GVEA Carbon Reduction Study

ACEP Presentation to

GVEA Board of Directors

August 24, 2020

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GVEA Policy 7.6

- Safely provide member-owners with
  - reliable electric service
  - quality customer service and
  - innovative energy solutions
  - at fair and reasonable prices
- Goal: Reduce CO_2e emissions rate 26% by 2030
  - No adverse long-term increase in rates
  - No adverse impacts on reliability

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Carbon Reduction Study Goals

- How can GVEA meet the Board goals?
  - 26 percent reduction in CO_2e rate / MWh
  - AND no adverse long-term increase in rates
  - AND no adverse impacts on reliability
- What options are there?
  - How should GVEA consider the future cost of carbon emissions?

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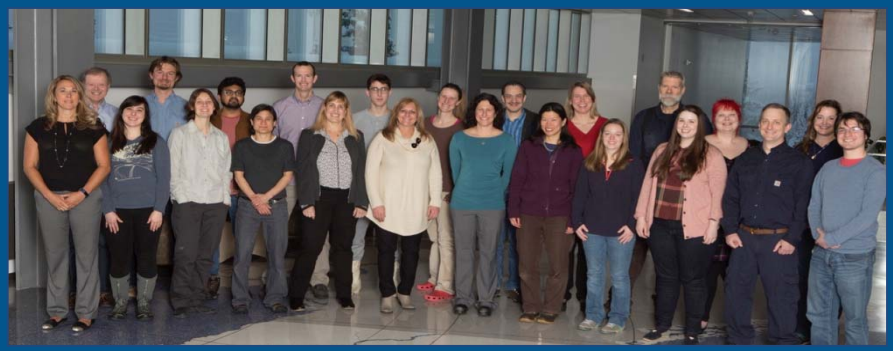
Mission: Fostering development of practical, innovative and cost effective energy solutions for Alaska and beyond

- Applied energy research program
- Technology testing & optimization
- Energy systems modeling & analysis
- Knowledge network creation
- Commercializing energy innovation



ACEP study team

- Gwen Holdmann, principal investigator
- Brian Rogers, project manager
- Steve Colt, economics professor
- Tim Leach, research associate
- George Roe, research professor
- Mohammed Kapourchali, electrical engineering assistant professor
- Christian Seekins, engineering intern

Caveats

- A high-level overview of options
- Not a full integrated resource plan
- Options considered will require
  - Pre-feasibility study for some
  - Feasibility study for most
  - Engineering studies for all
  - Staffing analysis for some

Challenge 1: Base year

- Base year of 2012
  - High availability of natural gas generation from Southcentral Alaska
  - Healy 2 decision was made, but not online
  - Eva Creek investment underway, but not online
  - Any single year has inherent challenges of varying climate, weather, Intertie availability and commodity price volatility

Challenge 2: Endpoint year

- 2030 selected in Board policy
- Aurora contract extends through 2030
- Technological change creates opportunities that may not be ready by 2030
- So: Goal measured as rate at end of 2030
- So: Extend analysis out to 2040

Challenge 3: CO_2e rate v. quantity

- Emissions *rate* vs. *quantity*
  - CO_2e emissions (numerator in rate calc)
  - Electric production (denominator)

$$\frac{Tons}{MWh}$$

- Simple calculation ignores effects of consumer generation and beneficial electrification
- So: adjust numerator for avoided CO_2e from BE (e.g displace internal combustion engines with EV's)
- So: adjust denominator for consumer production

Challenge 4: Load forecasting

- High variability in load forecast
- Highly dependent upon industrial demand
  - Fort Knox, International Tower Hill, Ft. Wainwright CHP, Clear AFB LRDR
- Other demand can vary considerably
  - Recession, climate & weather, consumer energy production, beneficial electrification

Challenge 5: GVEA current fuels

- Coal = low cost, high carbon, very available
- Gas = moderate cost, low carbon, highly variable supply
- Naphtha = moderate cost & carbon
- Diesel = high cost, high carbon, price volatility
- Wind = moderate cost, zero carbon, highly variable supply so must be regulated
- Solar = higher cost, zero carbon, seasonal variability
- Bradley hydro = low cost, zero carbon, capacity fixed

Challenge 6: Carbon inventory

- Inventory methodology does not include
  - Coal/oil/gas extraction and production emissions
  - Embedded CO_2e emissions for plant construction
    - All generation sources have some embedded CO_2e
  - Fuel transportation emissions for coal/oil/gas
- No good Alaska data sources available for 2012 or for now
- So: ignored for purposes of this study

Challenge 7: Social costs/benefits

- Study does not
  - Include calculation of social costs and benefits other than reduction of carbon emissions
- So
  - No direct calculation or inclusion of $PM_{2.5}$ health or economic impacts, but impact noted
  - No potential solution automatically "off the table"

Progress builds on prior GVEA Board green goals and programs

- Home$ense energy audits
- 2005: SNAP and Net Metering
- 2005: 10% peak load from renewable sources
  - Achieved in late 2007
- 2008: 20% peak load from renewable sources
  - Achieved in 2013 with Eva Creek

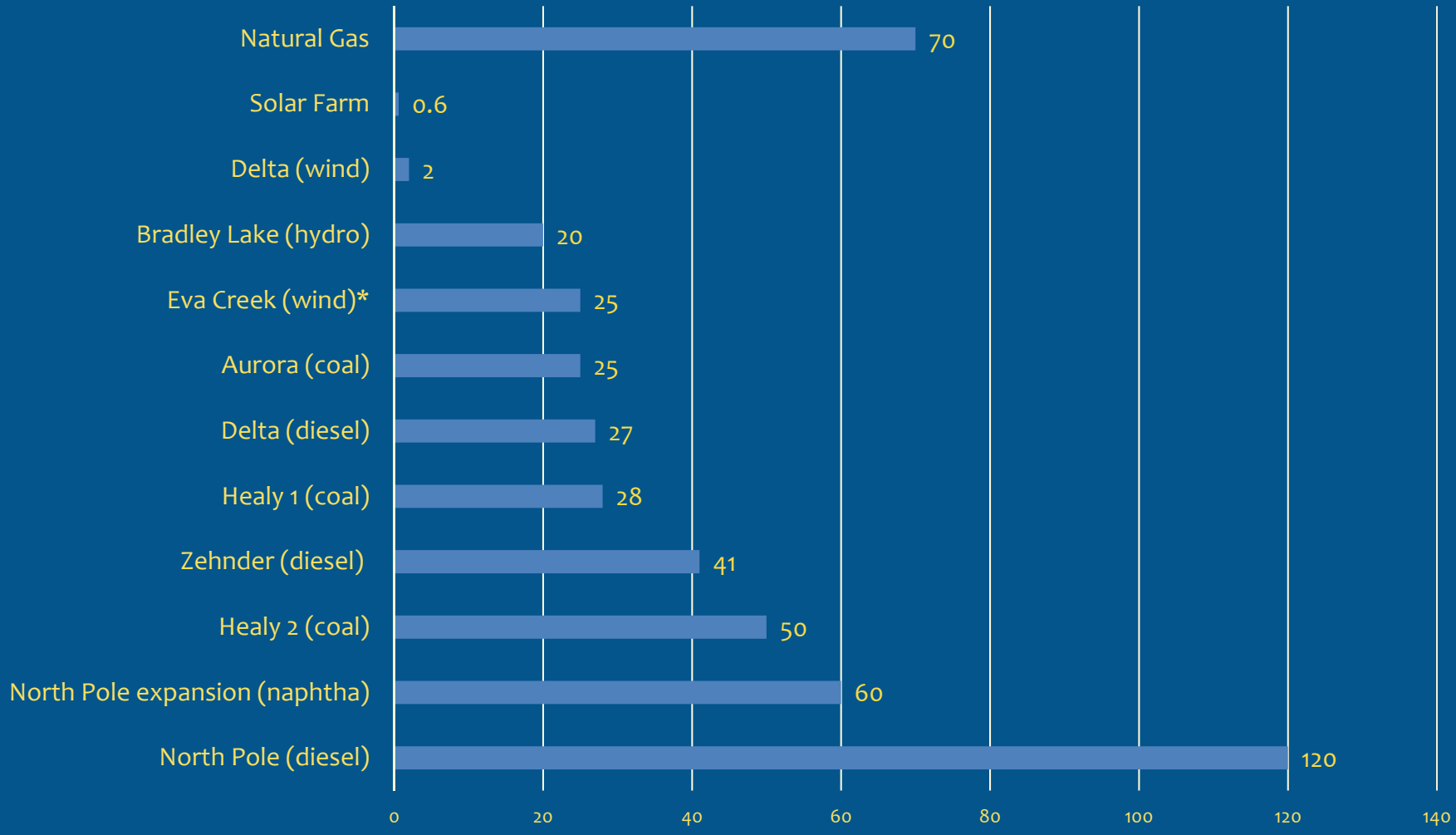
Starting point: 2012

- 2012 – from 2012 Unit Data:
  - 1.2 million Tons CO_2e produced by GVEA and power suppliers
  - 1.3 million MWh produced by GVEA and power suppliers
  - Rate of CO_2e – 0.89 T/MWh
- 2030 target – reduce rate of CO_2e by 26 percent to 0.66 T/MWh

Midway checkpoint: 2019

- 2019 – from Unit Data:
  - 1.3 million Tons CO_2e produced by GVEA and power suppliers
  - 1.2 million MWh produced by GVEA and power suppliers
  - Last year's rate of CO_2e – 1.027 T/MWh
- 2019 is higher than 2012:
  - Healy 2 is online
  - Significantly reduced SC gas-fired generation
    - mitigated in part by Eva Creek online
- 2030 target is now– reduce rate of CO_2e by **32 %**

GVEA production capacity (MW)



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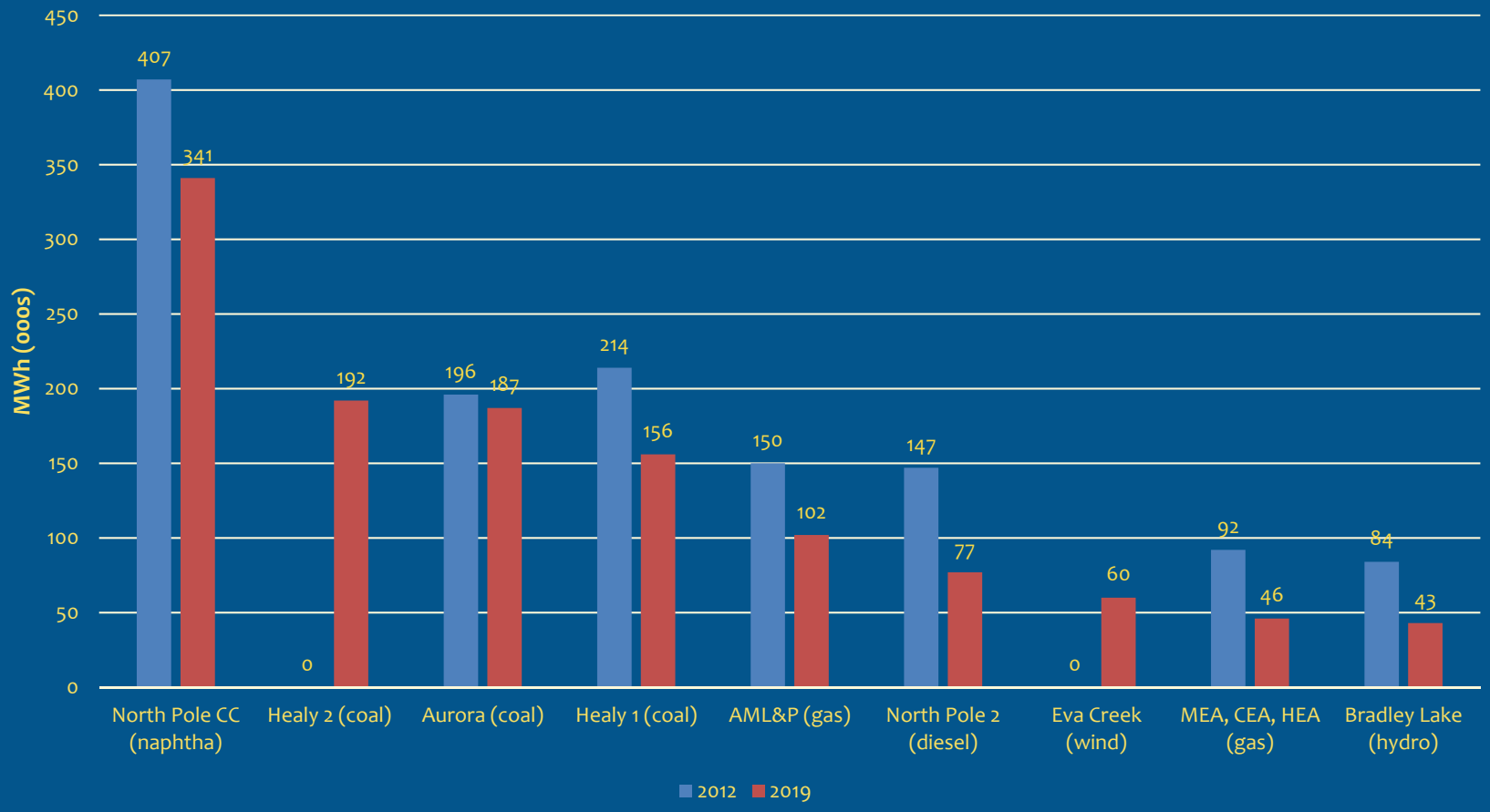
GVEA primary production: 2012 and 2019



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2019 CO_2e emission rates (T/MWh)

- 1.62 – 1.64 Coal (Healy 1, Healy 2, Aurora)
- 1.11 – 2.53 Diesel (Zehnder 1, Zehnder 2, Delta)
- 0.53 – 0.54 Naphtha (North Pole Expansion)
- 0.42 – 0.56 Natural Gas (purchased AMLP, CEA, HEA, MEA)
- 0.00 + Wind (Eva Creek, Delta Wind)*
- 0.00 + Solar (Solar Farm)*
- 0.00 Hydro (Bradley Lake)

* Wind and solar production must be paired with diesel or naphtha generation unless sufficient storage exists to regulate changes in output

General findings

- No silver bullet
- Unique challenges among smaller US utilities
- Cannot operate 2 coal plants year-round
- SC gas-fired generation availability has a significant effect on GVEA ability to reach goal

Generation options

- Major decisions:
  - Upgrade Healy 1 by 2024 for seasonal use OR close Healy 1 in 2024?
  - Purchase 60 MW LM-6000 to replace North Pole 1 & 2 generation (keep NP 2 for emergency use)?
  - Contract with ~16 MW regulated wind project or equivalent?
  - Build out remaining Eva Creek capacity regulated by storage?

Beneficial electrification and conservation options

- Major decisions:
  - GVEA program to stimulate electric vehicle market for CO_2e reduction and increased sales?
  - Initiate residential on-bill financing package for energy efficiency, generation & storage?
  - Initiate support for C-PACE program for commercial customer energy efficiency & clean energy?

Future planning options

- Major decisions:
  - Pre-feasibility studies for new wind + pumped hydro energy storage?
  - Feasibility study for Resilient Home Program for storage to regulate wind?
  - Internal task force to monitor new developments in renewable energy generation & storage?

Statewide initiatives

- GVEA decisions:
  - Leadership in RRC implementation?
  - Actively support consideration of Pumped Hydro Energy Storage and new Hydro projects?
  - Actively support Railbelt Intertie expansion or Roadbelt Intertie?
  - Seek RCA "regulatory sandbox" for greater flexibility, experimentation and pilot programs?

Easy early decisions

- Engineering study for voltage regulation
- Voluntary carbon offsets program
- Continue SNAP program
- N Pole waste heat for hot water
- Seasonal variability in Bradley take once Chugach-AMLP merger is complete

4 near-term big decisions

- Healy 1 upgrade or not
- LM-6000 to replace North Pole 1 & 2
- Electric Vehicle plan implementation
- Seek GVEA supply of natural gas

- And two smaller ones
  - Residential on-bill financing scope, plan and timing
  - GVEA support for C-PACE implementation

Policy changes that would help

- Negotiations to allow GVEA purchase of SC gas-fired generation in smaller blocks of time with less notice
- RCA approval of carbon-reduction measures as addition to rate base
- RCA change in demand charge for EV's
- RRC support for monitoring new technologies
  - Embed monitoring new technologies in IRP

Two ways to reach goal:
A: without Healy 1

- Close Healy 1 in 2024
- New 60 MW LM-6000 to replace N Pole 1 & 2
- IPP contract: 16 MW regulated wind or equiv.
- Cease purchase of Aurora power in 2030
- EV, Residential, Commercial packages
- Expand Eva Creek w/ partial storage regulation
- Estimated 0.553 T/MWh rate at end of 2030

Two ways to reach goal:
B: with Healy 1

- Upgrade Healy 1 in 2024; operate seasonally
- New 60 MW LM-6000 to replace N Pole 1 & 2
- IPP contract: 16 MW regulated wind or equiv.
- Cease purchase of Aurora power in 2030
- EV, Residential, Commercial packages
- Expand Eva Creek w/ partial storage regulation
- Est. 0.628 T/MWh rate at end of 2030

Under either option

- Could drop IPP contract for regulated wind
- Cost / MWh would be ~$1.45 lower
- BUT:
  - No room for error:
    - Won't make goal if SC gas availability constrained
    - Barely make goal if Healy 1 (option B): 0.655

Additional 60 MW LM-6000

- Replaces 44-year old 120 MW North Pole 1 & 2
  - Use for base generation, peaking, regulation
  - Keep N Pole 2 as emergency backup
- Reduces CO_2e from diesel (1.51 and 1.11 T/MWh) to naphtha (0.53); reduces fuel cost significantly
- Reduces CO_2e from coal (1.64 T/MWh) to naphtha (0.53); increases fuel cost somewhat

Regulated wind project

- Using 16 MW capacity in model
- Example: 70% propane / 30% wind over course of year to calculate CO_2e rate
- Reduces CO_2e from coal (1.64 T/MWh) to propane/wind blend (0.29) in summer
- Provides additional base load power in winter

Add to Eva Creek Wind project

- 8 MW addition to current system at $40 M cost
- Pair with GVEA-sponsored Resilient Home Program – home energy storage (e.g. Tesla Wall)
- Use RHP and battery for regulation
- More feasible under Option A No Healy 1 Upgrade due to transmission line constraints

Electric vehicle package

- Significant opportunity to lower CO_2e while increasing sales of electricity
- Positive rate of return for GVEA investment
- GVEA potential roles that pay off:
  - Build out Electric Vehicle Supply Equipment (fast charging stations)
  - Subsidize EV purchase in early years
  - Establish tailored rate to incentivize EV smart charging
  - Promote adoption of EV's for residential and commercial customers

EV's: Size of the opportunity

- US EV penetration expected 7% cars & pickups by 2030
- Our model: 5% of FNSB cars & pickups with GVEA actions to stimulate the pace of adoption
- = 486 cars & pickups per year, 4,860 EVs by 2030
- Additional opportunity for commercial trucks & busses

GVEA EV model program

- GVEA invests 50% of cost of Level 3 EV (addressable) charging equipment: $3.9 million
- GVEA invests $5.3 million in EV purchase subsidies
  - Starting at $2,000 / EV, declining to $0 over 10 years
- EV load requirement grows to 29,400 MWh in 2030, 58,800 MWh in 2040
- GVEA IRR over 20-year program is 12.6%
- GVEA Net Present Value is $7.5 million after expenses
- Net effect on 2030 CO_2e rate: -0.057 T/MWh (6%)
- GVEA average profit / Ton CO_2e reduced: $10.99

GVEA commercial carbon reduction program

- GVEA support for FNSB C-PACE implementation
- GVEA C-PACE demonstration project
- GVEA pays C-PACE energy audits for commercial customers
- Results:
  - Reduced heating oil consumption; increased heat pump load; potential for utility-controlled DSM
  - Net effect on 2030 CO_2e rate: -0.005 T/MWh (0.5%)
  - GVEA average cost $18.01 / Ton CO_2e reduced; could scale by amount of energy audit subsidy

GVEA C-PACE demonstration

- GVEA C-PACE demonstration project using own facilities – member services, operations, warehouse
- Full transparency to other commercial customers
- Energy audit of facilities
- Building envelope energy conservation measures
- Increase efficiency of lighting and equipment
- Net positive cash flow for GVEA from day one
- Est. GVEA cost: $129,500; annual savings $31,600

GVEA residential carbon reduction program

- On-bill financing for solar & wind generation, heat pump installation, energy efficient boilers, storage
- Pay 50% of cost for 2 community solar installations & 2 utility solar installations; continue SNAP program
- Increases electricity sales (heat pumps) & production (solar), reduces residential CO_2e
- Cost to GVEA: $2.2 million over 20 years
- Net effect on 2030 CO_2e rate: -0.002 T/MWh (0.5%)
- GVEA average cost $6.65 / Ton CO_2e reduced

Opportunities to watch

- Storage – to reduce wind regulation costs
  - New battery storage
  - Pumped hydro storage
  - Power to gas to power hydrogen storage
- Transmission – Strengthen Southcentral Intertie
  - Railbelt System or Road Belt Electrical Transmission
- Generation
  - Tiekel River and other hydro projects
  - Nuclear generation, possibly with Ft. Wainwright
- Carbon capture and storage technologies

Summary of 2030 options

- 60 MW 2024 LM-6000
- (28 MW) 2024 Healy 1 – under option #1
- (120 MW) 2024 North Pole 1 & 2 emergency only
- (25 MW) 2031 Aurora
- 16 MW 2022 Regulated wind equivalent
- 8 MW 2030 Eva Creek 2 + storage regulation
- 1 MW 2022 & 2026 Community solar
- 5 MW 2021 UAF available; could use occasionally

Summary of 2030 MWh impacts

- 23,500 MWh Electric vehicle demand
- 4,750 MWh Residential heat pump demand
- 3,375 MWh Commercial heat pump demand

- 3,500 MWh SNAP production
- 750 MWh Community solar production

2030 CO_2e rate impacts

- +0.149 New LM-6000
- +0.048 Propane regulated wind project
- -0.004 Consumer & community solar
- -0.016 Delta & Zehnder emergency use only
- -0.149 N Pole 1 & 2 emergency use only
- -0.150 *B: Operate Healy 1 seasonally
- -0.300 *A: Shut down Healy 1
- -0.360 Cease purchases from Aurora

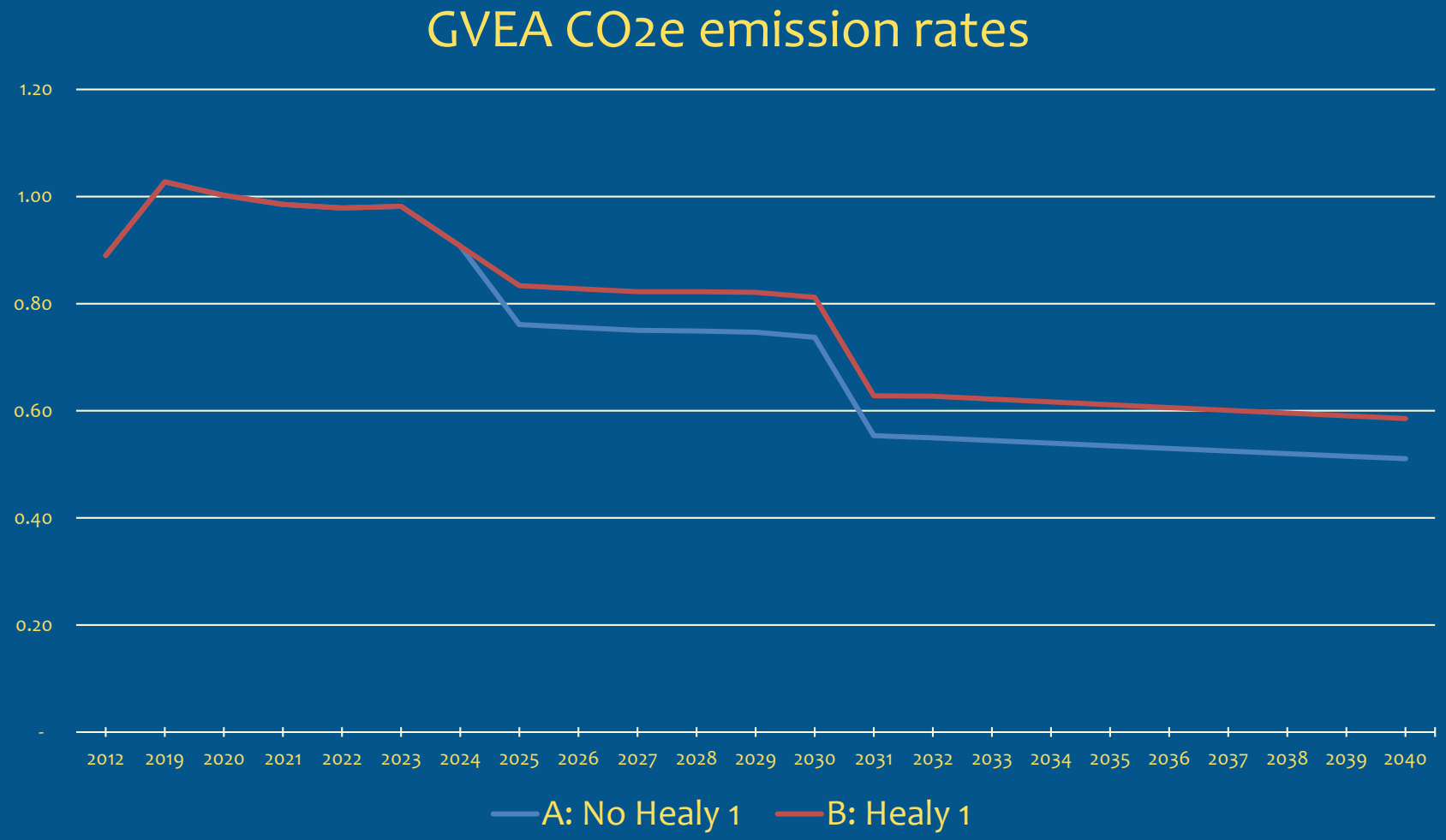
2030 CO_2e rate impacts

- -0.038 Electric vehicles
- -0.011 Residential heat pumps & boilers
- -0.005 Commercial energy efficiency
- -0.004 Residential energy efficiency
- -0.003 Voluntary offsets

2030 CO_2e rate impact summary

Year	Option	Rate	Change
2012		0.890	
2019		1.029	+ 13.7 %
2025	A	0.761	- 12.9%
	B	0.834	- 5.6%
2031	A	0.553	- 33.7%
	B	0.628	- 26.2%
2040	A	0.510	- 38.0%
	B	0.586	- 30.4%

2030 CO_2e rate impact summary



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Potential GVEA debt impacts

- GVEA capacity for new debt to address CO_2e with stable rates is about $100 M
- $ 3.9 M 2022 EVSE installation ($0.3 M debt svc.)
- $55.0 M 2024 LM-6000 ($3.4 M)
- $10.0 M 2025 Healy 1 upgrade ($ 0.6 M)
- $40.0 M 2030 Eva Creek 8 MW upgrade ($ 2.5 M)
- $ 1.1 M 2022 & 2026 community solar ($0.1 M)
- $12.0 M Upgrade NPE for natural gas ($0.8M)

2030 Cost impacts: Fixed

- $3.4 M LM-6000 annual debt service
- $0.3 M EV Service Equipment buildout debt service
- $2.5 M Eva Creek 2 and RHP storage debt service
- $0.6 M Healy 1 upgrade (under Option B)
- $0.1 M Community solar debt service
- $0.8 M Upgrade NPE for natural gas (if economic)

2030 Cost impacts: Variable

- $ 120 k C-PACE audits (30 per year)
  - ($130 k) GVEA margin on commercial heat pump MWh sales
- $ 90 k EV purchase subsidy
  - Note: Subsidy starts at $1.0 M in 2021, declines by $100k each year
  - ($1.2 M) GVEA margin on EV charging MWh sales
- $ 100 k On-bill financing support
  - ($39 k) Consumer carbon offsets
  - ($190 k) GVEA margin on residential heat pump MWh sales

2030 Cost impacts: Fuel

- Our model is based on 2019 costs – from GVEA Form 12 (RUS) and GVEA COPA Filing to RCA (2/28/2020)
- Oil prices fell substantially post-COVID
- We believe 2019 prices are more likely than 2020 prices over the long term but can model different assumptions. Initial analysis does not change the basic options
- 2019 naphtha prices were comparable to $10.50 natural gas delivered in Fairbanks; gas availability in the $10-12 range would provide impetus to convert the NPE plant to natural gas

Net changes in cost / MWh

- 2020 – 2023 Costs within 1% below current cost /MWh
- 2024 – 2030 Cost / MWh about $4 below current
  - Primary driver is replacement of N Pole 1&2 generation with new LM-6000
- 2031 Cost / MWh increases to same as current
  - Primary driver is replacement of Aurora generation with increased LM-6000 generation, and new debt service for Eva Creek 2
- 2032 – 2040 Costs decrease very slowly, total 1%
- Little difference between Option A and Option B

Other opportunities (not included)

- Purchase of carbon credits (net cost to GVEA)
- Utility-supported Distributed Energy Resources (DERs)
- Demand side management to reduce total electric demand or to shift timing of demand
- Rate designs to bring down peak loads

Risk management issues

- Reliability: risk of downtime
- Rates: risk of fuel volatility
- Regulatory: risk of regulatory change
- Policy: risk of carbon tax or management

- CO_2e reduction plan reduces risk of significant carbon impact on rates in coming decade

Timeline

- Next:
  - Consider issues you raise today in final report
  - Refine model if and as required
  - Model additional scenarios as requested
- Sept 15:
  - Present full report for 9/28 Board packet

Questions?
Comments?

Requests for additional analysis?

Thank you

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