

# Emerging Technologies and Trends in GESPC



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# Why ESPC and Why Solar Photovoltaic?



- Hawaiian islands are the most remote islands in the world
- Hawaii has the highest utility rates in the nation
- Each island has its own generation capacity and electrical grid
- There is no interconnection of grids between islands
- 90+% of electricity is generated via fossil fuel
- Billions of dollars leave Hawaii annually for fuel costs alone
- Renewable energy and sustainability are key to keeping these dollars at home
- State is committed to renewable technology and sustainability
- Governor Ige's goal is to become carbon neutral by 2045
- State committed to energy savings performance contracting as an important tool towards achieving this goal

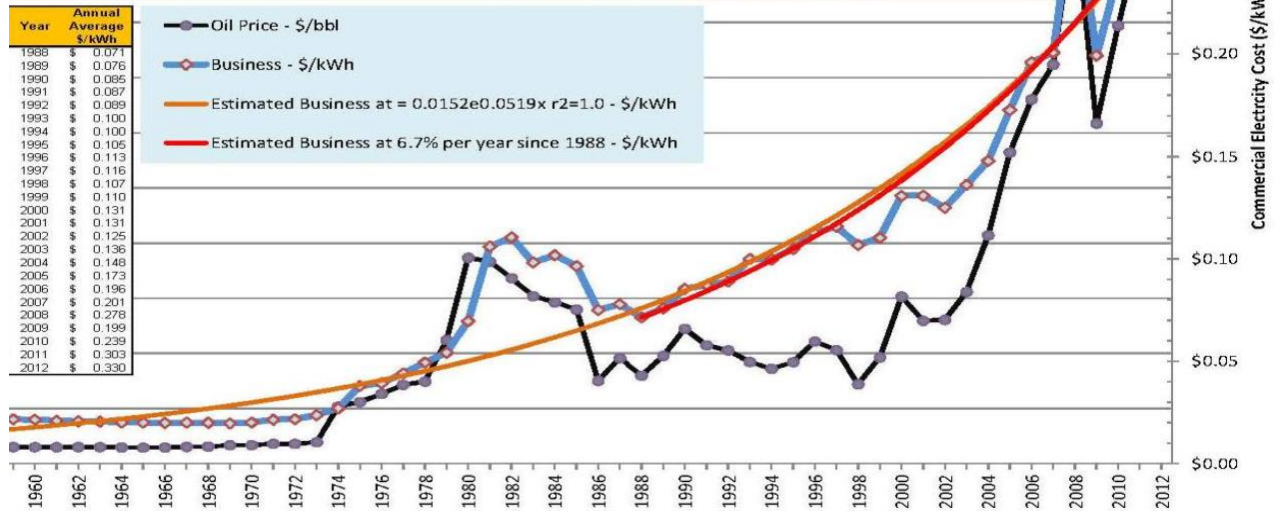
# Rising Electricity Prices are a Burden for Businesses



## State of Hawaii - Historical Business Electricity Cost 1958 to 2012 YTD (Sep. 2012) - \$/kWh

### Notes:

1. Figures are in real dollars with no inflation adjustment.
2. Combined Average for Hawaii Island, Kauai, Lanai, Maui, Molokai, and Oahu.
3. Hawaii Energy derived estimates are provided for review and discussion purposes only. Time series data are not fully notated or researched verified and it not intended to be used for critical budgeting and planning purposes as a prediction of future electrical costs.
4. Business Cost Data 1958 to 2010 State of Hawaii DBEDT from [http://hawaii.gov/dbedt/info/economic/databook/Data\\_Book\\_time\\_series/](http://hawaii.gov/dbedt/info/economic/databook/Data_Book_time_series/)
5. Business Cost Data 2011 to 2012 YTD (Sep. 2012) from State of Hawaii DBEDT [http://hawaii.gov/dbedt/info/economic/data\\_reports/energy-trends/](http://hawaii.gov/dbedt/info/economic/data_reports/energy-trends/)
6. West Texas Intermediate Spot Oil Price from Forecastchart.com <http://forecastchart.com/chart-crude-oil.html>





# 2012 Large Service Electricity Costs in Hawaii



Twelve Month Average of Utility Rates

Rate Name	\$/kWh	\$/kW
<b>Oahu – HECO (Hawaiian Electric Company)</b>		
'G' – GENERAL SERVICE NON-DEMAND	\$ 0.32	\$ -
'J' – GENERAL SERVICE DEMAND	\$ 0.28	\$ 11.50
'P' – LARGE POWER SERVICE	\$ 0.26	\$ 22.97
<b>Hawaii – HELCO (Hawaii Electric Light Company)</b>		
'G' – GENERAL SERVICE NON-DEMAND	\$ 0.42	\$ -
'J' – GENERAL SERVICE DEMAND	\$ 0.35	\$ 10.25
'P' – LARGE POWER SERVICE	\$ 0.32	\$ 19.50
<b>Maui – MECO (Maui Electric Company)</b>		
MAUI 'G' – GENERAL SERVICE NON-DEMAND	\$ 0.38	\$ -
MAUI 'J' – GENERAL SERVICE DEMAND	\$ 0.34	\$ 8.56
MAUI 'P' – LARGE POWER	\$ 0.31	\$ 18.69
LANAI 'G' – GENERAL SERVICE NON-DEMAND	\$ 0.48	\$ -
LANAI 'J' – GENERAL SERVICE DEMAND	\$ 0.46	\$ 8.55
MOLOKAI 'G' – GENERAL SERVICE NON-DEMAND	\$ 0.50	\$ -
MOLOKAI 'J' – GENERAL SERVICE DEMAND	\$ 0.43	\$ 8.82
<b>Kauai – KUIC (Kauai Island Utility Cooperative)</b>		
'G' - GENERAL LIGHT & POWER SERVICE (Small Commercial):	\$ 0.43	\$ -
'J' - GENERAL LIGHT & POWER SERVICE (Large Commercial):	\$ 0.40	\$ 6.62
'P' - LARGE POWER (Secondary)	\$ 0.37	\$ 11.14

# State of HDOT Airports in 2012



- Airports budget was unsustainable
- Budgets were not tracking increased utility costs
- “Steal from Peter to pay Paul” to balance budgets – promoted increased deferred maintenance
- Increasingly difficult to maintain mission
- Desire to make a difference

**The mission of the Airports Division is to develop, manage and maintain a safe and efficient global air transportation organization. 15 Airports, including Daniel K. Inouye International Airport (HNL), make up the Airports Division.**

# HDOT-Airports 2012 Baseline Electricity Use



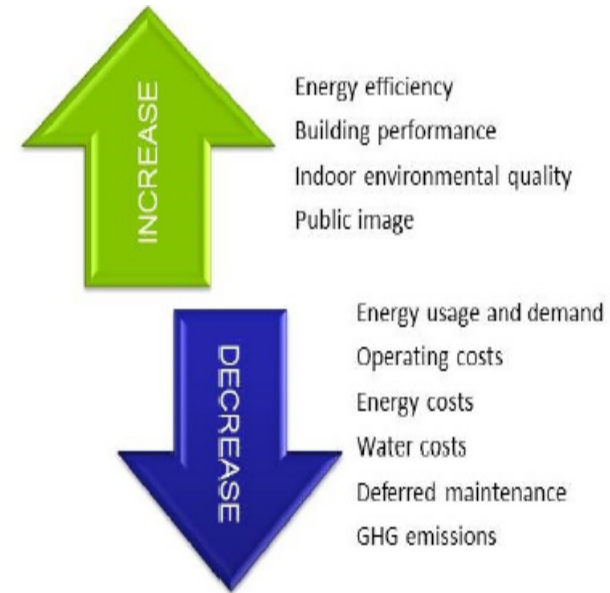
- Electricity costs at 12 Airports:
  - \$34,224,731 annual costs
  - 123,326,151 kWh consumed, 17.5 MW monthly demand
  - Range from \$0.26 to \$0.50 per kWh energy charge
- Five Airports use 99% of this electricity:
  - Daniel K. Inouye International Airport (HNL)
  - Kahului (OGG)
  - Lihue (LIH)
  - Kona (KOA)
  - Hilo (ITO)

# HDOT-Airports Vision



Part of the Department of Transportation's vision is to transform Hawaii's airports into world-class facilities to meet the needs of residents and visitors

- To increase energy efficiency and building performance with the goal of reducing energy usage and demand
- To improve management and efficiency of utility usage through monitoring and submetering
- Reduce facilities life cycle costs including: maintenance, equipment replacement, energy and water utilities, waste disposal, emergency power outages, etc.
- To improve indoor environmental quality for occupants
- To address deferred repair and maintenance projects





# HDOT Airports Energy Savings Project



- Largest single state energy savings performance contract (ESPC) to date executed through two phases
- Started in 2011 with competitive bid for development phase
- Resulted in a 20-year ESPC between the HDOT – Airports and Johnson Controls, Inc. (JCI)
- Construction of Phase 1 started in January 2014 and was completed in January 2016
- Phase 2 started in March 2017 and was completed last month
- JCI installed \$206.8 million of energy efficiency projects to reduce electric and water utility bills by 52% (estimated savings of \$22.3 million at the end of this fiscal year, FY19)
- Significant amounts of solar photovoltaic - 6.35MW capacity and 3.2 Million kWh annual savings



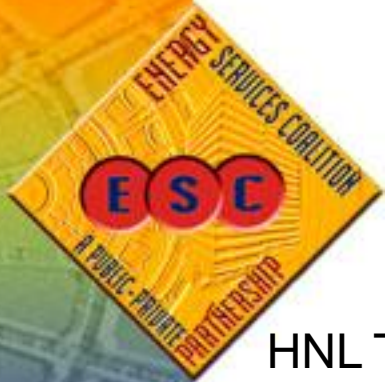
# HDOT- Airports Benefit From Large-Scale PV Installations



<u>Project / Site</u>	<u>Total Modules</u>	<u>System DC- kW</u>	<u>System AC- kW</u>	<u>Module Type</u>
<b>HIDOT Airports Phase 1</b>	<b>8,706</b>	<b>2,644</b>	<b>2,150</b>	
<b>Daniel K. Inouye International Airport (HNL)</b>				
Inter Island Terminal (IIT) 3rd Floor	300	138	400	TRINASMART DC-TSM-PD14.002 (300W)
Inter Island Terminal (IIT) 7th Floor	1,536	421		TRINA-TSM-PD14 (305W)
Central Concourse	2,370	711	700	TRINASMART DC-TSM-PD14.002 (300W)
<b>Kahului Airport (OGG)</b>				
Check-In / Baggage Claim	3,408	1,039	900	JA SOLAR JAP6-72-305/3BB (305W)
Baggage Handling	492	153		JA SOLAR JAP6-72-310/3BB (310W)
<b>Hilo Airport</b>	600	183	150	JA SOLAR JAP6-72-305/3BB (305W)
<b>Airports Phase 2</b>	<b>12,592</b>	<b>5,330</b>	<b>4,202</b>	
HNL Site 1A - Terminal 1 (IIT Garage)	4,260	2,002	1,602	SunPower X470W
HNL Site 4 - Terminal 3 (OST Roof Top)	5,352	1,927	1,472	SunPower X360W
HNL Site 6B - Overseas Garage	2,980	1,401	1,128	SunPower X470W
<b>GRAND TOTAL</b>	<b>21,298</b>	<b>7,974</b>	<b>6,352</b>	

Source: Johnson Controls, Inc.

# Phase 1 at HNL and Kahului



HNL Terminal 2 – Central Concourse  
Installed 2015



Kahului Ticketing and Baggage Claim Roof  
Installed 2015



# Phase 2 PV at HNL

Parking Canopies and International Terminal Roof



# HDOT-Airports PV Costs and Annual Savings



<u>Project / Site</u>	<u>Total Cost</u>	<u>Annual kWh Guarantee</u>	<u>Annual Savings</u>	<u>Payback Period</u>
<b>HIDOT Airports Phase 1</b>	\$ 25,258,546	3,222,522	\$ 931,127	27.1
<b>Daniel K. Inouye International Airport (HNL)</b>				
Inter Island Terminal (IIT) 3rd Floor				
Inter Island Terminal (IIT) 7th Floor	\$ 12,736,143			
Central Concourse				
<b>Kahului Airport (OGG)</b>				
Check-In / Baggage Claim	\$ 11,178,485			
Baggage Handling				
<b>Hilo Airport</b>	\$ 1,343,919			
<b>Airports Phase 2</b>	\$ 24,894,764	7,989,120	\$ 1,606,385	15.5
HNL Site 1A - Terminal 1 (IIT Garage)	\$ 8,491,585			
HNL Site 4 - Terminal 3 (OST Roof Top)	\$ 7,059,424			
HNL Site 6B - Overseas Garage	\$ 9,343,755			
<b>GRAND TOTAL</b>	<b>\$ 50,153,310</b>	<b>11,211,642</b>	<b>\$ 2,537,512</b>	

Source: Johnson Controls, Inc.



# HDOT-Airports PV Performance FY19 Results



HDOT-Airports Solar Photovoltaic Site	Actual FY19 Measured Savings		
	kWh	kW	\$\$\$
Daniel K. Inouye International Airport (HNL)	1,705,686	1,620	\$ 589,303
Kahului Airport (OGG)	1,805,992	1,484	\$ 739,384
Hilo Airport (ITO)	175,550	154	\$ 72,997
<b>Totals</b>	<b>3,687,228</b>	<b>3,258</b>	<b>\$1,401,684</b>

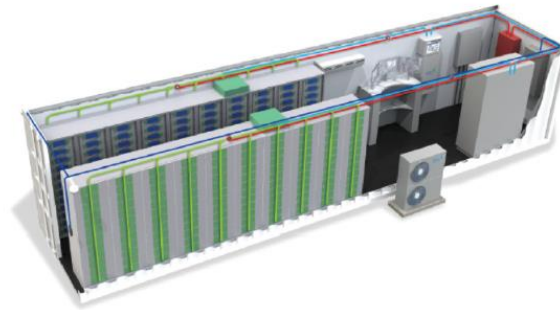
Source: Johnson Controls, Inc.

- FY19 – July 2018 to June 2019
- Exceeds guarantee by 14.4%
- Third year of production
- Previous year exceeded production by double digits
- Phase 2 PV Systems came on-line in July 2019

# Hawaii DOT Airports Energy Savings Project

## Distributed Energy Storage System

L2000 Modular Container



- Self-contained modular battery storage system
- Capacity of 1000 kWh with a 250 kW inverter (DC to AC)
- Store and release energy gathered through the PV arrays
- Increase the overall kWh savings by reducing the impact of PV curtailment
- Excess power used to charge the batteries when building demand is low and PV output is high
- Battery will provide power back to the building (discharge) when the PV output is low and building demand is high

# HDOT-Airports Environmental Impact



Total Reduced  
GHGs

**8,334.5**

*metric tons CO<sub>2</sub>-e*

\*

## Carbon Equivalents



Equivalent to emissions offset by **213,706** trees planted in an urban area and allowed to grow for ten years\*



Project will reduce emissions equivalent to **1,594** passenger vehicles over its lifespan\*



Equivalent to the electricity used by **1,723** homes for one year\*\*



Equivalent to **19,383** barrels of oil per year\*

\*Source: Johnson Controls, Inc.

\*\*Source: Hawai'i State Energy Office

# Conclusions



- Price of power is a driving factor for installing PV in Hawaii
- ESPC offers a great opportunity when capital is unavailable
- Environmental factors are also driving PV + storage
- PV technology is improving with panel production capacity increasing and prices dropping



# Mahalo!



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