

AGENDA
SPECIAL WORKSHOP MEETING
CITY OF BANNING
BANNING, CALIFORNIA

October 22, 2019
4:00 p.m.

Banning Civic Center
Council Chamber
99 E. Ramsey Street

I. CALL TO ORDER

Roll Call – Council Members Happe, Peterson, Wallace, Mayor Pro Tem Andrade and Mayor Welch

II. WORKSHOP

1. Integrated Resource Plan – lite (prepared by Black and Veatch)
Presentation by Tom Miller, Electric Utility Director

III. PUBLIC COMMENTS – *Opportunity for the public to address items on the Agenda*

IV. ADJOURNMENT

NOTICE: Pursuant to Government Code § 54954.3(a), the only public comment that will be permitted during this Special Meeting is that pertaining to items appearing on this special meeting agenda. Any member of the public may address this meeting of the Mayor and Council on any item appearing on the agenda by approaching the microphone in the Council Chambers and asking to be recognized, either before the item about which the member desires to speak is called, or at any time during consideration of the item. A five-minute limitation shall apply to each member of the public, unless such time is extended by the Mayor. No member of the public shall be permitted to “share” his/her five minutes with any other member of the public.

In compliance with the Americans with Disabilities Act, if you need special assistance to participate in this meeting, please contact the City Clerk's Office (951) 922-3102. **Notification 48 hours prior to the meeting** will enable the City to make reasonable arrangements to ensure accessibility to this meeting. [28 CFR 35.02-35.104 ADA Title II]

Pursuant to amended Government Code Section 54957.5(b) staff reports and other public records related to open session agenda items are available at City Hall, 99 E. Ramsey St., at the office of the City Clerk during regular business hours, Monday through Friday, 8 a.m. to 5 p.m.

The City of Banning promotes and supports a high quality of life that ensures a safe and friendly environment, fosters new opportunities and provides responsive, fair treatment to all and is the pride of its citizens.



Integrated Resource Plan - Lite

City of Banning

Banning Electric Utility

City Council Workshop

October 22, 2019

Planning Milestones



- Updated the 10-year Load Forecast 2018-2028
 - Pardee Homes completed in 10 years
 - No significant commercial or industrial additions
- Reviewed System Master Plan for 2004-2014
 - 4,160V to 12,470V conversion
 - Rebuilding Alola (Stagecoach) and Airport (Ivy) Substations
 - Automated Meter Reading and Advanced Metering Infrastructure
 - Fiber Optic Ring and SCADA
 - System Mapping
- 2005 Bond Issuance - \$45.8 Million
 - 2015 Bond Refinance - \$31.8 Million
- Updating the 5-year Financial Forecast 2019-2024
- Cost of Service Analysis in-progress 2019 historical year + 2020 Proforma
- General Fund Cost Allocation Model 2019
- Integrated Resource Plan – Lite for 2020-2030
 - Last Plan dated December 2003
 - San Juan Closing – 20 MW Baseload Capacity Resource
 - Biowaste Opportunities
 - Pardee Homes Microgrid
 - Local Generation Resources
 - CAISO - Resource Adequacy Requirements
- System Sectionalizing Plan
 - Distribution Automation
 - Automated Reclosers
 - Line Fusing
 - Voltage Support
 - Voltage Drop

Integrated Resource Plan External Influences

Energy
Efficiency
Requirements

1 Million Solar
Roof-Tops

Renewable
Portfolio
Standards

Green House
Gasses
Reduction

Net Zero
Building
Standards

De-
Carbonization
Goals

Transportation
Electrification

Technology
Improvements

Integrated Resource Plan - *Lite*

City of Banning dba Banning Electric Utility

Not required to have a full-blown IRP

- Small Utility Exemption
- Load and Customers

Good Utility Practices

- Legally equivalent to the “Prudent Man” Concept

Internal Influences

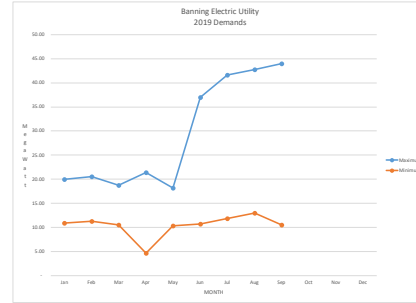
- City Manager – Biowaste Opportunities
- Electric Utility Director – Local Utility-Owned Generation
- Power Resource Manager – CAISO Resource Adequacy Requirements

Integrated Resource Plan - *Lite*

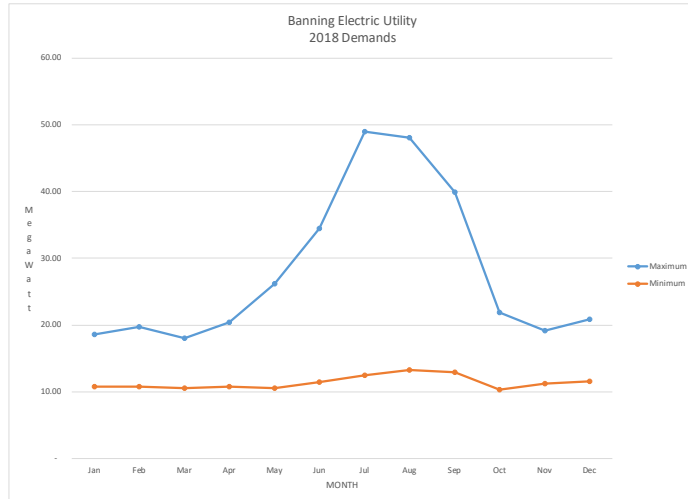
Piggy-Backed SCPPA's Contract with Black and Veatch (B&V) and issued a task order to develop a plan

B&V Deliverables included:

- Technology Assessment:
 - Solar, Wind, Biowaste, Microturbines, Fuel Cells, and Battery Storage
 - Report and Power Point Presentation of findings
- Energy Portfolio Modeling
 - 3 scenarios: Base load, expected load growth w/local generation, and resiliency (microgrid)
 - Power Presentation of findings
- Buy or Build Options
 - City ownership v. purchase power agreements



10 MW Minimum Load



Levelized Cost of Energy by Technology Summary

Technology	System Size	Economic Life (years)	Capital Cost (\$/kW)	Capacity Factor (%)	Fixed O&M Cost (\$/kW-Yr)*	Variable O&M Cost (\$/kWh)*	Fuel Cost (\$/MMBtu)*	Heat Rate (Btu/kWh)	LCOE (\$/MWh)-MUNI	LCOE (\$/MWh)-IPP
PV	10 MW	25	2,000	33	13	0	0	0	56	55
Wind	10 MW	25	2,888	14	40	0	0	0	206	354
Bioenergy- Small**	284 kW	25	27,025	85	0	0	0	15,000	245	483
Bioenergy-Large**	442 kW	25	22,155	85	0	0	0	15,000	201	396
Fuel Cells	1 MW	20	8,925	95	163	0	4	8,500	142	167
Microturbines	1 MW	20	4,325	92	175	0	4	10,300	116	138

*2% Escalation assumed
 **Low Case Revenue from non-energy sources is assumed to be only sufficient to cover the annual O&M cost and therefore the economic model assumes they net each other out.

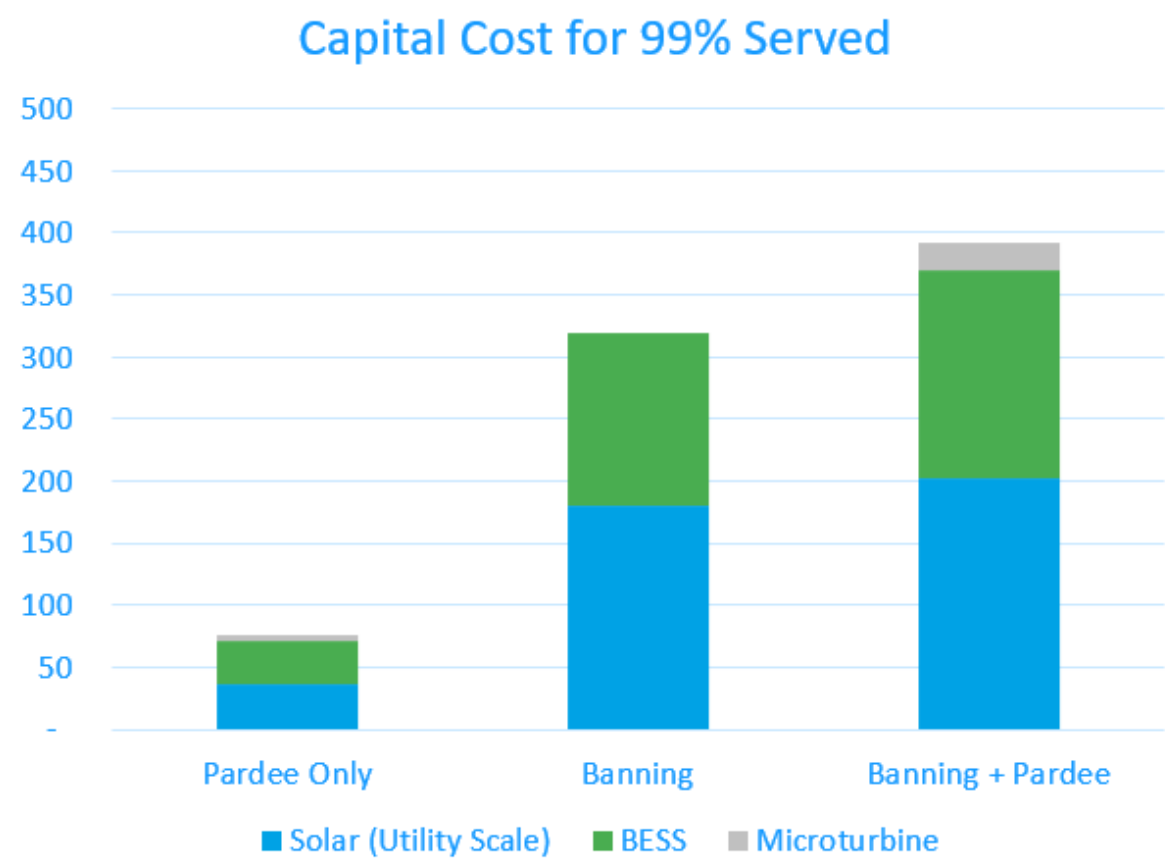
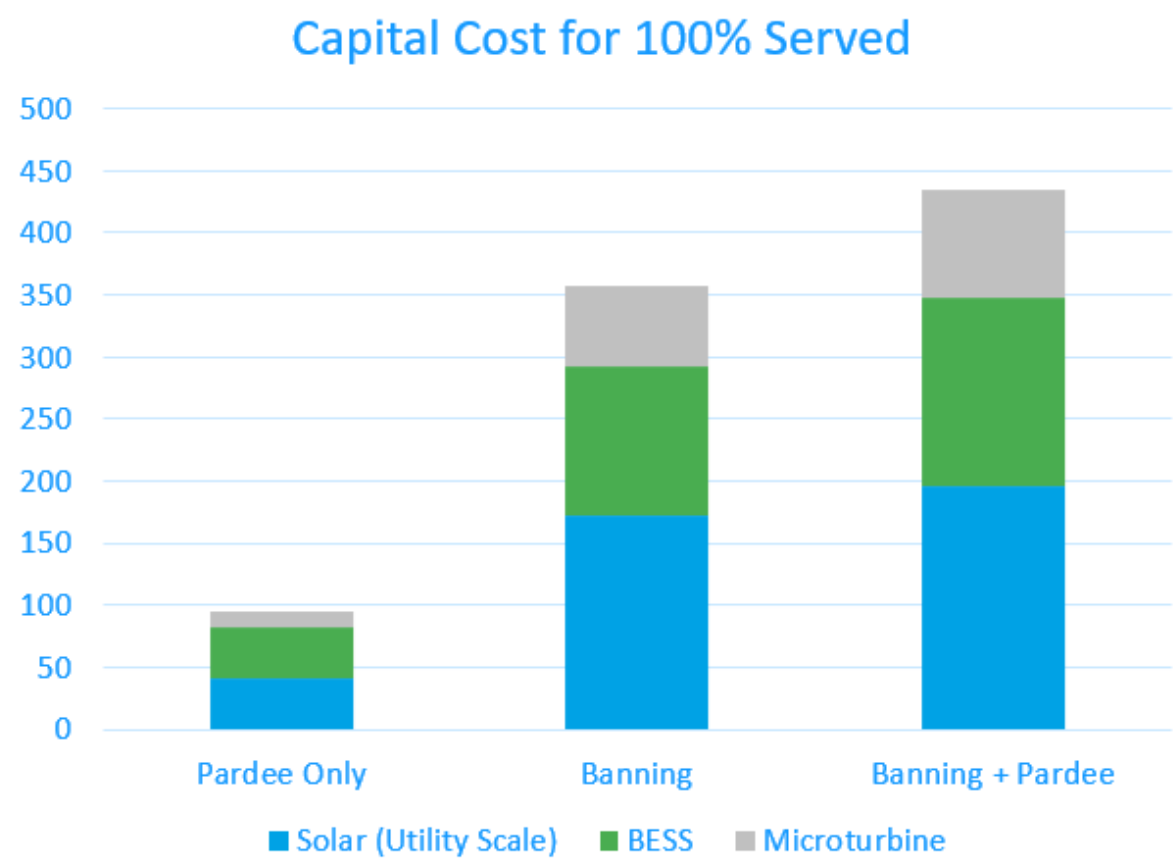
Task 1 Findings: Technology Assessment

- For a discussion starting point, we settle on 10 MWs of generation
- In B&V's expert opinion, a **utility scale** biowaste to energy project is not financially feasible.
- Photovoltaic generation is the most economically feasible technology based on the levelized cost of energy.
- The quality of the wind in the Pass Area is not adequate.

Task 2 Findings: Energy Portfolio Modeling

- Modelled multiple technologies to determine combinations as a Microgrid
 - Solar
 - Microturbines
 - Battery Storage
- Three cases:
 - Forecasted Load as of 2030 w/o Pardee Homes
 - Pardee Homes Load only
 - Forecasted load plus Pardee Homes (same as Itron load forecast)

Capital Costs by Scenario



Partial Microgrid Scenario (99% Served) requires lower capital.

Modeling Results for Microturbine Cases (Muni Ownership)

Scenario (100% Served)	Annual Load (MWh)	Utility-Scale PV Capacity (MW)*	Microturbine (MW)	BESS Capacity (MWh)	BESS Power (MW)	Cap Ex (\$ Mil)	LCOE (\$/MWh)
<u>Pardee</u>	42,996	28	3	136	21	\$ 95	\$ 228
Banning 2030	152,515	115	15	402	82	\$ 358	\$ 229
Banning 2030 + <u>Pardee</u>	195,511	131	20	507	80	\$ 434	\$ 218
(99% Served)							
<u>Pardee</u>	42,996	24	1	115	21	\$ 75	\$ 180
Banning 2030	152,515	120	0	463	82	\$ 319	\$ 195
Banning 2030 + <u>Pardee</u>	195,511	135	5	558	80	\$ 392	\$ 190

**Pardee Rooftop PV Capacity modeled is in addition to utility PV system listed above (rooftop PV modeled as a separate resource with zero capital and credit to customers equal cost of Utility-Scale PV); total capacity of 11.1 MWdc/ 9.3 MWac)*

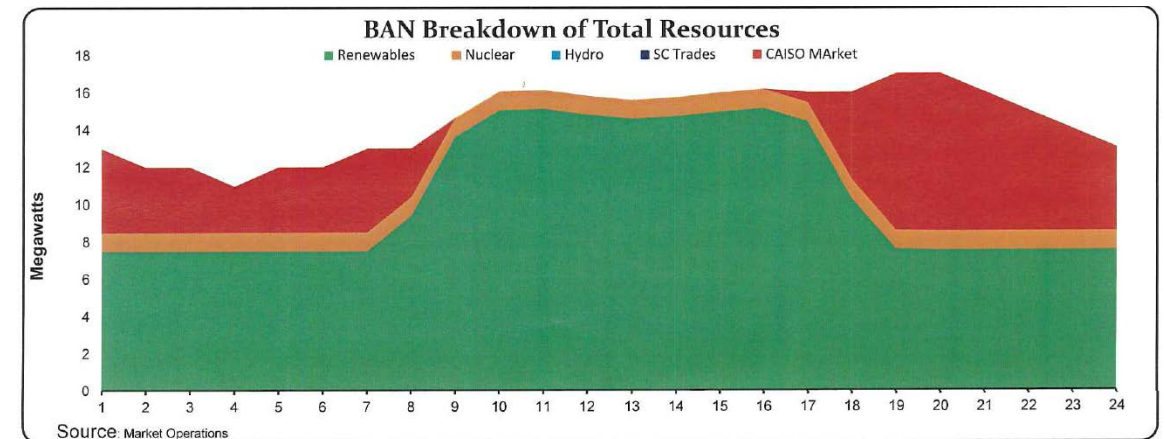
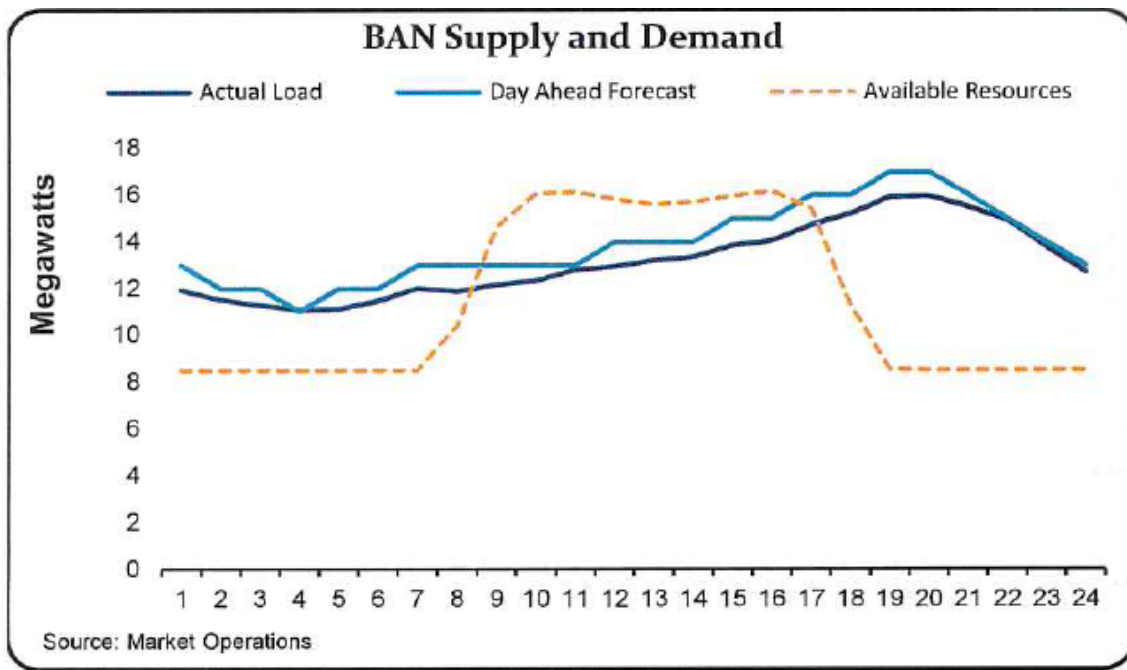
Substantially less microturbines are needed in partial microgrid case, resulting in LCOE savings.

Excess/Curtailed Solar Energy in All Scenarios

- Overgeneration of solar in all cases, modeled as curtailment
- Solar is oversized in each scenario because it appears to be more cost effective to overbuild PV to cover load during low solar resource and high load periods than adding more microturbine capacity.
- Sale of energy could potentially reduce LCOE

Excess/Curtailed Energy (MWh/yr)		
Scenarios	100% Served	99% Served
<u>Pardee</u>	45,543	37,251
Banning 2030	172,152	184,980
Banning 2030 + <u>Pardee</u>	169,645	181,582

A Routine Load Day in Banning



Overview of Resource Mix to Meet 2030 Load

- By 2030/2031, almost 11 MW of baseload energy is up for renewal
 - Landfill project will likely be retired
 - Geothermal contract will potentially be extended
- CAISO Market purchases = 58% of annual energy
- Excess energy sales from **Solar/Contracts?** = 37% of annual energy

Resources	Dispatch Priority	Contracted Capacity (MW)	Contracted Scheduled Delivery	Contract Expiration Year
Hoover Dam	Dispatchable to meet peak	2 MW, 1,847 Annually	Per Hoover Schedule B	2067
Palo Verde Nuclear Power Station	Baseload	2 MW	7x24	2045
Astoria 2 Solar	As generated	8 MW	As generated	2036
Puente Hills Landfill Gas-to-Energy	Baseload	9 MW but declining	7x24	2030
Heber South/Gould 2 Geothermal Project	Baseload	1.6 MW	7x24	2031
Anaheim - Ormat Project Firming	Firming to 2 MW	.4 MW	7x24	2031

Task 3 Results

2030 Resource Mix Considerations

- **Status of baseload RE contract renewals:** Depends on whether renewed contracts are also renewable baseload
- **RPS Requirement (60% by 2030):** Depends on RE baseload renewals and purchase of RECs-only
- **Value of Excess Energy Sales:** LCOE of Incremental Energy depends on this assumption.
- **Minimize Market Purchases:** Depends on expected cost of market purchases.

Case	Load Served	Baseload RE Contracts Renewed (MW)	Additional Solar (MW)	Percent Renewable Energy	BESS (MWh)	LCOE of Incremental Energy*(\$/MWh)	Excess Energy (MWh)	Market Purchases to Serve Remaining Load (MWh)
1	<u>Pardee</u>	2	0	28%	10	\$65	523	28,608
2	<u>Pardee</u>	9	0	60%	10	\$70	2,007	27,766
3	All Load	2	22	60%	100	\$86	3,661	81,323
4	All Load	9	0	60%	10	\$69	1,842	78,646
5*	All Load	9	10	74%	30	\$77	10,413	59,488

**Includes (rooftop PV modeled as a separate resource with zero capital and credit to customers that equal cost of Utility-Scale PV, counts toward RPS). Accounts for Excess Energy sales @ \$25/MWh*

Findings and Conclusions

- Solar and solar plus battery energy storage will likely be the most cost effective distributed energy resource (DER) options for Banning.
- Local wind will not be a good option due to poor resources, but opportunities to contract with non-local, utility-scale wind should still be considered.
- All of the other DER options (bioenergy, fuel cells, and microturbines), despite operating at baseload conditions, have much higher LCOE.
- Developing a microgrid to serve Pardee load or all of Banning by 2030 comes at a LCOE cost of \$180-\$220, resulting from need to oversize solar to meet seasonal needs and a large battery to store solar energy. A microturbine is still needed to cover the few hours of the year when solar plus BESS cannot meet load.
- A fully islandable, self-serving microgrid is likely not necessary for Pardee, especially at the estimated cost, but the availability of local generation and batteries to some degree will provide benefits during outages and emergency events.

Findings and Conclusions

- Given the pending expiration of up to 11 MW of baseload renewable energy, Banning needs to cover growing load by 2030 as well as meet California's renewable portfolio standard.
- In addition, Banning already faces surplus generation from existing solar contracts during all months except during the summer. This will be further exacerbated by Pardee, where almost 10 MW of rooftop solar on new homes is anticipated by 2030.
 - The sale of the excess energy may become problematic in 2030 when CAISO will see far more solar on the system, resulting in very low or negative value for the excess solar energy
- Based on the analysis, adding about 10 MWh of batteries will help mitigate part of the excess issues from anticipated solar. However, the amount of batteries need to be balanced against the forecasted value of the excess solar energy vs. procurement of market energy.
- Excess energy can be further minimized by procuring less baseload renewable energy than currently.

Recommendations

- Conduct a full IRP-like analysis that incorporates dispatch modeling and forecast market prices in 2030 and beyond, taking into account the renewable energy penetration across California. The cost of avoided market energy purchases will help inform the level of RE contracting.
- Consider building batteries totaling 5 to 10 MWh in the near-term to start capturing excess solar energy and strategically place batteries to provide local distribution system support where needed
- When baseload RE contracts expire in 2030/2031, seek to reduce the total capacity of the baseload contracts, provided the contracts are lower cost than solar plus battery storage (see Case 3).
- Consider exceeding the RPS requirement in 2030 by adding another 10 MW of solar and a larger battery (see Case 5 below), which will help reduce market purchases during the summer at a relatively modest LCOE. This also reduces reliance on market purchases from 40-45% to 30% of load.
- By 2030, a municipal financed model for solar plus battery storage could be more cost-effective than a 3rd party PPA, due to reduction in ITC, and should be considered.

Case	Load Served	Baseload RE Contracts Renewed (MW)	Additional Solar (MW)	Percent Renewable Energy	BESS (MWh)	LCOE of Incremental Energy*(\$/MWh)	Excess Energy (MWh)	Market Purchases to Serve Remaining Load (MWh)
5*	All Load	9	10	74%	30	\$77	10,413	59,488



Tom's Take-a-ways

We are going to miss the Investment Tax Credit due to timing

Replace baseload per B&V's recommendation

Consider adding battery storage in smaller increments in preparations for additional solar in 2030

Be patient

Attachment 1

SCOPE OF WORK

Task 1 – Technology Assessment

1.1 Project Management

1.1.1 Kick Off Meeting

Two Black & Veatch team members will participate in an initial 1-hour kickoff meeting via web conference call with the City. During the kickoff meeting, our project team will discuss and clarify the project objectives, based on the intent of the study. This will include discussion of such items as:

- Overview of the study process and methodology
- Confirm technology options to evaluate and factors to incorporate
- City load
- Coordination with Impact Bioenergy
- Project schedule milestones

Deliverables. Kick off meeting agenda, meeting minutes including action items and resolutions.

1.1.2 Bi-Weekly Meeting and Progress Reporting

Black & Veatch will conduct bi-weekly phone conferences, of an expected 30-minutes duration, to review current project status, review open Action Items, and work towards resolving ongoing issues. The meetings will be attended by key project team members from the Black & Veatch project team. Deliverables. Bi-Weekly progress reports including schedule updates.

1.2 Technology Assessment

Black & Veatch will provide a written request for relevant project data to be provided by the City prior to the kick-off meeting so that our project team can start reviewing the data to prepare for the meeting. Black & Veatch will review the existing development documents.

The following documents are expected to be initially provided by the City for Black & Veatch reference

- Current and forecast load
- Contracted resources
- City owned sites/land available for development
- City's cost of capital

Black & Veatch will work with the City to finalize a list of technologies and sizing to be considered for the study. The proposed list of the technologies is:

- Ground-mount Solar (Single Axis Tracking) – 10 MW
- Wind – 10 MW
- Bioenergy (Impact Bioenergy technology/Biomass Solution)
- Natural Gas Microturbines – 10 MW
- Stationary Solid Oxide Fuel Cells – 1 MW (or unit size close to 1 MW)
- Battery Storage – 1 MW/4 MWh system

For each of the technologies, Black & Veatch will estimate performance (hourly capacity factor/8760) assuming siting within the City of Banning, capital cost, fuel cost and O&M. These costs will be used to calculate levelized cost of energy (LCOE).

Is it assumed that performance and cost for the bioenergy option will be provided by Impact Bioenergy.

In addition to the LCOE, Black & Veatch will develop a technology matrix (qualitative comparison) to compare the various technologies. The matrix could include factors such as:

- Emissions
- Local job creation
- Potential revenue streams (e.g. tipping fees)
- Fuel availability (current and future)
- Eligibility for California's Clean Energy Act and other state goals

Tipping fees for biomass resources will be estimated using public information such as fees charged by local sanitation district and landfills. Natural gas prices (for microgrid and fuel cells) will be estimates using current market prices. Industry forecasts will be used to estimate future costs.

Black & Veatch will also perform a high-level review of the land available for development to inform the technical potential for solar and wind estimate.

Deliverables. PowerPoint detailing the analysis and results from Task 1.

Task 2 – Energy Portfolio Modeling

This task will develop 3 to 4 combinations of technologies that can reasonably meet a particular load profile specified by the City (modeling will be completed for one scenario only). Black & Veatch will work with the City to select a load scenario to be served by the local generation. Example load scenarios include:

- Base load for the City
- Expected load growth (the local generation would be used to serve future load growth not served by existing contracts)
- Resiliency scenario – load that should be covered in microgrid configuration in case of disturbance or outage of the Southern California Edison (SCE) feeder.

The City will also specify what planning year the portfolio is intended to address. HOMER modeling software will be used to conduct the analysis. Cost and performance characteristics from Task 1 will be used for the analysis.

Deliverables. PowerPoint detailing the analysis and results from Task 2.

Task 3 – Buy or build

Black & Veatch will also provide a comparison of the expected LCOE of a build scenario where the City owns and operates the projects vs. contracting through a power purchase agreement (PPA). We will comment on the potential risks and uncertainties related to each option.

Deliverables. PowerPoint summarizing the analysis from Task 3.

Execution Copy

IN WITNESS WHEREOF, the parties have signed this Task Order as of the date first written above.

SOUTHERN CALIFORNIA PUBLIC POWER AUTHORITY

By:

Michael S. Webster
Executive Director

Approved as to Legal Form and Content:

Richard J. Morillo
General Counsel

BLACK & VEATCH CORPORATION

By:

Jon R Feickert
Jon R. Feickert
Associate Vice President, Director

Participant's Acknowledgement and Agreement

The undersigned hereby attests that he has the requisite authority to bind the Participant to the obligations set forth in the Task Order and Participant agrees to reimburse SCPPA for all fees and expenses invoiced by Contractor and will be responsible for all payment obligations incurred by SCPPA in connection with the work performed at the direction of or on behalf of Participant. Participant agrees to hold SCPPA and all other SCPPA members harmless for payment for work performed at the direction of, and for the exclusive benefit of Participant. Participant agrees that the Services are provided to Participant subject to the provisions of the Agreement and Participant agrees to be bound by the limitations, waivers and restrictions in the Agreement with respect to the Services.

CITY OF BANNING

By:

[Signature]
TOM MILER
General Manager

Thomas Miller

From: Khangura, Jagmeet K. <KhanguraJK@bv.com>
Sent: Thursday, April 25, 2019 12:14 PM
To: Thomas Miller; Jim Steffens
Cc: Hong, Mon
Subject: Task 1 Final Document and Meeting Notes
Attachments: Final Task 1 Technology Evaluation April 25.pdf

Tom/Jim,

Please find attached the Final deliverable for Task 1 and notes from our meeting (see below). Let us know if we you have any corrections or concerns.

Meeting Notes

- Confirmed that 4.5% discount rate is representative for City of Banning
- City of Banning can only purchase power from ISO, no export. This will impact the ability to participate in ancillary services.
- Microturbine modeled as baseload for LCOE comparison but will be used for peaking in next phase of the project.
- Minimal load growth, 5-7 MW in peak load over the next 10 years
- City to connect Black & Veatch with ImpactBio to for further discussion
 - Revenue stream assumptions
 - Potential to support 10 MW facility
- After meeting, BV discussed internally and anticipates a 10 MW project will not be possible in the region, given the extensive amount of feedstock needed. Perhaps a 5 MW project would be more practical. From a community perspective, a 10 or 20 fold increase in feedstock means that there will be much more dump truck traffic, which some communities will not appreciate
- Modeling for Task 2
 - Exclude small biomass and wind
 - 10 MW Biomass facility, cost input from ImpactBio
 - Model 2 Loads both 10 Year out – 1) generation for Load growth & 2) Full load

Thank you,
Jagmeet.

Jagmeet Khangura, P.E.*
Microgrid Solutions Lead, Power

*Licensed in CA

Black & Veatch | 2999 Oak Road, Suite 490, Walnut Creek, CA 94597

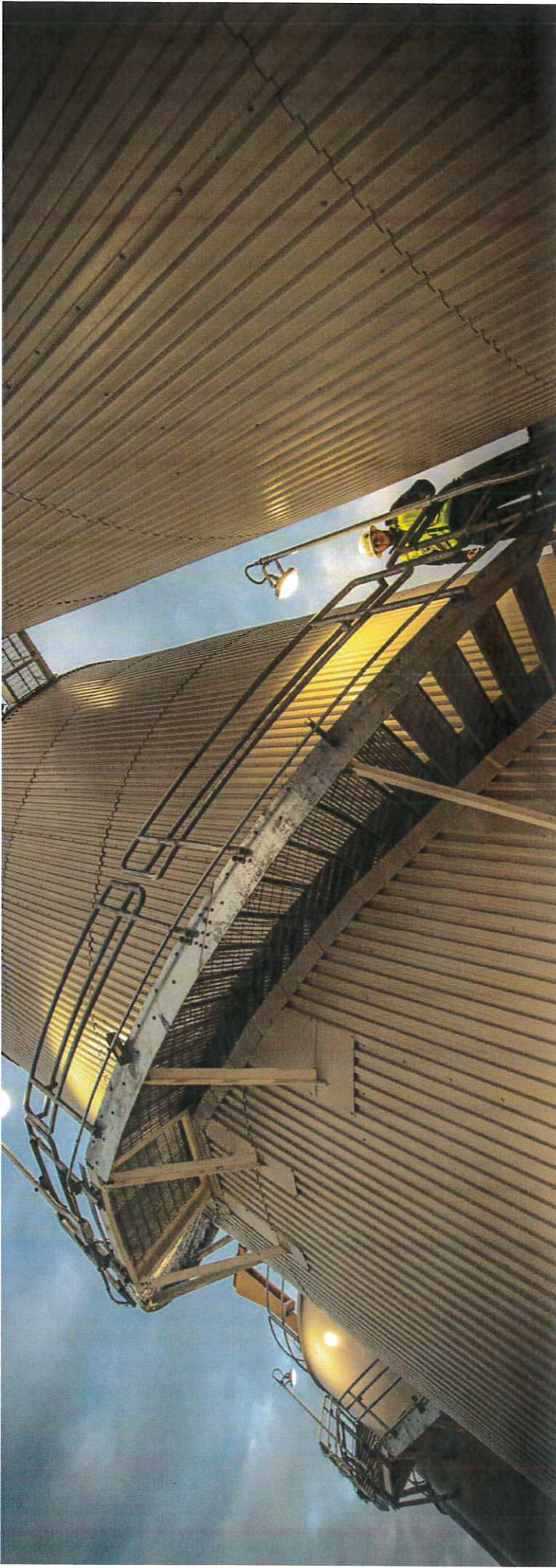
D +1 913-458-9859

E KhanguraJK@BV.com

Building a World of Difference.*

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25 April 2019

FINAL City of Banning Energy Resource Study

BUILDING A WORLD OF DIFFERENCE®



BLACK & VEATCH

Project Overview



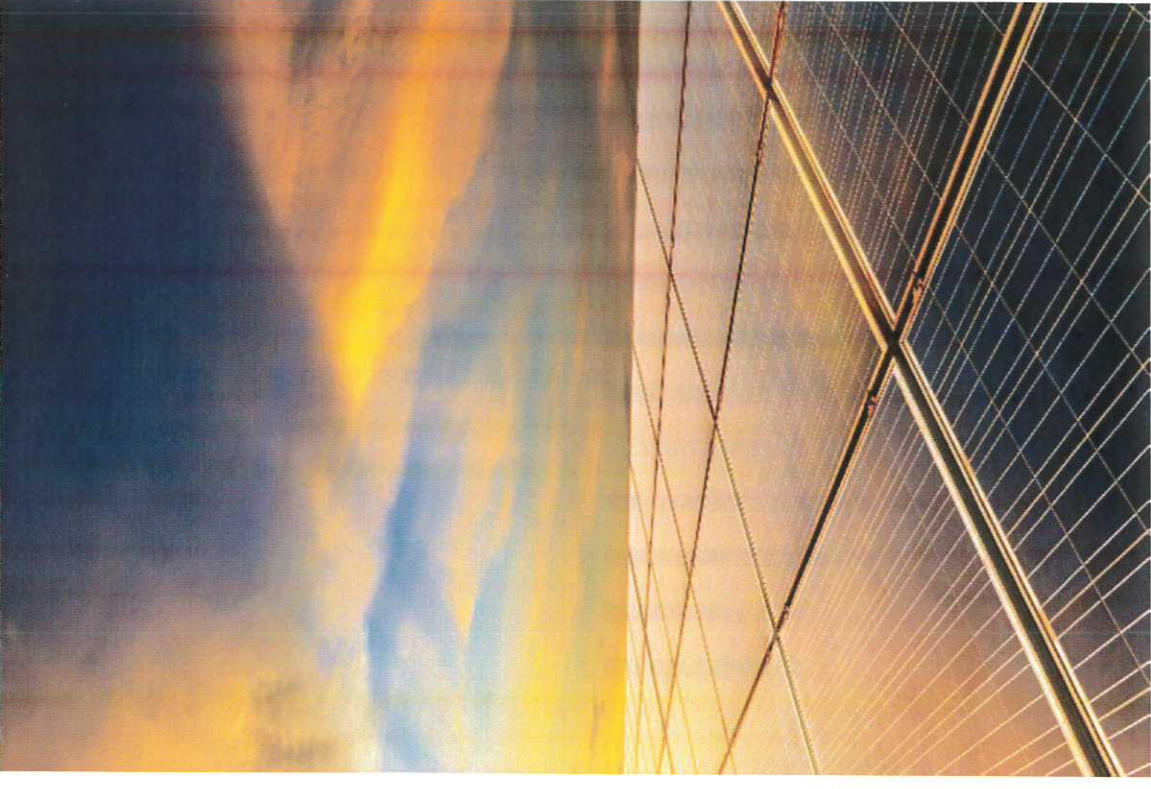
Task 1

- Proposed Technologies
 - Ground-mount solar (single axis tracking) – 10 MW
 - Wind – 10 MW
 - Bioenergy
 - Impact Bioenergy Technology
 - Natural Gas Microturbines
 - Phosphoric Acid Fuel Cells (PAFC) ~ 1 MW
 - Battery Storage – 1 MW/4 MWh System
- Cost, performance and qualitative factors

Cost Assumptions

- Construction starts in 2020
- Development Cost assumed to be 15% of EPC Cost
- Soft Cost assumed to be \$300 per kW for all technologies other than energy storage
- FOM costs do not include insurance and property taxes.
- For Independent Power Producer (IPP), the technologies are sited on City property and do not pay land leases.

Ground Mount Solar

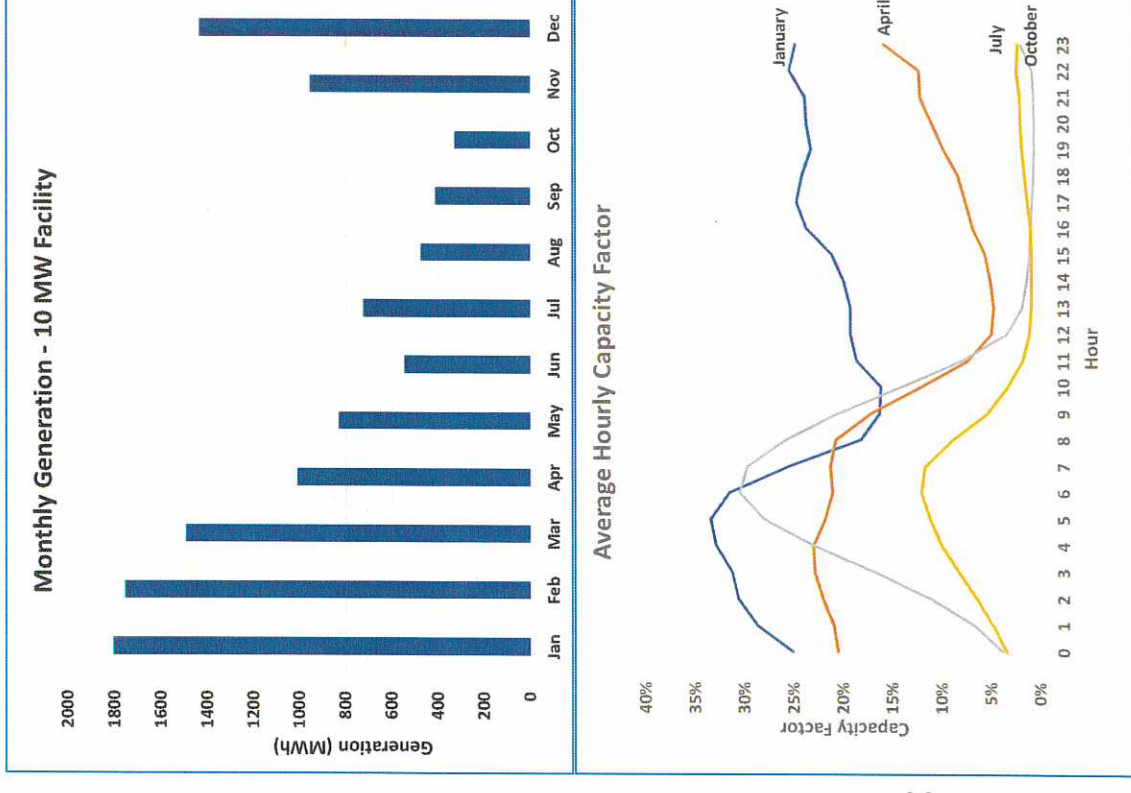


Qualitative Evaluation of Solar

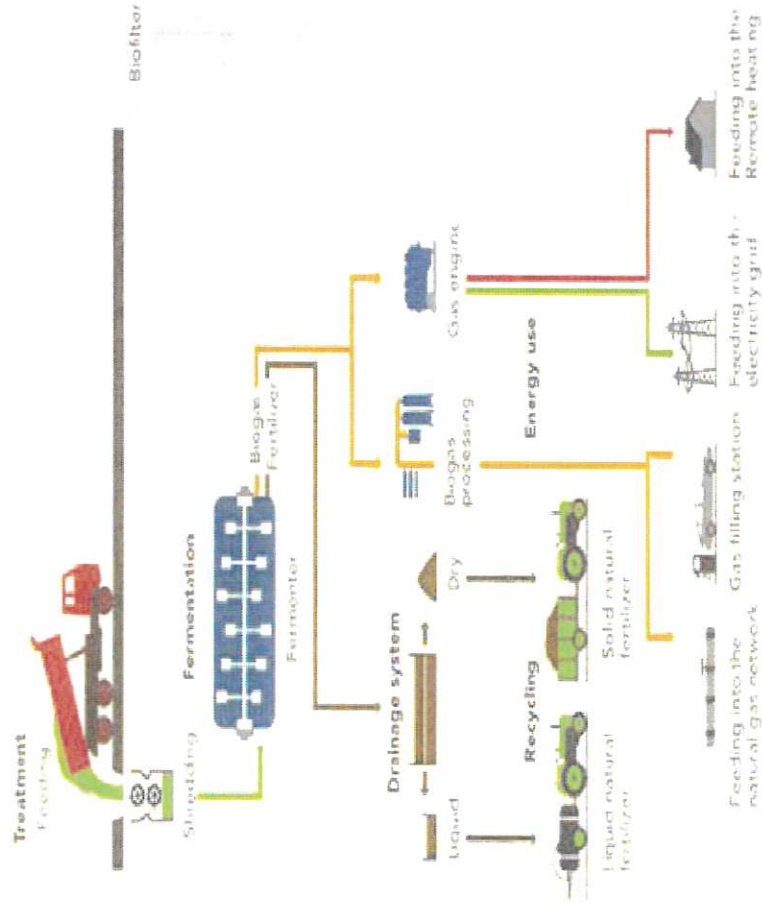
- No emissions
- Short term job creation during construction but limited during operation, likely less than one full time equivalent (FTE)
- No additional non-energy revenue streams
- No fuel necessary; high quality solar resource available on site
- Eligible for California's Clean Energy Act (Renewable Portfolio Standards)
- Incentives
 - Investment Tax Credit (ITC) : 26% in 2020 construction start date
 - Modified Accelerated Cost-Recovery System (MACRS) – 5 year

Wind Cost and Performance

- Capital Cost: \$2,888/kW
- O&M Cost
 - Fixed O&M Cost: \$40/kWac-Year
- Land Requirements
 - Varies depending on size of wind project
- Capacity Factor: 13.5%
- Design Assumptions
 - Wind Speeds : 4.1 m/s at 80 meter hub height
 - Wing span :110 m rotor diameter
 - Vestas V110-2.0



Bioenergy



Source: BioImpact

Impact BioEnergy O&M Cost

- Small Facility O&M costs - \$3,764/kW-Year

Type	Quantity	Units	Rate	Expense
Labor*	30,857	staff-hours/yr	\$28.00/hour	\$864,000
On-site Material Handling	5,400	tons/yr	\$20.00/ton	\$108,000
Power*	150,211	kWh/yr	\$0.09/kWh	\$13,519
Consumables	7,200	tons/yr	\$10.00/ton	\$72,000
Waste Disposal	36	tons/yr	\$319.45/ton	\$11,500
TOTAL				\$1,069,019

- Large Facility O&M costs - \$3,695/kW-Year

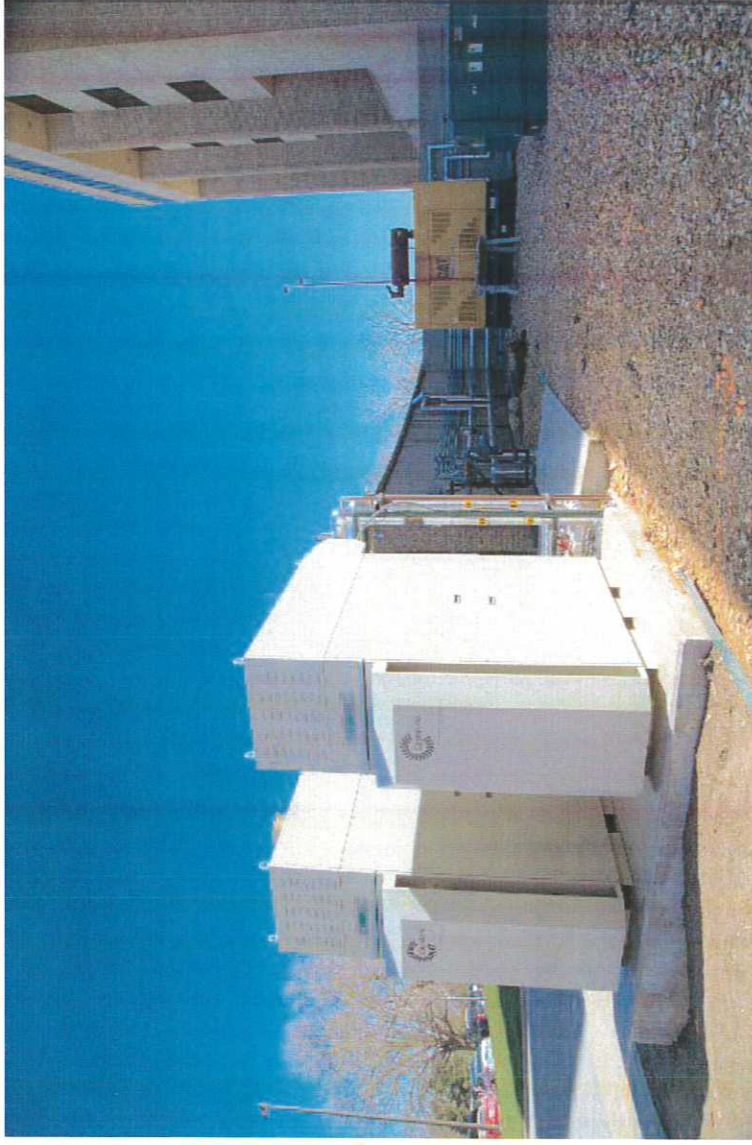
Type	Quantity	Units	Rate	Expense
Labor*	47,143	staff-hours/yr	\$28.00/hour	\$1,320,000
On-site Material Handling	8,250	tons/yr	\$20.00/ton	\$165,000
Power*	229,489	kWh/yr	\$0.09/kWh	\$20,654
Consumables	11,000	tons/yr	\$10.00/ton	\$110,000
Waste Disposal	55	tons/yr	\$319.45/ton	\$17,570
TOTAL				\$1,633,224

- Quantities for each O&M line item category calculated based on ImpactBio rates and total expenses
- Labor (wage) rates based on ImpactBio; however, these rates should be confirmed as appropriate for Banning
- Burden, overhead, or general and administration (G&A) may not have been included in labor rates reflected. These costs can be significant thus they need be included in the economic assessment of a project.
- Black & Veatch has left the cost of electric power in O&M figures for purpose of this analysis; however, actual project would likely subtract parasitic power usage and compute levelized costs based on net power to grid

BiolImpact Modeling Methodology

- O&M and low case Revenue is assumed to be only sufficient to cover the annual O&M cost therefore the economic model assumes they net each other out
 - High case can be modeled
- Black & Veatch developed independent estimates for revenue for tipping and carbon credits as noted on previous slide
- Revenue assumptions for compost and soil amendments were assumed to be the values provided by ImpactBio but appear to be high and required additional clarification

Natural Gas Microturbines



Microturbine Cost and Performance

- Capital Cost: \$4,325/kW (Capstone with no CHP)
- O&M Cost
 - Fixed O&M: \$175/kW-Year
- Land Requirements
 - Containerized and modular solution minimizes plot space
- Fuel
 - Can use natural gas, biogas, propane, diesel and kerosene
 - Natural gas assumed for this evaluation
 - Cost: \$4/MMBtu
- Performance
 - Availability: 92%+
 - Electrical Efficiency: 33% (Lower Heating Value – LHV)
 - Heat Rate: 10,300 BTU/kWh (LHV)

Stationary Fuel Cells



Source: Dooson

Fuel Cell Cost and Performance

- Capital Cost: \$8,925/kW (PAFC with no CHP)
- Fixed O&M: \$163/kW-Year
- Fuel Cost: \$4/MMBtu (assumed to be natural gas)
- Land Requirements
 - Like Microturbines, minimal land required
 - Module/containerized solutions reduce plot space
- Performance
 - Availability: 95 – 97% (95% used for modeling)
 - Electrical Efficiency: 42%
 - Heat Rate: 8,500 BTU/kWh

Battery Storage



Battery Storage Cost and Performance

- Capital Cost: \$500 per kWh installed (1 MW/4 MWh Lithium-Ion)
- O&M Cost: \$35 per kW includes capacity maintenance (does not account for cost of energy to charge the battery)
- Typical efficiencies – 92.5% round-trip efficiency at beginning of life (BOL)
- Degradation/Battery augmentation
 - 20% Capacity degradation after 3,000 cycles (approximately 10 years with one cycle by day)
 - End of life round trip efficiency of 87.5% at 10 yrs (0.5% reduction per year)

Technology Comparisons

Levelized Cost of Energy by Technology Summary

Technology	System Size	Economic Life (years)	Capital Cost (\$/kW)	Capacity Factor (%)	Fixed O&M Cost (\$/kW-Yr)*	Variable O&M Cost (\$/kWh)*	Fuel Cost (\$/MMBtu)*	Heat Rate (Btu/kWh)	LCOE (\$/MWh)-MUNI	LCOE (\$/MWh)-IPP
PV	10 MW	25	2,000	33	13	0	0	0	56	55
Wind	10 MW	25	2,888	14	40	0	0	0	206	354
Bioenergy- Small**	284 kW	25	27,025	85	0	0	0	15,000	245	483
Bioenergy-Large**	442 kW	25	22,155	85	0	0	0	15,000	201	396
Fuel Cells	1 MW	20	8,925	95	163	0	4	8,500	142	167
Microturbines	1 MW	20	4,325	92	175	0	4	10,300	116	138

*2% Escalation assumed

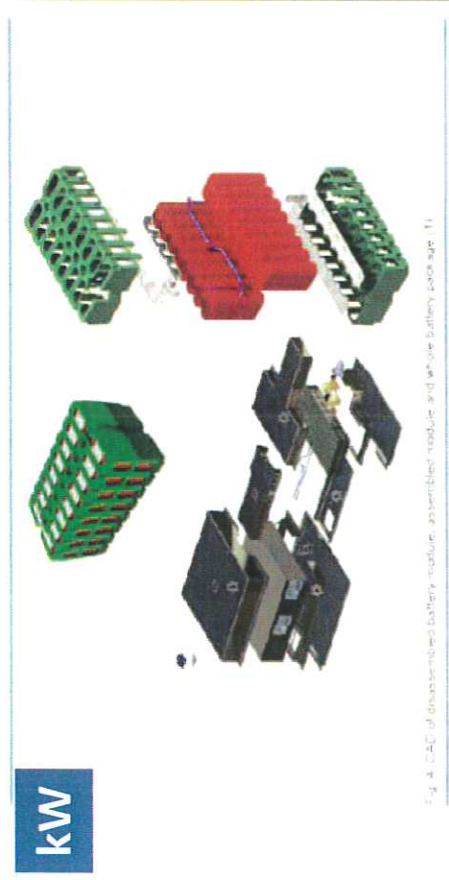
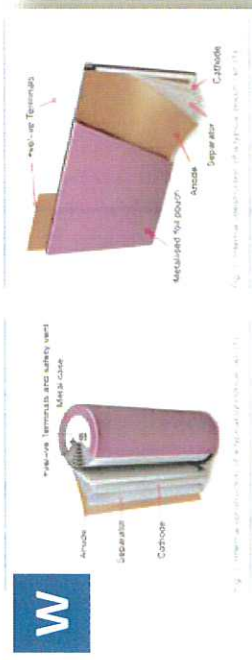
**Low Case Revenue from non-energy sources is assumed to be only sufficient to cover the annual O&M cost and therefore the economic model assumes they net each other out.

Overall Comparison

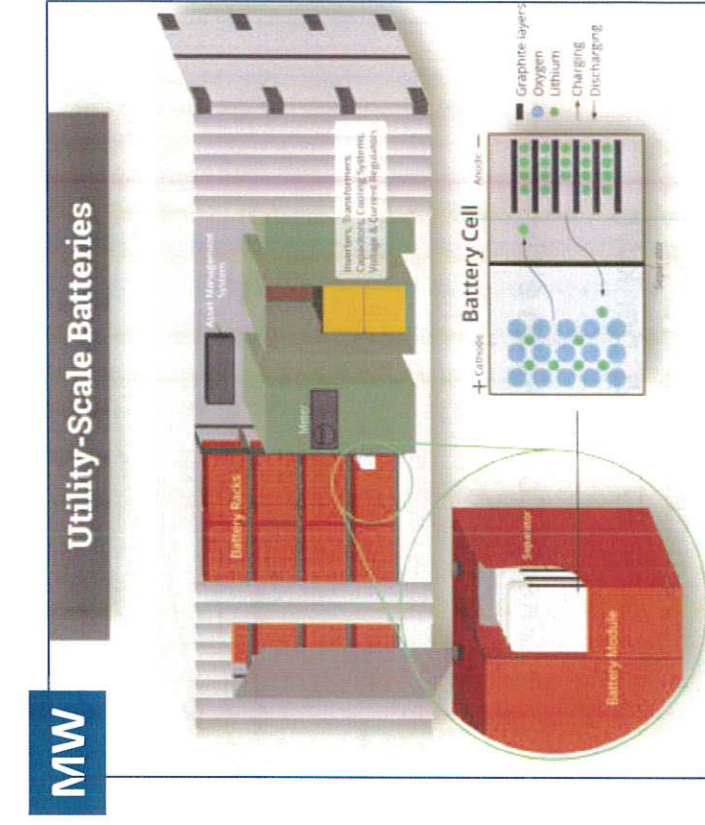
Technology	LCOE (\$/MWh) MUNI	LCOE (\$/MWh) IPP	Renewable Portfolio Standard	Emissions	Local Job Creation (FTE)	Potential Revenue Streams	Fuel Availability
PV	56	55	Eligible	None	<1	None	High Quality
Wind	206	354	Eligible	None	<1	None	Poor Quality
Bioenergy- Small	245	483	Eligible	Multiple pollutants	14	Tipping Fees	Further Evaluation Needed
Bioenergy-Large	201	396	Eligible	Multiple pollutants	20	Tipping Fees	Further Evaluation Needed
Fuel Cells	142	167	Not Eligible	GHG & Multiple pollutants	<1	None	From Local Pipeline
Microturbines	116	138	Not Eligible	GHG & Multiple pollutants	<1	Ancillary Services	From Local Pipeline

Technology:

Cell > Module > Battery > Rack > Container > Building (>50 MW)



Source: Johnson Matthey

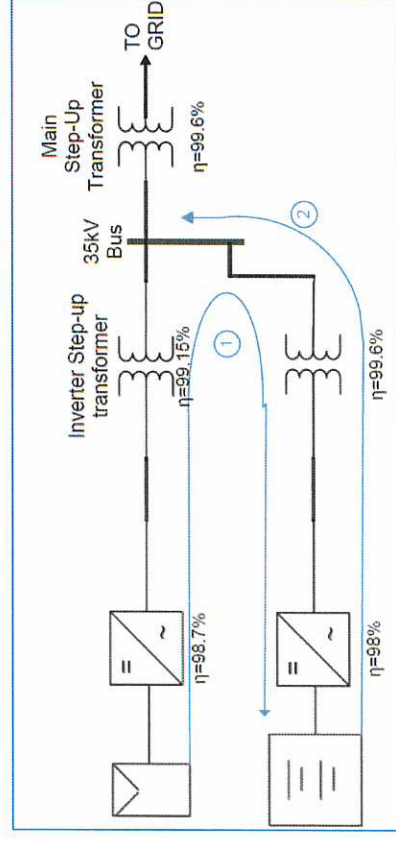


Source: American Jobs Project

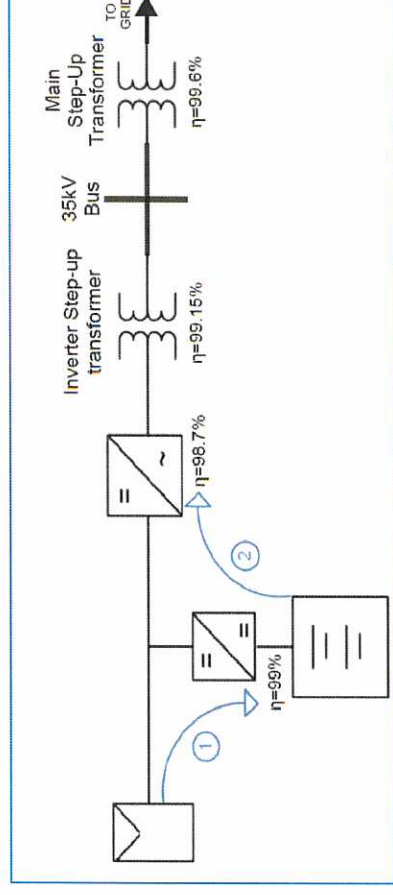
Batteries scale as individual elements (e.g., transistors)

Energy Storage with PV:

AC coupling



DC coupling



Advancements in DC-DC power conversion has enabled consideration of DC-coupled storage, accelerated by the dramatic price decreases for Li-ion storage technology



City of Banning

Banning Electric Utility

Memorandum

To: Doug Schulze, ICMA-CM, City Manager
From: Tom Miller, Electric Utility Director
Copy: Jim Steffens, Power Resources Manager
Date: April 26, 2019
Subject: Black and Veatch (B&V) – Resource Study Task 1
Attachments: B&V Confidential Memorandum of April 2nd
Task 1 slide deck
B&V Email – Jagmeet Khangura, Thursday, April 25th

TAM

SUMMARY:

Black and Veatch completed Task 1 of 3 by delivering two work products: a biomass energy review and a technology assessment.

The first work product is a confidential memorandum by B&V reviewing Impact Bio's Bainbridge Island report. The purpose of this exercise was to consider the portability/compatibility of the Bainbridge Island study to Banning. Is Banning similarly situated, is there enough local feedstock to supply a 10 MW project, is the operation able to sustain itself, and is the levelized cost of energy competitive? Based upon the Bainbridge Island case study, B&V calculated the individual system cost range for a similar Banning project. The short answer in B&V's opinion that a similarly situated project in Banning would not be financially feasible as a utility scale generation technology. In follow-up discussion with B&V staff, they did agree there could be significant value as a general fund project less the utility scale generation. (Memorandum attached)

The second work product reviewed a number of technologies (including bioenergy) from an individual perspective for cost, performance, and qualitative factors in order to determine the levelized cost of energy for each technology. A fundamental assumption was to consider the technology from a base load generation perspective as this is the strength of bioenergy technology. The accompanying slide deck is packed with information. For me, the most telling information was variability in levelized cost of energy between the technologies. Photovoltaic generation is the most financially feasible technology based on the levelized cost of energy. Also, it is important to understand that this evaluation and analysis is not specific to Banning Electric's portfolio needs. It is intended to provide a relatively generic technology comparison as a starting point for Banning Electric Utility. (Task 1 Slide Deck attached)

NEXT STEPS:

Staff and B&V mutually agreed to exclude a small biomass (less than 1 MW) or wind technology from future discussions. Small biomass is not practical for Banning Electric's needs and the wind quality in the Pass Area is substandard. Also, we agreed to reach out to ImpactBio for discussion on the feasibility of a 5 MW biomass project and take advantage of ImpactBio's project experience. We will be moving on to Task 2 – Energy Portfolio Modeling for four scenarios. Based on the 10-year load forecast, the scenarios will model for load growth of only (5-7 MWs) and model for full load (56 MWs).

Doug, I was quite surprised by the cursory review of the levelized cost of energy for biomass base on the review of Bainbridge Island. Hopefully, ImpactBio can educate and refine more specifically to Banning. Notwithstanding utility scale generation, bio-waste collection is a great business model. We will get ImpactBio involved.

Please let me know if you have any questions or comments. Also, let me know if you have any further direction as we proceed.

**DRAFT MEMORANDUM**

City of Banning
Resources Study
Bioenergy Review

B&V Project Number 401649
B&V File Number 32.0000
2 April 2019

This memo summarizes the bioenergy review of the City of Banning Resources Study. Black & Veatch reviewed the Conceptual Design of a Bainbridge Island Bioenergy Project completed by Impact Bioenergy for Puget Sound Energy (PSE) provided by the City of Banning.

Key takeaways:

- Bainbridge Island Bioenergy Project is sufficiently representative of Banning
- The concept requires active local businesses engaged in composting, topsoil production, manure management, and sustainable agriculture. The absence of any of these will significantly impact project economics.
- The individual system costs range from \$19,000 per kW to \$23,000 per kW depending on the system size, which is substantially higher than other renewable energy projects.
- The overall estimated revenues from non-energy streams (Low Case) barely offsets the operating expenses. Thus, any energy revenues must recover the full capital cost of the system.
- The non-energy revenue streams can be potentially higher to help offset the high capital cost, but more information is needed to confirm such higher revenues are feasible.

Further Clarification from Impact Bioenergy needed:

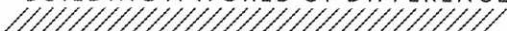
- Confirm whether burden, overhead, and/or general and administration (G&A) have been included in labor cost. The addition of these costs could significantly increase operating costs.
- Impact Bioenergy assumes that the project will receive significant revenue from the soil amendment (liquid product) stream and notes that a retail level market survey was completed to estimate the \$ per gallon value. Black & Veatch recommends requesting additional information on the market survey conducted by Impact BioEnergy. Clarification should also be requested on why retail value is used in lieu of bulk for the PSE study.

Project Review**Study Applicability for Banning**

Current population and future population growth were investigated to demonstrate applicability of concept for PSE being applied to Banning

- PSE region includes Bainbridge Island and Pulsbo Area with combined current population of approximately 34,000 residents as of late 2017, according to ImpactBio
- Banning's current population estimated at 31,230 residents as of mid-2017, according to US Census Bureau ¹

¹ <https://www.census.gov/quickfacts/fact/table/banningcitycalifornia/PST045217>



- PSE region expected to grow to population of 43,000 residents by 2035, representing annual growth rate of approx. 1.4%
- Historical growth statistics for Banning over 2000-2017 indicate annual growth rate of approx. 1.6%
- Given similarities in current population and growth rate, Black & Veatch concludes that ImpactBio report for PSE is roughly applicable to Banning, not accounting for differences in other demographic metrics (e.g. difference in quality based on geography, differences in socio-economic status, availability/penetration of local recycling programs, etc.)

ImpactBio Technical Concept Overview

The conceptual design reflected in the ImpactBio study for PSE is a multi-functional bioenergy facility that is geared toward communities that have existing private-sector and/or public-sector waste collection/transfer and organic waste separation capabilities

- The concept requires active local businesses engaged in composting, topsoil production, manure management, and sustainable agriculture
- The absence of any one of these third-party elements could jeopardize the economics reflected
- Organic waste feedstocks considered within the concept include:
 - Tier 1: uncontaminated landscape and food waste (4,200 tons per year [tpy] and managed by others)
 - Tier 2: contaminated food waste, paper waste, and landscape waste from commercial/residential sources as well as manure/bedding and biosolids (7,200 to 11,000 tpy and focus of proposal)
- Products / sources of revenue envisioned from the processing of these feedstocks within the ImpactBio concept include:
 - Landfill avoidance / tipping fees
 - Avoided greenhouse gas carbon credits
 - Fertilizers / Nutrients: compost, dry fertilizer, liquid soil amendment
 - Combined heat and electric power (CHP) sales
- Waste composition (i.e. fractions of each type of organic waste feedstock) provided for PSE appears to be based on a resource assessment / waste characterization study that is specific to the region. A more tailored resource assessment would need to be conducted by Banning in order to tailor the ImpactBio concept for the specific application. Feedstock composition for proposed Tier #2 concept is as follows, all reported in tons per year (tpy):

Table 1: Feedstock Composition for Tier #2

Component	Minimum (tpy)	Maximum (tpy)
Commercial	3,700	3,700
Residential	3,000	3,000
Manure	500	500
Biosolids	0	3,800
Total	7,200	11,000

- Small and Large Bioenergy Facilities were designed for PSE based on the minimum and maximum waste quantities. Once again, these facilities were designed and optimized based on the quantities and types of organic wastes available to PSE but are not optimized for the City of Banning application. Recognizing these limitations, the major unit operations envisioned for the ImpactBio concept are outlined in the following process overview:
 - Separate wet (400 tpy) and dry (6,800 to 10,600 tpy) feedstock receiving / storage
 - Dry feedstock pre-processing
 - Dry feedstock / high solids anaerobic digestion (HSAD)
 - Liquid feedstock / continuously-stirred tank reactor (CSTR) digestion
 - HSAD effluent (compost) post-processing
 - CSTR effluent (soil amendment and dry fertilizer) post-processing
 - Product storage
 - Biogas storage
 - CHP generator
- Performance characteristics for the proposed Tier #2 concept are outlined in the following table:

Table 2: Performance Characteristics for Tier #2

Performance Metric	Small Facility (7,200 tpy)	Large Facility (11,000 tpy)
Base Load Power Generation	284 kW	442 kW
CHP Heat Generation	256 therms/day	399 therms/day
Compost Production	8,400 yd ³ /yr	11,300 yd ³ /yr
Dried Fertilizer Production	8 tpy	
Liquid Soil Amendment Production	18,000 gal/yr	
Digestate Marketability	All markets	No sales into organic market

ImpactBio Process Economics

- Capital Costs
 - Small Bioenergy Facility (284 kW): \$6,600,000
 - Large Bioenergy Facility (422 kW): \$8,400,000
- Operations and Maintenance (O&M) Costs
 - Based on the economic analysis provided by ImpactBio, the annual O&M costs for the Small and Large Bioenergy Facility are as follows:

Table 3: Small Facility O&M Costs

Type	Quantity	Units	Rate	Expense
Labor	30,857	staff-hours/yr	\$28.00/hour	\$864,000
On-site Material Handling	5,400	tons/yr	\$20.00/ton	\$108,000
Power	150,211	kWh/yr	\$0.09/kWh	\$13,519
Consumables	7,200	tons/yr	\$10.00/ton	\$72,000
Waste Disposal	36	tons/yr	\$319.45/ton	\$11,500
TOTAL				\$1,069,019

Table 4: Large Facility O&M Costs

Type	Quantity	Units	Rate	Expense
Labor	47,143	staff-hours/yr	\$28.00/hour	\$1,320,000
On-site Material Handling	8,250	tons/yr	\$20.00/ton	\$165,000
Power	229,489	kWh/yr	\$0.09/kWh	\$20,654
Consumables	11,000	tons/yr	\$10.00/ton	\$110,000
Waste Disposal	55	tons/yr	\$319.45/ton	\$17,570
TOTAL				\$1,633,224

- Assumptions and deviations from the ImpactBio economic analysis are as follows:
 - Quantities for each O&M line item category calculated based on ImpactBio rates and total expenses
 - Labor (wage) rates based on ImpactBio; however, these rates should be confirmed as appropriate for Banning
 - Burden, overhead, or general and administration (G&A) may not have been included in labor rates reflected. These costs can be significant thus they need be included in the economic assessment of a project.
 - Black & Veatch has left the cost of electric power in O&M figures for purpose of this analysis; however, actual project would likely subtract parasitic power usage and compute levelized costs based on net power to grid
- Revenues
 - Based on the economic analysis provided by ImpactBio, revenues for the Small and Large Bioenergy Facility are as follows:

Table 5: Revenue Streams for Small Bioenergy Facility

Type	Quantity	Units	Low Rate	High Rate	Low Revenue	High Revenue
Tipping Fees ²	6,700	tpy	\$39.31/ton	\$52.43/ton	\$263,377	\$351,281
Carbon Credits ³	11,520	MT/yr	\$13.00/MT	\$15.00/MT	\$149,764	\$172,805
Compost	8,400	yd3/yr	\$30.00/yd3	\$40.00/yd3	\$252,000	\$336,000
Dry Fertilizer	8	tpy	\$4,000/ton	\$14,000/ton	\$32,000	\$112,000
Soil Amendment (Retail Value)	18,000	gal/yr	\$18.00/gal	\$140.00/gal	\$324,000	\$2,520,000
CHP Heat	93,440	therms/yr	\$0.40/therm	\$0.60/therm	\$37,376	\$56,064
TOTAL					\$1,058,517	\$3,548,150

² <http://www.rcwaste.org/landfill/lambcanyon>

³ <http://calcarbodash.org/>

Table 6: Revenue Streams for Large Bioenergy Facility

Type	Quantity	Units	Low Rate	High Rate	Low Revenue	High Revenue
Tipping Fees ²	6,700	tpy	\$39.31/ton	\$52.43/ton	\$263,377	\$351,281
Carbon Credits ³	17,600	MT/yr	\$13.00/MT	\$15.00/MT	\$228,806	\$264,007
Compost	11,300	yd3/yr	\$30.00/yd3	\$40.00/yd3	\$339,000	\$452,000
Dry Fertilizer	8	tpy	\$4,000/ton	\$14,000/ton	\$32,000	\$112,000
Soil Amendment (Retail Value)	18,000	gal/yr	\$18.00/gal	\$140.00/gal	\$324,000	\$2,520,000
CHP Heat	145,635	therms/yr	\$0.40/therm	\$0.60/therm	\$58,254	\$87,381
TOTAL					\$1,245,437	\$3,786,669

- Assumptions and deviations from ImpactBio economic analysis are as follows:
 - Quantities for each revenue line item category calculated based on ImpactBio rates and total revenues (with exception of tipping fees)
 - Quantity of organic waste to which tipping fee applies is only commercial and residential organics, which is the same for both the Small and Large Facilities
 - Tipping fee rates for City of Banning used and based on rates for Riverside County, per footnote reference. Rates used in ImpactBio analysis were unrealistically high.
 - Carbon credit rates based on actual California's Global Warming Solutions Act carbon prices over past five years, per footnote reference. Rates used in ImpactBio analysis were unrealistically high.
 - Quantities and rates for compost, fertilizer, and soil amendment all based on ImpactBio market assessment for PSE. Some of these rates appear unrealistically high, particularly for soil amendment.
 - Analysis assumes off-taker exists for CHP heat, which would need to be confirmed for Banning application.

Qualitative Technology Assessment

- Emissions (all values in tpy) ⁴

Table 7: Facility Emissions

Pollutant	Small Facility (7,200 tpy)	Large Facility (11,000 tpy)
CO	15.63	24.33
NOX	9.38	14.60
SO2	0.01	0.01
VOC	3.13	4.87
PM	0.23	0.36
PM10	0.23	0.36
PM2.5	0.23	0.36

⁴ <https://www3.epa.gov/ttnchie1/ap42/ch03/index.html>

MEMORANDUM

CONFIDENTIAL

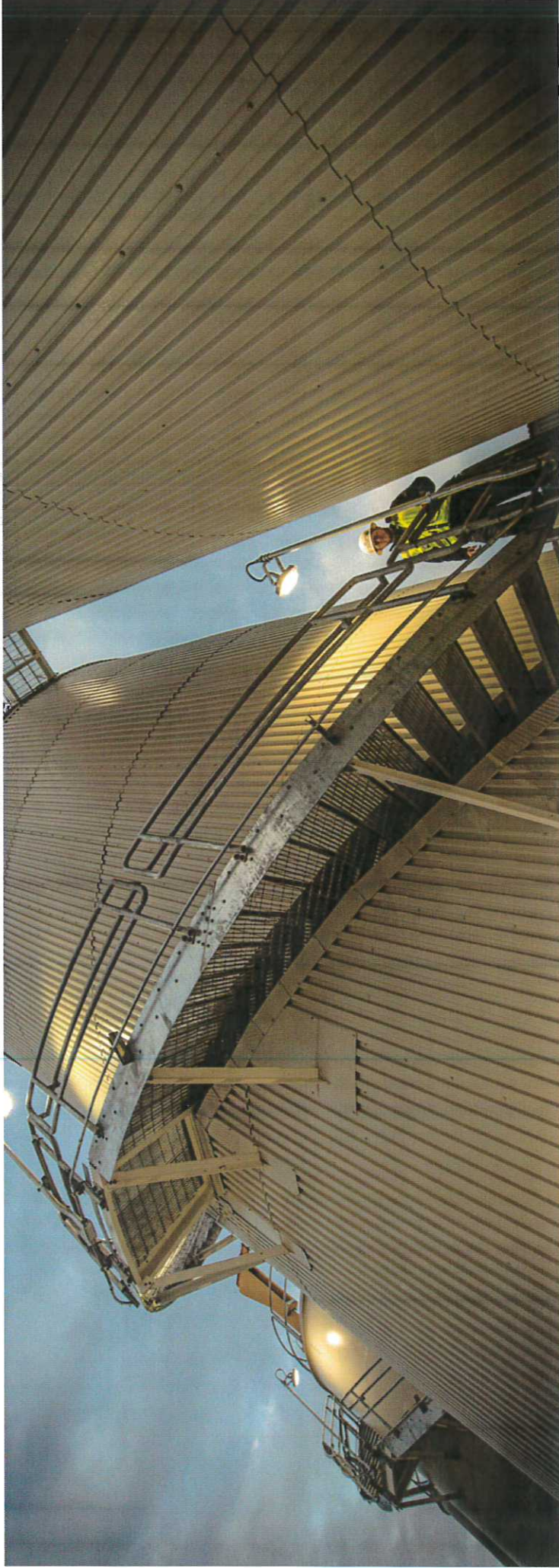
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B&V Project 401649

B&V File 32.0000

2 April 2019

- Local Job Creation: 14 to 23 full time equivalent (FTE). Based on staff-hours included in process economics and 2,080 hours per year per FTE
- Potential revenue streams: See process economics
- Fuel availability: Full waste characterization and demographic study for the region should be conducted to evaluate fuel availability.
- Applicable to California State RPS, and may be applicable to SB 1122 BioMAT program if located within SCE service territory



22 October 2019

DRAFT City of Banning Energy Portfolio Modeling Study

BUILDING A WORLD OF DIFFERENCE®



BLACK & VEATCH



Table of Content

- Project Overview
- Task 1 Summary
- Task 2 Overview
 - Task 2 Results
- Task 3 Overview
 - Task 3 Results

Project Overview

Scope of Work

- Task 1 – Technology Assessment
- Task 2 – Energy Portfolio Modeling
- Task 3 – Buy or Build Comparison

Task 1: Technology Assessment

- Proposed Technologies
 - Ground-mount solar (single axis tracking) – 10 MW
 - Wind – 10 MW
 - Bioenergy
 - Impact Bioenergy Technology
 - Natural Gas Microturbines
 - Phosphoric Acid Fuel Cells (PAFC) ~ 1 MW
 - Battery Storage – 1 MW/4 MWh System
- Cost, performance and qualitative factors

Levelized Cost of Energy by Technology Summary

Technology	System Size	Economic Life (years)	Capital Cost (\$/kW)	Capacity Factor (%)	Fixed O&M Cost (\$/kW-Yr)*	Variable O&M Cost (\$/kWh)*	Fuel Cost (\$/MMBtu)*	Heat Rate (Btu/kWh)	LCOE (\$/MWh)-MUNI	LCOE (\$/MWh)-IPP
PV	10 MW	25	2,000	33	13	0	0	0	56	55
Wind	10 MW	25	2,888	14	40	0	0	0	206	354
Bioenergy- Small**	284 kW	25	27,025	85	0	0	0	15,000	245	483
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Fuel Cells	1 MW	20	8,925	95	163	0	4	8,500	142	167
Microturbines	1 MW	20	4,325	92	175	0	4	10,300	116	138

*2% Escalation assumed

**Low Case Revenue from non-energy sources is assumed to be only sufficient to cover the annual O&M cost and therefore the economic model assumes they net each other out.

Financial Assumptions LCOE Calculation – Independent Power Producer (IPP)

Ownership Type	Technology	MACRS	ITC	ITC Depreciation Basis	Debt Rate	Cost of Equity
Muni (0% Tax Rate, Muni Debt for 100% Project Cost)	All Technologies	N/A	N/A	N/A	4.5%	N/A
IPP (28 % Composite Tax Rate)	PV	5 yr	26%	87%	N/A	7.0%
	Wind	5 yr	0%	0%		7.5%
	Bioenergy- Small	7 yr/20 yr	0%	100%		10%
	Bioenergy-Large	7 yr/20 yr	0%	100%		10%
	Fuel Cells	5 yr	26%	87%		10%
	Microturbines	5 yr	10%	95%		10%

Banning discount rate assumed to be 4.5%

Cost Assumptions

- Construction starts in 2020
- Development Cost assumed to be 15% of EPC Cost
- Soft Cost assumed to be \$300 per kW for all technologies other than energy storage
- FOM costs do not include insurance and property taxes.
- For Independent Power Producer (IPP), the technologies are sited on City property and do not pay land leases.

Overall Comparison

Technology	LCOE (\$/kWh) MUNI	LCOE (\$/kWh) IPP	Renewable Portfolio Standard	Emissions	Local Job Creation (FTE)	Potential Revenue Streams	Fuel Availability
PV	56	55	Eligible	None	<1	None	High Quality
Wind	206	354	Eligible	None	<1	None	Poor Quality
Bioenergy- Small	245	483	Eligible	Multiple pollutants	14	Tipping Fees	Further Evaluation Needed
Bioenergy-Large	201	396	Eligible	Multiple pollutants	20	Tipping Fees	Further Evaluation Needed
Fuel Cells	142	167	Not Eligible	GHG & Multiple pollutants	<1	None	From Local Pipeline
Microturbines	116	138	Not Eligible	GHG & Multiple pollutants	<1	Ancillary Services	From Local Pipeline

Task 2 Overview

Task 2: Energy Portfolio Modeling

- Multiple technologies modeled to determine combinations that can meet defined load profile specified by the City.
- Load scenarios evaluated:
 - City of Banning Load in 2030
 - Pardee Development Load Only
 - City of Banning + Pardee
- HOMER modeling software used to conduct the analysis. Cost and performance characteristics from Task 1 used for the analysis.
 - Model solves for combination of resources resulting in lowest LCOE using capital cost, O&M, fuel cost and financial assumptions

Modeled Load Data

- Year 2030 Load Modeled
- 8760 Data used to create 12x24 Load Profiles (Average Monthly Load)
- City of Banning
 - 2017 Hourly Data (2017 used because 2018 was much warmer than normal)
 - Scaled to projected 2030 Load (Itron LRLF Report)
- Pardee Load
 - 4862 Units with 2.3 kWdc Solar PV per unit
 - Average hourly profile for a resident provided by the City
 - Profile scaled to total load for residential development estimated by Itron
 - Itron estimated base, mild and severe load scenarios
 - Base load used for analysis

Resources Modeled

- Lowest cost resources from Task 1 included in modeling
 - Microturbine
 - Solar (New Utility Scale and Pardee Rooftop PV)
 - BESS

Technology	System Size	Economic Life (years)	2030 Capital Cost (\$/kW)	Capacity Factor (%)	Fixed O&M Cost (\$/kW-Yr) *	Variable O&M Cost (\$/kWh) *	Fuel Cost (\$/MMBtu) *	Heat Rate (Btu/kWh)	LCOE (\$/MWh) - MUNI	LCOE (\$/MWh) - IPP
PV	10 MW	25	1,500	33	13	0	0	0	56	55
Microturbines	1 MW	20	4,325	92	175	0	4	10,300	116	138
BESS	1 MWh	20	\$300 (per kWh)		35	0	N/A	N/A	N/A	N/A

*2% Escalation assumed

Task 2 Results

Modeling Results for Microturbine Cases (Muni Ownership)

Scenario (100% Served)	Annual Load (MWh)	Utility-Scale PV Capacity (MW)*	Microturbine (MW)	BESS Capacity (MWh)	BESS Power (MW)	Cap Ex (\$ Mil)	LCOE (\$/MWh)
Pardee	42,996	28	3	136	21	\$ 95	\$ 228
Banning 2030	152,515	115	15	402	82	\$ 358	\$ 229
Banning 2030 + Pardee	195,511	131	20	507	80	\$ 434	\$ 218
(99% Served)							
Pardee	42,996	24	1	115	21	\$ 75	\$ 180
Banning 2030	152,515	120	0	463	82	\$ 319	\$ 195
Banning 2030 + Pardee	195,511	135	5	558	80	\$ 392	\$ 190

*Pardee Rooftop PV Capacity modeled is in addition to utility PV system listed above (rooftop PV modeled as a separate resource with zero capital and credit to customers equal cost of Utility-Scale PV); total capacity of 11.1 MWdc/ 9.3 MWac

Substantially less microturbines are needed in partial microgrid case, resulting in LCOE savings.

Capital Costs by Scenario



Partial Microgrid Scenario (99% Served) requires lower capital.

Excess/Curtailed Solar Energy in All Scenarios

- Overgeneration of solar in all cases, modeled as curtailment
- Solar is oversized in each scenario because it appears to be more cost effective to overbuild PV to cover load during low solar resource and high load periods than adding more microturbine capacity.
- Sale of energy could potentially reduce LCOE

Scenarios	Excess/Curtailed Energy (MWh/yr)	
	100% Served	99% Served
Pardee	45,543	37,251
Banning 2030	172,152	184,980
Banning 2030 + Pardee	169,645	181,582

Task 3 Buy or Build: Overview

Overview of Resource Mix to Meet 2030 Load

- By 2030/2031, almost 11 MW of baseload energy is up for renewal
 - Landfill project will likely be retired
 - Geothermal contract will potentially be extended
- CAISO Market purchases = 58% of annual energy
- Excess energy sales from **Solar/Contracts?** = 37% of annual energy

Resources	Dispatch Priority	Contracted Capacity (MW)	Contracted Scheduled Delivery	Contract Expiration Year
Hoover Dam	Dispatchable to meet peak	2 MW, 1,847 Annually	Per Hoover Schedule B	2067
Palo Verde Nuclear Power Station	Baseload	2 MW	7x24	2045
Astoria 2 Solar	As generated	8 MW	As generated	2036
Puente Hills Landfill Gas-to-Energy	Baseload	9 MW but declining	7x24	2030
Heber South/Gould 2 Geothermal Project	Baseload	1.6 MW	7x24	2031
Anaheim - Ormat Project Firming	Firming to 2 MW	.4 MW	7x24	2031

Task 3 Buy or Build: Results

2030 Resource Mix Considerations

- Status of baseload RE contract renewals: Depends on whether renewed contracts are also renewable baseload
- RPS Requirement (60% by 2030): Depends on RE baseload renewals and purchase of RECs-only
- Value of Excess Energy Sales: LCOE of Incremental Energy depends on this assumption.
- Minimize Market Purchases: Depends on expected cost of market purchases.

Case	Load Served	Baseload RE Contracts Renewed (MW)	Additional Solar (MW)	Percent Renewable Energy	BESS (MWh)	LCOE of Incremental Energy* (\$/MWh)	Excess Energy (MWh)	Market Purchases to Serve Remaining Load (MWh)
1	Pardee	2	0	28%	10	\$65	523	28,608
2	Pardee	9	0	60%	10	\$70	2,007	27,766
3	All Load	2	22	60%	100	\$86	3,661	81,323
4	All Load	9	0	60%	10	\$69	1,842	78,646
5*	All Load	9	10	74%	30	\$77	10,413	59,488

*Includes (rooftop PV modeled as a separate resource with zero capital and credit to customers that equal cost of Utility-Scale PV, counts toward RPS). Accounts for Excess Energy sales @ \$25/MWh

Example of LCOE Sensitivity to Assumptions: Case 3 All Load 2MW Baseload

- Note the changes to LCOE of incremental energy changes with size of Battery and value of Excess Energy Sale price.
- While LCOE increases significantly, with battery size, there is also a reduction in excess energy sales and market energy purchases.

All Load 2MW Baseload	Battery Size (MWh)				
Excess Energy Sale Price	50	100	150	200	250
\$0.00	\$74	\$87	\$104	\$123	\$143
\$25.00	\$70	\$86	\$103	\$123	\$143
\$50.00	\$65	\$85	\$103	\$123	\$143
Market Energy Purchases (MWh)	88,525	81,323	78,475	78,061	78,029
Excess Energy Sales (MWh)	11,663	3,661	496	36	0

Municipal Ownership

- City of Banning would be sole owner of the facility and receive all energy generated
- Responsible for the development and construction of the project
- Financing
 - Obtained through municipal bond market with general obligation bonds or revenue bonds
 - Financed with internal retained earnings
- Tax-exempt entities cannot take advantage of incentives available to taxable entities

Based on Task 1 analysis as well as the reduction in ITC in the future, forecasted LCOE will likely be lower assuming the City maintains low bond rate.

Power Purchase Agreement (PPA)

- The purchase of renewable energy by a public utility through a PPA is the most common way in which renewable energy projects have been developed
- Not uncommon for renewable energy PPAs to be offered with fixed prices over their full term
- Taxable counter parties are able to claim tax incentives, and these benefits would, in theory, be passed on in the form of lower PPA prices

Given reduced tax incentives for renewable energy in the future, PPA pricing for renewable energy will likely be higher than Municipal option.

Power Purchase Agreement with Transfer

- This option is similar to the PPA option, but adds a provision for asset transfer at the end of or during the PPA term
- The developer must own and operate the project for at least six years to be able to claim any federal tax credits.
- The transfer price must be based on “fair market value” (FMV).
 - This allows a taxable counter-party to receive all tax benefits and recover some portion of the capital cost of the project.

PPA with Transfer option is also likely not as cost-effective if developer is faced with reduced tax credits in the future.

Pre-Paid Power Purchase Agreement

- The PPA prepayment option follows the general form of a conventional PPA; however, payment for part of the power is made in one lump sum at the beginning of the PPA term.
- For the remainder of the power that is not pre-paid, the utility would pay an ongoing “tariff” to make up the difference. The US Treasury Department issued a ruling in 2003 allowing publicly owned utilities to use tax-exempt financing to prepay future electric supplies.
- This type of structure is not very common in the public power sector, since it tends to be complicated and only makes economic sense for larger projects.

The benefit here is to help reduce the capital cost for the developer, while allowing the developer to access tax incentives and pass along the savings to the tax-exempt entity. However, the complexity of structure may not be worth pursuing once incentives are reduced.

Conclusions and Recommendations

Findings and Conclusions

- Solar and solar plus battery energy storage will likely be the most cost effective distributed energy resource (DER) options for Banning.
- Local wind will not be a good option due to poor resources, but opportunities to contract with non-local, utility-scale wind should still be considered.
- All of the other DER options (bioenergy, fuel cells, and microturbines), despite operating at baseload conditions, have much higher LCOE.
- Developing a microgrid to serve Pardee load or all of Banning by 2030 comes at a LCOE cost of \$180-\$220, resulting from need to oversize solar to meet seasonal needs and a large battery to store solar energy. A microturbine is still needed to cover the few hours of the year when solar plus BESS cannot meet load.
- A fully islandable, self-serving microgrid is likely not necessary for Pardee, especially at the estimated cost, but the availability of local generation and batteries to some degree will provide benefits during outages and emergency events.

Findings and Conclusions

- Given the pending expiration of up to 11 MW of baseload renewable energy, Banning needs to cover growing load by 2030 as well as meet California's renewable portfolio standard.
- In addition, Banning already faces surplus generation from existing solar contracts during all months except during the summer. This will be further exacerbated by Pardee, where almost 10 MW of rooftop solar on new homes is anticipated by 2030.
 - The sale of the excess energy may become problematic in 2030 when CAISO will see far more solar on the system, resulting in very low or negative value for the excess solar energy
- Based on the analysis, adding about 10 MWh of batteries will help mitigate part of the excess issues from anticipated solar. However, the amount of batteries need to be balanced against the forecasted value of the excess solar energy vs. procurement of market energy.
- Excess energy can be further minimized by procuring less baseload renewable energy than currently.

Recommendations

- Conduct a full IRP-like analysis that incorporates dispatch modeling and forecast market prices in 2030 and beyond, taking into account the renewable energy penetration across California. The cost of avoided market energy purchases will help inform the level of RE contracting.
- Consider building batteries totaling 5 to 10 MWh in the near-term to start capturing excess solar energy and strategically place batteries to provide local distribution system support where needed
- When baseload RE contracts expire in 2030/2031, seek to reduce the total capacity of the baseload contracts, provided the contracts are lower cost than solar plus battery storage (see Case 3).
- Consider exceeding the RPS requirement in 2030 by adding another 10 MW of solar and a larger battery (see Case 5 below), which will help reduce market purchases during the summer at a relatively modest LCOE. This also reduces reliance on market purchases from 40-45% to 30% of load.
- By 2030, a municipal financed model for solar plus battery storage could be more cost-effective than a 3rd party PPA, due to reduction in ITC, and should be considered.

Case	Load Served	Baseload RE Contracts Renewed (MW)	Additional Solar (MW)	Percent Renewable Energy	BESS (MWh)	LCOE of Incremental Energy* (\$/MWh)	Excess Energy (MWh)	Market Purchases to Serve Remaining Load (MWh)
5*	All Load	9	10	74%	30	\$77	10,413	59,488

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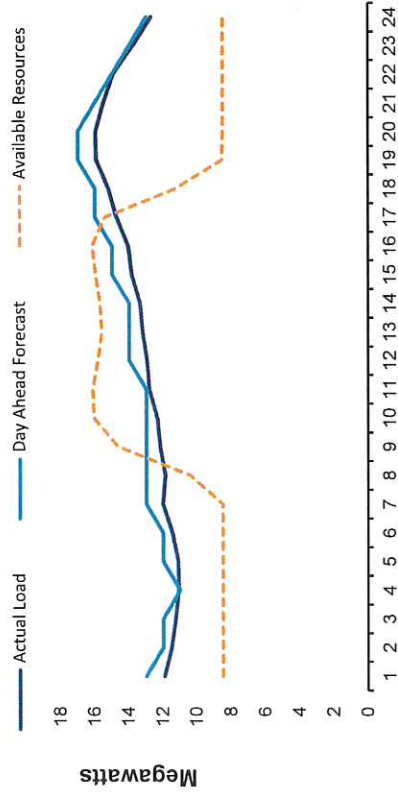


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City of Banning Market Operations Daily Report

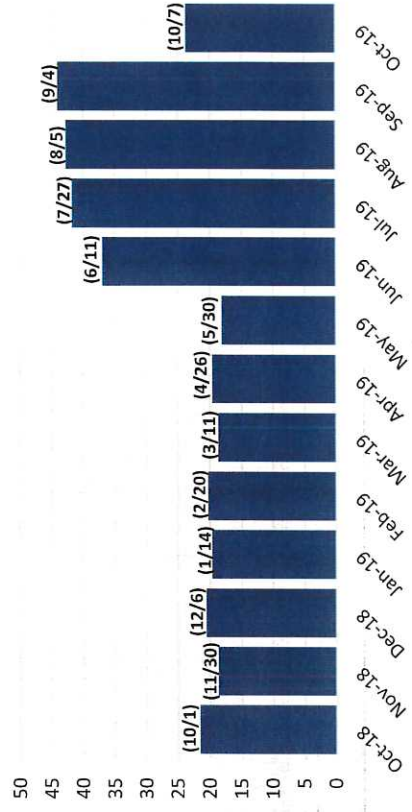
Operating Day: October 12, 2019

BAN Supply and Demand

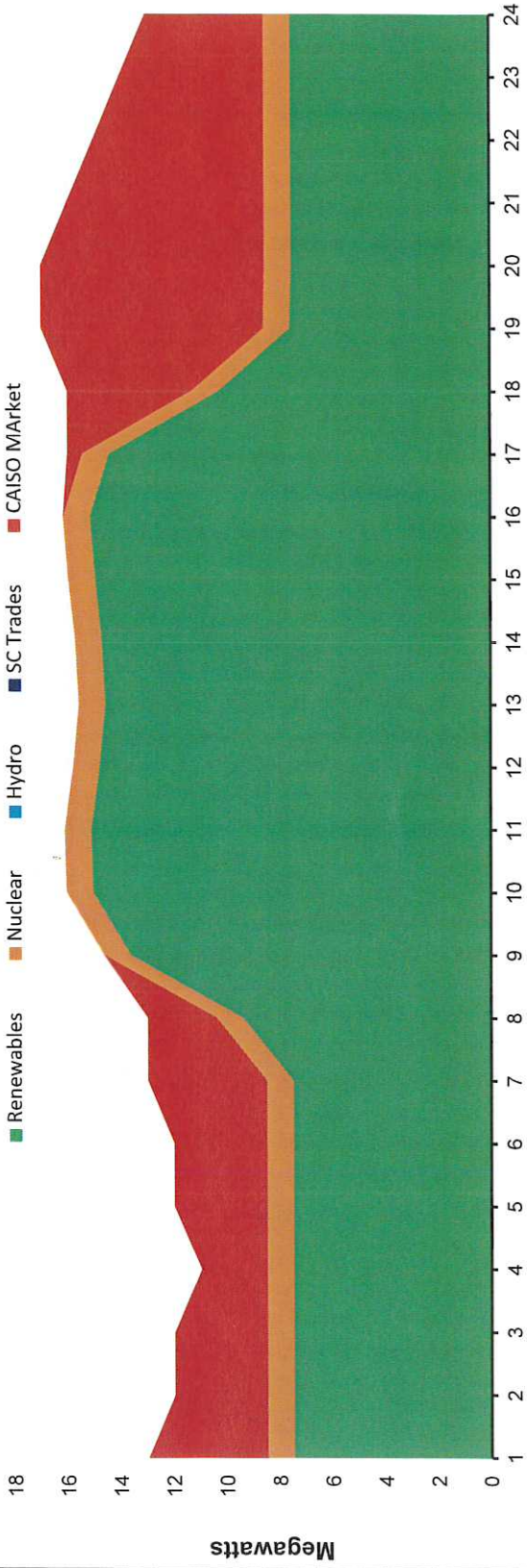


Source: Market Operations

BAN Monthly Peak Load



BAN Breakdown of Total Resources



Source: Market Operations