




STRATEGIC PORTFOLIO PLANNING, DESIGN AND DELIVERY PLATFORM

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The **INQUISITIVE OWNER** is interested in finding ways to understand their portfolio, and enhance its performance before, during and after an event.

The **INFORMED OWNER** is often exploring several initiatives within their portfolio, each posing variations of the same 4 questions:



The **EMPOWERED OWNER** is tackling these issues through an integrated platform

WHERE ARE YOU NOW?

WHERE DO YOU WANT TO GO?

WHAT ARE YOUR OPPORTUNITIES?

HOW WILL YOU GET THERE?

Data Collection

Site Assessment

Policy and Goals Review

Baseline Performance

Future Development

Gap Analysis

Opportunities Assessment

Scenario Development

Preferred Scenario Identification

Goals Refinement

Implementation Plan

Project Design

Project Delivery



**STRATEGIC PORTFOLIO PLANNING,
DESIGN AND DELIVERY PLATFORM**

WHO WE ARE + WHAT WE DO



WHO WE ARE

AECOM

AECOM IS A GLOBAL NETWORK OF 87,000 EXPERTS

Working with clients, communities and colleagues to develop and implement innovative solutions to the world's most complex challenges. Worldwide, we design, build, finance, operate and manage projects and programs that unlock opportunities, protect our environment and improve people's lives.

A TRUSTED PARTNER TO OUR CLIENTS

What differentiates us from others is the collaborative way we work globally and deliver locally. We draw together teams of engineers, planners, architects, landscape architects, environmental specialists, economists, scientists and program managers—all dedicated to finding the most innovative and appropriate solutions and improving the quality of life for those affected by each project. Our adaptable and flexible approach to projects allows us to deliver with consistency, longevity, high quality and with efficiencies in cost and time.

HISTORY

Formed from many of the world's finest engineering, design, environmental and planning companies, AECOM Technical Services, Inc was incorporated in the State of California on September 29, 1970.

WHAT WE DO

BUILDINGS + PLACES

Buildings + Places is focused on transforming spaces to places. From planning and economics to architectural design and building engineering, B+P is an integrated services group with the experience to tackle the most complex issues related to the built environment. Our six primary disciplines are:

- Building Engineering
- Urban Design, Planning & Economics
- Strategy +
- Architecture
- Interiors
- Asset Advisory

AECOM's team of experts, supported by state of the art planning and assessment tools has conducted energy and emissions assessments for over 500 million square feet of complex campus settings including municipalities, military bases, universities, and private developments.

In addition to the detailed energy and sustainability analysis expertise central to this project, AECOM will leverage our industry experts in economic analysis, planning, and implementation services to ensure we undertake a holistic assessment and generate a robust final product.

ENERGY

Our Energy practice comprises the entire lifecycle of energy, from extraction and refining of fuels, through transmission and distribution, power generation in all forms, and how energy is efficiently and effectively used. This lifecycle perspective uniquely positions us to know about technology and regulatory changes, and the subsequent opportunities. In some cases we drive those changes, such as piloting next generation waste to energy processes, and creating business cases for community benefit microgrids.

In addition to the development, design, construction and retrofit of energy infrastructure, AECOM is a fully accredited energy services company (ESCO) that provides turnkey energy efficiency retrofits. We audit, model, and benchmark, developing solutions for demand reduction through equipment replacement, control system optimization, and onsite generation and storage. We guarantee that performance through real time energy monitoring, leveraging our monitoring-based commissioning practice.

INTEGRATION

Together, our Buildings + Places and Energy practices combine their expertise and deliver visionary, practical, and technically sound energy master plans, using the methodology in this proposal, and demonstrated through the cited past performance.

RELATED PROJECT EXPERIENCE:

Our core team for this project have several ongoing efforts together. The most relevant are:

- City and County of Denver and The National Western Center Authority Integrated Campus Energy System
- ComEd Microgrid and Smart City Support, Bronzeville Neighborhood, Chicago
- Fort Carson Energy Savings Performance Contract with Battery Energy Storage System
- Los Angeles Community College District, Measurement and Demand Response Project
- NASA Strategic Energy Investment Plan
- Naval Facilities Engineering Command (NAVFAC) Guam Energy Vision
- San Diego County Regional Airport Authority, Strategic Energy Master Plan
- University of California Merced, P3 Advisory Services
- University of Colorado Anschutz Medical Campus Bundled Energy Projects
- U.S. Air Force Resilient Energy Planning

100⁺ YEARS

OF LEGACY COMPANY EXPERIENCE; WE HAVE
CONCEIVED, PLANNED, AND BUILT ENERGY PROJECTS
OF EVERY TYPE AND SIZE

ROSETTA THINKING



Electricity

Natural Gas

Other Fuel

Heating/Hot Water

Cooling

Other Demand

METHODOLOGY OVERVIEW

The creation of a robust Energy Master Plan (EMP) that aligns with the strategic vision, and also enhances the organization's larger strategic vision, requires a practiced and progressive methodology, empowered by analytical rigor, but also flexible to adjust priorities and capture unique opportunities. Our Rosetta™ methodology incorporates the full suite of capabilities within AECOM – strategic planning; energy efficient design and project development; control strategy optimization; generation and storage; community engagement; and financing.

Rosetta™ is a methodology – a combination of a web-based analytics platform, workshops, gameboarding, and the ideas of many experienced professionals, both at the client and AECOM levels – that results in a consensus-built roadmap to achieve energy performance goals. It accomplishes the three key principles in NREL's Strategic Energy Management Evaluation Protocol: customer commitment, planning and implementation, and measurement and reporting. The Rosetta™ methodology is also built leveraging the Department of Energy's BuildingSync data structure, allowing it to leverage existing audit data.

The analytics platform uses parametric (industry benchmarks and simulated); audited (from inspection of the site); and real utility data to model future scenarios, whether it be the impact of 25% of parking spots being fitted with chargers for electric vehicles, or the resiliency to a natural disaster using the inbuilt resiliency scorecard.

We have learned many lessons through the delivery and deployment of EMPs for almost 1 Billion square feet of facilities at multiple campus environments across the United States. The interactive nature of our Rosetta™ methodology engages stakeholders from definition of goals to the development of the implementation plan. When stakeholders see how their actions impact progress towards goals, when they see how the contributions of the whole team achieve the results agreed upon, the plan becomes actionable.

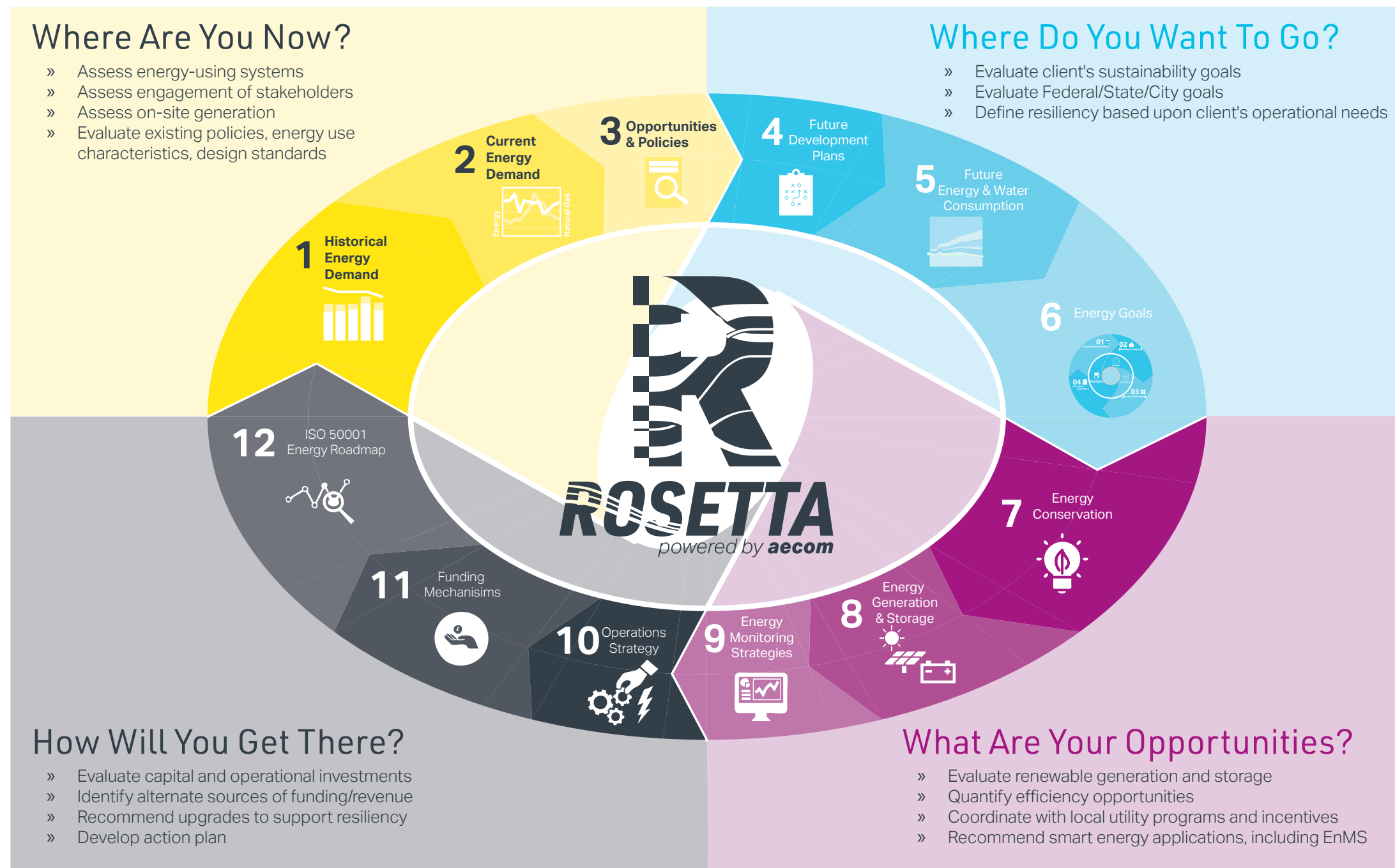
While this expanded stakeholder engagement brings greater likelihood of success, it also brings a risk of confusing non-technical stakeholders. For this reason, our platform is designed to be accessible with well-designed graphics to convey impacts and timeframes, simplifying the strategic planning process without diminishing technical robustness. Simply put, Rosetta™ helps our clients make smarter decisions faster.

Where Are You Now?

- » Assess energy-using systems
- » Assess engagement of stakeholders
- » Assess on-site generation
- » Evaluate existing policies, energy use characteristics, design standards

Where Do You Want To Go?

- » Evaluate client's sustainability goals
- » Evaluate Federal/State/City goals
- » Define resiliency based upon client's operational needs



How Will You Get There?

- » Evaluate capital and operational investments
- » Identify alternate sources of funding/revenue
- » Recommend upgrades to support resiliency
- » Develop action plan

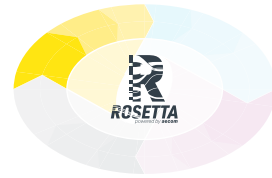
What Are Your Opportunities?

- » Evaluate renewable generation and storage
- » Quantify efficiency opportunities
- » Coordinate with local utility programs and incentives
- » Recommend smart energy applications, including EnMS

Our Rosetta™ methodology empowers the definition, direction and delivery of your long term energy security.

METHODOLOGY

WHERE ARE YOU NOW?



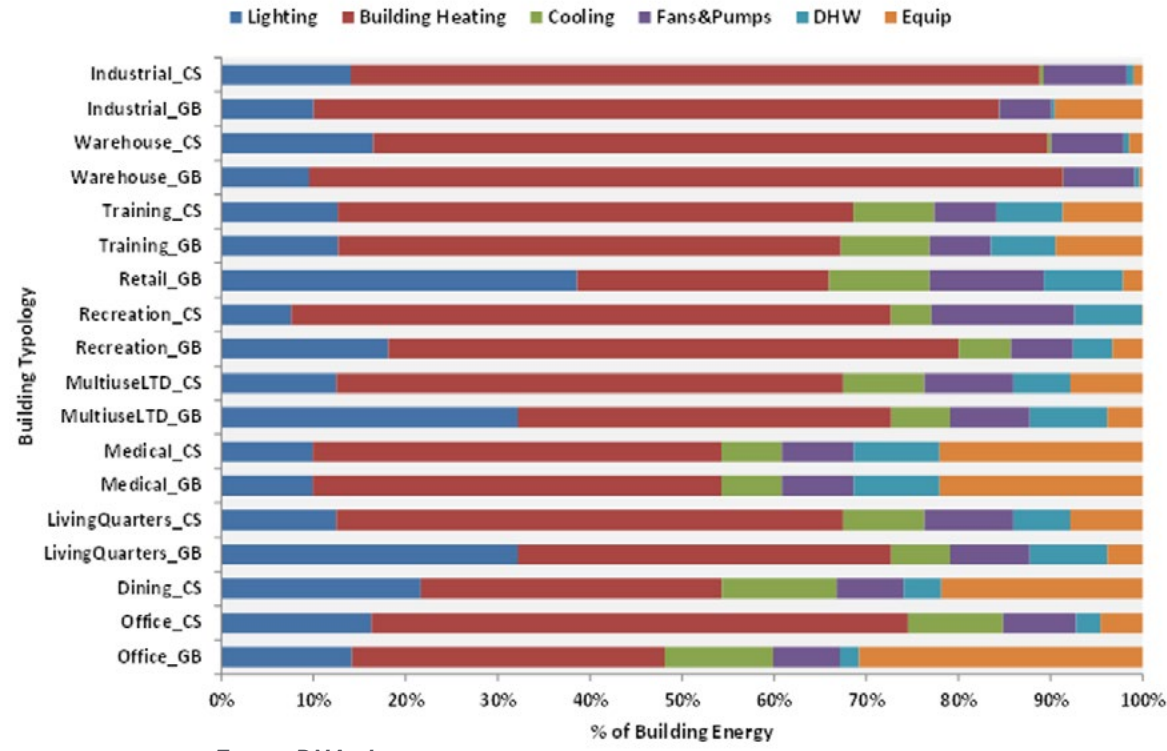
A strategic plan must be built on a solid foundation, which in turn begins with understanding where you are today. From the creation of EnergyDNA plots that assess energy use intensity and size for each identified facility typology, to the creation of Sanki diagrams that provide insight of how energy flows from source to end use at all scales – this data helps inform the campus facilities and broader portfolio.

Adopting a comprehensive data collection process, our team will seek to better understand the performance of the existing facility portfolio, and all energy consuming and producing assets. Gaining insight into the current planned maintenance strategy, renewable energy generation and existing energy metering information, we are able to empower a robust, strategic energy planning process.

Seeing beyond a facility list and understanding the portfolio is also important; however, it is recognized that traditional energy audits require a significant investment in both money and time. Our Rosetta™ methodology has therefore been developed to combine parametric, typology based insight with a ground truthing sampling strategy to initiate the strategic energy planning process. We take advantage of any existing, detailed information that is available, while still providing invaluable insight and a robust planning process for those sites where limited existing data is available. This is achieved by having a cascading parametric, audited, real-time (PAR) approach that provides improved calibration and specificity to enhance the confidence associated with the results.

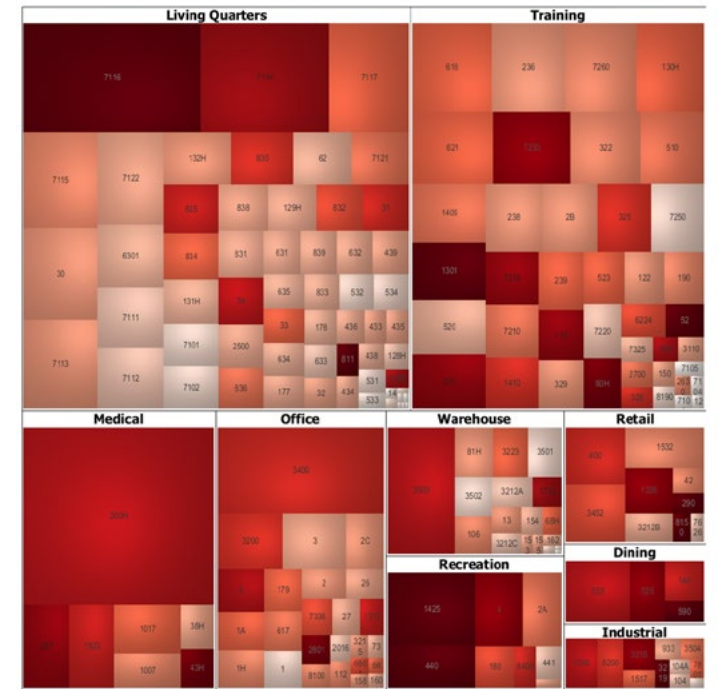
As a result of this approach, the investment associated with a comprehensive detailed energy audit is deferred until such a time when greater insight is needed. As such, energy auditing becomes a more surgical process that is focused on those facilities that either show greatest return on investment in terms of energy savings potential or aligned with critical functions where enhanced resiliency is of greatest value.

The resulting insight allows us to understand how you are performing with not only a qualitative assessment but a quantifiable gap analysis of the anticipated performance against currently identified goals. We use this phase to set our baseline and benchmark against best practices, not just in energy performance but in energy management and community engagement as well.



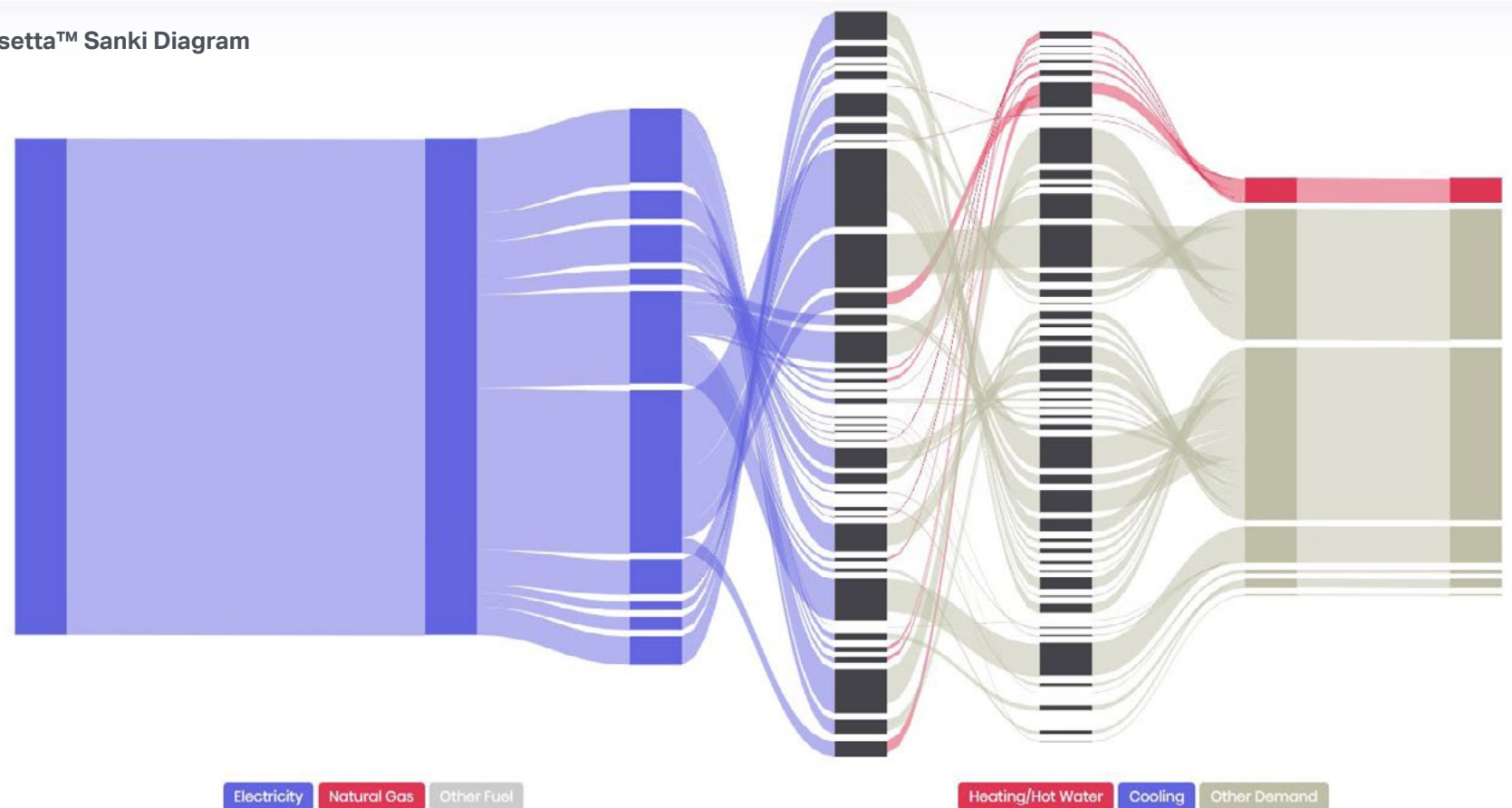
EnergyDNA plots

Intensity of Energy Use by Facility Type



EnergyDNA plots

Rosetta™ Sanki Diagram



METHODOLOGY

WHERE DO YOU WANT TO GO?



This phase of the process is where we endeavor to fully understand the diverse goals of the institution, both in terms of those directly related to the energy performance, as well as the broader vision for the campus. It is anticipated that these goals would include sustainability performance including energy usage / cost and GHG performance along with a broader transformational vision for the facility portfolio. We also expect to include initial fiscal goals under which the overall plan must operate.

A key component of this stage will be defining resiliency for the client based upon their operational requirements. We have worked through this process with the Navy and the Air Force, as well as with numerous municipalities. We recommend starting with those frameworks, and adjusting factors and weightings as needed. Our tools in the Rosetta™ methodology integrate a resilience scorecard so we can see the current posture, and weigh the potential benefit of proposed strategies.

Having achieved consensus on the full spectrum of relevant goals that relate to the energy performance, either directly or indirectly, our team's focus switches to understanding how the portfolio is currently performing against these goals.

Understanding the impact of existing confirmed and planned capital programs is also important as they can have significant impact in the overall energy performance. From fundamental changes in core business functional needs, to a renovation through replacement or recapitalization program, broader strategic efforts can have a transformative impact on the energy performance. The continued engagement of our Strategy+ partners in this exploration and ongoing interaction with the core stakeholders allows us to maintain alignment of the strategic energy vision and the broader vision of the institution.

Through a heavily data driven analysis process, leveraging the previous stage's data collection efforts, our team is able to ascertain the current baseline performance along with the anticipated "do nothing" future state that takes into consideration these broader strategic moves. This includes incorporating the performance of new facilities based on existing design standards.

COMMON GOAL COMPONENTS	
CARBON NEUTRALITY	How much do you want to reduce your GHG emissions by, and by when?
CONSERVATION & EFFICIENCY	How much do you want to reduce your water and energy consumption by, and by when?
RESILIENCY	How do we define resiliency of critical organizational infrastructure needs?
COST CONTAINMENT	How we we create a financially sustainable roadmap to achieve our GHG and energy goals?
ENGAGEMENT	How do we engage the campus community in achievement of our energy and sustainability goals?
LEADERSHIP	How do we create a financially sustainable roadmap to achieve our GHG and energy goals?

METHODOLOGY

WHAT ARE YOUR OPPORTUNITIES?



Answering the question of “Where are your opportunities?” is where the process gets exciting. Here we are able to take advantage of the full power of the Rosetta™ platform.

The model at this point is fully scalable, with parametric data, audited data, and real-time data from meters and controls systems. Typically generating thousands of Energy Conservation Opportunities across a campus or facility portfolio, our team relies on our in-house Energy Project Developers and technical experts, skilled in the identification, development and deployment of energy saving projects, to review this initial data set. Based upon the insight gained through conversations with the local facility team and available documentation, they identify those that show most potential. This filtered list is then tested against several scenarios developed based upon the goals, with the goal being to balance performance with the financial constraints, to create a balanced, prioritized roadmap that will optimize the long term energy performance.

Exploring energy conservation, generation, storage and smart strategies, our Rosetta™ methodology gives comprehensive insight into how and where energy strategies could be deployed. These range from the quick wins to the incorporation of more innovative, cutting edge technologies, as well as programs like monitoring based commissioning, ISO 50001, or other EnMS deployment that are essential to the longevity and persistence of performance.

We can also incorporate financial opportunities from utility incentive programs, state programs, renewable energy credit markets, or even community benefit projects with cost share.

While the scenarios are typically developed in collaboration with the client stakeholders, scenarios that are often evaluated include:

- Maximize energy performance and achieve energy goals in a particular timeline
- Maximize energy system resiliency
- Minimize carbon footprint
- Maximize energy performance within financial constraints of existing maintenance budget
- Maximize energy cost reduction

Having developed an initial set of scenarios, we recognize that it is critical to refine (and often combine) the insights that these scenarios provide. As such, the workshop associated with this phase is focused on presenting the scenarios and refining them in real time through a interactive modeling process. We find that not only does this get to the preferred solution faster, the stakeholders are more vested in the solution as they were actively engaged in its development. Consequently, their passion for the preferred solution and confidence in advocating for it long after the AECOM team has left is significantly higher than that associated with a plan developed through a more traditional consulting engagement.

It is the combination of this scenario based approach; the active engagement of key stakeholders, and the engagement of our Project Developers, that we believe is the unique formula within AECOM’s Rosetta™ methodology.

Focus Area	Critical Activities	Responsibility	Time Horizon	
A. On-Site Energy Generation and Storage 	A.1	Finalize location of a chilled water TES tank within the ADP.	AP	2 years
	A.2	Develop a chilled water generation and distribution strategy to support ADP program.	FMD / ADC	5 years
	A.3	Install a chilled water storage tank and reconfigure control strategy.	FMD / ADC	10 years
	A.4 (CN A.3)	Install approximately 4 MWh of battery storage to work in conjunction with existing solar installations.	FMD / ADC	2 years
B. Airport Critical Systems are Prioritize to Ensure Continued Operations 	B.1 (CC A.1)	Develop prioritization matrix of Airport facilities and critical systems.	FMD	2 years
	B.2 (CC A.2)	Develop robust load shedding strategy.	FMD / T+T	2 years
	B.3	Develop an energy chapter of the Business Continuity Plan.	EAD	2 years
	B.4 (CC A.3)	Implement campus wide energy management and demand response system.	FMD / FDD	2 years
C. Redundant Systems to Minimize Disruptions to Operations 	C.1	Develop redundancy study to identify where current spare capacity exists and where it is insufficient.	FMD	2 years
	C.2	Incorporate redundancy requirements into ADP project scope.	ADC	2 years
	C.3	Deploy additional redundancy measures to achieve the required redundancy needs.	FMD	10 years

Facilities Management
 Facilities Development
 Airport Design & Construction
 Business & Financial Management
 Environmental Affairs
 Airport Planning
 Terminals & Tenants
 Information & Technology Services

METHODOLOGY

HOW WILL YOU GET THERE?



Having understood what is possible, our Rosetta™ methodology focuses on developing a roadmap that illustrates how you will get there.

This final phase of the process starts with a step that is often missed – the validation that the goals are still appropriate, aligned and achievable. With the insight gained during the previous phase, the AECOM team will give your stakeholders the information required to make informed decisions and, where necessary, refine the goals relating to long term energy performance. Our experience has shown that it is not uncommon for this process to identify necessary refinements in the timing of milestone achievements.

Having ensured that the goals are right sized and aligned with the broader mission, our team develops a draft energy deployment plan – our Energy Roadmap – that identifies what energy projects should be implemented and what strategies should be followed; in which facilities; and in what timeframe.

Our team reviews this initial roadmap from the perspective of alignment with funding opportunities. Unlike many other capital investments, energy projects generate savings, or revenue, of all types: commodity, demand, operational, incentives/grants, avoided cost, and more. Starting with the more traditional funding strategies, including annual O&M budgets and the integration within ongoing capital programs, we refine the baseline Energy Roadmap to ensure that there is alignment not only with the technical potential of the project but also the viability of its funding and execution.

We also include alternative funding approaches such as Power Purchase Agreements (PPA) and performance contracting to leverage other people's money to support the incorporation of energy efficiency strategies. Given the energy transformation taking place in Colorado, there may even be opportunities for "non-wires alternatives" projects with serving utilities, including ancillary grid service support and bespoke demand response. Our team has the expertise to have those conversations and to model the impact of such financial arrangements. Our experience has shown that beyond simply achieving more with less, one of the biggest benefits that can be achieved by integrating alternative funding mechanisms is an expedited roadmap and the early achievement of goals.

There are a number of soft strategies that are critical to the overall success of the EMP but do not necessarily include physical changes to facilities or the associated equipment. The deployment of training programs to educate the facilities and maintenance teams in the needs of high performance, smart buildings and the update of procurement policies to seamlessly integrate the delivery of energy efficient solutions in all subsequent capital projects are two such examples that would be explored and considered as part of the EMP process to achieve long term success.

As with any strategic planning effort, we see the final Energy Roadmap not as the completion of an Energy Planning effort, but simply as the first milestone in a longer term effort where our integrated AECOM team can continue to support your long term energy success.

Some examples where we envision our team providing continued value include:

Ongoing Performance Monitoring: Management, interpretation, troubleshooting, and adjustment based on actual performance is a pillar of persistence of savings. Whichever EnMS system or approach is selected, our energy engineers can assist at any level with the longevity of savings.

Energy Project Deployment: Starting with the focused energy auditing and opportunity refinement, or Energy Project Developers can assist you in developing the bridging documents and contractual mechanism required to deploy the projects associated with achieving the end state – whether using traditional funding or alternative financing strategies.

Energy Roadmap Support: It is reasonable to assume that the Energy Roadmap is going to have to adjust to changes over the period of deployment. Whether there is a need to adjust to a new core mission or a surprise capital injection, our strategic energy planners can provide an ongoing engagement through which the roadmap can be adjusted on a periodic basis – typically every 1, 3 or 5 years depending upon the change frequency in the client's business.

INTEGRATED PROJECT LIST

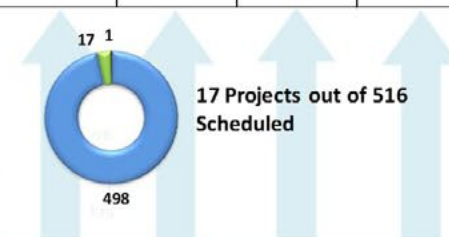
Our Integrated Project List (IPL) provides a clear timeline to implement each sub-project that is included within the submitted solution.

The IPL includes the anticipated funding source, timeline, pre-cursor projects and responsible parties.



ECM#	ECM_1	ECM_2	ECM_3	ECM_4	ECM_5	ECM_6	ECM_7	ECM_8	ECM_9	ECM_10	SE_1	SD_1&2	PV_1	Summary			
ECM Name	Lighting & Controls	Heating System	Cooling System	Air Delivery	HVAC Programming	DHW System	Cont-commissioning	Pumps & Fan Upgrades	Weatherization	Advanced Lighting (LED)	Smart Energy	Steam Decentralization	Renewables (PV)	Total Energy Savings (MBTU/year)	Total Capital Cost \$M	Total Utility Savings \$M	Average Payback (years)
Total Buildings (#)	27	0	0	53	46	0	127	7	60	0	127	53	-	1,097,518	125.0	14.7	8.5
Total Energy Savings (MBTU/Yr)	21,422	0	0	47,460	67,058	0	132,765	480	36,084	0	55,123	737,126	0				
Total Capital Cost \$M	\$12.12	\$0.00	\$0.00	\$10.69	\$2.20	\$0.00	\$4.74	\$2.18	\$5.32	\$0.00	\$17.77	\$70.00	\$0.00				
Total Utility Savings (\$M/yr)	\$0.56	\$0.00	\$0.00	\$0.73	\$0.81	\$0.00	\$2.06	\$0.01	\$0.52	\$0.00	\$0.76	\$9.22	\$0.00				
Average Payback (years)	21.7	-	-	8.8	1.3	-	1.3	124.0	10.9	-	23.4	7.6	-				
Implementation Time Frame	2020 - 2025	0 - 0	0 - 0	2020 - 2035	2013 - 2035	0 - 0	2010 - 2035	2013 - 2025	2025 - 2035	0 - 0	2015 - 2015	2015 - 2015	0 - 0				

STATUS	Lighting & Controls	Heating System	Cooling System	Air Delivery	HVAC Programming	DHW System	Cont-commissioning	Pumps & Fan Upgrades	Weatherization	Advanced Lighting (LED)	Smart Energy	Steam Decentralization	Renewables (PV)
Un-Scheduled	27	0	0	53	31	0	125	7	60	0	127	53	0
Scheduled / Completed	0	0	0	0	15	0	2	0	0	0	0	0	0
Deleted	0	0	0	0	0	0	0	0	0	0	0	0	0



ECM Cost & Benefit Details at Building Level														Summary			
Bid_ID	ECM_1	ECM_2	ECM_3	ECM_4	ECM_5	ECM_6	ECM_7	ECM_8	ECM_9	ECM_10	SE_1	SD_1&2	PV_1	Total Energy Savings (MBTU/year)	Total Capital Cost \$M	Total Utility Savings \$M	Average Payback (years)
GL-s7115-7	2025				2013		2010	2013			2015			27,410	2.9	0.43	6.8
GL-s7103-5							2010				2015			18,801	0.4	0.26	1.5
GL-s7113-4	2025				2013		2015	2013			2015	2015		16,891	2.0	0.27	7.2
GL-3400	2025				2013		2015				2015	2015		13,700	1.3	0.24	5.4

CASE STUDIES

AIU	HJI	WWE	PLD	EER	ORT	OPY
1,822	20,369	890	6,350	10,985	25,800	6,800
(-35)	(+580)	(-20)	(-200)	(+580)	(-15)	(-115)
MBC	LJH	MJB	PON	NFR	HGH	OMJ
3,605	9,542	2,609	7,654	6,522	20,000	3,652
(-210)	(-128)	(+35)	(+169)	(+122)	(-54)	(+182)
GBV	QMN	MMJ	IIT	KLM	15,000	
3,264	5,211	7,100	7,150	782	1,901	3,288
(-33)	(+156)	(-60)	(-150)	(+74)	(+101)	(-120)
MBB	WFF	HJM	QLC	LSD	10,000	6H5
3,320	712	134	2,022	631	6,287	12,630
(-120)	(+12)	(+5)	(-18)	(+40)	(-57)	(+330)



AIU	1,822	12,349,000
EJK	3,680	238,681,000
HPL	1,062	85,678,000
KEE	485	8,369,000
NAH	8,569	189,301,000
GOP	6,602	102,698,000
TIK	890	24,697,000
WIG	6,280	76,002,000
AHD	2,436	57,610,000

CASE STUDY

U.S. AIR FORCE RESILIENT ENERGY PLANNING

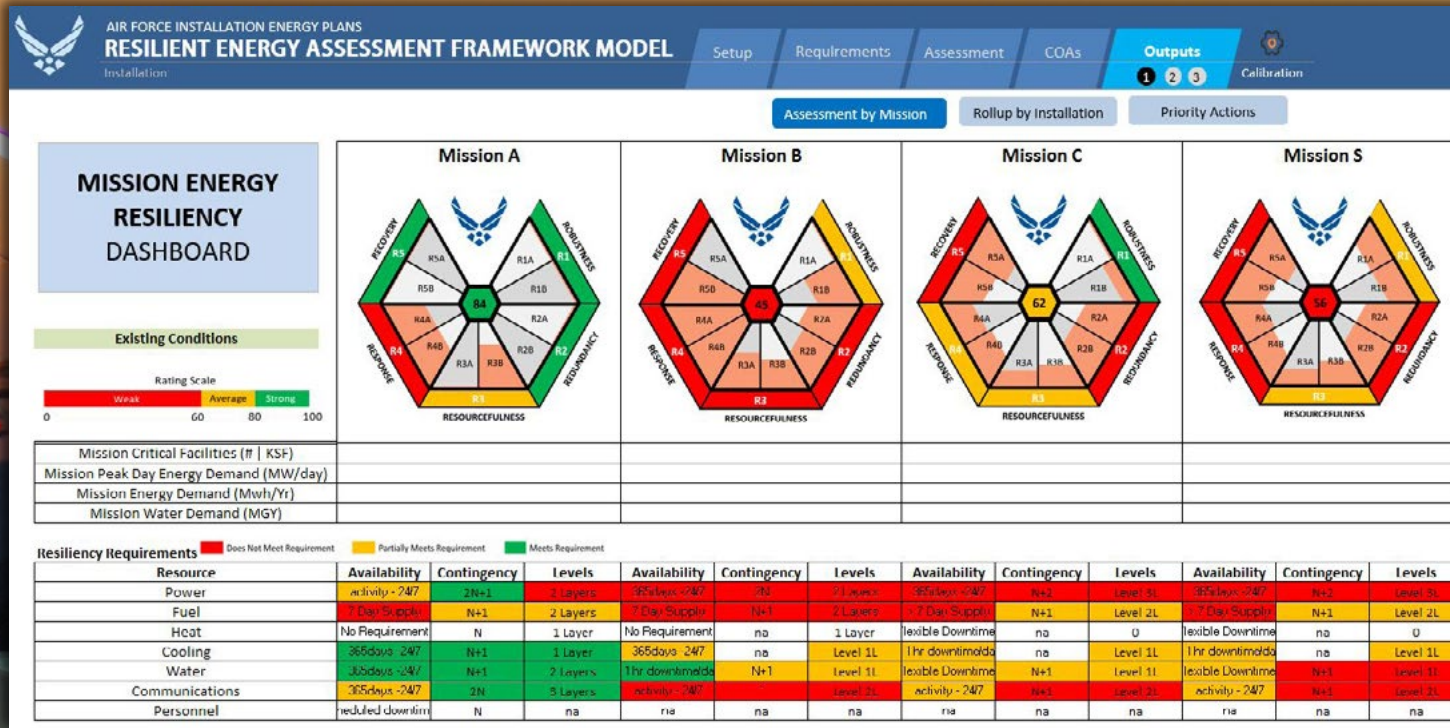
INTRODUCTION

AECOM recently developed a methodology for the US Air Force to help them understand the resiliency of their energy infrastructure and its ability to support the needs of their core mission.

PROJECT HISTORY + SCOPE OF WORK

By leveraging our Rosetta™ methodology to create a Resilient Energy Scorecard that combines multiple factors within 5 overarching criteria essential to a resilient infrastructure – Robustness, Redundancy, Resourcefulness, Response, and Recovery – which are then used to clearly define the multi-faceted energy performance goals. Our team has since deployed this methodology at several US Air Force Bases as part of the initial roll out, with a broader deployment across all Air Force installations anticipated to start later this year.

Our team also utilized this methodology to retrospectively assess the risks at Tyndall AFB, which was decimated during last year's Hurricane Michael, incurring an estimated \$5Bn of damage. The analysis was used to not only further calibrate and validate the insight that the analysis can provide but also provide invaluable insight into the optimization of the ongoing rebuilt effort.



CHECKLIST FACTOR

Factor	Status
Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	
Energy Master Plan Development	X
Roadmap Development	X

CASE STUDY

NASA STRATEGIC ENERGY INVESTMENT PLAN

Our integrated approach delivered a financially viable project that also greatly improved the reliability of mission critical systems.

INTRODUCTION

AECOM developed NASA's first ever Agency-wide decision-making framework to guide to energy investments aimed at reducing energy use intensity and consumption and increasing renewable electric generation. This effort provides a portfolio-level roadmap for NASA leadership toward meeting a 25% energy intensity reduction and a 25% renewable energy component by the year 2025.

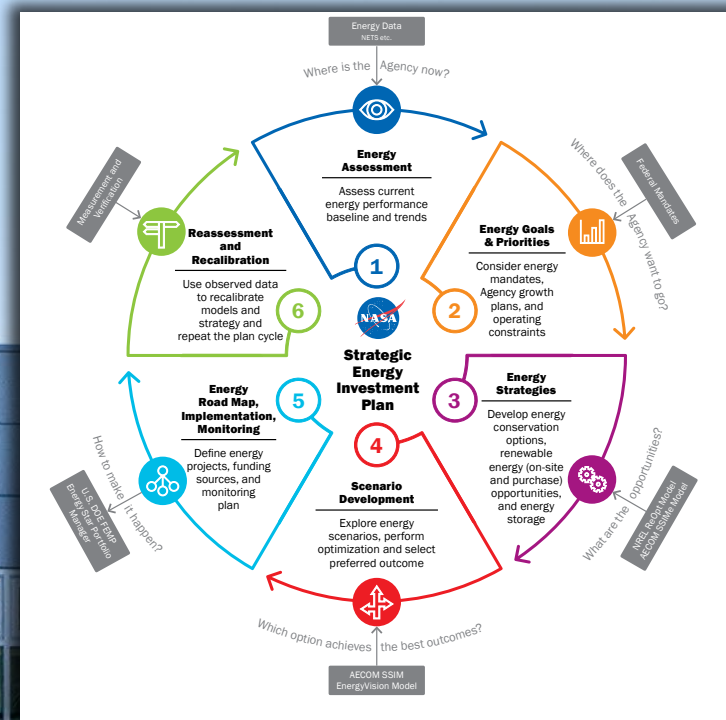
PROJECT HISTORY + SCOPE OF WORK

A top-down energy assessment that examined NASA's current energy baseline and performance and projected energy consumption, followed by the application of AECOM's Sustainable Systems Integration Methodology™ (SSIM) modeling platform, facilitated the identification of energy strategies at the facility level that offer the best energy reduction potential and highest cost savings for the Agency as a whole.

Working with NASA Headquarters, AECOM developed eight distinct future energy scenarios to explore a range of outcomes and cost implications. A preferred scenario was identified that achieves a 23.7% reduction in energy intensity by 2025 and a cost savings of \$162.1M between FY2015 and FY2025.

The investment plan identifies almost 2,000 individual energy conservation measures that affect over 600 facilities across the portfolio. Various procurement options were explored for the preferred scenario including how best to leverage appropriated funds and third party financing. The Plan sets forth a guide for year by year implementation by project type and includes several recommended strategies to strengthen NASA's overall energy management program.

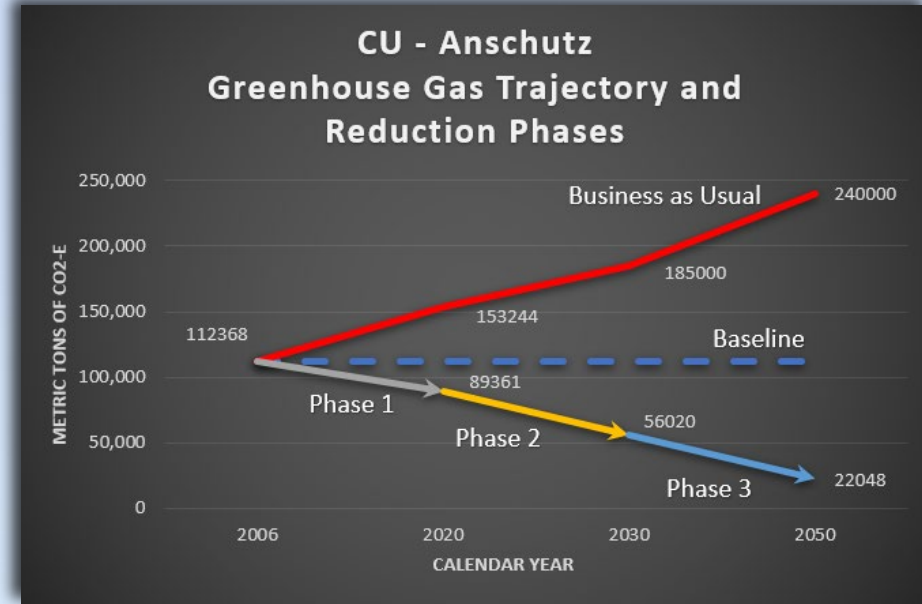
AECOM coordinated the effort with the Department of Energy (DOE) Federal Energy Management Program (FEMP) and the National Renewable Energy Laboratory (NREL) who evaluated renewable energy potential at each NASA site.



CHECKLIST FACTOR	
Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	
Energy Master Plan Development	X
Roadmap Development	X

EFFICIENT ENERGY
 IMPACT
 INNOVATION

CHECKLIST FACTOR	
Education	X
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	
Energy Master Plan Development	X
Roadmap Development	X



CASE STUDY

UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS BUNDLED ENERGY PROJECTS

INTRODUCTION

AECOM is currently working side-by-side with the CU Anschutz Sustainability Team to evaluate more than one million square feet of facility assets in an effort to advance their Climate Action Plan and reduce their energy footprint.

PROJECT HISTORY + SCOPE OF WORK

Facility Energy Assessments are currently underway. AECOM is conducting a detailed engineering review of how the buildings consume energy – steam, electricity, water, natural gas, etc. AECOM is examining all the major building systems (Architectural/ Mechanical/ Electrical/ Plumbing) to determine if they are functioning as originally intended, or if opportunities exist to increase performance and reduce energy consumption. The assessment and analysis will lead to recommendations in the form of energy conservation measures (ECM) to improve the overall operations of the buildings through improvement of building system components that support each facility.

The identification and evaluation of the ECMs presented in the final program plan deliverable report are developed in the following, general evaluation stages:

- **Modeling:** Existing system components are modeled through a whole-building energy model that utilizes connected loads developed through the equipment inventorying process and calibrated to facility energy consumption data.
- **Benchmarking:** AECOM will determine the energy use intensity as compared to peer buildings using square footage, building use type and other criteria. Data will be assessed on monthly and annual bases to determine consumption patterns versus climate and relative building activity.
- **ECM Design:** Recommended conservation measures to architectural, mechanical, electrical, and plumbing systems are developed based on potential for success; as determined by their impact on energy usage.
- **ECM Evaluation:** ECMs identified from the facility inspections will be modeled against component systems energy consumption in order to evaluate energy and cost savings.
- **Cost Estimations:** Implementation costs associated with the prescribed ECMs are developed using known contractor pricing and RSMMeans cost data.
- **Financial Analyses:** Cost/benefit analyses were developed, including payback calculations for the proposed energy conservation opportunities.



CASE STUDY

ComEd MICROGRID AND SMART CITY SUPPORT, CHICAGO, IL

INTRODUCTION

The historic Bronzeville neighborhood, located on Chicago's Southside is proposed as the location of ComEd's first microgrid. Additionally, the Bronzeville neighborhood has been targeted for a broader ComEd Smart Community of the Future initiative that builds on the utility's investments in grid modernization to pilot and deploy a range of smart city technologies.

PROJECT HISTORY + SCOPE OF WORK

AECOM developed integrated resilience performance metrics for the Bronzeville microgrid and related grid modernization and smart city improvements. The metrics focus on the measurable and deliverable benefits of grid modernization initiatives such as the resilience of the electrical system, critical infrastructure, and community as a whole. The project is one of the first efforts to define integrated metrics covering all three areas.

AECOM's Community of the Future smart city support includes development and implementation of strategies for stakeholder outreach and engagement related to ComEd's Community of the Future, smart city, grid modernization, and microgrid initiatives in Bronzeville. Outreach approaches consider both general awareness and engagement related to the development of specific technology applications associated with grid improvements the smart city investments. COM is also developing a Community of the Future Smart City Plan, focusing on smart grid as platform for a smart city services.

AECOM has also developed a detailed implementation approach that optimizes energy savings, prioritizes critical system upgrades, and targets smart city service enhancements to areas of high need.

Community Solar

Microgrid + Energy Storage

Public WiFi

Home Energy Portal

Intelligent Management

First / Last Mile Mobility

Traffic Management

CHECKLIST FACTOR

Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	
Alternative Financing Strategies	
Energy Master Plan Development	
Roadmap Development	X



Snow Removal Monitoring



Disaster Management & Notification



Energy Benchmarking



Air Quality Monitoring

CASE STUDY

SAN DIEGO INTERNATIONAL AIRPORT STRATEGIC ENERGY PLAN

INTRODUCTION

In order to maintain San Diego County Regional Airport Authority's (SDRAA) leadership amongst the global airport community in sustainability and energy performance, SDRAA engaged AECOM to lead the development of an Airport strategic energy plan.

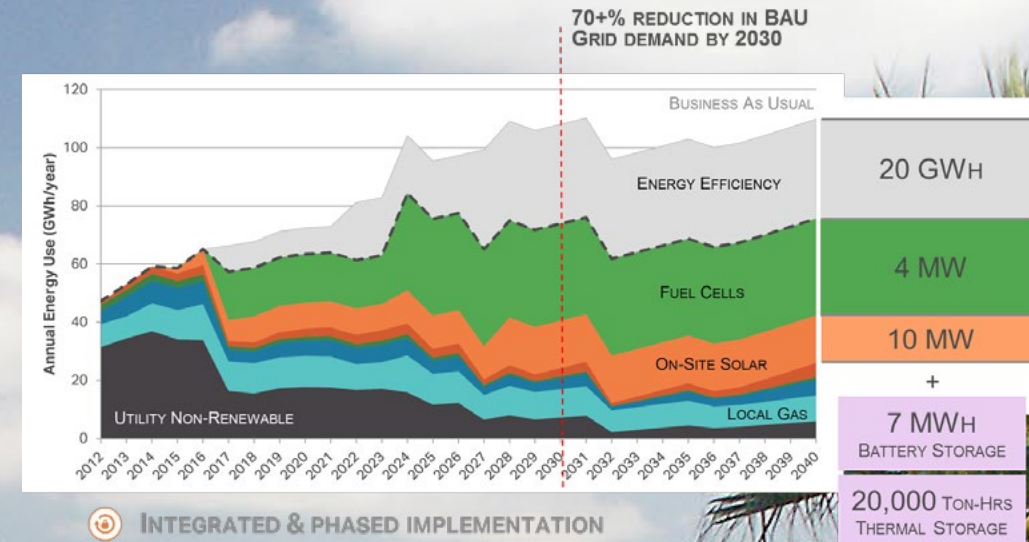
PROJECT HISTORY + SCOPE OF WORK

The Strategic Energy Plan (STEP) establishes the Airport's approach to being a world-class thought leader in the provision of cost effective energy resiliency strategies that are environmentally responsible and fully aligned with Airport operation and development.

The STEP provides a framework for developing energy-efficient and carbon-neutral Airport facilities into the future. It establishes long-term goals and strategies for best utilizing energy and conservation practices while aligning with the vision presented in the Airport Development Plan and Capital Improvement Plan. These goals will ultimately allow the Airport to establish more dependable energy sources while offsetting GHG emissions.

Specifically, the STEP addresses key issues of energy efficiency and conservation; on-site energy generation and storage; enhanced monitoring of key energy metrics; and mechanisms through which to actively engage the broad spectrum of Airport stakeholders. The plan presents an integrated approach that will enable the Airport to grow its operations while protecting the San Diego region's limited resources.

The resultant plan contains an action-focused roadmap leading to 30% energy cost reduction, 66% reduction in on-site GHG emissions, and ability to reduce reliance on grid energy by 70%. \$15M in capital cost savings were achieved.



CHECKLIST FACTOR	
Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	X
Energy Master Plan Development	X
Roadmap Development	X



AECOM developed and published The Strategic Energy Plan for San Diego International Airport.

CASE STUDY

LOS ANGELES COMMUNITY COLLEGE DISTRICT, MEASUREMENT AND DEMAND RESPONSE

INTRODUCTION

Through the Measurement and Demand Response (M&DR) project, LACCD leveraged AECOM's expertise, familiarity with utility demand response programs, intimate knowledge of multiple building automation and energy measurement systems and the equipment and features in the marketplace. Having a familiarity with the nine campuses and working collaboratively with our energy and engineering teams, LACCD was able to complete this project in 12 months and 38 percent under budget.

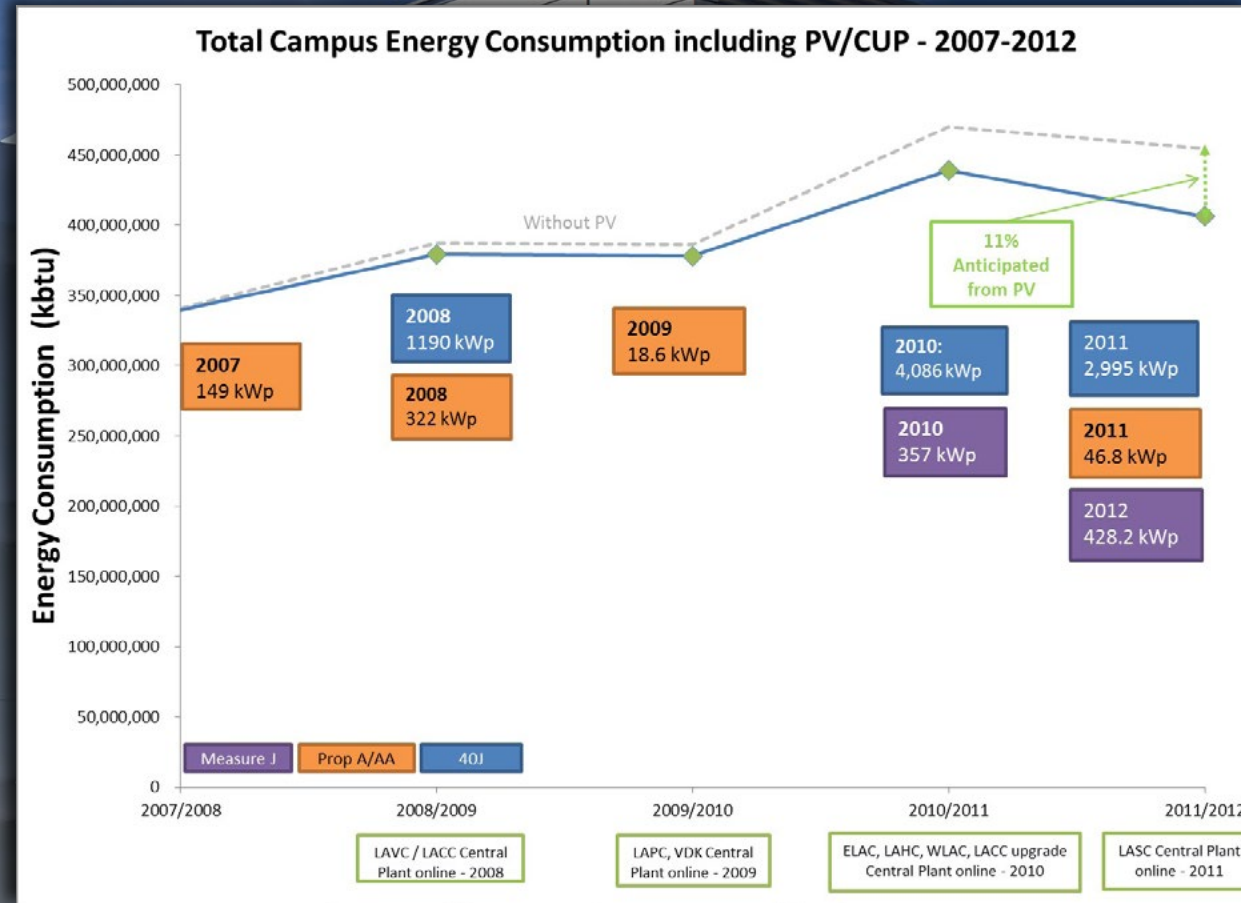
PROJECT HISTORY + SCOPE OF WORK

LACCD is now in the position to manage their utility usage and has active benchmarking to inform the Utilities department. The District is now an active (and significant) participant in both Southern California Edison and the Los Angeles Department of Water and Power's demand response programs.

As one of the largest customers, LACCD's ability to automatically load-shed without impacting teaching improves the reliability of the grid and helps prevent brown-outs and black-outs.

The M&DR project allows the District to monitor energy consumption at each building level and allow colleges to make informed decisions to reduce/curtail energy use, known as "load reduction," during times of peak demand.

This involved the development, design, procurement, and installation of 160 electric, water, and gas meters at identified/designated buildings at each college along with required IT infrastructure components/elements for integration to the existing buildings EMS*/BAS* to implement auto-DR* measures and participate in DR program savings from the utilities (SCE & LADWP). The installation required the energy management and building automation systems to implement the demand response measures. The project was implemented in two Phases: 1) the meter design and installation, and 2) the auto demand response system design and implementation of the demand response measures.



CHECKLIST FACTOR	
Education	X
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	
Energy Master Plan Development	X
Roadmap Development	X



CASE STUDY

GUAM JOINT MILITARY MASTER PLAN AND SUSTAINABILITY

INTRODUCTION

Under the NAVFAC Pacific Strategic Basing Initiatives IDIQ contract, AECOM—as an equal partner in the prime joint venture—led development of the full spectrum of planning requirements and products to aid US Marine Corps decision-makers in identifying viable alternatives to support mission and training objectives for the realignment of USMC forces from Okinawa, Japan to Guam. A major deliverable under the contract is a comprehensive Guam Joint Military Master Plan, which addresses Joint Service requirements related to the military build-up on Guam plus sub-plans for related enhancements including the addition of new Navy platforms, Air Force airfield facilities, an Army Missile Defense Detachment and firing ranges for joint service training.

PROJECT HISTORY + SCOPE OF WORK

The Guam Joint Military Master Plan addresses infrastructure, housing, and quality of life improvements for new DoD installation with a construction budget greater than \$10 billion. Planning efforts resulted in facility development plans for several locations on Guam with major consideration of housing and joint service community requirements to accommodate the influx of over 17,000 military and dependent personnel.

Planning products include base facility requirements; capital improvement plans; condition and feasibility assessments of existing facilities for reuse; MILCON program documents; and electronic 3D models to present alternative development plans.



CHECKLIST FACTOR

CHECKLIST FACTOR	
Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	
Energy Master Plan Development	X
Roadmap Development	X

CASE STUDY

UNIVERSITY OF CALIFORNIA MERCED, P3 ADVISORY SERVICES

INTRODUCTION

The AECOM team was commissioned by University of California, Merced to assist them in the formulation of a new Private Private Partnership procurement process for a 1.2 million campus expansion that included student housing, new academic buildings and additional student life facilities.

PROJECT HISTORY + SCOPE OF WORK

This effort involved the development of the programmatic needs, technical, and energy performance requirements of the proposed campus expansion. The energy effort included the initial energy performance benchmarks beyond code compliance, development of energy strategy to serve growing demand, along with the development of the proposed contractual pain share / gain share methodology that would be leveraged over the 30 year concession period to ensure that the proposed facilities are operating at optimal performance.



CHECKLIST FACTOR	
Education	X
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	X
Energy Master Plan Development	X
Roadmap Development	X

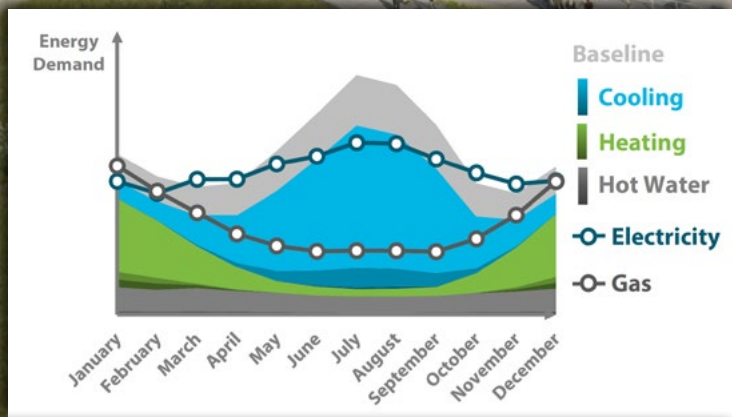


image credit: UC Merced

CASE STUDY

FORT CARSON, ENERGY SAVINGS PERFORMANCE CONTRACT

INTRODUCTION

Fort Carson is a major U.S. Army training facility and leader in energy management. As this is the installation's fifth ESPC, AECOM's efforts to achieve deep energy savings were challenging. The installation has an extremely low energy rate (4.4 cents/kilowatt-hour [kWh] on peak), and almost all of the "easy" energy saving strategies were implemented as part of previous ESPC efforts.

PROJECT HISTORY + SCOPE OF WORK

To deliver a comprehensive ESPC program that delivers on Fort Carson's current and future goals, our team developed a master plan using AECOM's Sustainable Systems Integration Model Energy Vision (SSIMe™).

Using the SSIMe process enabled AECOM to present various project options in a dynamic and transparent framework, allowing the team to analyze various options in a live "game-boarding" environment. SSIMe also enabled the team to easily manipulate critical project factors, such as scope of work, financial inputs, utility rates/escalation and project phasing to evaluate the project options against Fort Carson's program goals.

Ultimately, Fort Carson decided on a mix of traditional energy conservation measures – such as lighting and heating, ventilation and air conditioning (HVAC) improvements – combined with advanced strategies – such as smart energy management control systems (EMCS) and a battery energy storage system (BESS) that manages electrical demand charges (pictured).



CHECKLIST FACTOR

Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	X
Energy Master Plan Development	
Roadmap Development	

CASE STUDY

NATIONAL WESTERN CENTER

CAMPUS ENERGY PLANT

INTRODUCTION

The National Western Center (NWC) – in the heart of Denver – will be undergoing significant revitalization in the coming years. AECOM, and partners Saunders and Enwave, have been selected by the City of Denver to become the official campus energy partner of the NWC.

PROJECT HISTORY + SCOPE OF WORK

The NWC has set a long-term goal of becoming a net-zero energy campus, where energy consumption would be completely offset by renewable on-site energy production annually. As the campus energy partner, AECOM and partners will deliver district and renewable energy solutions while also being responsible for the long-term operation and maintenance of NWC energy systems.

The current energy concept features a sewer heat recovery system to transfer heat between the Delgany sewer main and an ambient campus wide piping distribution loop as well as a solar photo-voltaic (PV) system located on the rooftops of campus buildings. Site utility upgrades will see the demolition and replacement of sewer, natural gas, heating, cooling, electrical and abandoned infrastructure as they are discovered under this historic site.

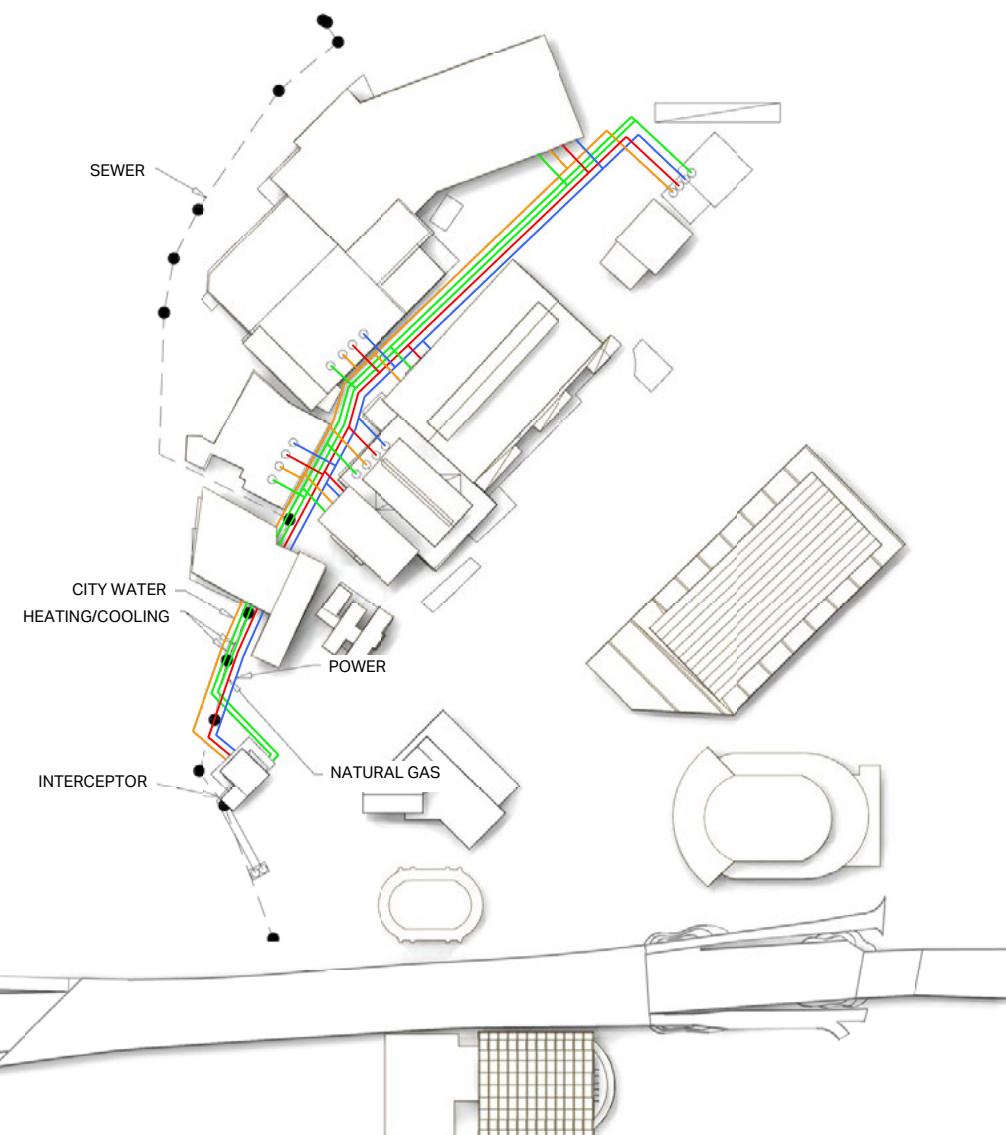
District Utility Infrastructure. AECOM is providing the campus energy plant design as well as campus utility and infrastructure placement to each building. The campus utilities have been designed to meet the future build-out of the campus, with phased connections; each site building will be constructed independently under their own project schedule and connected to the campus systems in turn.

Engaging with Xcel Energy. The infrastructure upgrades require a careful coordination with local utility provider Xcel to fully integrate with their utility grid and establish required upgrades to support the final connected loads, careful collaboration is necessary.



CHECKLIST FACTOR

Education	
Campus Environment	X
Multiple Stakeholders	X
Energy Efficiency Projects	X
Onsite Energy Generation Projects	X
Onsite Energy Storage	X
Alternative Financing Strategies	X
Energy Master Plan Development	
Roadmap Development	





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Strategic Portfolio Planning, Design and Delivery Platform

BACK TO START