in strategic energy management over time.

1 International Energy Agency (2015). Energy Efficiency Market Report 2015. Market Trends and Medium Term Prospects. Available at: https://www.iea.org/publications/freepublications/publication/MediumTermEnergyefficiencyMarketReport2015.pdf

2 Energy project recommendations made by EDF Climate Corps fellows during their fellowships are not necessarily completed projects. Fellows are directed by host organizations to explore specific projects of interest to each host organization. Therefore each project recommendation serves as a proxy for organizational energy management priorities. The EDF Climate Corps Project Database yields valuable insights into the investments organizations are considering internally.

KEY FINDINGS INCLUDE:

Finding 1

ORGANIZATIONS ARE ENGAGING IN MORE HIGH-LEVEL AND STRATEGIC ENERGY MANAGEMENT ACTIVITIES

Although the program began in 2008 with a focus on energy efficiency, in recent years host organizations have been deploying fellows on more holistic, high-level and strategic exercises, which have the potential for a broader impact. Organizations are also beginning to take advantage of the rapidly increasing number of opportunities presented by clean energy.

Finding 2

ORGANIZATIONS ARE CONSIDERING INVESTMENTS OF EVEN GREATER SCOPE AND SCALE

Host organizations are directing fellows to focus on a smaller number of project opportunities, but the scale and geographic scope of these initiatives has increased. The number of multi-facility and multi-state projects is growing at a fast rate, and while the average project identified by EDF Climate Corps fellows now requires a larger upfront investment, it has the potential to offer a more sizeable return.

Finding 3

ENERGY PROJECT INVESTMENT OPPORTUNITIES ARE OFFERING INCREASINGLY SIGNIFICANT FINANCIAL BENEFITS

The average Net Present Value (NPV) of investments and average annual savings from proposed projects have grown consistently over the years, showing an increasing scale of initial investment. Performance across project opportunities remains strong and stable with the average payback for all project categories remaining under 2.5 years.

Finding 4

THE SCALE OF POTENTIAL ENVIRONMENTAL BENEFITS HAS INCREASED EVEN FASTER THAN THE FINANCIAL OPPORTUNITIES

Between 2008 and 2015, the average GHG reductions of evaluated projects grew more than five-fold, outpacing the increases in average NPV, initial investment and annual savings. Whether through finding more cost-effective ways to reduce GHG emissions or benefitting from market and technology trends, organizations now have more opportunities to realize positive environmental impacts from energy management.

Organizations that are taking on more high-level, large-scale and strategic approaches to energy management have to overcome significant challenges and barriers across a range of organizational functions to create the necessary internal alignment of mandates, resources and communication. Assessments of the EDF Climate Corps Project Database have led to the identification of six major categories of barriers to energy management:

- Lack of executive or high-level support
- Lack of funding or competing priorities
- Lack of staff or expertise
- Lack of visibility or reporting
- Limitations of project analysis or insufficient data and tracking
- Factors unrelated to project

The analysis examined the prevalence of each barrier in the private sector, government, universities, and non-profits and found that some barriers were felt more acutely in one sector over another. The presence of these barriers also had varying degrees of impact on projected project success. The barriers that most threaten projected implementation were found to be: insufficient funding, lack of executive support, competing priorities, and limited data availability and quality.

Implementing a comprehensive approach to strategic energy management can help organizations achieve the coordination needed to address disparate and diffuse barriers. With proper management, over time these efforts can become self-reinforcing as early successes inspire continued and increased investment. In this way, strategic energy management can create a "virtuous cycle", growing the scale of action and environmental impact.

INTRODUCTION

SHAPING THE LANDSCAPE FOR ENERGY MANAGEMENT DECISION-MAKERS TODAY

Photo: EDF Climate Corps fellow Elizabeth Halford using an infra-red camera to identify heat loss for the Department of Energy and Environment.

Since 2007, building energy use intensity has decreased in commercial and industrial spaces, primarily due to improvements in energy efficiency practices and technologies. An estimated $90 billion was spent on energy efficiency investments globally in 2014, with growth expected. In the United States, non-residential building efficiency investments were the highest growing sub-segment, doubling from $7 billion in 2006 to $16 billion in 2014.[3] There are many economic and policy drivers influencing the increased uptake of energy efficiency in the private sector. A few of these motivators include:

> An estimated **$90 BILLION** was spent on energy efficiency investments globally in 2014, with growth expected.

- **Sustainability** is becoming increasingly ingrained into corporate DNA and major organizations have made public commitments to climate and energy targets. Energy efficiency is a tool to implement and enhance these goals, and can lead to more institutional support for **strategic energy management** (See Box 1).[4]
- **Savings** from energy efficiency and short-payback projects offer easy wins for cost reductions. Leading edge companies have also looked to demand response, green power purchasing and other voluntary programs as ways of creating more predictable and stable energy costs.
- **State and local policies** are driving more commercial and industrial organizations to think strategically about energy efficiency. Stricter energy codes and the increasing prevalence of reporting and disclosure ordinances make organizational energy use more transparent to the public. Strong energy performance is now a way to signal value to stakeholders either through governmental policies or voluntary certification and labeling programs, like LEED or ENERGY STAR certification.[5]

Policies such as utility-focused efficiency targets, renewable portfolio standards and the Clean Power Plan, and the increasing cost-effectiveness of many efficiency technologies, are driving the important role energy efficiency has to play in delivering savings and value to commercial and industrial facilities.

3 International Energy Agency (2015). Energy Efficiency Market Report 2015. Market Trends and Medium Term Prospects. Available

4 Carbon Disclosure Project (2016). Commit to Business Leadership on Climate. Online. Available at: https://www.cdp.net/en-US/Pages/commit-to-action.aspx

5 CBRE and the Institute for Market Transformation (2015). Guide to State and Local Energy Performance Regulations. Available at: http://www.buildingrating.org/file/1698/download

BOX ONE

WHAT IS STRATEGIC ENERGY MANAGEMENT (SEM)?

While many organizations have taken initial steps to manage energy use, efforts are often piecemeal, uncoordinated and limited in scope. Even where ambitious targets have been set, deep cuts in energy consumption are often elusive.

Strategic Energy Management refers broadly to the approaches to energy management that are focused on: achieving specific, time-bound and quantified targets, spanning an organization’s full portfolio rather than isolated facilities or assets, seeking continual improvement rather than one-off successes, targeting long-term savings, and/or seeking to efficiently allocate resources by prioritizing them among a portfolio of project opportunities.

THE EDF CLIMATE CORPS PROGRAM HAS PLAYED A SIGNIFICANT SUPPORTING ROLE IN IMPROVING ORGANIZATIONAL ENERGY PERFORMANCE.

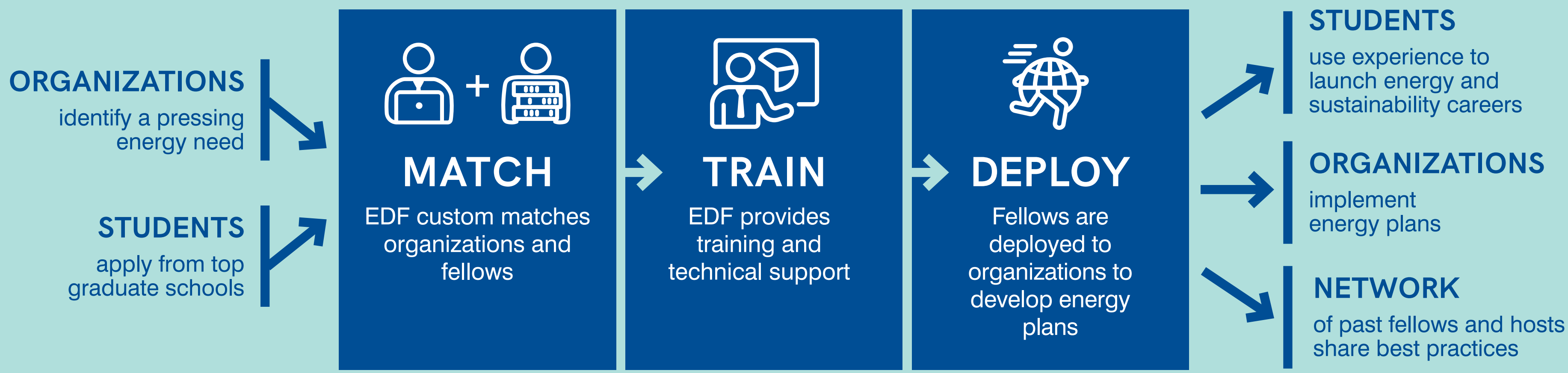
In 2008, Environmental Defense Fund created EDF Climate Corps – an innovative graduate fellowship program that helps organizations jumpstart the development and implementation of energy management solutions that would otherwise be unrealized. EDF recruits top graduate students and places them in “host” companies, non-profits and public sector institutions, to design actionable energy reduction strategies (see Box 2). Participating organizations are typically large energy consumers that demonstrate a strong interest in voluntary adoption of energy efficiency technologies and practices. The organizations have specific energy management challenges that they want to work on, but are in need of support to overcome barriers, such as a lack of time or expertise. EDF Climate Corps fellows help these organizations accelerate strategic energy management projects. Since its inception, EDF Climate Corps has deployed over 600 fellows to more than 350 organizations, where they have identified the potential for nearly $1.5 billion in savings, over 2 million metric tons of annual emissions reductions and close to 13.9 million MMBtu of annual energy reductions from recommended energy efficiency and clean energy projects.

KEY ELEMENTS OF THE EDF CLIMATE CORPS PROGRAM AND PROCESS ARE IMPORTANT TO UNDERSTAND IN ORDER TO INTERPRET THE RESULTS OF THIS REPORT:

- **“Host” or “host organization.”** EDF Climate Corps engages with companies, institutions and government agencies in the U.S. and internationally that are interested in hosting a paid fellow for the summer. Hosts direct fellows based on their current projects or priorities.
- **“Fellows.”** EDF Climate Corps fellows are graduate students who are matched with host organizations based on skill sets, experience and project focus areas. Fellows work onsite with their host organizations for 10-12 weeks to design actionable energy reduction plans.
- **“Projects,” “project recommendations” or “project opportunities.”** During each placement, a fellow will identify and/or evaluate an average of 5 specific opportunities for their host to save energy. Because fellows work under the direction of their host organizations, project opportunities are a good indication of the type of energy management activities hosts are considering.

BOX TWO

HOW EDF CLIMATE CORPS WORKS



Over the past 8 years, the EDF Climate Corps program has not only contributed to significant energy savings and GHG reductions, but has also yielded valuable insights into successful energy management practices. Since its formation, EDF staff has tracked information on each project opportunity evaluated by a EDF Climate Corps fellow. By the end of the 2015 program cycle, EDF had developed a database of over 3,200 energy reduction opportunities (the "EDF Climate Corps Project Database"), capturing a wide range of project characteristics, including project type, scale, potential financial and environmental impact, barriers to implementation and implementation likelihood.

The Climate Corps Database is regularly used to measure aggregate program impacts and help refine fellow training and program design. In addition, EDF's engagement with fellows, host organizations and industry experts has yielded extensive working knowledge of leading practices and drivers of success in the field of organizational energy management. Combining EDF's field experience with an analysis of the EDF Climate Corps Project Database offers a unique opportunity to gain new insights and identify broad trends over time that are shaping the current and future practice of strategic energy management.

This report summarizes the results of a new analysis that explores patterns in the EDF Climate Corps Project Database. In particular, the analysis focused on identifying meaningful trends in strategic energy management over time and assessing the barriers and opportunities currently shaping the landscape for energy management decision-makers today.

Section 3 discusses trends in strategic energy management, drawing on data from 2008-2015 in the EDF Climate Corps Project Database. Four key research questions are explored:

Over time, how have energy projects changed in terms of their…

- Type of activity?
- Scale of investment?
- Financial viability?
- Scale of environmental impact?

Section 4 discusses the challenges and opportunities facing energy decision-makers focusing on the fellows' assessments of barriers to implementation and the predicted likelihood of completion, concluding with best practices for SEM developed from EDF's experience working with over 350 organizations since 2008.

Finally, **Appendix A** presents an overview of the research questions, methodologies and process used to develop the analysis presented in this report.

It is important to note that the analysis is based on a compilation of energy project recommendations made by EDF Climate Corps fellows during their fellowship and does not necessarily reflect completed projects.[6] However, because fellows are directed by host organizations to explore energy project opportunities of interest to the host, the data yields valuable insights into the investments organizations are considering.

It is also important to note that the majority of the database represents U.S.-based project opportunities[7] and therefore the conclusions in this report may or may not be applicable in other countries or regions globally.

The hope is for this research to provide useful guidance into strategic energy management that will benefit current and future Climate Corps host organizations as well as energy managers, researchers, policymakers, and service providers in the broader market. In particular, this report can help decision-makers understand the trajectory of energy management practices and strategies, benchmark the quality of project opportunities against a broad base of peers and identify strategies for identifying and addressing barriers to energy management in their organizations.

6 EDF Climate Corps collects project implementation status data in the months and years following each program cycle, but does not have access to the detailed proprietary measurement and verification data necessary to verify actual cost and emissions reductions.

7 In 2014, the EDF Climate Corps program was expanded to include work with organizations based in China, though this remains a minority of projects (<5% each year).

TRENDS IN STRATEGIC ENERGY MANAGEMENT

SECTION 3.1

ENGAGING IN MORE HIGH-LEVEL, MORE STRATEGIC ENERGY MANAGEMENT ACTIVITIES

A growing number of organizations are focusing on more holistic and strategic energy projects. In the EDF Climate Corps program's early years, a central focus on identifying energy efficiency project opportunities fueled rapid growth. But, recently the fellows' work has concentrated on more analytical, planning and/or strategic efforts and hosts have put a greater emphasis on quality over quantity of projects.

Photo: EDF Climate Corps fellow Ashwin Shankar analyzing time-of-use energy pricing for the Pecan Street research lab.

RESEARCH QUESTION:

How is the **NATURE** of energy management projects explored by organizations changing over time?

Finding 1

Organizations are deploying a greater number of fellows to work on broader energy strategy-related projects as opposed to focusing just on discrete energy efficiency opportunities now as compared to in 2008.

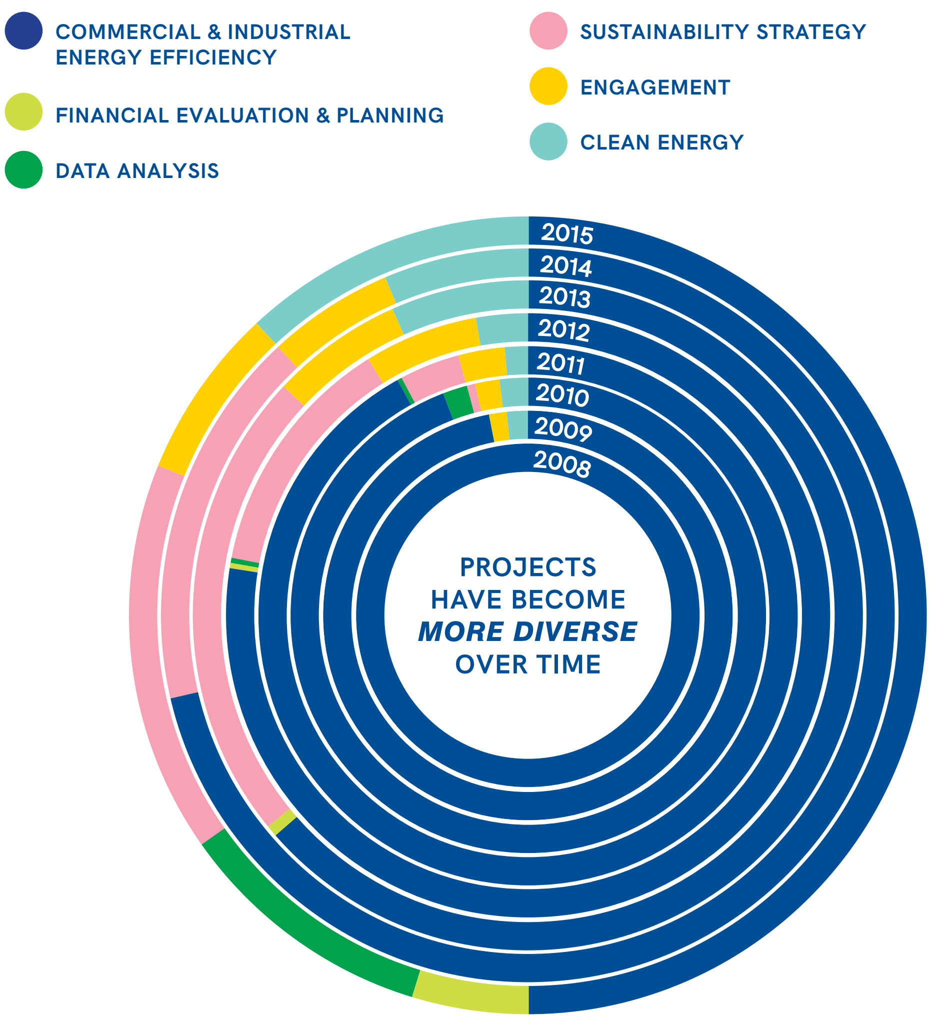
As the program has matured, so have the ways in which fellows are deployed. This reflects both the growing success of the program, the rising capabilities of EDF Climate Corps fellows and the multi-year history many hosts now have with the program.

This also indicates a maturing approach to SEM in many organizations. From 2008-2011, commercial and industrial energy efficiency projects represented at least 92% of all fellowship projects. By 2015, specific energy efficiency upgrades had declined to just half of all proposed projects, displaced largely by an increased focus on engagement, clean energy, sustainability strategy, advanced energy data analysis, and financial planning, which together had grown to represent 38% of all fellowship projects.[8] The increasingly diverse range of project activities and rising focus on planning and strategy can be seen in Figure 1, which shows project type as a proportion of all projects in each year.

8 An important fifth category that has grown, Clean Energy, is discussed in detail in Box 3.

EDF CLIMATE CORPS PROJECTS BY TYPE OVER TIME (AS % OF TOTAL PROJECTS)

Fig.1



Organizations are exploring a broader range of energy-related initiatives today than they were in 2008. The composition of EDF Climate Corps projects has become more diverse over time, shifting from predominantly energy efficiency to a wider array of analysis, planning, engagement, and strategy initiatives. Clean energy has also begun to emerge as a significant portion of the total project mix.

The trends in the data are mirrored by observations and anecdotal evidence. In recent years, EDF Climate Corps hosts have been seeking support at a higher level as their focus has shifted shifting from predominantly one-off, site-specific approaches to energy management, to portfolio-wide evaluations of project opportunities (see Case Study 1).

As host organization's energy needs have matured and diversified, so has the training and support for EDF Climate Corps fellows. Each year, EDF updates and modifies its training curriculum in response to host organizations' energy management priorities, in order to prepare its fellows for the diversity of work they will undertake during their summer fellowship. In the early years, fellows were primarily trained on how to identify energy efficiency upgrade opportunities and build the financial case for those investments. The training curriculum has since evolved to include additional modules on baselining and evaluating the performance of building portfolios, energy efficiency and renewable energy project financing, carbon accounting, sustainability strategy and more.

Photo: EDF Climate Corps fellows Wei Shao and Yinghaung Ji evaluating equipment in one of Walmart's China-based supplier manufacturing facilities.

CASE STUDY 1:

COMCAST CORPORATION

Comcast Corporation, the largest cable operator, home Internet service provider and fourth largest home telephone service provider in the United States, services both to both residential and commercial customers in 40 states and the District of Columbia. Headquartered in Philadelphia, Pennsylvania, the company has approximately 139,000 employees and thousands of buildings spread across the country. Comcast has participated in EDF Climate Corps since 2013, and year upon year its fellows' work has helped the company move towards the implementation of portfolio-level energy efficiency improvements.

Comcast first hosted an EDF Climate Corps fellow in 2013. Nadim Rajabi was asked to spend the summer focusing on building the business case for energy saving opportunities at Comcast's greater Boston area facilities. Rajabi calculated and compared power usage effectiveness (PUE) of multiple data centers to prioritize a subset for targeted energy efficiency analysis. He also evaluated energy improvements in cooling systems and examined the potential for energy management software on call center PCs. As the first EDF Climate Corps fellow at Comcast, Rajabi set the stage for future energy efficiency and conservation programs at the company.

In 2014, Comcast enlisted EDF Climate Corps fellow, Joe Chavez, to develop a baseline of electricity use and billing data for Comcast's data centers in the Greater Boston Region. After prioritizing data centers based on energy use and cooling loads, Chavez performed a quantitative study of energy savings from installing variable frequency drives (VFDs) on computer room air conditioners. Additionally, Chavez developed a best practices guide for facilities and engineering managers along with a playbook for obtaining rebates from utility incentive programs to standardize Comcast's process for future data center energy efficiency. Chavez's VFD analysis was used in the 2015 capex budget to procure funding and his recommendations are currently undergoing implementation.

In 2015, Comcast enlisted Charlie Umberger to build off Rajabi and Chavez's pilot initiatives and develop a plan to scale the implementation of VFDs and lighting retrofit projects across Comcast's Northeast Division. Umberger found that scaling these projects has the potential to reduce the division's annual energy consumption by over 12.7 million kilowatt hours and reduce carbon dioxide emissions by over 6,600 tons with a payback of less than 4 years, not including rebates.

By having consecutive fellows build off each other's work, Comcast is well on the way to scaling energy-efficiency initiatives at its data centers across the Northeast Division. Comcast will carry out these efforts in 2016 as its new fellow continues to evaluate energy saving technologies that could be implemented across its large portfolio of data centers, warehouses, office buildings and call centers.

6,600

Tons of CO_2 emissions could be reduced with a payback of less than four years.

EDF Climate Corps ***FELLOWS***

2013 / Nadim Rajabi

2014 / Joe Chavez

2015 / Charlie Umberger

RESEARCH QUESTION:

How is the **NATURE** of energy management projects explored by organizations changing over time?

Finding 2

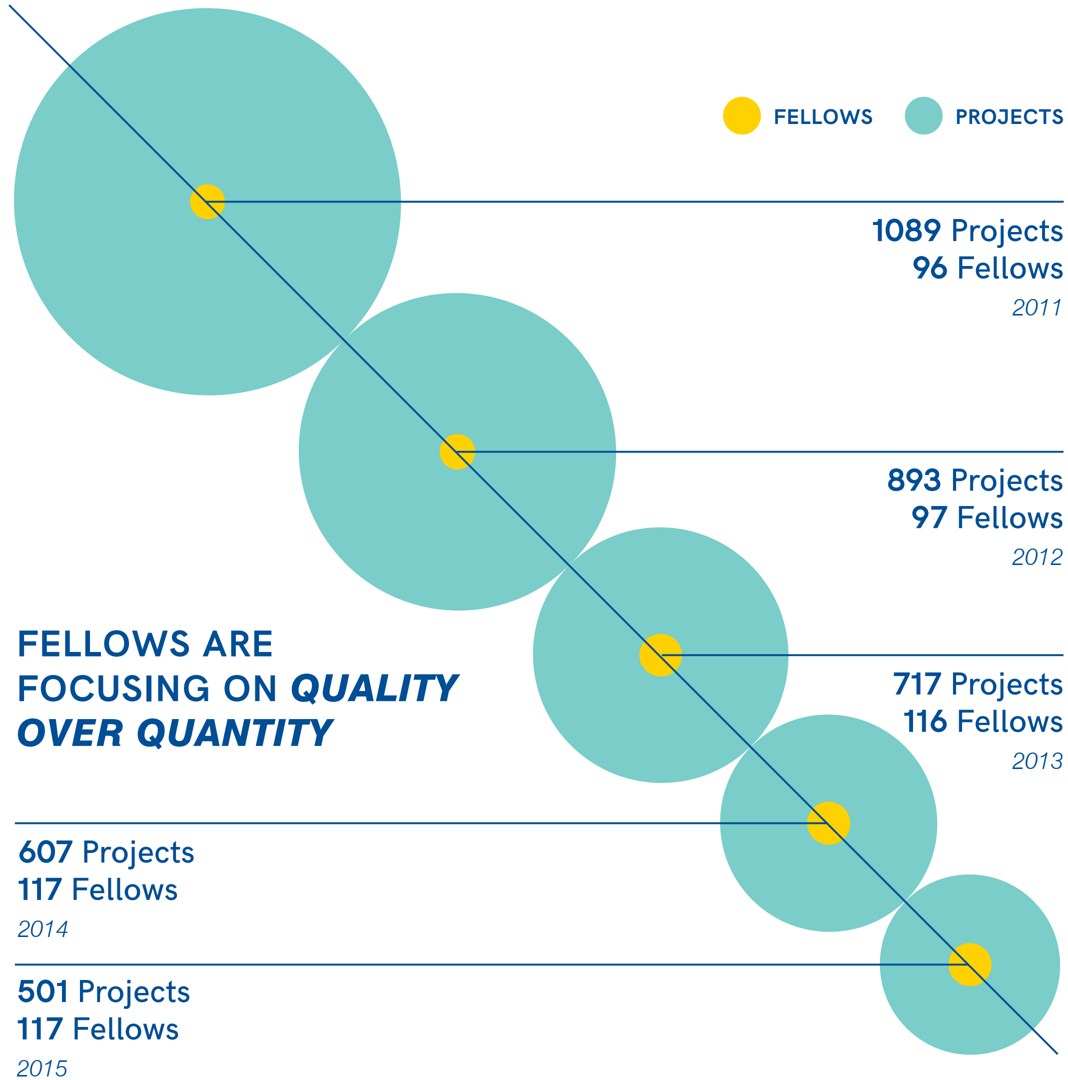
Host organizations are deploying fellows in a more focused way, with a greater emphasis on quality over quantity of project opportunities. Despite growth in the number of fellows deployed, the total number of projects has declined for the last 5 years (See Figure 2).

This fits with the pattern discussed in Finding 1: if fellows are deployed on higher-level, portfolio or organization-wide efforts, the number of activities will decline even as their collective impact rises. As discussed in Sections 3.2 and 3.4 the rising scale of investment and impact also supports this interpretation.

NUMBER OF EDF CLIMATE CORPS FELLOWS AND PROJECTS BY TYPE OVER TIME

Fig.2

EDF Climate Corps has deployed more fellows each year as the program has grown, though the total number of projects analyzed by fellows has dropped every year since 2011.



BOX THREE

IN FOCUS

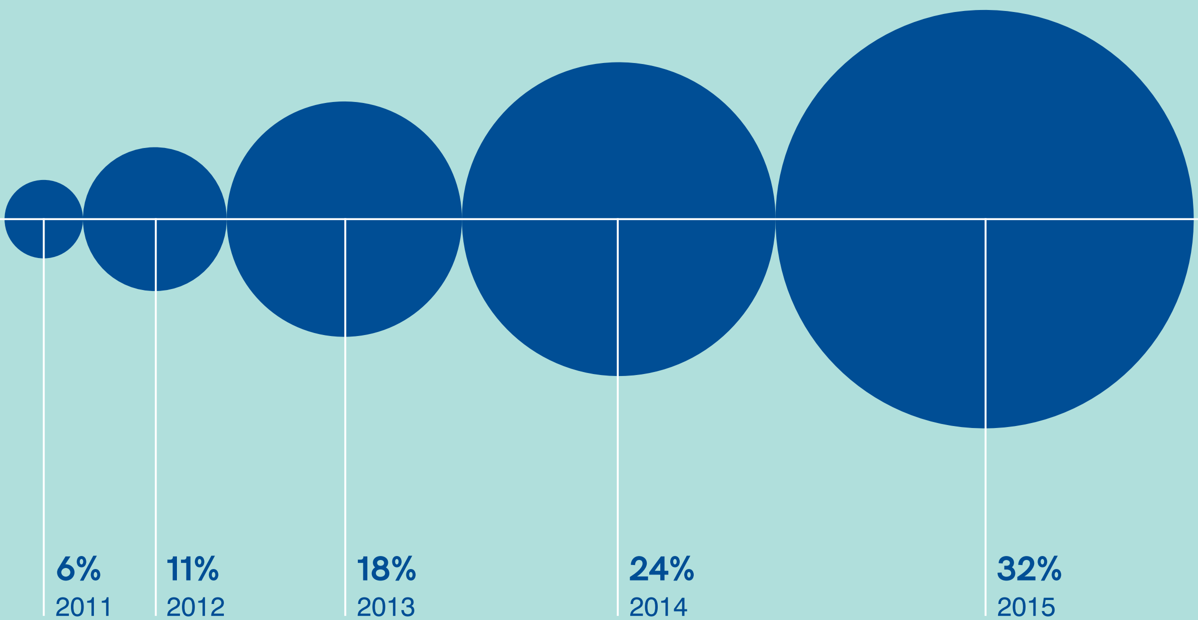
CLEAN ENERGY EMERGES AS A SIGNIFICANT FOCUS FOR EDF CLIMATE CORPS HOST ORGANIZATIONS

Though initially formed in response to the growing interest in energy efficiency, EDF Climate Corps has since responded to the rapidly rising interest in clean and renewable energy opportunities. As shown below, in 2015 over 30% of hosts worked on at least one clean energy project and an even greater emphasis is anticipated in 2016 as more and more host organizations consider the opportunities of clean energy.

MORE THAN

1 in 3

HOST ORGANIZATIONS ARE CURRENTLY WORKING ON A CLEAN ENERGY PROJECT



Organizations are also beginning to take advantage of the growth in opportunities presented by clean energy (see case study 2).

Renewable energy costs have decreased dramatically in recent years, leading to a boom in renewable energy worldwide.

In the U.S., installed costs for solar PV fell by nearly 52% between 2009 and 2014 alone, while the number of PV installations increased more than 12 fold (see Figure 3). The U.S. wind power industry also continues to see dramatic year-on-year growth, having almost doubled total installed capacity during the same time period, reaching 63 GW in 2014.

CASE STUDY 2:

NESTLÉ WATERS NORTH AMERICA

Nestlé Waters North America (Nestlé Waters), the leading bottled water company in North America, enlisted EDF Climate Corps fellows to work on a range of projects, including energy efficiency and off-site renewable power purchase agreements.

Nestlé Waters first hired two EDF Climate Corps fellows in 2011 to identify hidden energy savings opportunities at both the corporate headquarters and a recently acquired plant in Ohio. Fellows Justin Lindenmayer and Jenny McColloch recommended a multitude of ways to reduce energy use, such as optimizing occupancy sensors and installing LED exit signs. If implemented, these low-cost projects could save Nestlé Waters over 200,000 kWh per year.

42,000

Tons of CO_2 Emissions could be saved per year.

In 2015, Nestlé Waters participated in EDF Climate Corps again, this time to work on a project with the potential for an even greater impact on both the business and the environment. Kayla Fenton was enlisted to develop a plan to help Nestlé achieve its global commitment to use 100% renewable energy in the United States. Although the company had made progress towards meeting its ambitious renewables goal, it found that navigating the complexity of the renewable power purchasing agreement process in the United States would take additional expertise. Putting her skill set to work, Fenton analyzed the potential for off-site renewable power-purchase agreements for facilities in Texas and Pennsylvania. By implementing these plans and switching to renewable power at two of its bottled water facilities, Nestlé Waters North America could save thousands of dollars per year in energy costs, while also reducing greenhouse gas emissions by about 42,000 tons per year. The company is now exploring renewable energy opportunities to power all operations in the US.

EDF Climate Corps ***FELLOWS***

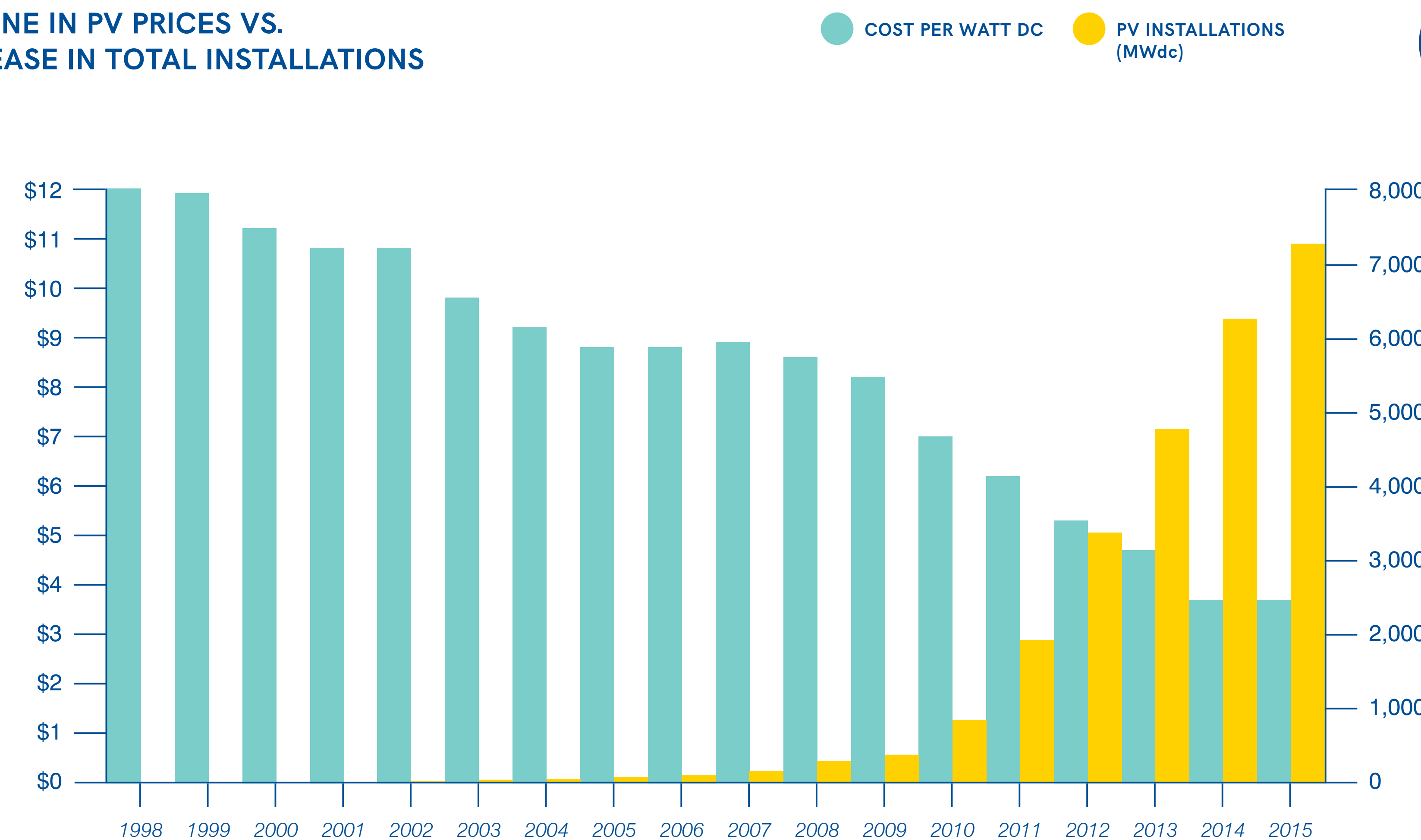
2011 / Justin Lindenmayer

2011 / Jenny McColloch

2015 / Kayla Fenton

DECLINE IN PV PRICES VS. INCREASE IN TOTAL INSTALLATIONS

Fig.3



Between the late 1990's and today, PV installation costs have fallen dramatically[9]. These price reductions helped drive rapid growth in total system installations[10], which increased by 350% between 2011 and 2015 alone.

In the past, renewable energy was typically purchased at a premium; however, today supportive policies and innovative procurement schemes have created opportunities to purchase renewable energy at a substantial saving. These broader trends are clearly reflected in the increased interest in clean energy from EDF Climate Corps host organizations as well as the declining paybacks reported for clean energy opportunities, as discussed later in Section 3.3.

9 Tracking the Sun VI: The Installed Cost of Photovoltaics in the US from 1998-2013 (LBNL); Solar Energy Industry Association, Solar Market Insight Report 2014 Q4
10 SEIA/GTM Research, U.S. Solar Market Insight: 2015 Year-in-Review.

SECTION 3.2

INCREASING THE SCOPE AND SCALE OF INVESTMENT

Although organizations are focusing on fewer projects, their scale and geographic scope has increased. The average project opportunity identified by EDF Climate Corps fellows now requires a larger upfront investment, but has the potential to offer a more sizeable return. Although the majority of projects are still single-site, the number of multi-facility and multi-state projects is growing at a fast rate. These trends confirm that many organizations are thinking more large-scale and portfolio-wide, resulting in new opportunities for larger financial rewards.

Photo: EDF Climate Corps fellow Jason Uppal assesses the feasibility of a microgrid installation for Shedd Aquarium.

RESEARCH QUESTION:

How is the **SCALE** of energy management activities changing over time?

Finding 3

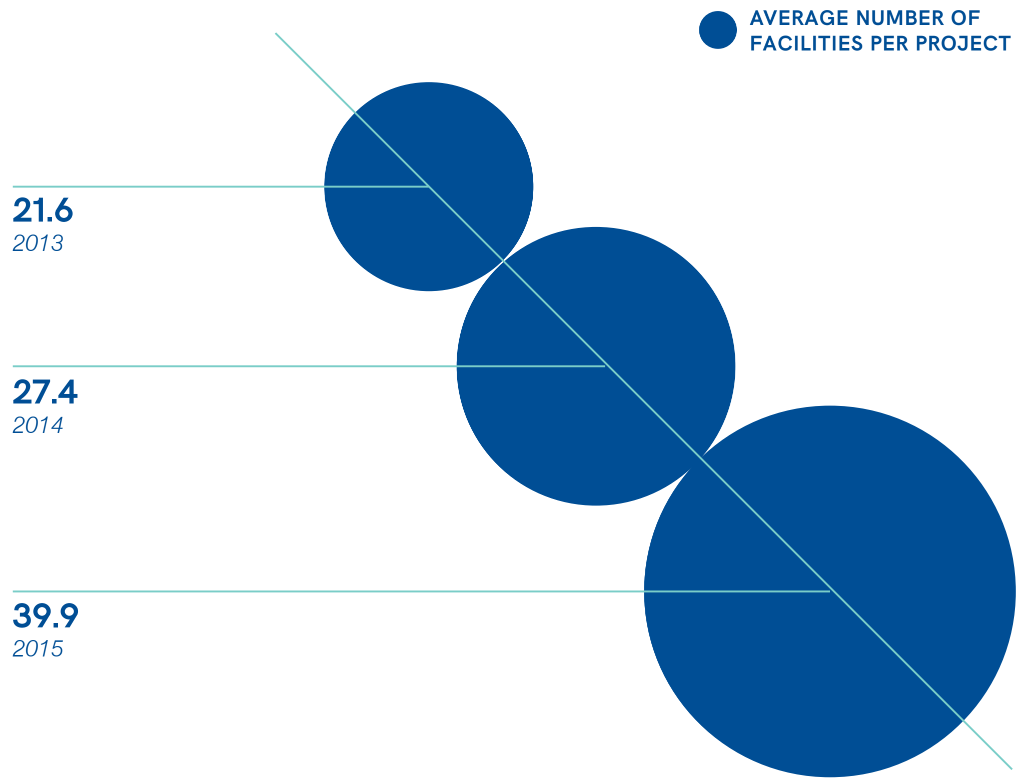
Host organizations are deploying fellows to work on more multi-site projects (see case studies 3-5).

Starting in 2013, fellows reported how many facilities would be impacted by each proposed investment. The facility-level data shows a rapid increase in the size of projects, doubling from about 20 to 40 facilities per project in just two years between 2013 and 2015 (see Figure 4). Although the majority of fellow project proposals are still for a single-site, the gap between the number of single-site and multi-site project has narrowed, and multi-site project proposals were almost half of the total in 2015.

NUMBER OF FACILITIES COVERED BY EVALUATED PROJECTS[11]

Fig.4

Projects evaluated by EDF Climate Corps fellows have generally increased in their scale and scope. While most projects are still single-site, in the past three years the average number of facilities covered by a given project has doubled.



11 Three outliers well in excess of 7,000 facilities were excluded.

CASE STUDIES 3-5:

TIFFANY & CO., SHORENSTEIN PROPERTIES AND IRON MOUNTAIN

EDF Climate Corps ***FELLOWS***

2014 / Saba Abid

2015 / Trevor Anderson

2015 / Jong Tae Park

TIFFANY & CO.

Retrofitted almost 100 Tiffany & Co. retail stores with LED lighting.

In 2014, Tiffany & Co., the internationally renowned jeweler founded in New York in 1837, enlisted Saba Abid to build the business case for replacing halogen lighting with LED fixtures at 66 stores in its portfolio. Rising to the challenge, Abid set to work. In the end, her analysis found that those LED retrofits could contribute to an estimated 6% global reduction in the company's carbon footprint. Over 2014 and 2015, the company retrofitted almost 100 Tiffany & Co. retail stores with LED lighting overhead or in display cases in the United States and abroad.

SHORENSTEIN PROPERTIES

Could save nearly $2 million in avoided energy costs.

In 2015, Shorenstein Properties, one of the country's oldest realty services companies, hosted Trevor Anderson at one of its buildings in Los Angeles. Using the building as a test site for future portfolio-wide energy and sustainability projects, Anderson uncovered energy savings from lighting, which if scaled throughout the portfolio, could save almost $2 million in avoided energy costs and 17.3 million kWh in annual energy use.

IRON MOUNTAIN

Will deliver energy efficiency solutions across a portfolio of over 600 facilities.

In 2015 at Iron Mountain, the enterprise information management services company, Jong Tae Park analyzed energy data gathered from the company's Connecticut facilities, developed a model to quantify consumption by end use and then calibrated the results to estimate the consumption patterns of the company's North American portfolio. Iron Mountain will use the findings of Park's data analysis to inform its strategy for delivering energy efficiency solutions across a portfolio of over 600 facilities.

RESEARCH QUESTION:

How is the **SCALE** of energy management activities changing over time?

Finding 4

The portion of host organizations deploying fellows to work on multi-state projects is quickly increasing.

Although the vast majority of projects remain focused in a single state, Figure 5 shows how there has been a noticeable increase in the proportion of projects whose scope spans facilities in multiple states. In particular, 2014 and 2015 saw a rapid rise in the number of opportunities that extend across the entire U.S. This trend is even more significant when looking at the proportion of total initial investment (Figure 5B).

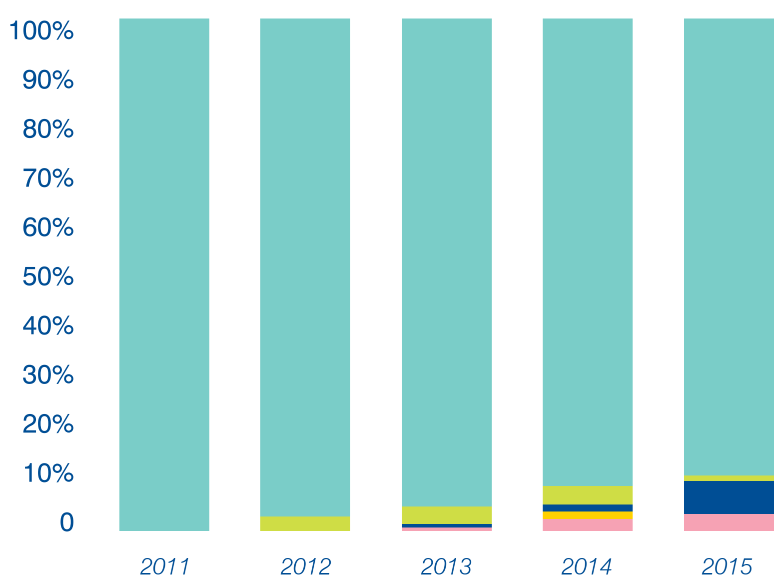
PROPORTION OF PROJECTS WITH MULTI-STATE SCOPE

Projects span multiple states as more hosts with operations across the U.S. are taking a portfolio-wide approach. The strong majority of projects are still single-state, but the number and scale of multi-state initiatives has grown rapidly since 2011, now representing over 10% of projects and 40% of estimated initial investment.

1 STATE · 2-5 STATES · 6-15 STATES · 16-25 STATES · ALL 50 STATES

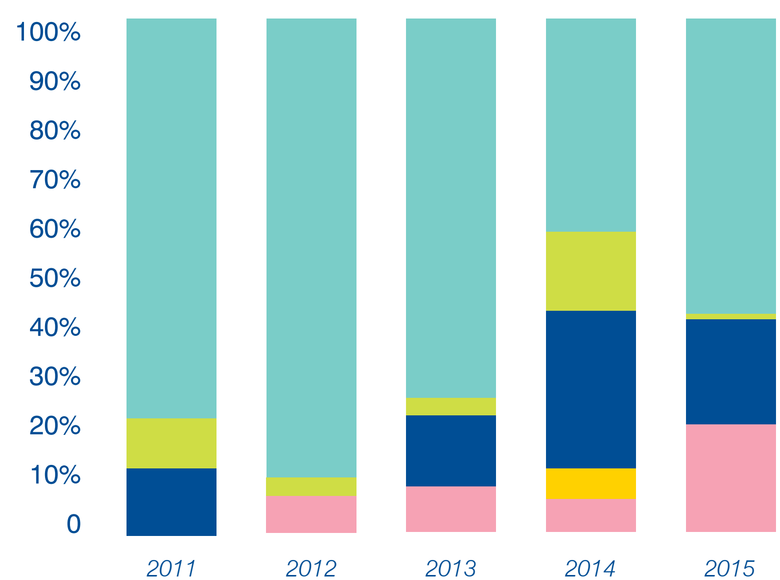
By Number of Projects

Fig.5A



By Total Initial Investment

Fig.5B



RESEARCH QUESTION:

How is the **SCALE** of energy management activities changing over time?

Finding 5

The average initial cost of project opportunities evaluated by EDF Climate Corps Fellows rose gradually from 2008 to 2014 and more than doubled between 2014 and 2015.[12]

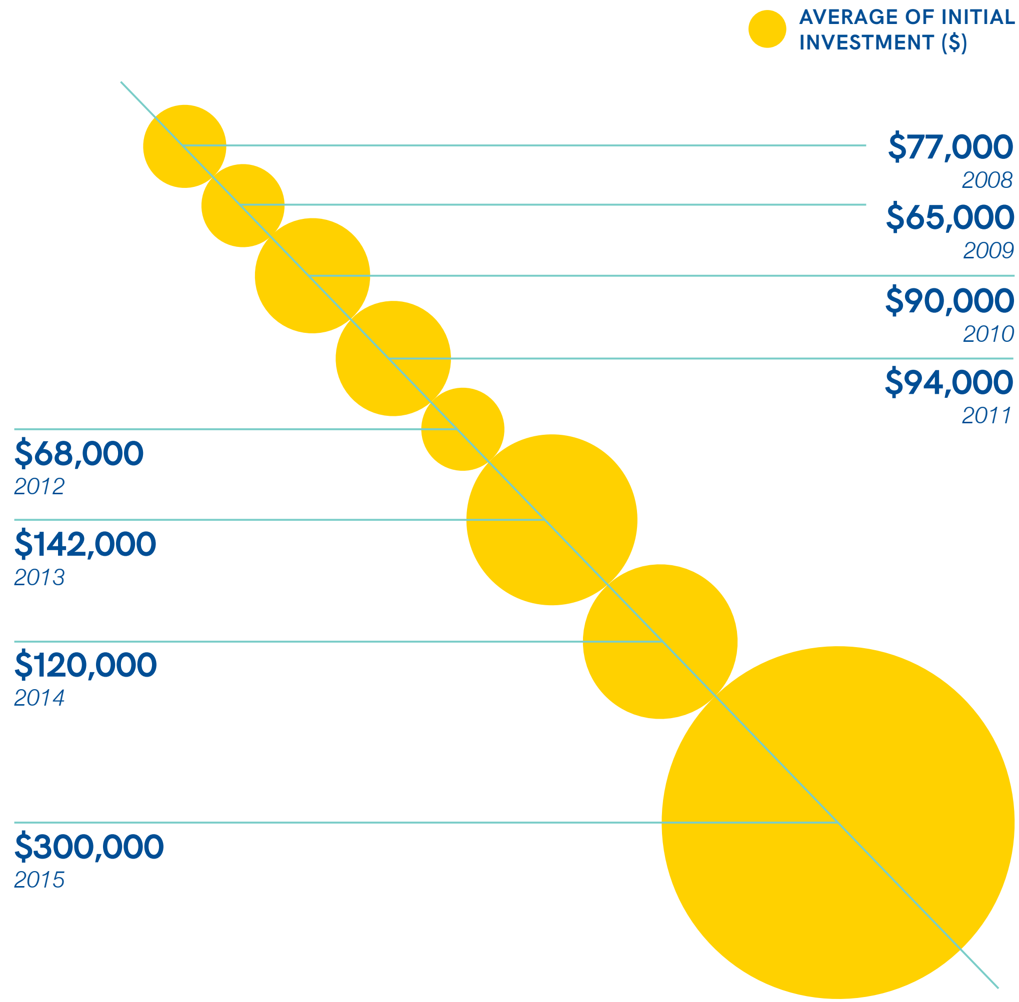
Figure 6 shows the trend in average initial cost over time. Although the average project size varies from year to year, there is an overall upward trend in scale, increasing from $77,000 in 2008 to $300,000 in 2015. As discussed in Section 3.3, the potential financial returns from these larger investments have also increased at similar rates. For example, the average NPV of project opportunities nearly tripled from 2008 to 2015.

12 Outliers have been removed from most analysis in this paper. EDF Climate Corps defines outliers as project recommendations where the NPV, annual kWh savings or initial investment is outside of 3 standard deviations of the mean for the year. Outliers make up about 2% of fellow projects.

AVERAGE INITIAL INVESTMENT OVER TIME

Fig.6

The average initial investment of projects (an important indicator of overall scale of investment considered by organizations) has increased substantially since EDF Climate Corps was launched in 2008. The average project now requires an investment of approximately $300,000, up by nearly a factor of four since 2008.



SECTION 3.3

REAPING EVEN GREATER FINANCIAL REWARDS

As the scope and scale of energy investment has grown, so has the potential financial benefits for organizations. Both the average NPV of investments and the average annual savings have grown consistently over the years, trending with the increasing scale of initial investment. Analysis of project performance (measured in terms of simple payback), however, tells a more complicated story: taken together, paybacks have generally held constant or improved slightly, though this varies by both sector and project type. The dramatic cost declines in clean energy technologies (particularly solar and wind) seen in the U.S. in recent years is reflected in the predicted paybacks for clean energy projects, which fell from 4 years in 2013 to under 2 years by 2015.

Photo: EDF Climate Corps fellow Ajith Das Menon identifying energy efficiency opportunities for Volvo/ Mack Trucks.

RESEARCH QUESTION:

How is the predicted **FINANCIAL PERFORMANCE** of projects changing over time?

Finding 6

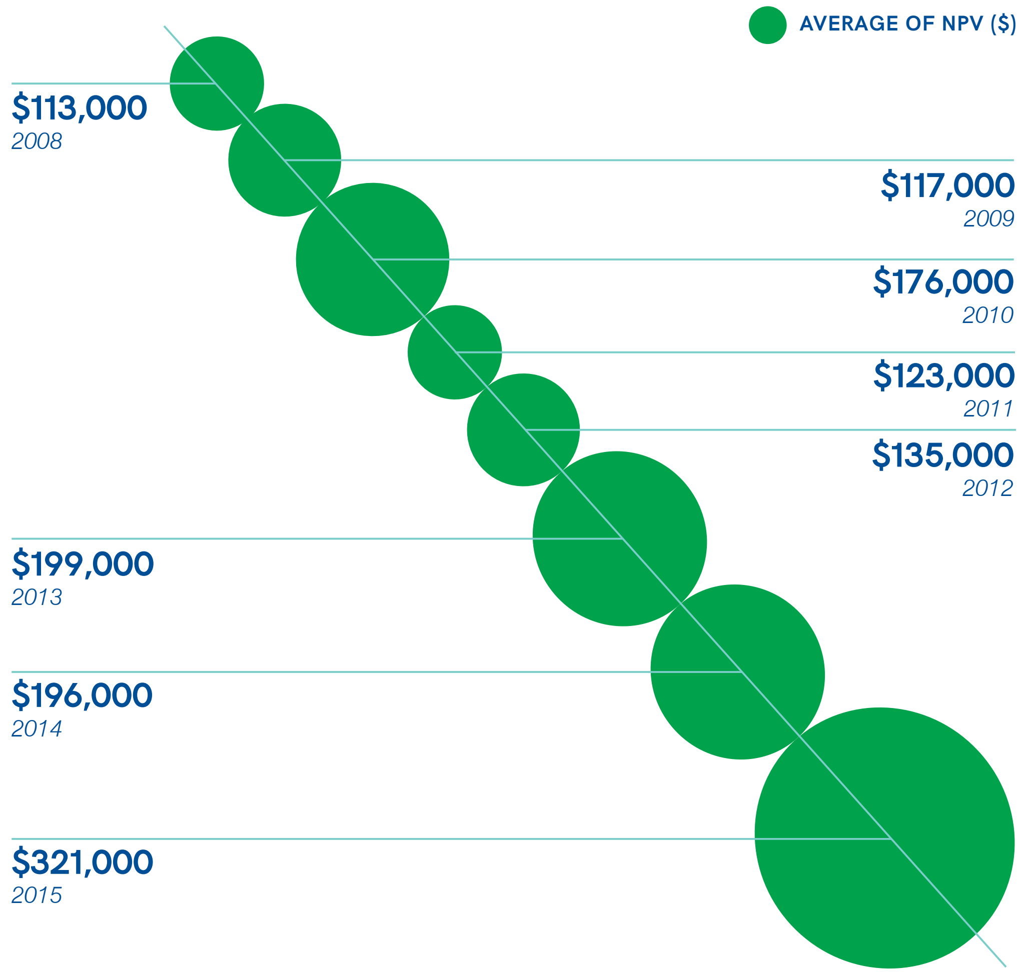
The energy projects that organizations are considering today generate larger financial returns than earlier projects. The average NPV of project opportunities evaluated by EDF Climate Corps fellows has increased significantly over time, consistent with the rising scale of initial investment presented earlier in Figure 6.

Figure 7 shows that although the average project size varies from year to year, there is an overall upward trend in average NPV, increasing from a little over $100,000 in 2009 to well over $300,000 in 2015.

AVERAGE NET PRESENT VALUE (NPV) OF PROJECT OPPORTUNITIES IDENTIFIED IN EACH YEAR

Fig.7

Projects evaluated in the first two years of the EDF Climate Corps program had an average NPV of a little over $100,000. By 2015, the average NPV of project opportunities had increased nearly three-fold to over $300,000 per project. Although NPV growth could indicate increasing project scales or profitability, or both, it demonstrates the significant opportunity for profitable investment.



RESEARCH QUESTION:

How is the predicted **FINANCIAL PERFORMANCE** of projects changing over time?

Finding 7

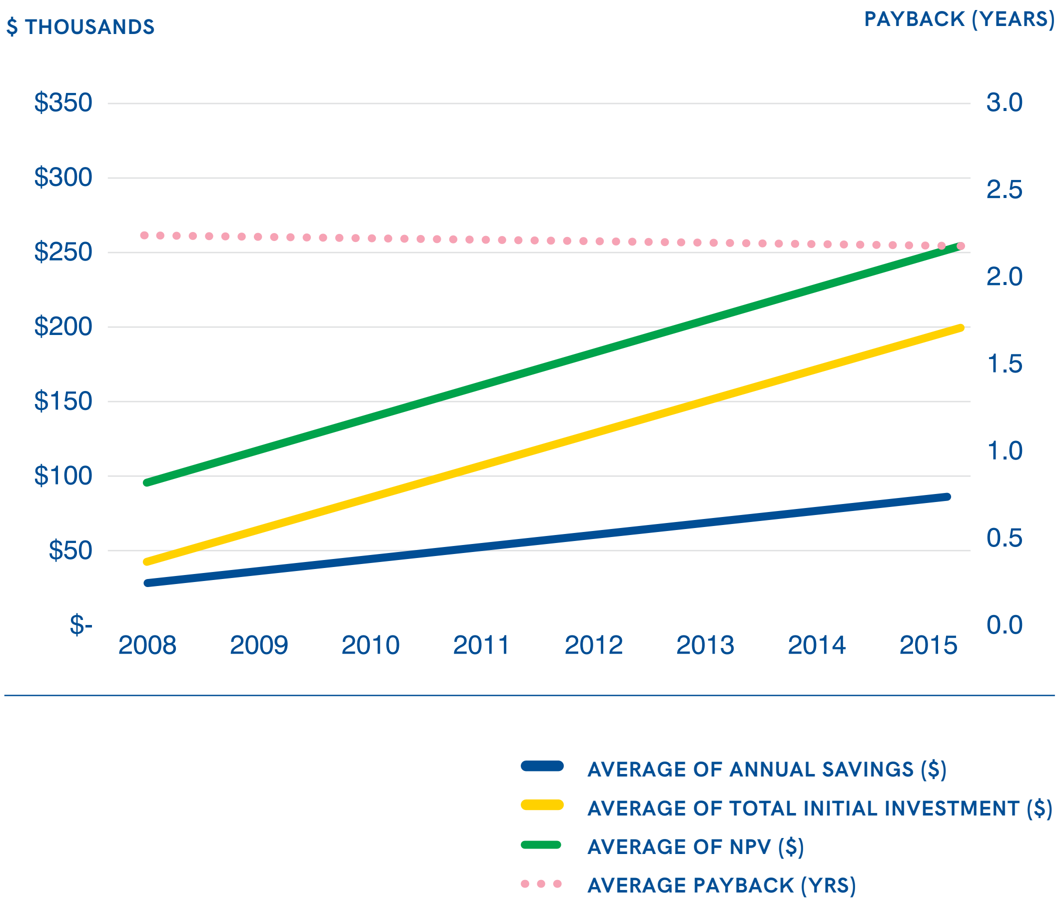
The overall financial performance of energy projects has improved over time by multiple measures.

The average annual savings and NPV of EDF Climate Corps projects have nearly tripled between 2009 and 2015, and average paybacks have improved slightly. Figure 8 summarizes each of these measures, as well as initial investment. Linear trendlines show the overall trajectory (dotted lines).

SUMMARY OF AVERAGE PROJECT FINANCIAL PERFORMANCE OVER TIME

Fig.8

Over time, projects have become significantly larger in scale and slightly better in terms of financial benefit. This graph summarizes four key indicators and shows the overall trendline of their improvement (dotted lines).



RESEARCH QUESTION:

How is the predicted **FINANCIAL PERFORMANCE** of projects changing over time?

Finding 8

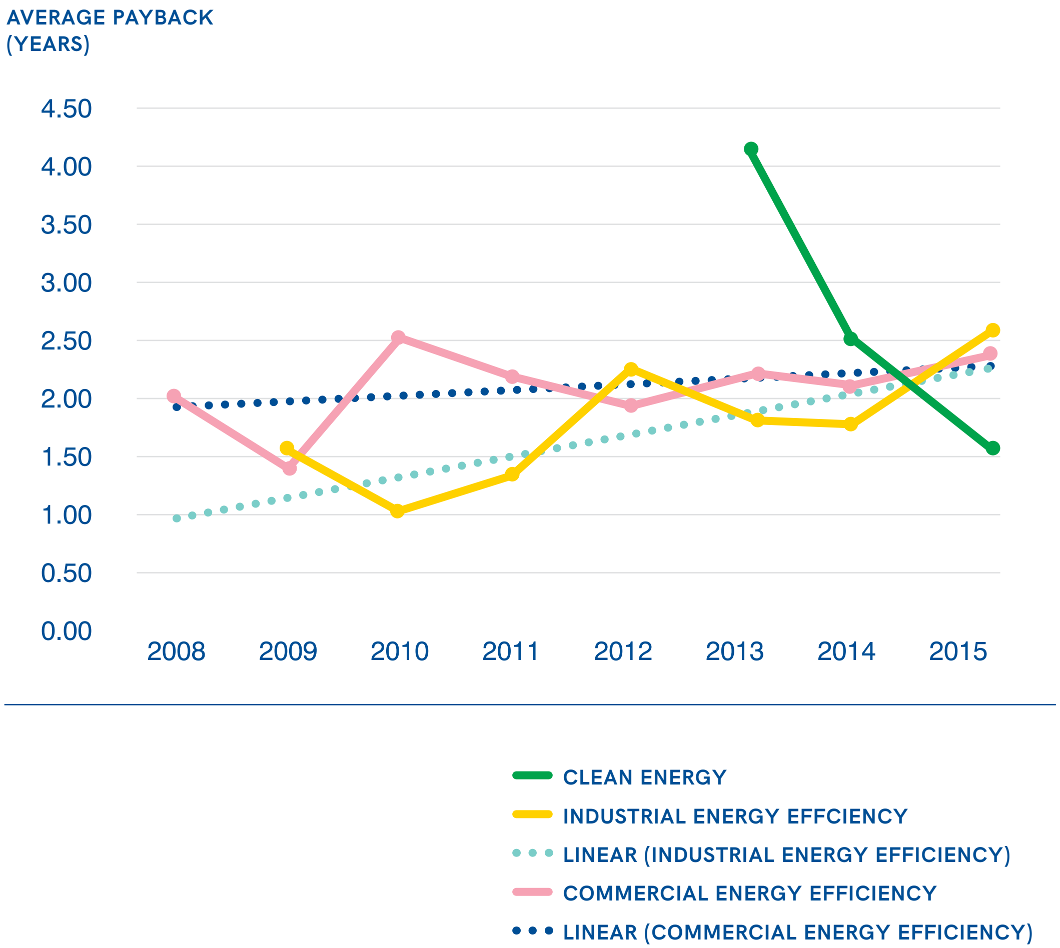
While the average payback for energy projects has declined slightly overall (see Figure 8), looking at the average payback of different project categories shows a more nuanced picture (see Figure 9).

Clean energy project paybacks have dropped by more than half in two years, consistent with overall cost declines in the industry (see discussion in Section 3.3). At the same time, commercial energy efficiency has consistently fluctuated around two years while average industrial energy efficiency payback periods have lengthened slightly over time. The drivers of these trends in commercial and industrial energy efficiency are more difficult to identify. It is possible this data indicates that the "low-hanging fruit" has been harvested, which would require organizations to accept gradually lengthening payback periods for continued energy investment. The differences could also be driven by fluctuations in local or regional energy prices, or, perhaps years of successful energy efficiency projects could be making organizations more comfortable with energy investments in general, and thus more willing to consider projects with longer payback periods. Figure 8 indicates that decision-makers are not put off by slightly longer payback periods when pursuing large-scale investment.

SUMMARY OF AVERAGE PROJECT FINANCIAL PERFORMANCE OVER TIME

Fig.9

The average paybacks for three major project categories are summarized. Energy efficiency has remained relatively stable or worsened slightly depending on which sector is considered. Clean energy has experienced dramatic improvement in just two years. Years and project types without significant data are excluded.



SECTION 3.4

GROWING THE SCALE OF ENVIRONMENTAL IMPACT

As the scale of investment and financial benefits has grown, so has the scale of environmental benefits, and at an even more dramatic rate. A variety of external factors are likely contributing to this difference; organizations could be finding more cost-effective ways to generate positive environmental impacts or they could simply be benefitting from market and technology trends. Regardless, the outcome has been an increase in opportunities for organizations to reduce GHG emissions.

Photo: EDF Climate Corps fellow Menglian Zheng exploring renewable energy opportunities for Baxter International (China).

RESEARCH QUESTION:

How have projected greenhouse gas
EMISSIONS IMPACTS
of project opportunities changed over time?

Finding 9

The environmental benefit of organizational energy management projects is dramatically increasing over time. Between 2008 and 2015, the average GHG emissions reduction benefits of evaluated projects increased by a factor of five – significantly more than the increase in average initial investment cost, NPV or annual savings.

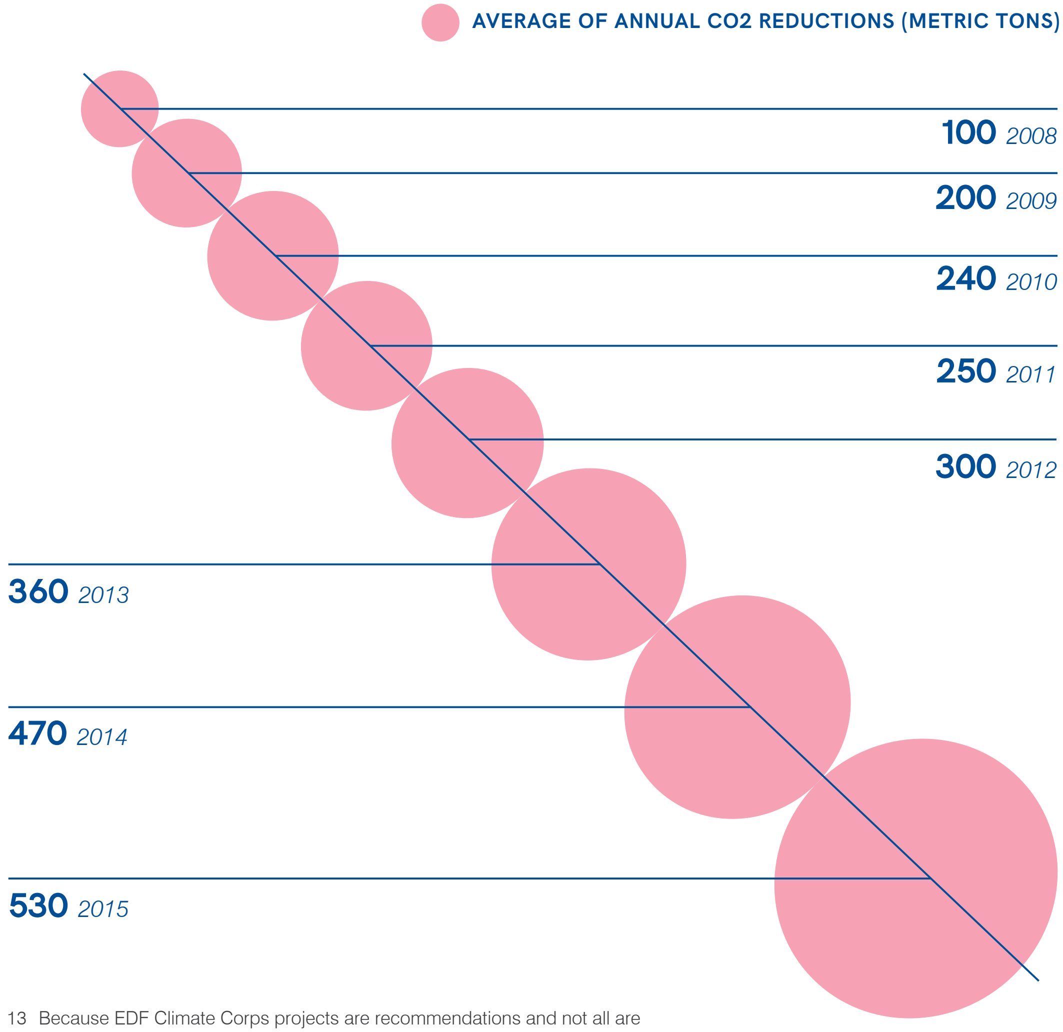
The scale of investment and financial benefits of evaluated project opportunities have grown significantly in the eight years since the EDF Climate Corps program was started (see Section 3.3): average NPV, annual savings and initial investment grew to 2.8, 3.9 and 3.7 times their 2008 levels, respectively. Over the same period, however, the average GHG reductions of evaluated projects grew more than five-fold, from just over 100 to 500 metric tons of carbon dioxide equivalent (CO_2e) (see Figure 10).

External trends may help explain why potential GHG reductions from project opportunities have grown at a pace beyond the scale of financial investment and returns. For example, where more efficient and lower-cost technology is available, organizations would see the GHG savings per dollar spent increase. In addition to external trends, this could also indicate more attention to-or effectiveness at-managing energy to reach GHG reduction goals. As a greater number of institutions set ambitious climate and energy targets, hosts and fellows may be focusing more on the opportunities with the greatest GHG reduction potential.

AVERAGE ESTIMATED POTENTIAL GHG EMISSIONS REDUCTIONS FROM PROJECT OPPORTUNITIES[13]

Fig.10

The average GHG emissions reduction of evaluated project opportunities has increased steadily over time. The scale of potential reductions for the average project is now more than five times what it was in 2008.



13 Because EDF Climate Corps projects are recommendations and not all are implemented, this represents an indication of the increasing scale of potential GHG savings.

SECTION 4

CHALLENGES AND OPPORTUNITIES

The previous section outlines the broad trends in the U.S. toward the increased scale of energy investments, financial returns and environmental impacts. However, organizations that are taking more high-level, large-scale and strategic approaches to energy management have not done so without having to overcome significant challenges. Realizing the opportunities offered by strategic energy management requires organizations to address barriers across a range of organizational functions and create the necessary internal alignment of mandates, resources and communication.

Photo: EDF Climate Corps fellow Michelle de Arruda analyzing electrical submetering and HVAC retrofits at Unicef's headquarters.

SECTION 4.1

UNDERSTANDING THE BARRIERS TO IMPLEMENTATION

It is often assumed that organizations will naturally align to take advantage of profitable investments. However, direct observation and growing academic literature has shown that even when the financial and environmental benefits of energy investments are significant, organizations face numerous internal and external barriers to action.[14] In a well-functioning market with widespread awareness of the benefits and uninhibited access to information and rational decision-making, numerous other variables can still impact organizations' decisions regarding energy management. The well-documented "gap" between profitable energy measures and those actually implemented raises the question of why profitable opportunities for energy conservation and self-generation go unpursued.[15]

In 2015, EDF Climate Corps fellows began evaluating the barriers to success and the likelihood of implementation for each project proposed. From this data, six primary categories were identified (see Figure 11), consisting of mostly internal challenges related to data management, funding, prioritization, staff capacity and capabilities, communication, and decision-making.

14 See e.g. Cagno, E., & Trianni, A. (2014). Evaluating the barriers to specific industrial energy efficiency measures: An exploratory study in small and medium-sized enterprises. Journal of Cleaner Production, (82), 70–83; De Groot, H., Verhoef, E., & Nijkamp, P. (2001). Energy saving by firms: decision-making, barriers and policies. Energy Economics, 23(6), 717–740; Moezzi, M., Hammer, C., Goins, J., & Meier, A. (2014). Behavioural strategies to reduce the gap between potential and actual savings in commercial buildings (Contract Number: 09-327). Sacramento, CA: Air Resources Board; Prindle, W. R. (2010). From shop floor to top floor: Best business practices in energy efficiency. Arlington, VA: Pew Center on Global Climate Change; Reinaud, J., & Goldberg, A. (2011). The boardroom perspective: How does energy efficiency policy influence decision making in industry? Paris, France and Washington, DC: International Energy Agency Working Group for Energy Efficiency and Institute for Industrial Productivity; Rudberg, M., Waldemarsson, M., & Lidestam, H. (2013). Strategic perspectives on energy management: A case study in the process industry. Applied Energy, 104, 487–496.

15 see e.g. Decanio, S. (1993). Barriers within firms to energy-efficient investments. Energy Policy, 21(9), 906–914; de Groot et al., 2001; Hirst, E., & Brown, M. (1990). Closing the efficiency gap: Barriers to the efficient use of energy. Energy Policy, 22(10), 804–810; Jaffea, A., & Stavins, R. (1993). The energy-efficiency gap: what does it mean? Energy Policy, 22(10), 804–810.

COMMON BARRIERS IDENTIFIED FOR ORGANIZATIONAL ENERGY PROJECTS

Fig.11

- Lack of executive or high-level support
- Lack of funding or competing priorities
- Lack of visibility or reporting
- Limitations of project analysis or insufficient data and tracking
- Lack of staff or expertise
- Factors unrelated to project

These barriers vary in terms of their prevalence and impact. Figure 12 on the following page shows which barriers are more common overall versus in particular sectors. Available funding for up-front investments is often noted as one of the most significant barriers to energy investment that organizations face, which is why it is not surprising that EDF Climate Corps fellows identified “Lack of funding or competing priorities” as the most significant challenge. However, “Lack of executive or high-level support” and “Lack of staff or expertise” were almost just as common.

In nearly a third of all projects, no barriers to action were identified.

The data also illustrates interesting trends across sectors. For example, visibility and reporting, funding, data availability, project analysis, and capacity/expertise are particularly acute challenges for non-profit organizations. In contrast, higher education institutions appear to face the fewest challenges obtaining funding, but are average in terms of staff expertise and executive support. More high-level attention and support is needed across all sectors, particularly in government, where more than a third of projects were flagged as needing stronger support from leadership and nearly half faced uphill battles obtaining funding because priorities were focused elsewhere.

The presence of these barriers also has varying degrees of impact on projected project success. EDF Climate Corps fellows assessed each project’s likelihood of implementation on a 5-point scale from “very unlikely” to “very likely.”[16] Figure 13 shows how the presence of different barriers correlates with greater or lower likelihood of implementation. For example, in projects where funding, executive support or data/analysis challenges exist, successful implementation was deemed significantly more unlikely or uncertain.

16 Note that almost none of the projects were rated as “very unlikely.” This likely reflects the fact that fellows and hosts would not choose to evaluate in detail any opportunities that faced such a low chance of success. The few projects with this rating were therefore excluded from this analysis.

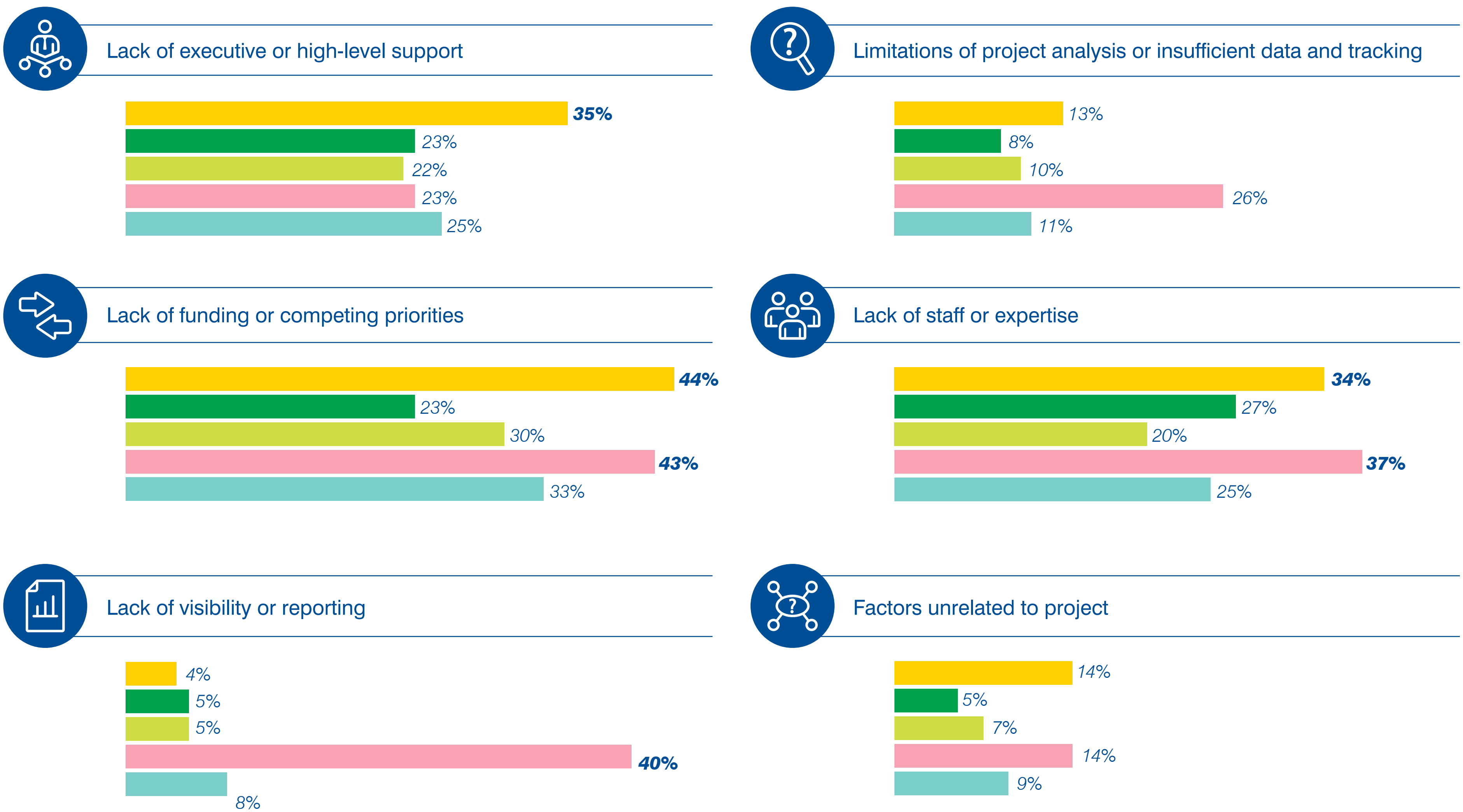
Photo: EDF Climate Corps fellow Affuembey Affuembey identifies water waste reductions for Southern University.

PROPORTION OF PROJECTS WHERE BARRIERS WERE NOTED, BY SECTOR OF HOST ORGANIZATION[17]

Different sectors face similar barriers overall, but certain obstacles appear more challenging in certain types of organizations. Below shows the percentage of projects in each sector where the indicated barrier was mentioned as an impediment to implementation.

GOVERNMENT
COLLEGE / UNIVERSITY
COMPANY
NON-PROFIT
OVERALL

Fig.12



17 Prevalence of each barrier is indicated as a "% of projects where barrier was present." Percentages may not total to 100% as multiple barriers were noted for many projects.

RATED LIKELIHOOD OF SUCCESS FOR PROJECTS WITH INDICATED BARRIER

Fig.13

The figure shows the rated likelihood of implementation for all projects where the indicated barrier was listed. The barriers that most threaten implementation appear to be insufficient funding, lack of executive support or clear goals, competing priorities, and limitations of data availability and quality.

SECTION 4.2

THE NEED FOR A COMPREHENSIVE APPROACH TO ENERGY MANAGEMENT

A key challenge in addressing the barriers to energy project implementation is that they span across many departments and functions within an organization, from executive leadership, to facility managers, to finance and accounting, communications and others. Achieving the coordination needed to address disparate and diffuse barriers rarely occurs without a deliberate and structured approach. This highlights the important need for a comprehensive approach to strategic energy management that considers the multitude of barriers and applies targeted solutions to address these specific challenges.

The drivers influencing energy management decision-making can be grouped into five organizational functions, following the "Virtuous Cycle of Strategic Energy Management" (the "Virtuous Cycle") framework, developed through collaboration between EDF and scholars at MIT Sloan School of Management.[18] The Virtuous Cycle framework draws from over two decades of field research and system modeling by MIT Sloan partners, learnings from hundreds of EDF Climate Corps engagements with companies and institutions and input from peer learning network events led jointly by EDF and MIT Sloan. This ongoing research and collaboration has given EDF critical insights into the methods available to organizations that are interested in pursuing effective strategic energy management.

The Virtuous Cycle provides a framework for understanding how an entity's executive, financial, human resources, performance management, and public relations functions must be aligned to overcome systemic barriers and to create a cycle of continuous improvement. Barriers in one function can prevent action even if the rest of the corporate functions are aligned. However, if each department is equipped with the right information, resources and authority, then targets set by executive leadership will be followed by successful implementation and positive public relations, thereby reinforcing the executive targets in a cyclical manner. The conceptual framework for the Virtuous Cycle is illustrated in Figure 14.

More information on the Virtuous Cycle framework can be found at http://edfclimatecorps.org/impact/virtuous-cycle.

18 Hiller, J., Reyna, E., Riso, C., & Jay, J. (2012). The virtuous cycle of organization energy efficiency: A fresh approach to dismantling barriers. Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA.

OVERVIEW OF THE "VIRTUOUS CYCLE" FRAMEWORK AND SELECT BEST MANAGEMENT PRACTICES

The Virtuous Cycle of Strategic Energy Management provides a framework for developing a continuous improvement system by overcoming barriers in key organizational functions and departments. More information is available at http://edfclimatecorps.org/impact/virtuous-cycle.

Fig.14

Executive Leadership

- *Create longterm Plans*
- *Routinely review opportunities*
- *Executive team responsible for energy*
- *Benchmark vs. leaders*
- *Metrics to track progress*
- *Set targets*

Human Resources

- *Clear mandate & formal responsibilities*
- *Cross-functional teams*
- *Engaged employees*
- *Learning opportunities*

Financial Resources

- *Clear process for obtaining funding*
- *Ample funding available for projects*
- *Reliable funding available*

Public Relations

- *Results are widely shared*
- *Projects are highly visable*
- *Regular energy & GHG reporting*
- *Executives involved in PR*

Projects & Performance Mgmt.

- *Potential projects are continuously identified*
- *Pipeline of projects implemented*
- *Potential energy savings is modeled*
- *Energy data is monitored and used in decisions*

SECTION 4.3

IMPLEMENTING A STRATEGIC ENERGY MANAGEMENT PROGRAM

A strategic energy management initiative may be launched with high-level engagement, announcements, resource commitments, or new energy targets. It can also emerge gradually over time through continual investment that targets specific barriers, such as those outlined in Figure 14. Four initial steps are recommended for organizations seeking to implement a strategic energy management program:

1 **BENCHMARK CURRENT ENERGY MANAGEMENT PRACTICES AGAINST BEST PRACTICES AND LEADING ORGANIZATIONS.**

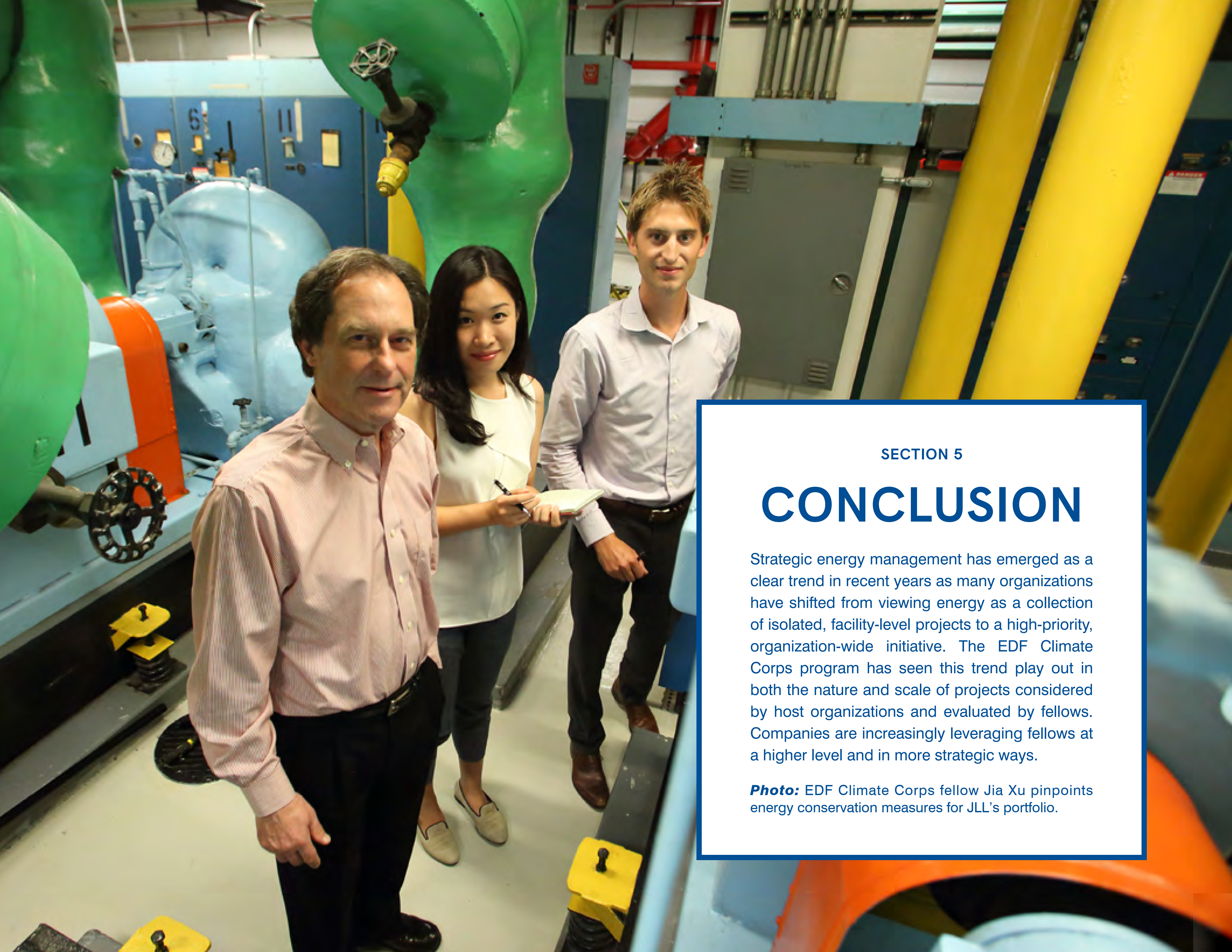
2 **PRIORITIZE ORGANIZATIONAL FUNCTIONS OR DEPARTMENTS FOR INITIAL FOCUS (E.G. ONE OR MORE OF THE FIVE COMPONENTS OF THE VIRTUOUS CYCLE).**

3 **PINPOINT SPECIFIC BARRIERS AND BOTTLENECKS IN THE TARGET AREAS.**

4 **IDENTIFY AND IMPLEMENT STRATEGIES, DRAWING FROM INDUSTRY BEST PRACTICES.**

A number of tools exist to help organizations identify and prioritize barriers. For example, the EDF Smart Energy Diagnostic tool can help organizations benchmark energy management practices against best practices, compare performance against leaders and identify an initial menu of opportunities for improvement. The Smart Energy Diagnostic survey can be accessed at **http://edfclimatecorps.org/edf-smart-energy-diagnostic-survey**. EDF Climate Corps fellows can also be deployed to address these barriers through onsite efforts.

Photo: EDF Climate Corps fellow Jiam Lu evaluates energy technologies for a Legrand subsidiary factory.



SECTION 5

CONCLUSION

Strategic energy management has emerged as a clear trend in recent years as many organizations have shifted from viewing energy as a collection of isolated, facility-level projects to a high-priority, organization-wide initiative. The EDF Climate Corps program has seen this trend play out in both the nature and scale of projects considered by host organizations and evaluated by fellows. Companies are increasingly leveraging fellows at a higher level and in more strategic ways.

Photo: EDF Climate Corps fellow Jia Xu pinpoints energy conservation measures for JLL's portfolio.

Photo: EDF Climate Corps fellow Imran Mehdi uncovers energy savings in Solo Cup's largest manufacturing facility.

Over the past eight years of the program's existence, there has also been a steady increase in the scale of investment and impact of evaluated projects. Contrary to common perspectives that the "low-hanging fruit" in energy management has been harvested, the data shows that the magnitude of potential financial benefits has grown. On average, evaluated projects continue to pay for themselves in less than 2.5 years. Although payback periods for energy efficiency have not improved over time, new opportunities for profitable investment, such as clean energy, continue to emerge. This proliferation has maintained a steady supply of even more financially compelling opportunities for organizations seeking financial benefits to pursue. Investments are also realizing even greater environmental impacts as markets, technologies and organizational energy management strategies are targeting investment in more efficient and effective ways.

While the opportunities for energy and GHG reductions are strong, the organizations best aligned to achieve deeper cuts are those that adopt strategic approaches to managing energy. A number of prevalent and persistent barriers to energy management threaten the implementation of projects, such as the absence of resources, executive attention, sufficient data, and internal communications and reporting practices. Analysis of these barriers has shown how critical a role an organization's leadership plays in establishing priorities, allocating resources and maintaining momentum. Funding—and other priorities that compete for limited funding—also remains a persistent challenge for energy investments across all sectors.

Organizations that take a strategic approach to energy can overcome these barriers and access deeper cost savings and GHG reductions. With proper management, over time these efforts can become self-reinforcing as early successes and benefits drive continued and increased investment. When successful energy management practices and benefits become more commonplace, organizations will turn to leaders to replicate their processes. In this way, strategic energy management can creating a "virtuous cycle" that spans across both sector and geography, growing the collective scale of action and environmental impact.

APPENDIX A - METHODOLOGY

The EDF Climate Corps Project Database (discussed in Section 2) has long been used as a reporting tool for EDF Climate Corps fellows and a mechanism for monitoring project recommendations and compiling implementation data. It is also used to report on aggregate program impacts. In 2015, program staff prioritized further analysis to explore other ways the EDF Climate Corps Project Database could be used to provide insights on organizational energy management practices and trends.

To this end, EDF worked with Meister Consultants Group, Inc. (MCG) to perform a range of quantitative analysis on the Database to explore patterns and identify trends or insights that would be valuable to EDF Climate Corps hosts and other organizations, researchers, policymakers, and/or other audiences.

MCG conducted initial rounds of exploratory analysis on a range of key research questions, as described in Figure 15.

To explore these research questions, MCG ultimately generated and evaluated over 70 tables and graphics. These were typically derived by combining one of the "key questions" with one of the "dimensions" outlined in Figure 15 (for example, "Types of projects over time" corresponds to Figure 1 in the final report). This provided a wide variety of ways to "slice the data" to reveal significant patterns and trends.

Results were prioritized and further refined based on initial findings through an interactive process under EDF's direction. A number of research avenues were not pursued due to either limitations in the data or a lack of statistically significant or clear patterns in the results.

Ultimately a primary focus on **trends over time** was selected based on the value of initial findings (see Section 3). In addition, MCG and EDF prioritized analysis of barriers—in particular, **barriers** by sector and **implementation likelihood**—in order to explore current challenges faced by organizations (see Section 4).

INITIAL RESEARCH QUESTIONS FOR EXPLORATORY ANALYSIS

Fig.15

KEY QUESTIONS

- What types of projects are being explored?
- What is the level/ scale of activity (e.g. # of projects, level of investment)?
- What barriers are faced?
- What has the best financial returns (e.g. NPV, payback, annual savings)?

DIMENSIONS

- Lack of funding or competing priorities
- By state/region
- By availability of incentives
- By sector (public/ private)
- By industry
- By current implementation status
- By likelihood of implementation
- By recommended implementation timeline

CLIMATE CORPS

EDF CLIMATE CORPS
18 Tremont Street, Suite 850
Boston, MA 02108
www.edfclimatecorps.org

For more information, please contact:
info@edfclimatecorps.org