OpConnect: The Ko'olani

Honolulu, Hawaii

Property Profile

The Ko'olani is a high-rise condominium building with 376 residential units (Figure 7). There are five underground parking levels for residents and two levels above ground for commercial parking. The building is located in the heart of Honolulu, roughly halfway between Diamond Head and Honolulu Harbor.

Two charging stations (also referred to as electric vehicle charging equipment [EVSE]) were installed in 2016 outside of the parking structure in shared parking spaces. Charging station use was originally open to residents and the public but has since been restricted to residents only and expanded to three total ports to improve availability for residents. As of 2021, approximately 10% (~35) of the building's residents drive electric vehicles (EVs). The shared charging approach, managed by the OpConnect system has been effective at conveniently providing the needed charging. However, users have indicated they want more charging stations to increase availability/convenience. The property has more than

Figure 1: Exterior of The Ko'olani condominium building

a dozen guest spots. It is rare for all of the shared spaces to be full. The property has not had issues/complaints with not having enough visitor parking because of the loss of the shared spaces.

Charging Barriers

The Ko'olani's management company, Hawaiian Properties, researched networked charging station/service providers to find the best fit for cost, capability, and service for shared use charging stations for their residents. Limited on-site electrical capacity dictated the need for shared charging. They looked at the leading networked charging station/service providers and needed an option that provided flexibility to expand, given very limited electrical capacity. The availability of ongoing service/maintenance was important given Hawaii's remote location. OpConnect's locally authorized repair staff and response time to service requests were key factors in the selection of OpConnect.

The Ko'olani installed the OpConnect charging stations as an amenity to attract and retain residents. Covering operational costs is a goal of the property management, making revenue from the charging stations is not a primary goal.

Given the ongoing desire for more charging, the building is planning on electrical upgrades to allow condo owners to also have the option to install their own charging station(s), however each resident will be required to pay the full installation cost for these individual stations.

Technology Solution Summary

OpConnect (http://opconnect.com/) provides the charging stations, its cloud-based software platform that provides data collection, control, data analytics, payment processing, and scheduling and maintenance ticketing for the charging stations, and support services for customers using the system. In most cases, the multi-unit dwelling (MUD) property owns the charging stations, so OpConnect gives the MUD control over setting the pricing policies (per unit of time, per kilowatt-hour [kWh], per session, or flat monthly fee) to meet their needs (e.g., cover costs or revenue generation). OpConnect's portal is used to implement the access-control and pricing with flexible controls that allow for setting different profiles based on time of day, weekday/weekend, for up to nine time periods (e.g., midnight - 6 a.m.) during the day. Charging station access can be granted to different user groups (e.g., residents and public) at different times, and with different pricing.

OpConnect resells non-networked EV charging stations manufactured by several leading manufacturers to provide MUD properties/users flexibility to select the charging station that meets their requirements (cost, design, etc.). OpConnect's system includes a utility grade electric meter to collect usage data on each charging station. As a result, OpConnect has upgraded the functionality of high quality, low-cost, non-networked charging stations (from Clipper Creek) into fully featured "smart" charging stations.

OpConnect's system (Figure 8) can be used for both shared-access charging stations (e.g., common parking areas) and for dedicated use (e.g., in residents' parking spaces). OpConnect can either bill residents directly and pay back the MUD property (less fees) or the MUD property can bill residents directly.

Figure 2. OpConnect dual-port charging station at the Ko'olani

Each station is wired directly to the electrical distribution panel. If there is enough power is available, each can provide full power. OpConnect's energy management functionality manages the load from all of the charging stations at the panel and/or transformer level to maintain a safe power draw, reducing the output of stations when necessary.

Load balancing and load management are key features. Load balancing is used to establish charging schedules to maximize vehicles charging during times of low building load (e.g., overnight). The system can be programmed to include a load profile for other building equipment to determine the optimal times/method to charge vehicles. Load management among charging stations to maintain the load limit below the threshold can be done in a variety of ways. A simple first in-first out (FIFO) approach can be used where charging for vehicles that are connected last are delayed until an earlier vehicle completes its charge and sufficient power is available. The load management can also use a balanced charging approach where power is shared among the connected charging stations. One result is the ability to support a larger number of charging stations than would be possible with an unmanaged system. The OpConnect system can be programmed for rate structures such as time-of-use rates and to participate in utility programs to respond to demand response/OpenADR commands.

OpConnect's user experience has led to its use of a queue-based reservation system, rather than one where users reserve a specific time. Users interact with the charging stations via OpConnect's mobile app. The app is used to view real-time charging station status, start a charging session, view the charging session status, enter the reservation queue, receive messages from the system (e.g., charge complete or charging station available).

MUD properties frequently have concrete parking structures (above or underground) so poor network signal often requires expensive networking equipment to boost/relay signal around the garage to the charging stations. **A key OpConnect innovation is its use of Bluetooth to connect to a driver's phone, via the OpConnect app to the charging station.** Charging station data transfer, charging session history, billing, utility pricing signal, etc. are transferred between the devices when the user's cell phone has a cellular network connection (then or later). The result is simpler installation without network requirements – the site only needs to mount the charging station and connect power. The Bluetooth enabled units are planned stations located in The Ko'olani's residential garage

Charging Analysis

The Ko'olani provided charging data for more than 1,200 sessions and 14,000 kWh of total usage, with an overall average session consumption of 12.7 kWh. Figure 3 shows the distribution of charging sessions. Given the strictly enforced (except for overnight) 4-hour charging limits, very few sessions exceeded 30 kWh.
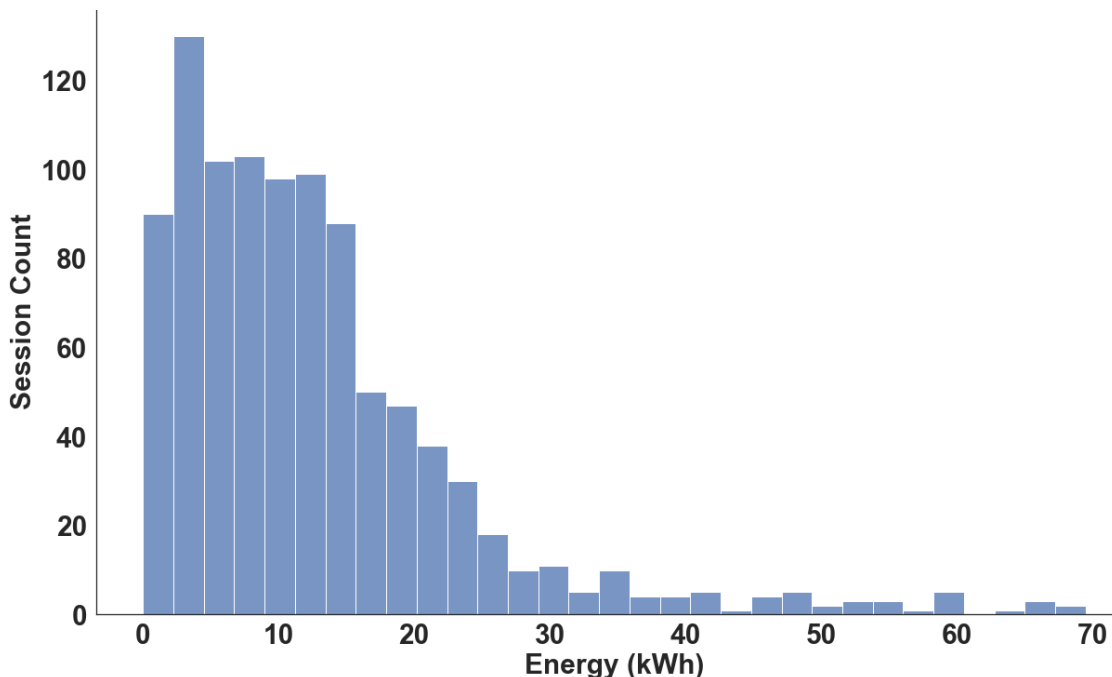

Figure 3: Distribution of energy usage (session counts binned by kWh)

OpConnect's user app notifies users when the vehicle had completed charging, and requests them to move their vehicle were quite effective, as shown in Figure 4. The average session duration exceeded the

active charging time by approximately 15 minutes. The graph excludes overnight sessions, between 10 p.m. and 7 a.m., when time limits are not in effect.
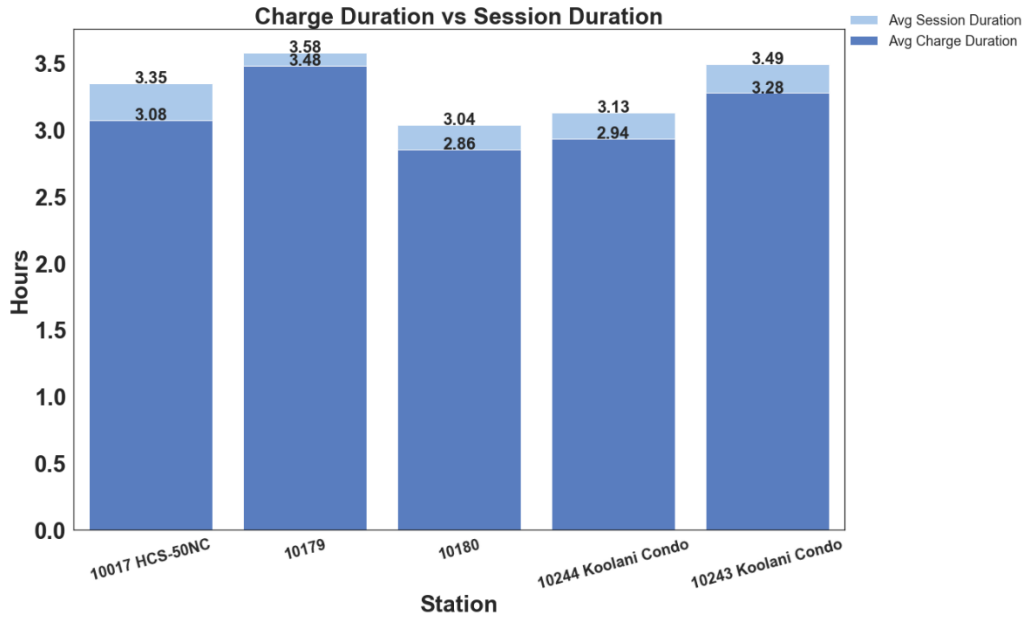

Figure 4: Comparison between average charge and average session duration. Charge duration is characterized by the amount of time that energy is being supplied to a vehicle and session duration refers to the amount of time that the vehicle is connected to the station

There was not an apparent decline in charging from the pre-COVID period (late 2019/early 2020) (Figure 5). However, the total combined charging station usage increased in late 2020/early 2021, with many days exceeding 10 hours, and sometimes even 20 hours of total charging time. This is likely a result of additional EV drivers as well as increased driving.
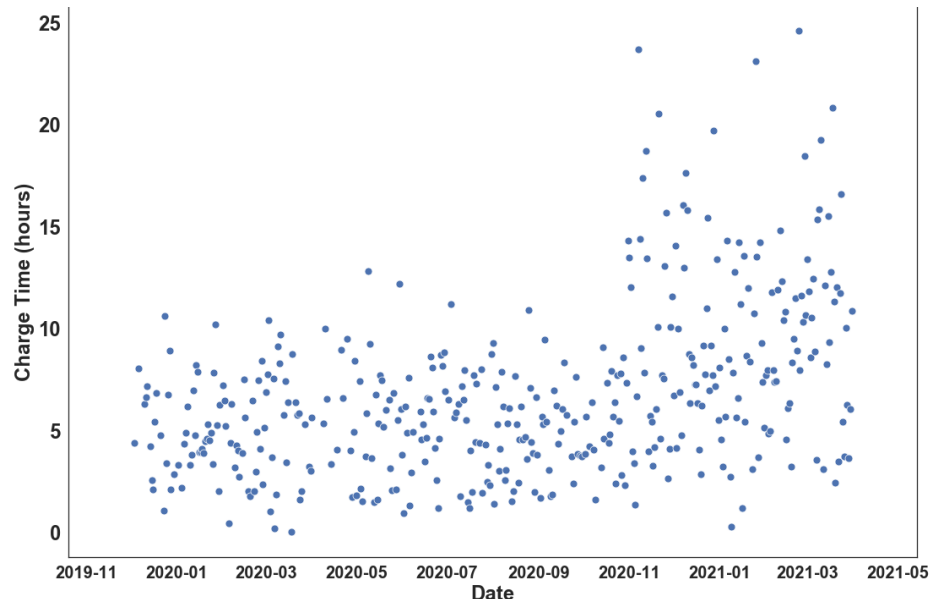

Figure 5. Each point represents the amount of time that vehicles were charging in a 24-hour period

Business Case Analysis

The Ko'olani charges $4/hour and covers the electricity cost plus some of the OpConnect fees. The Ko'olani sets its station usage policies to maximize use. The stations have a strict 4-hour maximum. A 15-minute grace period is allowed post-session (indicated by a message from the OpConnect app/text message) for users to move their car. After that, a $25/hour idle fee is assessed. Users have been receptive to the idle fee approach to encourage users opening the charging station up for others to use. The fee has rarely been assessed.

OpConnect has several business model/billing options to meet customers' needs and offers the property management full flexibility in setting fees. The station owner pays OpConnect a monthly fee ($/month/station) to be connected to OpConnect's software platform for management. The platform also collects usage data and provides data analytic services to allow MUD property owners to understand the charging station's use and to determine optimal pricing structures for pay-for-use charging stations. OpConnect also collects a percentage of the revenue collected by pay-for-use charging stations.

This business case analysis summary using the available provided data includes the following components:

1) <u>Initial costs:</u> charging station capital cost, charging station installation cost, electrical infrastructure work cost, and commissioning/activation costs

2) <u>Monthly costs:</u> electric costs, charging station service provider fees, charging station usage fees, and MUD property revenue

Here we compare the initial costs, operating costs, and revenue generation of the OpConnect charging stations to those of other standard high- non-networked charging stations.

At the time of the demonstration The Ko'olani had two OpConnect Mark II networked charging stations charging stations with cable management: 1) one single-port and 2) one dual-port; three charging ports total. The cost comparison reflects this installation configuration for all technology examples. OpConnect has retired the Mark II station model, so to present a current example, the cost analysis was done using comparable current charging station models. This included three (3) OpConnect HCS-40-N-B charging station units.[1] OpConnect uses Clipper Creek charging stations and adds functionality via a network interface card and software. The same base Clipper Creek charging station and installation configuration was used for the non-networked station costs. The business case analysis uses the same installation configuration as at The Ko'olani and the same standard alternative technology options other innovative charging technology business case analyses for all technology examples for consistency.

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[1] The HCS-40-N-B is a <u>40</u>A, <u>N</u>etworked, with <u>B</u>luetooth connectivity

Initial Costs

Table 1 shows a breakdown of the initial one-time costs to purchase and install each charging station option. Four options are shown: 1) the Vehicle Charging Innovations for Multi-Unit Dwellings (VCI-MUD) project innovative charging hardware option; the OpConnect system, 2) a typical standard high-feature public-access type charging station; the ChargePoint CT-4000, 3) a typical standard medium-feature MUD-property type charging station; the ChargePoint CPF-50, and 4) a typical standard non-networked charging station; the Clipper Creek HCS-40. All technology options require the same electrical power, so the electrical infrastructure costs were assumed to be the same.

Table 1. The Ko'olani charging station options initial cost comparison

INITIAL COSTS				
EVSE Type	**VCI-MUD Innovative Charging Technology**	**High-Cost/ Feature**	**Low-Cost/ Feature**	**Non-Networked**
Example Model	OpConnect HCS-40-N-C	ChargePoint CT-4000	ChargePoint CPF-50	Clipper Creek HCS-40
Charging Station	$6,285	$12,220	$7,785	$3,653
EVSE Installation	$2,370	$2,400	$2,400	$600
Electrical Infrastructure	$5,403	$5,403	$5,403	$5,403
Commissioning	$225	$698	$0	$0
TOTAL INITIAL COST	**$14,283**	**$21,586**	**$16,453**	**$10,521**

Monthly Costs and Revenue

OpConnect allows the MUD property to set their own charging session pricing structure. Usage fees can be set to offset the charging station costs, or higher to generate revenue. The Ko'olani currently charges residents $4/hour. There is also a $25/hour idle fee to incentivize residents to move vehicles after the session is finished to make the station available to others. The Ko'olani Condos stated that residents typically move their vehicles quickly, so this fee has rarely been assessed. The same session pricing scheme was assumed for the other charging station types, except for the non-networked unit where billing residents is not an option. Table 2 shows a breakdown of the monthly costs involved with each charging station option and monthly revenue generated from charging session fees. Net revenue is calculated as the monthly session revenue less service provider fees, and monthly electricity costs. Energy costs were calculated based on the assumption that electrical rates remain constant.

Table 2. Ko'olani charging station options monthly cost comparison

AVERAGE MONTHLY FEES				
EVSE Type	**VCI-MUD Innovative Charging Technology**	**High-Cost/ Feature**	**Low-Cost/Feature**	**Non-Networked**
Example Model	OpConnect HCS-40-N-B	ChargePoint CT-4000	ChargePoint CPF-50	Clipper Creek HCS-40
Subscription and Data	$80	$82	$55	$0
Maintenance	$59	$123	$50	$0
Warranty	$0[1]	$0[2]	$0[2]	$0
Energy Cost (kWh)	$132	$132	$132	$132
Demand Cost (kW)	n/a	n/a	n/a	n/a
Session Authorization & Processing	$20[3]	$0	$0	$0
TOTAL AVERAGE MONTHLY FEES	**$291**	**$337**	**$236**	**$132**
AVERAGE MONTHLY REVENUE				
Session Usage Fee	$4/hour	$4/hour	$4/hour	None
TOTAL SESSION REVENUE	**$403**	**$403**	**$403**	**$0**
NET REVENUE	**$112**	**$66**	**$167**	**-$132**

[1] Included in charging station purchase cost. Optional extended warranties for $995 and $1,995 (not included)

[2] Included in charging station maintenance fee

[3] $0.40 for Membership Access and $0.45 for Credit Card Access. The fee decreases with greater monthly transaction volume 5.0% for Membership Access and $6.0 for Credit Card Access. The fee decreases with greater monthly transaction volume

Estimated 10-Year Costs Summary

The total estimated costs for each EVSE type over 10 years are summarized in Table 3 and Figure 6. Costs were calculated under the assumption of double the current monthly usage for the entire 10-year period (anticipating increased demand in the future). The payback period is shown.

Table 3. Ko'olani estimated 10-year cost summary

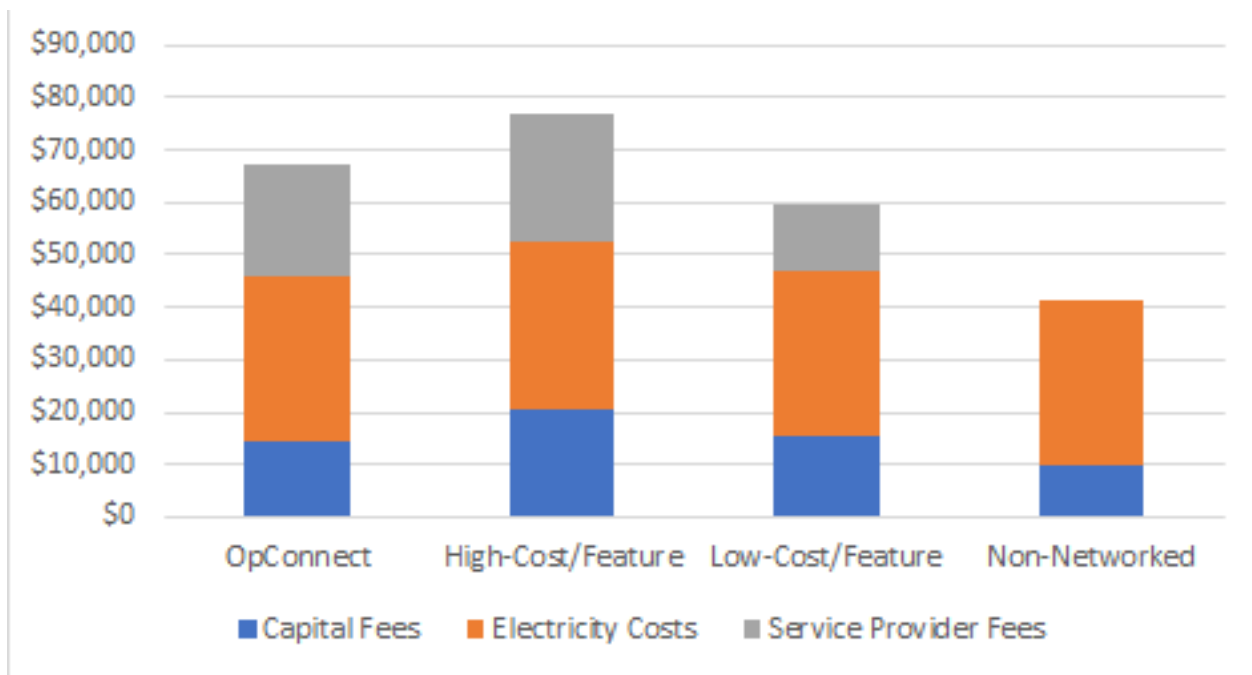| EVSE Type	VCI-MUD Innovative Charging Technology	High-Cost/ Feature	Low-Cost/ Feature	Non-Networked
Example Model	OpConnect HCS-40-N-B	ChargePoint CT-4000	ChargePoint CPF-50	Clipper Creek HCS-40
Capital Costs	$14,283	$20,721	$15,588	$9,656
Electricity Costs	$31,586	$31,586	$31,586	$31,586
Service Provider Fees	$21,616	$24,670	$12,570	$0
TOTAL COST	$67,484	$76,977	$59,744	$41,242
PAYBACK PERIOD	10 yrs., 8 mo.	26 yrs., 3 mo.	7 yrs., 10 mo.	n/a

Figure 6. The Ko'olani 10-year cost analysis summary plot

Cost Analysis without Location-Dependent

Some costs are installation-specific (region, state, building). These costs include permitting, electrical infrastructure upgrades/installation, charging station installation, and electricity. These costs vary by location but remain similar between EVSE type. Table 4 and Table 5 are modifications of Table 1 and Table 2 with the location dependent costs removed. The intent of this is to show a more equal comparison for VCI-MUD Toolkit users to build off for their specific location conditions.

Table 4. The Ko'olani Charging Station Options Initial Cost Comparison with Location-Dependent Costs Removed

INITIAL COSTS				
EVSE Type	VCI-MUD Innovative Charging Technology	High-Cost/ Feature	Low-Cost/ Feature	Non-Networked
Example Model	OpConnect HCS-40-N-B	ChargePoint CT-4000	ChargePoint CPF-50	Clipper Creek HCS-40
Charging Stations	$6,285	$12,220	$7,785	$3,653
Site Validation	$0	$599	$599	$0
Commissioning/ Network Activation	$225	$698	$0	$0
TOTAL INITIAL COSTS	**$6,510**	**$13,517**	**$8,384**	**$3,653**

Table 5. The Ko'olani charging station options monthly cost comparison with location-dependent costs removed

AVERAGE MONTHLY FEES				
EVSE Type	VCI-MUD Innovative Charging Technology	High-Cost/ Feature	Low-Cost/ Feature	Non-Networked
Example Model	OpConnect HCS-40-N-B	ChargePoint CT-4000	ChargePoint CPF-50	Clipper Creek HCS-40
Subscription and Data	$80	$82	$55	$0
Maintenance	$59	$123	$50	$0
Warranty	$0[1]	$0[2]	$0[2]	$0
Session Authorization	$9	$0	$0	$0
Session Processing	$11	$0	$0	$0
TOTAL AVERAGE MONTHLY FEES	**$159**	**$206**	**$105**	**$0**
AVERAGE MONTHLY REVENUE				
Session Usage Fee	$4/hour	$4/hour	$4/hour	None
TOTAL MONTHLY SESSION REVENUE	**$403**	**$403**	**$403**	**$0**
TOTAL NET MONTHLY REVENUE	**$244**	**$198**	**$298**	**$0**

[1] Included in charging station purchase cost. Optional extended warranties for $995 and $1,995 (not included)

[2] Included in charging station maintenance fee