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AIRPORTS COUNCIL INTERNATIONAL

Session 2.5

Advanced Energy Management: You've Installed LEDs & Solar Panels—Now What?

September 30, 2018

NASHVILLE 2018
AIRPORTS COUNCIL INTERNATIONAL – NORTH AMERICA
ANNUAL CONFERENCE AND EXHIBITION
SEPTEMBER 30 – OCTOBER 2, 2018

#AIRPORTS18

Operations & Technical Affairs Workshop

Our Panelists

- Douglas Nordham, Associate Principal-Energy Consulting, ARUP
- Cullen Choi, Energy Manger, Denver International Airport
- Roy Palk, President/CEO, New Horizons Consulting
- Chad Reese, Environmental Affairs Manager, San Diego County Regional Airport Authority

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Defining Advanced Energy Management

Douglas Nordham
ARUP

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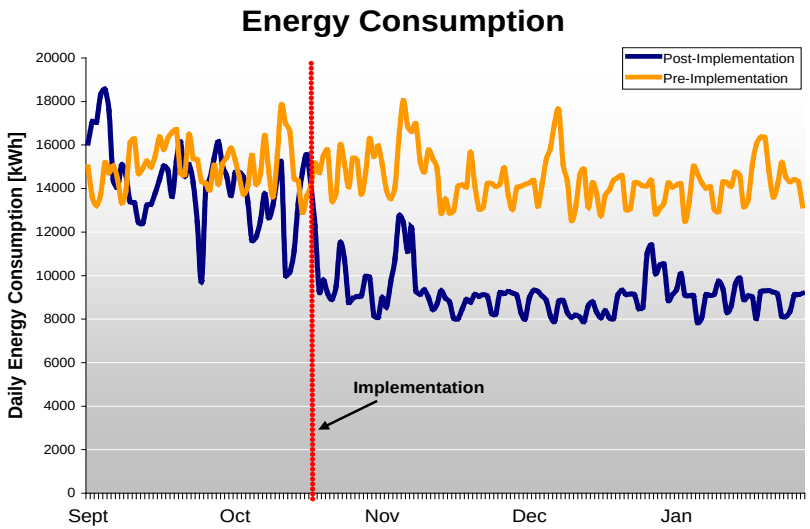
What is “Advanced” Energy Management?

- “Old School” Energy Management
- Basic Concepts:
  - Reduce/Conserve
  - Increased Efficiency
  - Focus on energy (kWh)
  - Lower Annual Cost



What is “Advanced” Energy Management?

- **Advanced** Energy Management (AEM) utilizes available technology, business models, financing options, and multiple value streams to provide synergies and achieve the Stakeholder’s stated objectives.

Technology

- Renewables, CHP
- Batteries
- Thermal Storage
- Digital, IOT
- Utility/Grid Interactions

Business Models

- Energy Services (ESCO)
- Power Purchase (PPA)
- Public Private Partnerships (P3)

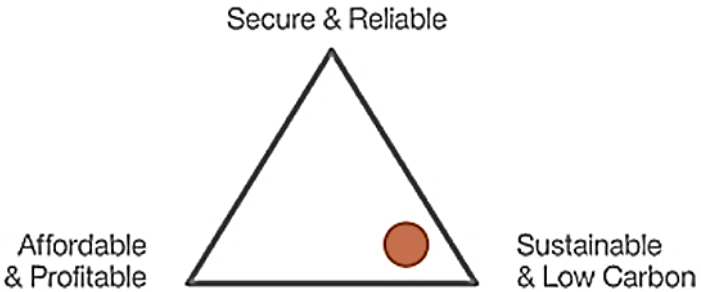
Operational Benefits

- Reliability
- Resiliency
- Low-Carbon
- Low-Cost

AEM Example: Airport Microgrids

With lots of competing opportunities, challenges and perspectives:

How do we select the most appropriate features and criteria for the Microgrid?



Solution: Use Case Analysis

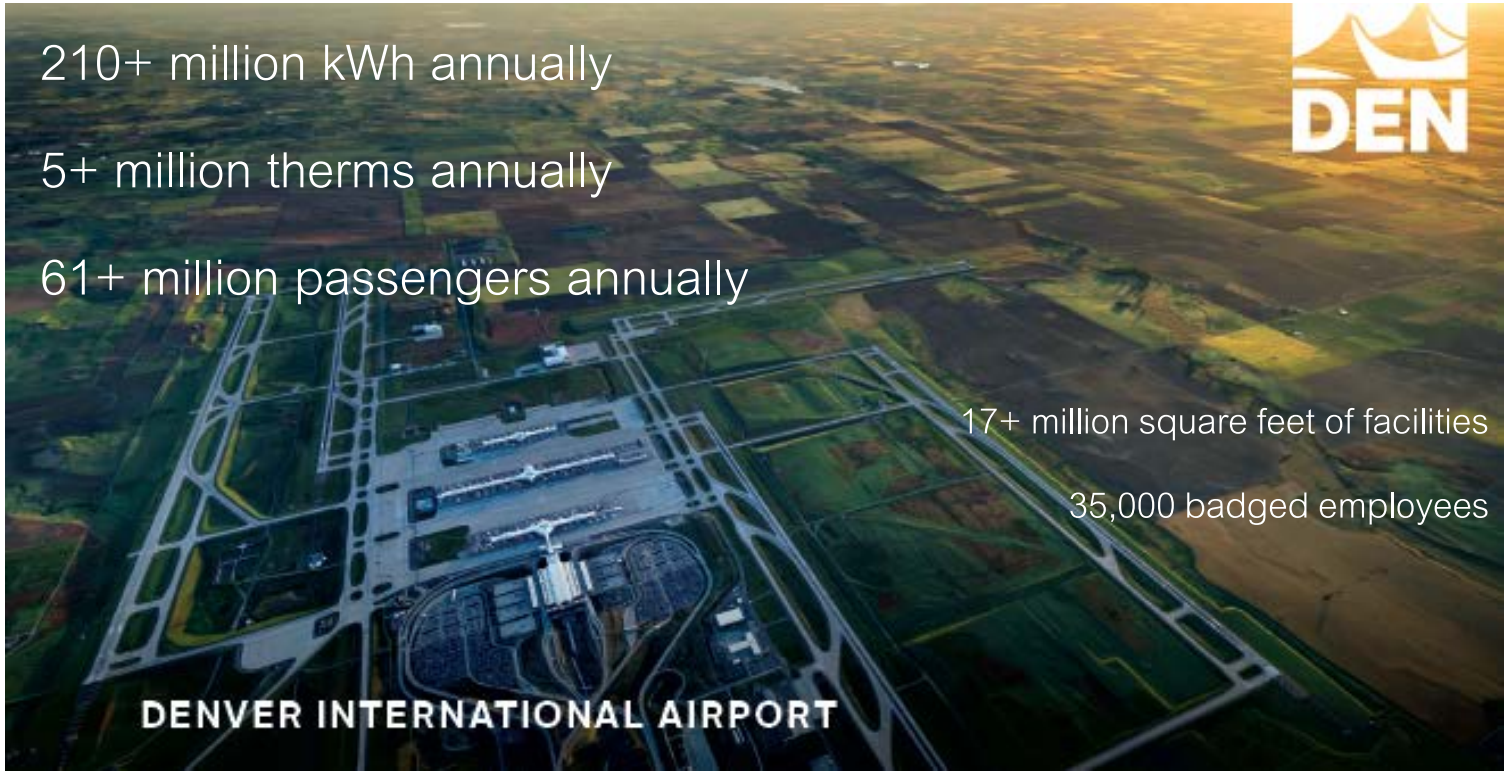
- Determine the general expectations (Owners Project Requirements) of the Airport Microgrid system as determined through the Microgrid Owners/Users survey process and meeting(s), including:

  - Define the **functional** Use Case requirements of the Airport Microgrid, including any required operational limits and constraints
  - Define the **non-functional** Use Case requirements and attributes of the Airport Microgrid, such as desired economics and risk tolerance.
  - Define the desired Use Case **transactional** features, including advanced metering, dashboards, financial optimization, and operational performance information that needs to be provided/available to the Airport Microgrid operators, users, and utility.

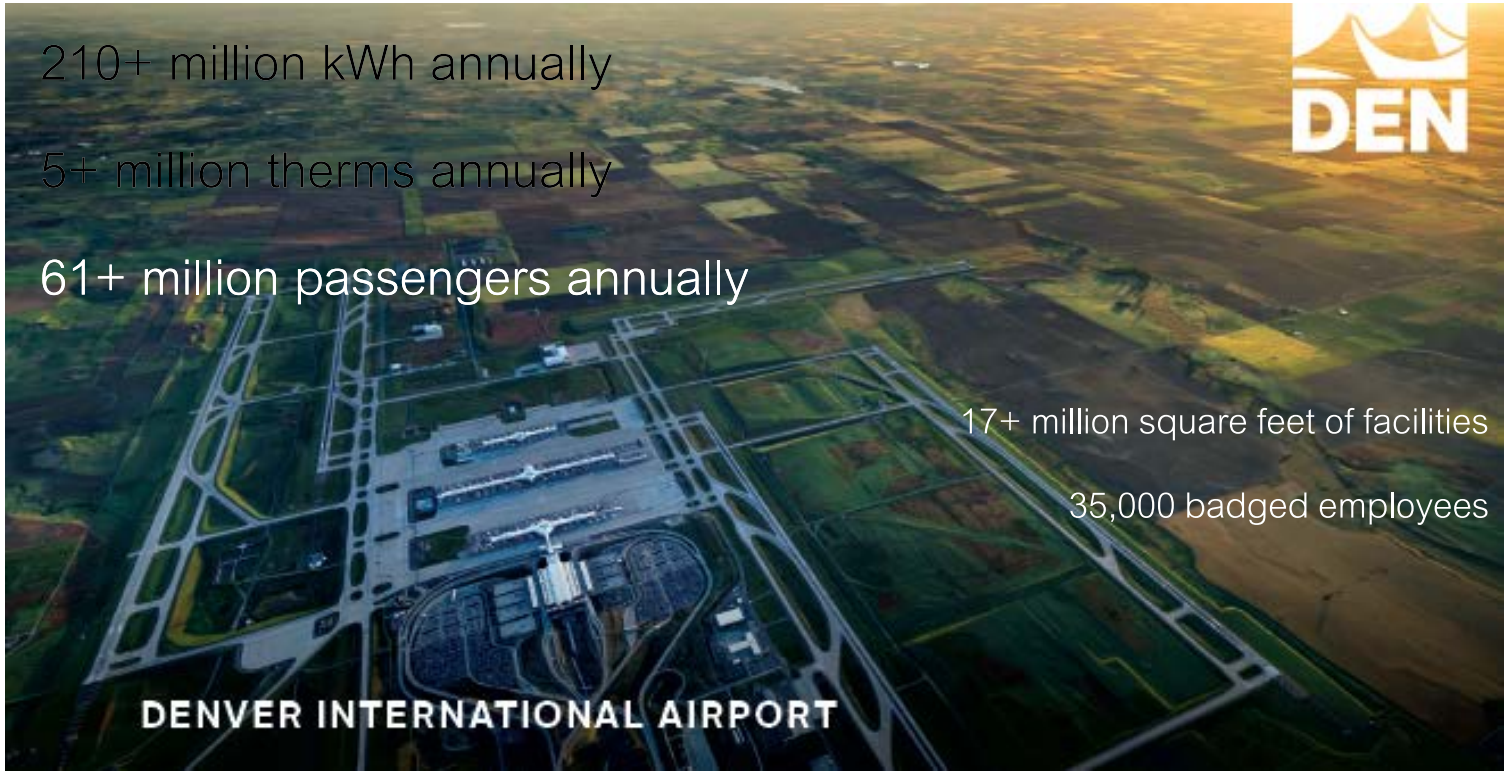
Advanced Energy Management at DEN

Cullen Choi
Denver International Airport

Characterization of DEN



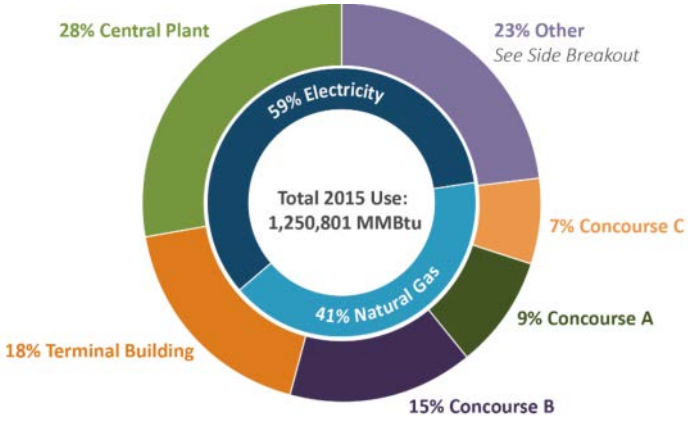
Characterization of DEN

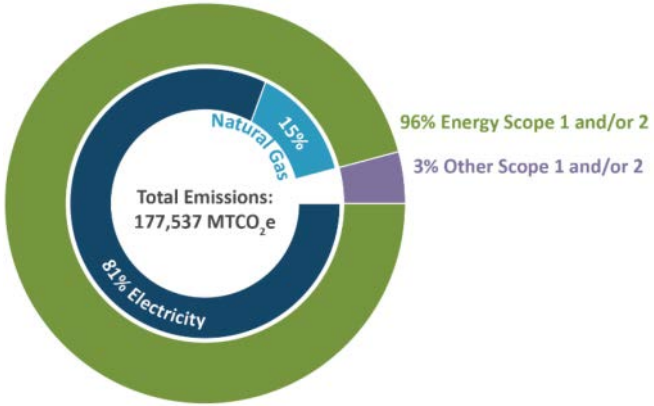


Characterization of DEN

210+ million kWh annually

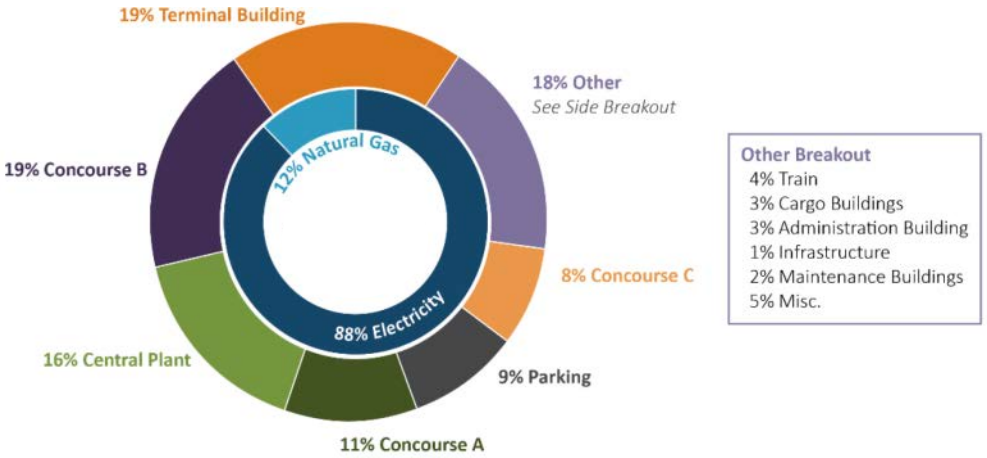
5+ million therms annually



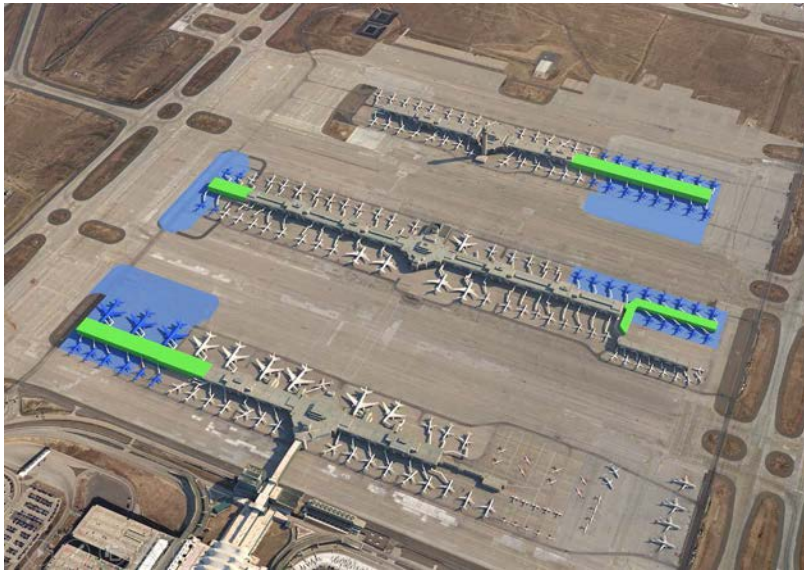


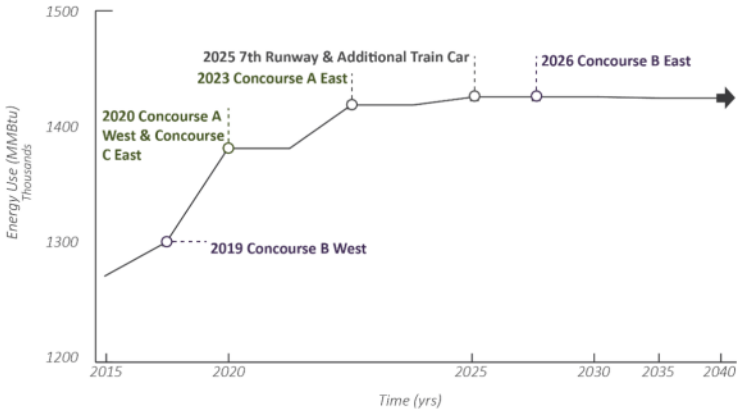
Characterization of DEN

2017 cost: $24.5 million



Evolution of Energy Management



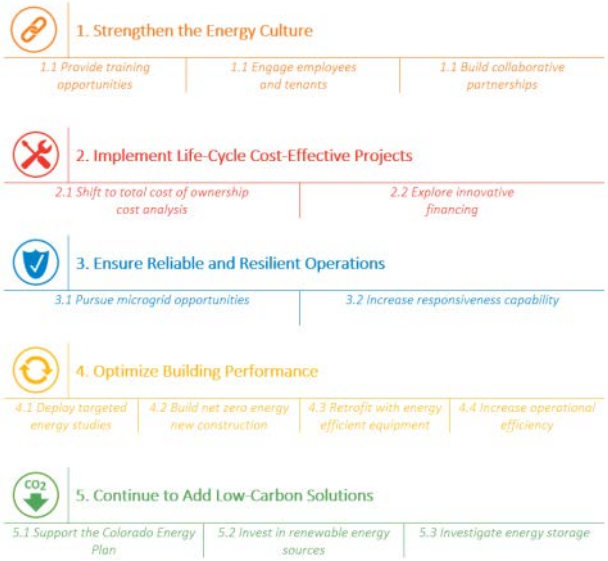


Evolution of Energy Management

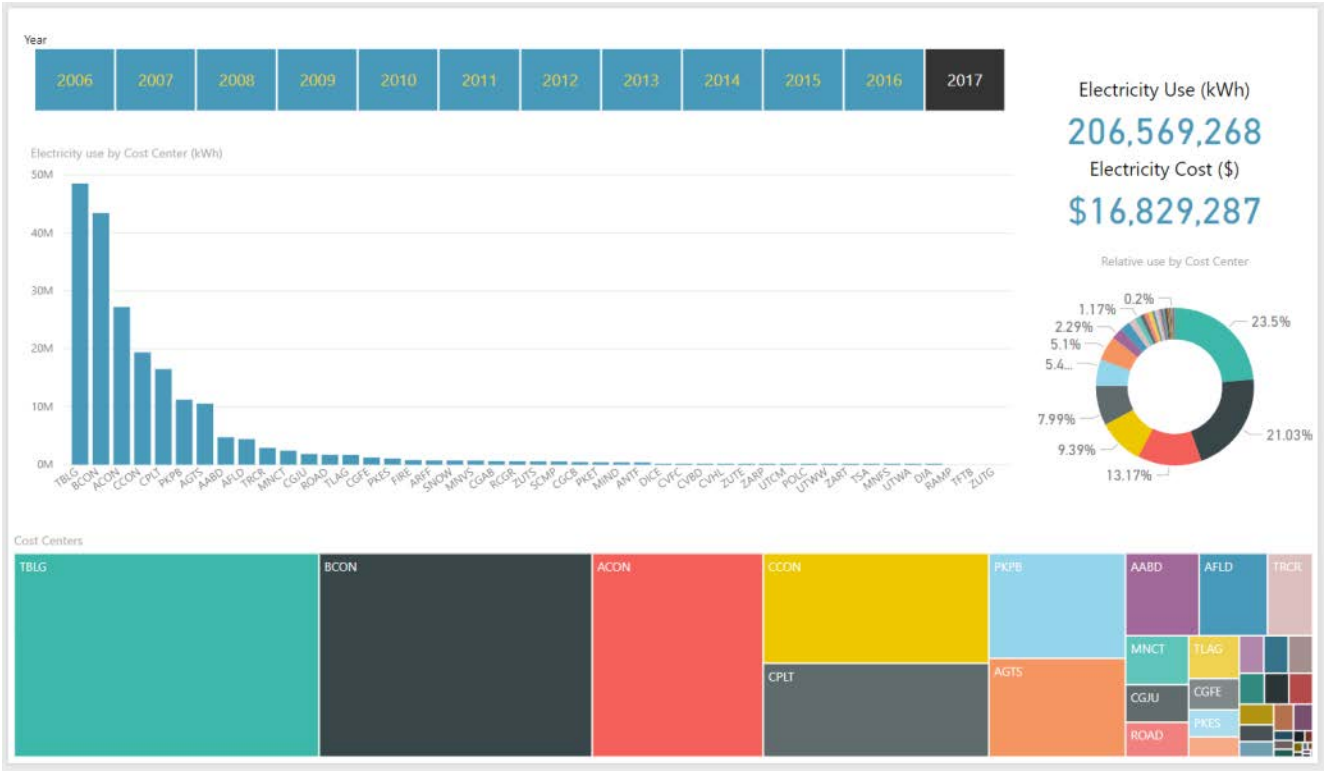
✈ Energy Master Plan

Evolution of Energy Management

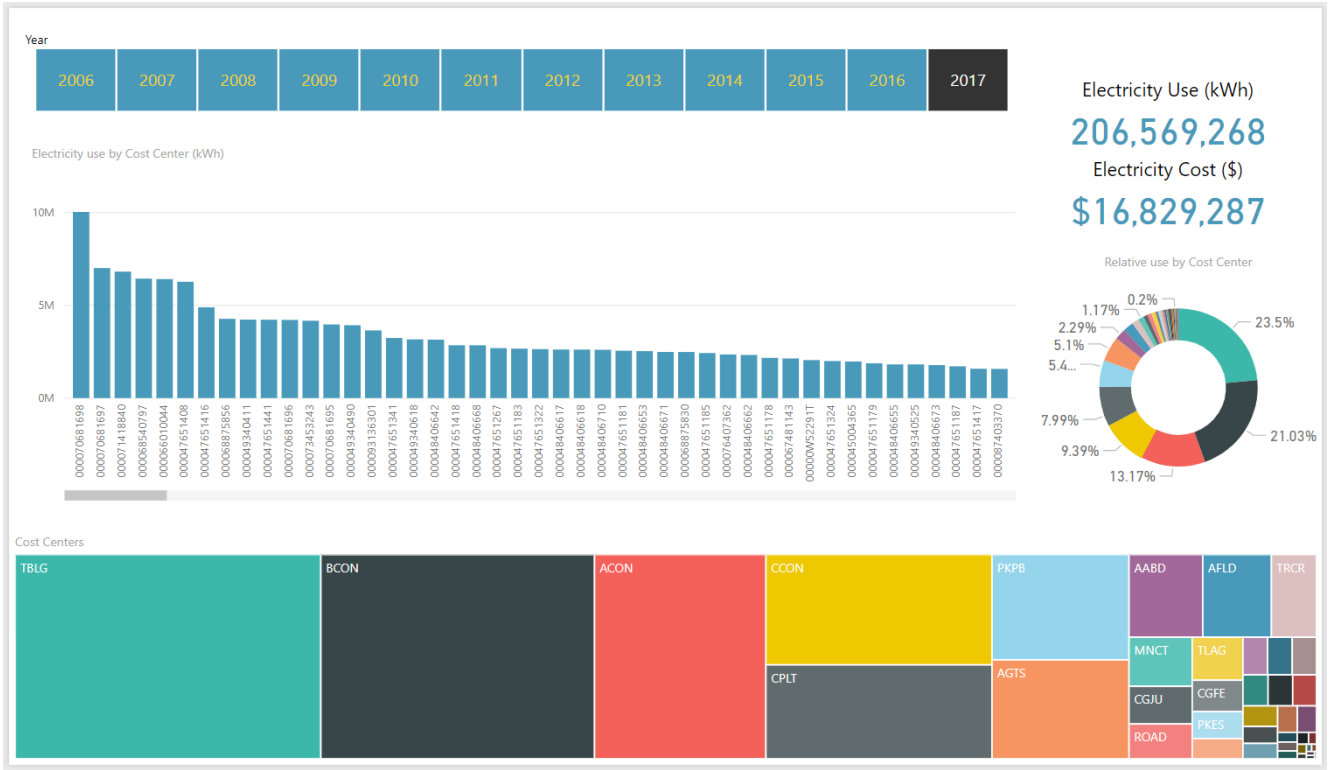
1. STRENGTHEN THE ENERGY CULTURE
2. IMPLEMENT LIFE-CYCLE COST-EFFECTIVE PROJECTS
3. ENSURE RELIABLE AND RESILIENT OPERATIONS
4. OPTIMIZE BUILDING PERFORMANCE
5. CONTINUE TO ADD LOW-CARBON SOLUTIONS



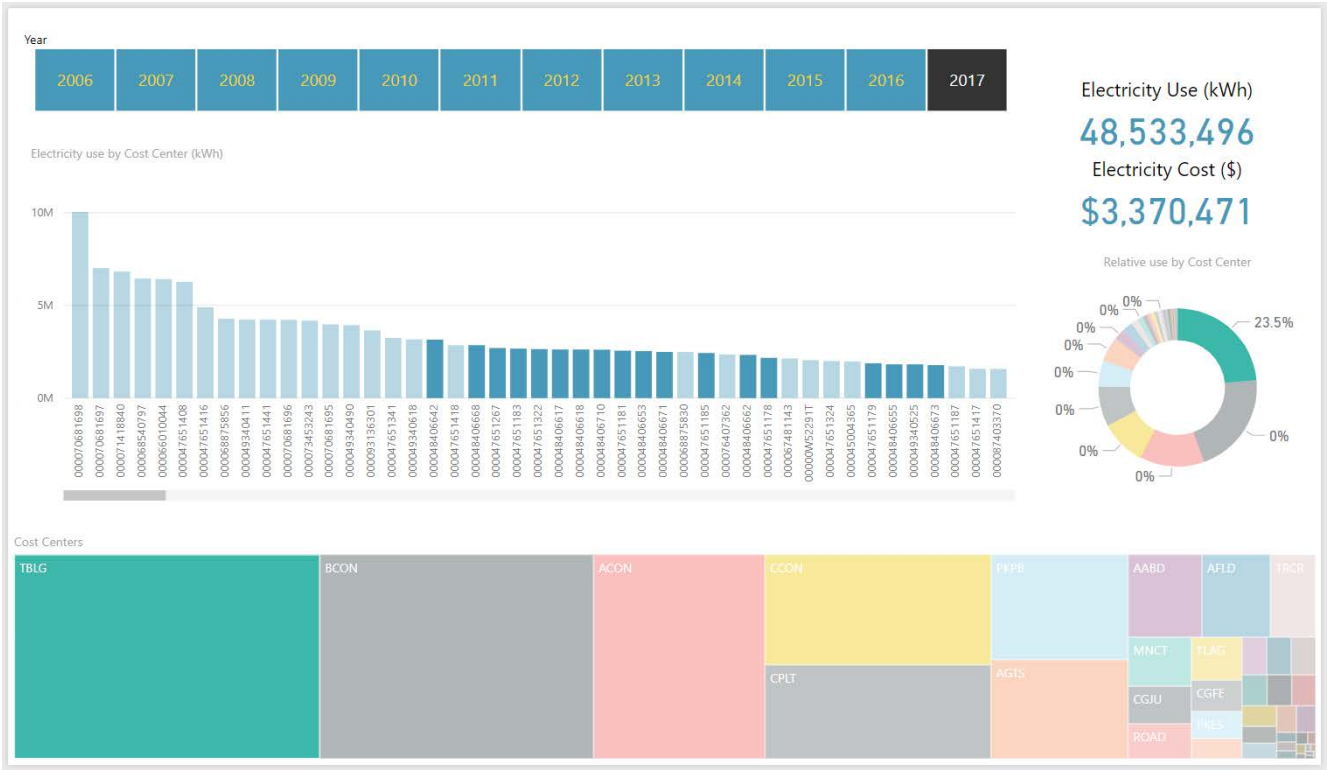
Benchmarking & Analytics



Benchmarking & Analytics

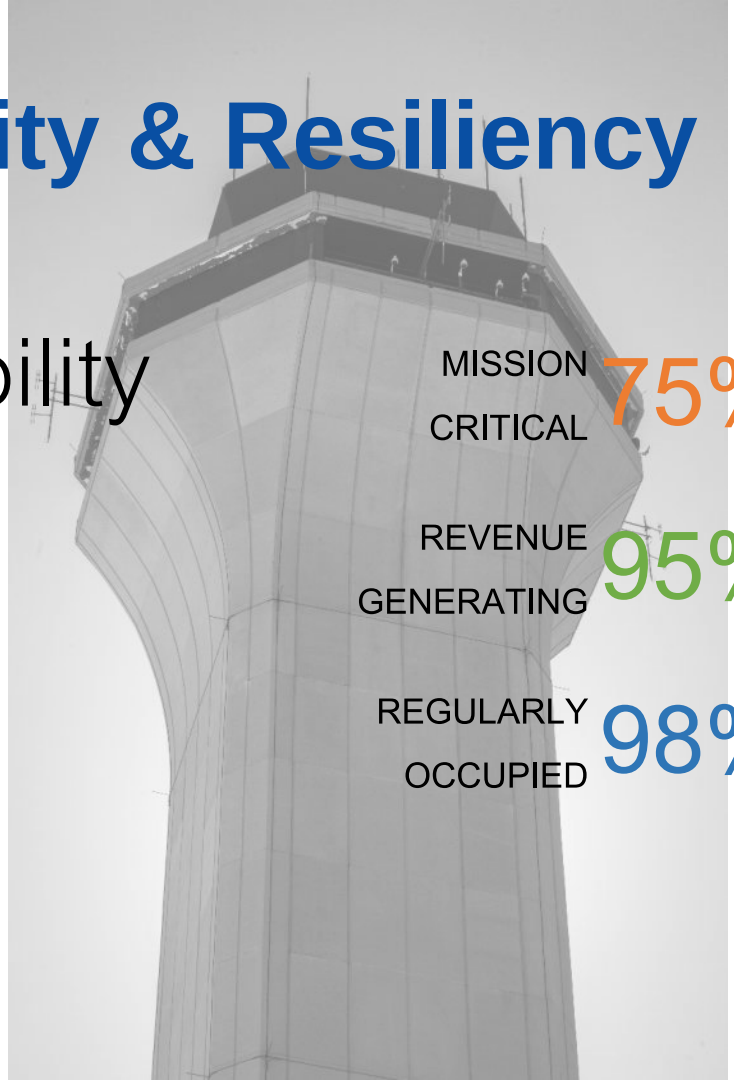


Benchmarking & Analytics



Reliability & Resiliency

reliability



MISSION CRITICAL 75%

REVENUE GENERATING 95%

REGULARLY OCCUPIED 98%

Reliability & Resiliency

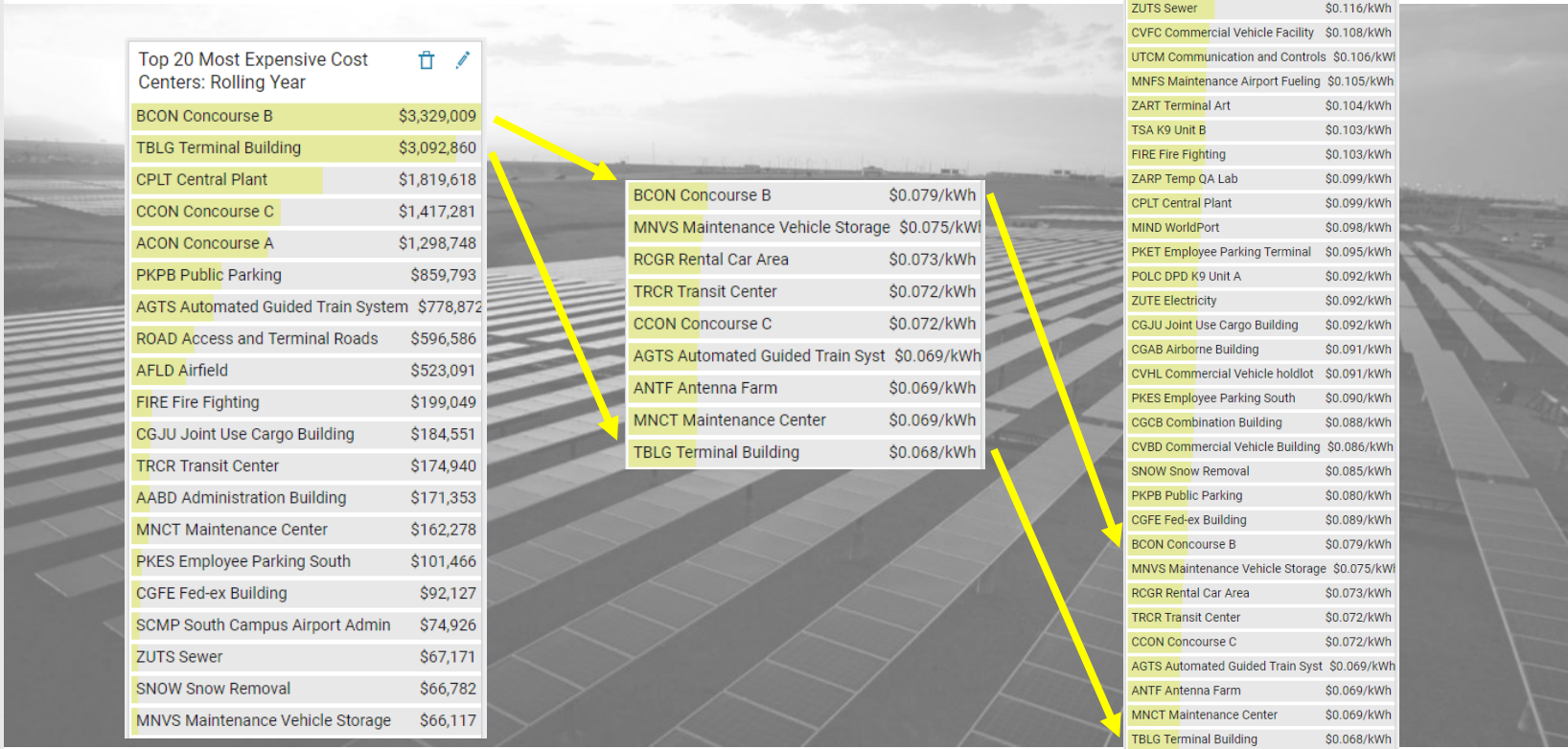
resiliency

SINGLE SOURCE <1%

2+ SOURCES 99%

LIGHTING
CONTROL TOWERS
PASSENGER MOVEMENT
HVAC
COMMUNICATIONS… 100s

Unaffordable Efficiency



Top 20 Most Expensive Cost Centers: Rolling Year	
BCON Concourse B	$3,329,009
TBLG Terminal Building	$3,092,860
CPLT Central Plant	$1,819,618
CCON Concourse C	$1,417,281
ACON Concourse A	$1,298,748
PKPB Public Parking	$859,793
AGTS Automated Guided Train System	$778,872
ROAD Access and Terminal Roads	$596,586
AFLD Airfield	$523,091
FIRE Fire Fighting	$199,049
CGJU Joint Use Cargo Building	$184,551
TRCR Transit Center	$174,940
AABD Administration Building	$171,353
MNCT Maintenance Center	$162,278
PKES Employee Parking South	$101,466
CGFE Fed-ex Building	$92,127
SCMP South Campus Airport Admin	$74,926
ZUTS Sewer	$67,171
SNOW Snow Removal	$66,782
MNVS Maintenance Vehicle Storage	$66,117

BCON Concourse B	$0.079/kWh
MNVS Maintenance Vehicle Storage	$0.075/kWh
RCGR Rental Car Area	$0.073/kWh
TRCR Transit Center	$0.072/kWh
CCON Concourse C	$0.072/kWh
AGTS Automated Guided Train Syst	$0.069/kWh
ANTF Antenna Farm	$0.069/kWh
MNCT Maintenance Center	$0.069/kWh
TBLG Terminal Building	$0.068/kWh

Electricity Blended Rate by Cost Center: Rolling Year	
ROAD Access and Terminal Roads	$0.356/kWh
UTWW Wastewater	$0.197/kWh
DICE De-Icing System	$0.137/kWh
AFLD Airfield	$0.128/kWh
SCMP South Campus Airport Admin	$0.123/kWh
UTWA Water Distribution	$0.117/kWh
ZUTS Sewer	$0.116/kWh
CVFC Commercial Vehicle Facility	$0.108/kWh
UTCM Communication and Controls	$0.106/kWh
MNFS Maintenance Airport Fueling	$0.105/kWh
ZART Terminal Art	$0.104/kWh
TSA K9 Unit B	$0.103/kWh
FIRE Fire Fighting	$0.103/kWh
ZARP Temp QA Lab	$0.099/kWh
CPLT Central Plant	$0.099/kWh
MIND WorldPort	$0.098/kWh
PKET Employee Parking Terminal	$0.095/kWh
POLC DPD K9 Unit A	$0.092/kWh
ZUTE Electricity	$0.092/kWh
CGJU Joint Use Cargo Building	$0.092/kWh
CGAB Airborne Building	$0.091/kWh
CVHL Commercial Vehicle holdlot	$0.091/kWh
PKES Employee Parking South	$0.090/kWh
CGCB Combination Building	$0.088/kWh
CVBD Commercial Vehicle Building	$0.086/kWh
SNOW Snow Removal	$0.085/kWh
PKPB Public Parking	$0.080/kWh
CGFE Fed-ex Building	$0.089/kWh
BCON Concourse B	$0.079/kWh
MNVS Maintenance Vehicle Storage	$0.075/kWh
RCGR Rental Car Area	$0.073/kWh
TRCR Transit Center	$0.072/kWh
CCON Concourse C	$0.072/kWh
AGTS Automated Guided Train Syst	$0.069/kWh
ANTF Antenna Farm	$0.069/kWh
MNCT Maintenance Center	$0.069/kWh
TBLG Terminal Building	$0.068/kWh
ACON Concourse A	$0.064/kWh
AABD Administration Building	$0.059/kWh

Advanc(ing) Energy Management

Advanc(ing) Energy Management

cost + savings + use

integration + planning

reliability + resiliency

Advanced Energy Management and Sustainability

Chad Reese
San Diego County Regional Airport Authority

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SAN's Definition of Sustainability

"Plan and build an enduring and resilient customer-focused enterprise by effectively managing our financial; social; and environmental risks, obligations and opportunities."

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Sustainability Management Planning

Main Topic Areas

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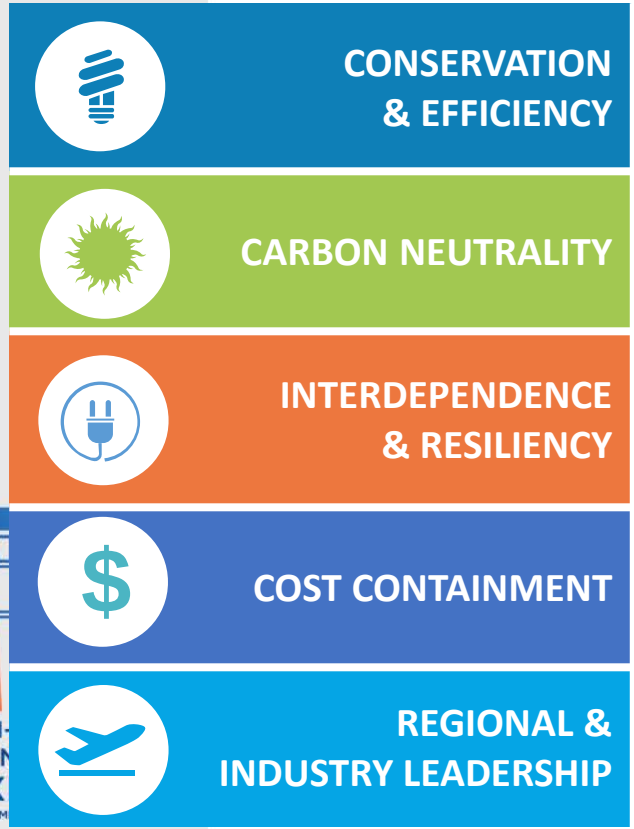
CONTENTS

https://san.org/green

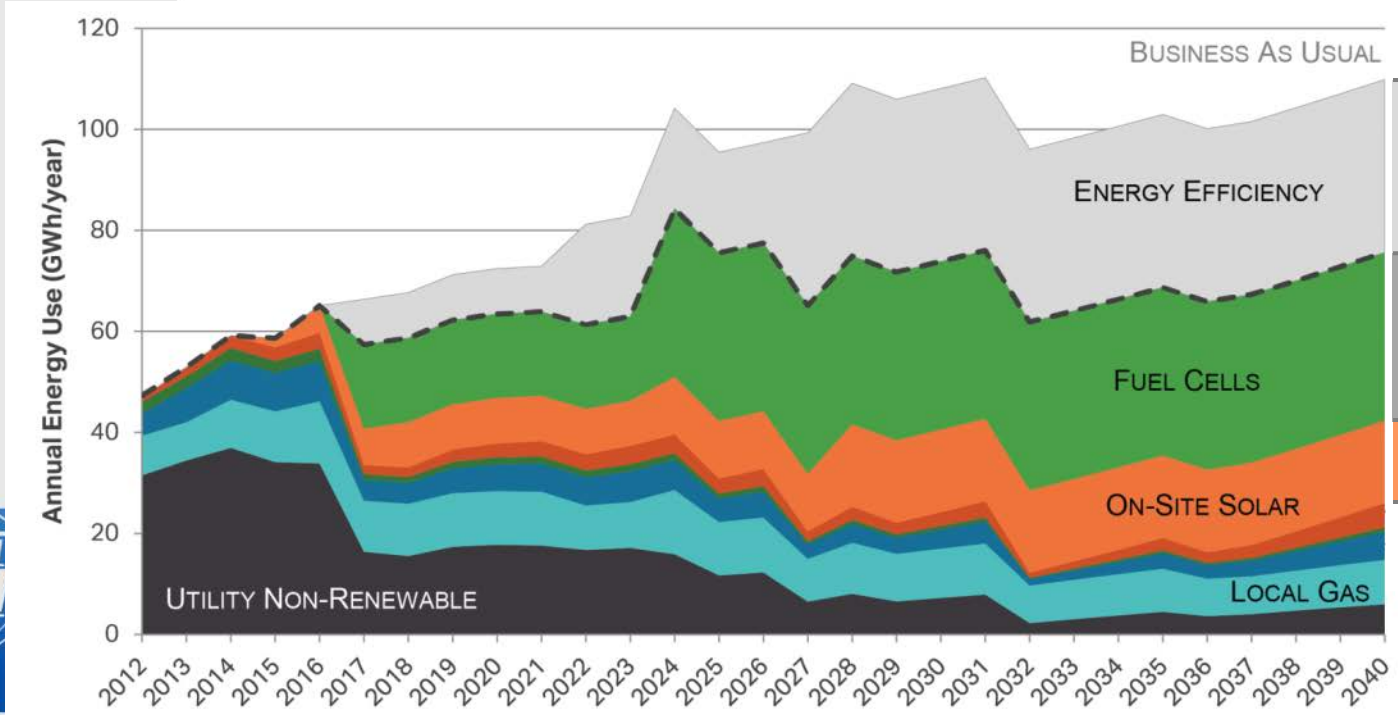
Strategic Energy Plan

Dimensions



Strategic Energy Plan

Integrated & Phased Solutions



Totals

20 GWh

4 MW

10 MW

+

7 MWh
Battery Storage

20,000 Ton-Hrs
Thermal Storage

Strategic Energy Plan

Updated Phased Energy Projects

Energy Project	Capacity	Year	Funding Mechanism	Goal Alignment				
				Energy Efficiency	Carbon Neutrality	Independence	Cost Containment	Leadership
Battery Storage (ongoing)	4 MWh	2018	Shared savings / Other		•	•	•	•
Upgrade Central Plant	+ 900 tons	2022	T1RP Funding	•		•	•	
Photovoltaic Solar	2 MW	2023	PPA / CIP		•	•	•	•
Battery Storage	4 MWh	2023	PPA / Other		•	•	•	•
Photovoltaic Solar	2 MW	2026	PPA / CIP		•	•	•	•
Energy efficiency projects (identified from audit)		Every 5 years	On-bill financing / CIP		•	•	•	•

Strategic Energy Plan

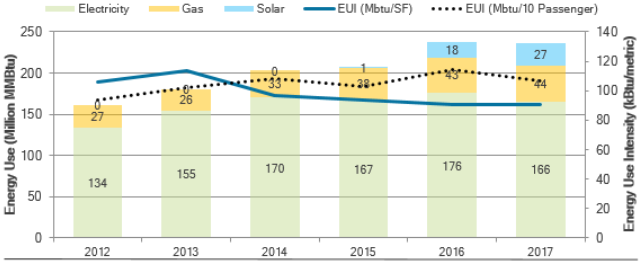
SUSTAINABLE ENERGY

DRAFT

Primary 2035 Goals	• 30% energy use intensity reduction • 100% renewable energy • Systems resilient for 24-hours • 30% reduction in energy cost per passenger
GRI Key Performance Indicators	• Energy consumption within the organization (302-1) • Reduction of energy consumption (302-4) • Energy use intensity (SAN measurement) • Percent renewable electricity (SAN measurement)

Context

Operating Airport facilities requires substantial energy use, and electricity use represents the single greatest source of Authority-controlled greenhouse gas emissions. As SAN plans to accommodate future passenger growth, the Airport Authority is working to ensure facilities are constructed and operated to optimize energy efficiency and renewable energy opportunities.



Progress Towards Goals

Key: Exceeding goals | On track | Needs work

ENERGY EFFICIENCY	• EUI: (Mbtu/SF) decreased 0.21% and (Mbtu/10 pass) decreased 6% in 2017. Still 4% above 2015 Baseline for MBtu/pass. Need 2% per year.
RENEWABLE ENERGY	• 51% of SAN's electricity use in 2017 was from renewable sources (highest ever). In 2018, over 80% with the implementation of Ecochoice.
RESILIENCE	• Redundant circuits on 12kV "microgrid" provide protection against grid outages.
COST CONTAIMENT	• Total Energy cost reduced by $389,000 from CY16 to CY17.

Quarterly Implementation Update (March – May 2018)

The Airport's Strategic Energy Plan (STEP) provides a roadmap for the Authority to establish cleaner, more dependable, and cost-effective energy sources. Implementation updates in the STEP's five primary strategy areas are provided below:

1. Conservation & Efficiency

- 38% of storefronts are certified Green Concessions
- Updating Rules and Regulations
- Pursuing energy storage, retro-commissioning, & lighting capital projects

2. Carbon Neutrality

- Calculating energy savings from VALE Pre-Conditioned Air (PCA) and 400 hz jet bridge meters
- Piloting renewable diesel in Authority vehicles (lower carbon intensity)

3. Interdependence & Resiliency

- Installed 5.5 MW of Solar PV onsite to date
- Designing new, larger capacity generator for Central Utility Plant (CUP)
- Developing SMP Air Quality & Clean Transportation Plans (FY 2018/19)

4. Cost Containment

- Generated 3,249,565 kWh of solar CY18 to date
- Saved $50,000 in Ecochoice program in April
- Implementing retro-commissioning project
- 4 MWh Battery Energy Storage Project in contract stage
- Revisiting AIMMS support contract

5. Regional & Industry Leadership

- Provided SAN tours to City of Chula Vista, Port of Portland (PDX), Ontario Airport Authority (OIAA), International Facilities Management Association (IFMA)
- Participated with other airports in Sustainability Management Association webinar

Look Ahead Activities	Strategy Areas 1	2	3	4	5
Update Design Guidelines to incorporate the STEP		✓	✓		
Improve AIMMS to develop energy metering program	✓			✓	
Host additional energy-focused "Lunch & Learns"	✓				✓
ADP Programmatic Document integrating STEP throughout the document, with stand-alone Sustainability chapter		✓		✓	

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Thank You!

Utility Provider Perspectives

Roy M. Palk
New Horizons Consulting

Traditional Power Planning Models Are Evolving

- Historically, has been utility initiated via I.R.P.
- Delivery from central station supply model
- Tariffs were almost totally energy recovery
- Very little attention to demand/capacity side
- Changing model sometimes creates panic

Disruptive Doesn't Have to be Destructive

- Distribution connected generation
- Various technologies
- May or may not be owned by the utility
- PPAs becoming more commonly used
- Smart utilities partnering with their customer

Changes in the Energy Planning are Also Affecting the Capital and Financing Industry

- Historically, debt amortization and PPA were co-terminus, exact 1-1 match, all-requirements contract between utility and customer
- Today's model becoming less all-requirements, generation may be distributed, may be connected to the distribution grid

For Utilities - How to be a Passenger on the Train Rather Than in Front of It

- Engage with customers, don't resist changes
- Look for win-win scenarios
- Seek ways to share customer-owned resources
- Study behind-the-meter utility-owned options
- Don't make market changes a contest of wills, realize the customer will eventually win
- Consider off-balance sheet approaches

For Customers—
You, the Airport Operators

- ✈ Seek to understand the utility's concerns
- ✈ Open mindedness and look for partnerships
- ✈ View distribution connected or on-site generation as a mutual resource (peak diversity, use of PPAs)
- ✈ Compare off-balance sheet financing with bonds plus other advantages of a third-party partner

Operations & Technical Affairs Workshop

Thank you!

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