



Hog Fuel Supply and Power Generation Trends for 2020

Greg Frohn, Thermal Fuels Manager

Mapping the Course – Heathman Lodge - Vancouver, WA

January 23, 2020

Avista Utilities

A vertically integrated utility company celebrating 129 years: Energy Generation, Transmission & Distribution Thermal, Hydro, Solar and Wind

Formed in 1889, Washington Water Power Company (WWP) – now known as Avista began eight months before Washington Territory became a state.

- Today, Avista is involved in the production, transmission and distribution of energy.
- Electricity to 382,000 customers
- Natural gas to 347,000 customers
- Service territory that covers 30,000 square miles in eastern Washington, northern Idaho and parts of southern and eastern Oregon.

Avista's Kettle Falls Generating Station was the first electric generating station of its kind constructed within the United States for the sole purpose of producing electricity from wood waste began operating in October **1983**.

“Today is not a choice between conservation, coal, nuclear, renewable, or all forms of generation – but rather it’s the need to use all of them when practical. If we fail to plan and build today, tomorrow could be too late.”

Kettle Falls Generating Station

- 53 MWH Plant located on Lake Roosevelt
- 1200 PSI, 950 degree walking grate boiler
- Commissioned, in 1983
- 37+ years of partnering with regional forest products industry
- 30+ Residual suppliers within 125 mile radius
- In-woods grinding operations within 25 mile radius
- Renewable Energy Credit compliant in WA and CA
- Future upgrades planned



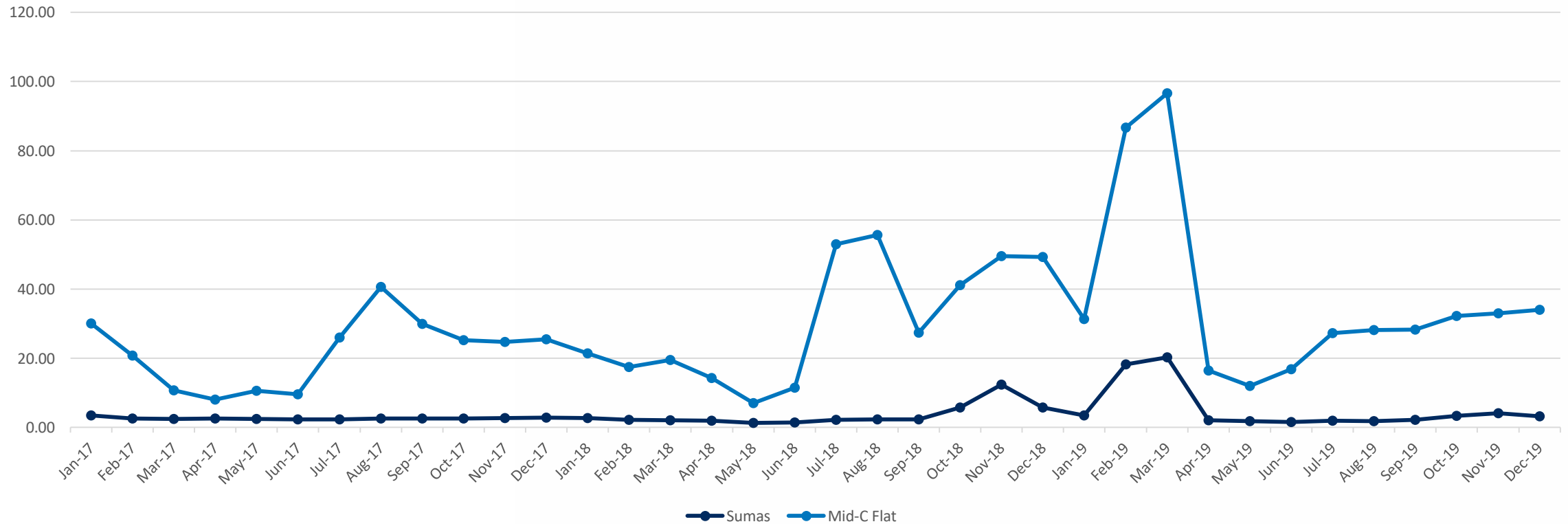
Renewable “Baseload” Energy

- KFGS generates 300 - 500,000 MWH depending demand
- That is enough to power 50,000 homes.
- The plant’s 52 MWh output meets Renewable Energy Certification requirements in CA and WA power markets.
- New Fuel yard upgrade project in progress. Completion in late 2021.



PNW enjoys reliable energy resources already

Regional Gas and Power Pricing Relationship

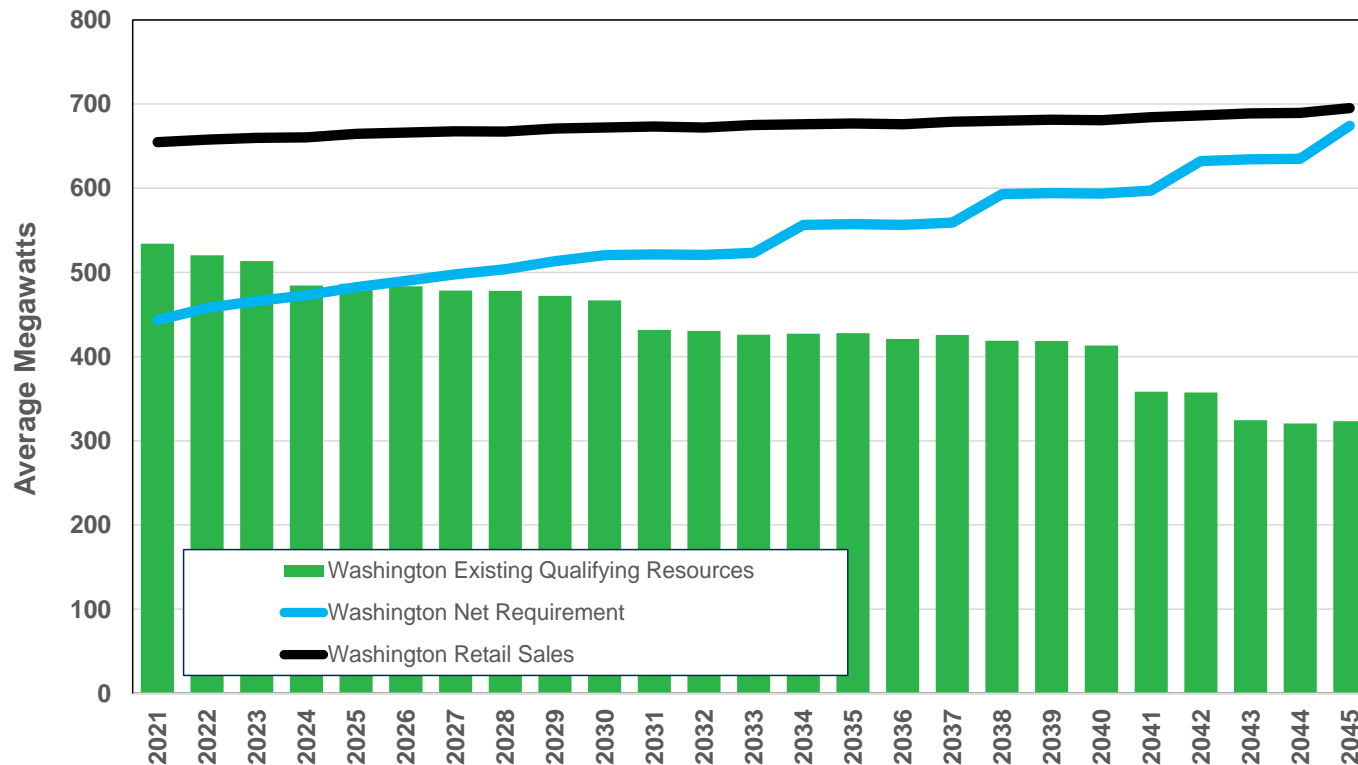


Washington SB5116 Clean Requirements

2026: Colstrip can no longer serve Washington Load

2030: 80% energy delivered over a four-year period is clean and 20% can be RECs

2045: Goal to be 100% clean (will require new technology to stay under cost cap)



Gap

2030: 54 aMW

2035: 130 aMW

2040: 182 aMW

2045: 353 aMW

Key Losses:

Mid-C: 2030

Lind: 2039

Rattlesnake: 2040

Palouse: 2043

Resource Options

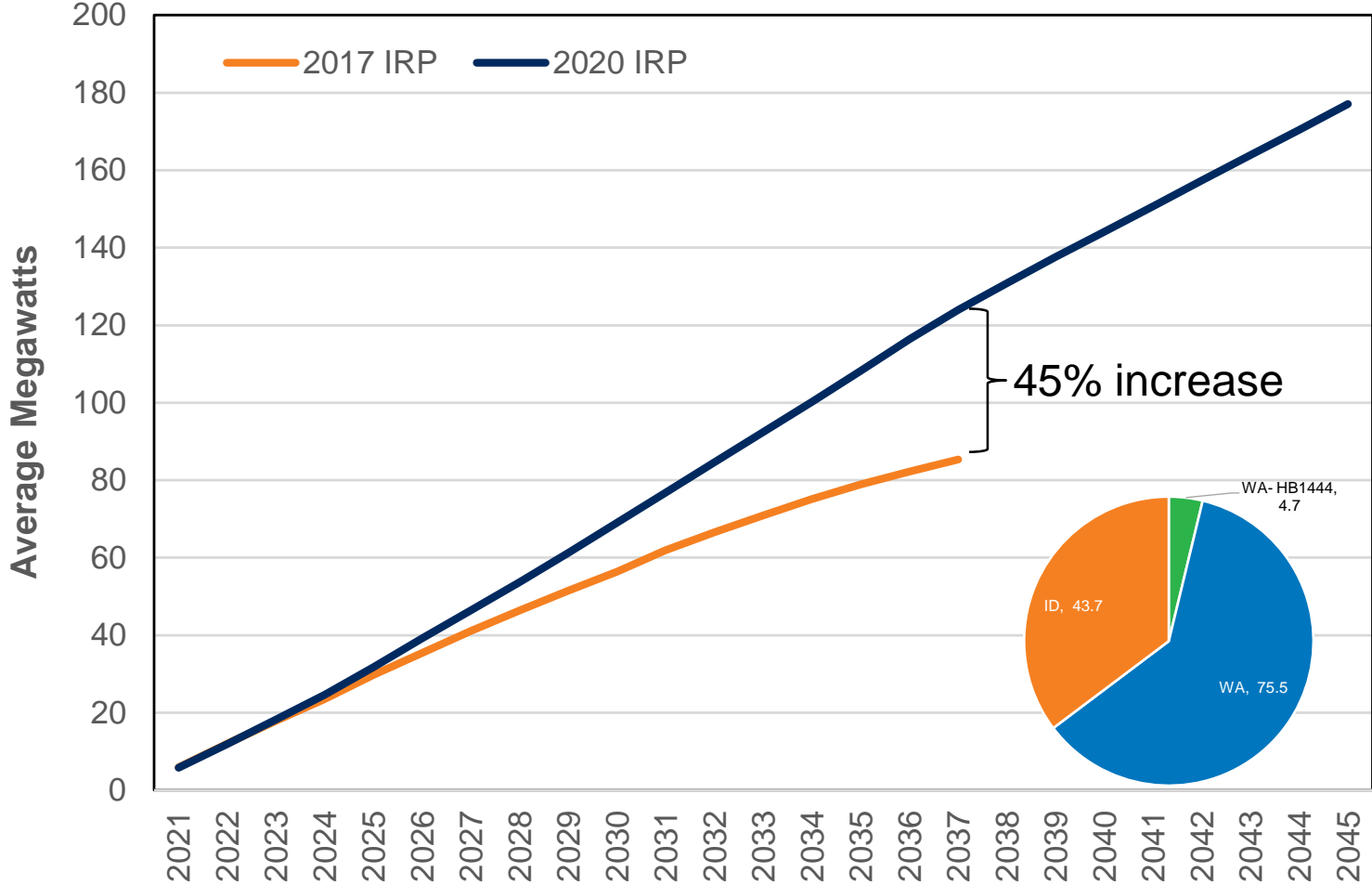
Clean

- Wind (WA/OR/MT)
- Solar (WA/ID/OR)
- Biomass (WA/ID)
- Hydro Upgrades (MS, LL)
- Hydro (Mid-C)
- Geothermal
- Nuclear
- Energy Efficiency
- Demand Response

Other

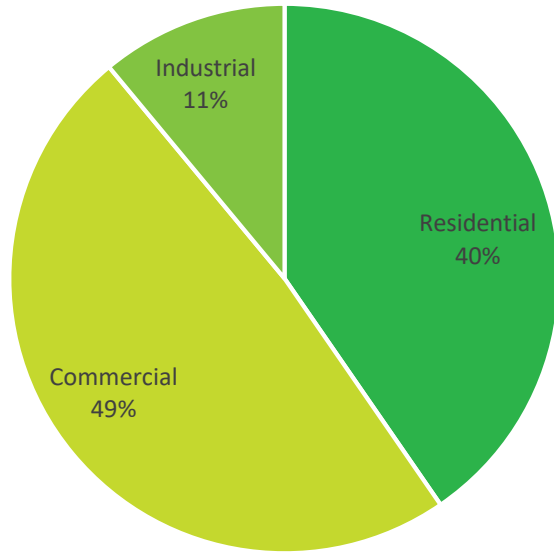
- Natural Gas CT
- Natural Gas CCCT
- Storage
 - Pumped hydro
 - Lithium-ion batteries
 - Liquid air
 - Hydrogen
 - Flow batteries

Energy Efficiency Results

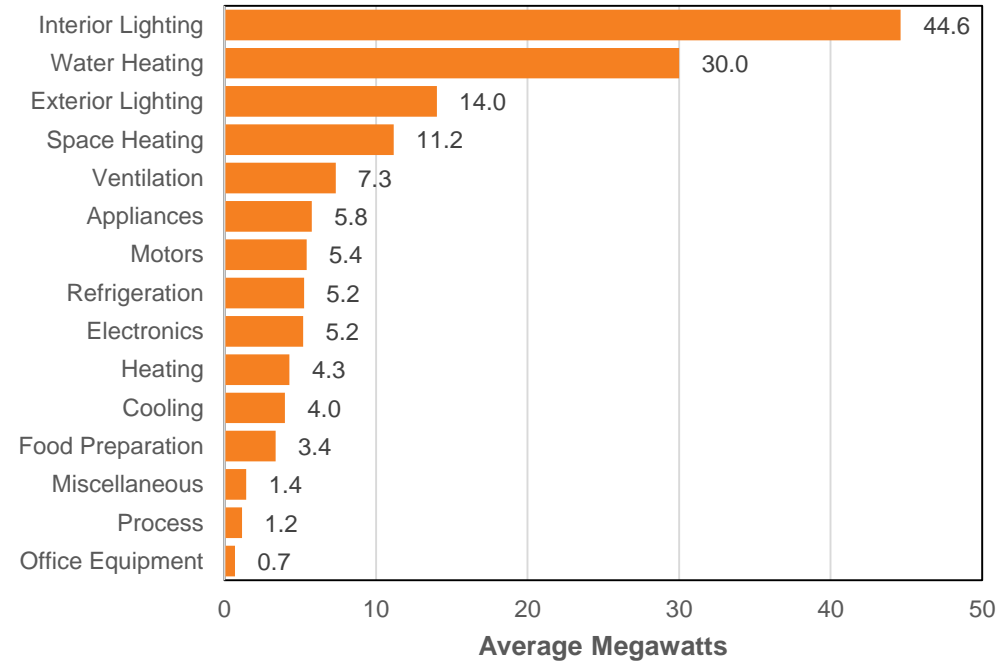


Where is the Cost Effective Energy Efficiency Savings?

2040 Customer Class Savings



2040 Cumulative Savings



Preferred Resource Strategy

Load reduction of 187 aMW due to Energy Efficiency by 2045

2021-2030

2022: 100 MW, MT Wind
2022: 100 MW, NW Wind
2023: 100 MW, NW Wind
2024: 12 MW, Kettle Falls Upgrade
2026: 222 MW, Colstrip removed
2026: 175 MW, Pumped Hydro
2026: 24 MW, Rathdrum Upgrade
2026: 257 MW, Lancaster PPA expires
2025-2030: 76 MW, Demand Response
2026/27: 200 MW, MT Wind
2027: 8 MW, Post Falls Upgrade

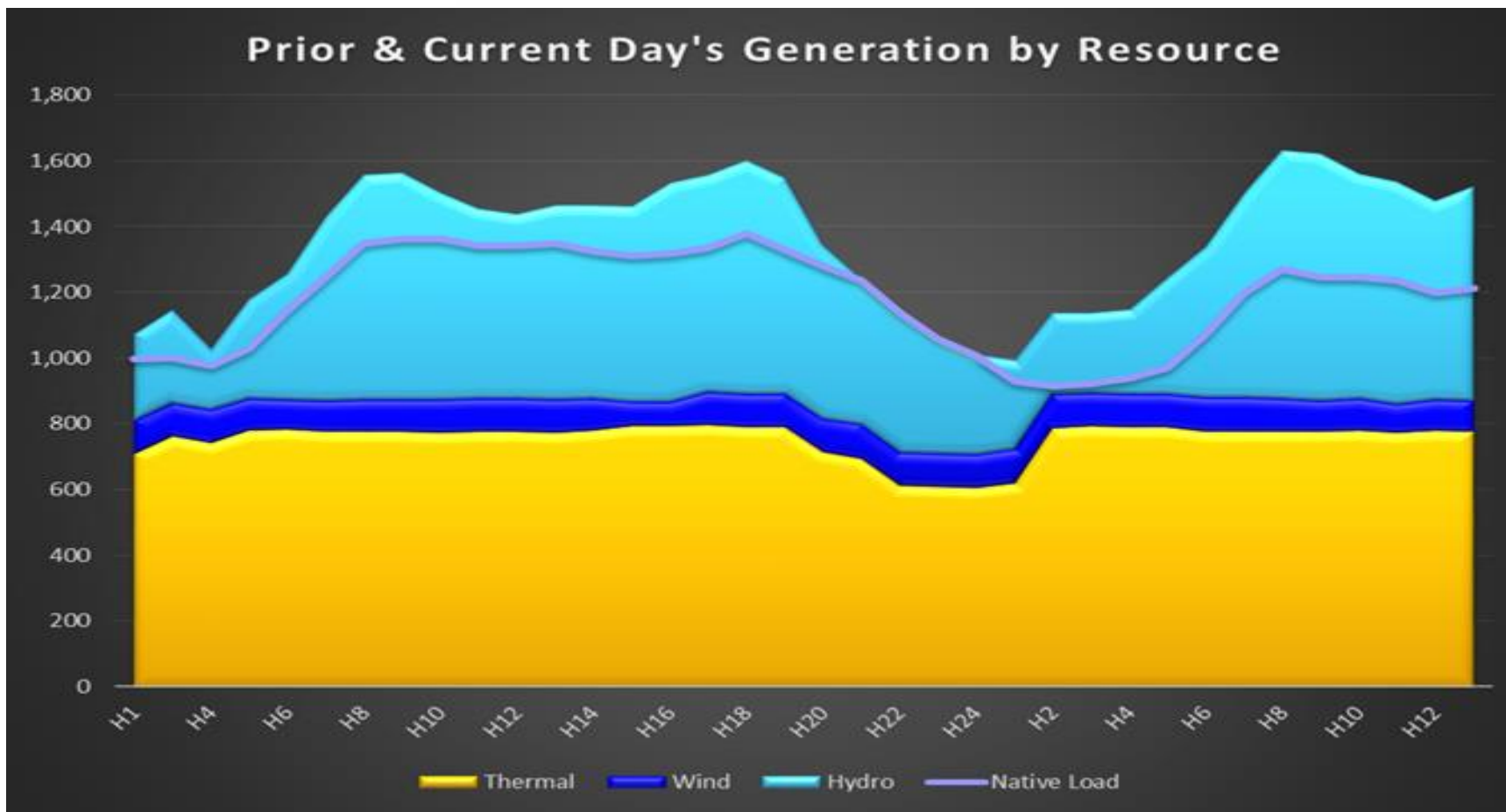
2031-2040

2031: 75 MW, Mid-C PPA Renew
2032: 32 MW, Demand Response
2035: 55 MW, Northeast CT retires
2035: 68 MW, Long Lake 2nd Powerhouse
2036-40: 75 MW x 16 hr, Liquid Air Storage
2037: 1 MW Demand Response

2041-2045

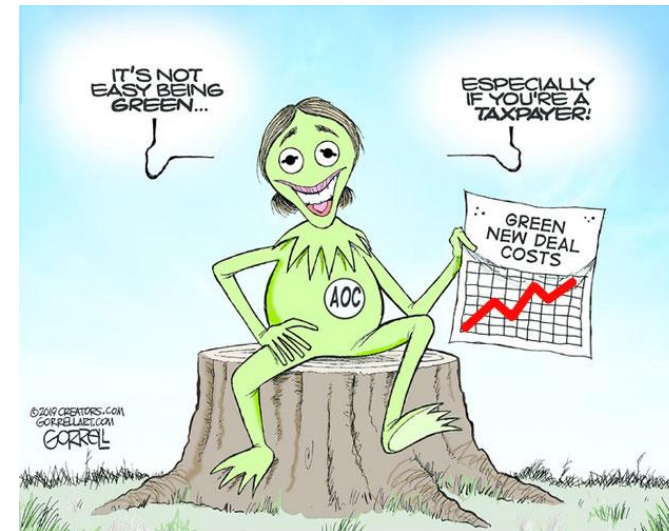
2041: 25 MW x 16 hr, Liquid Air Storage
2042: 2.5 MW, Demand Response
2042-2045: 300 MW Wind PPA Renew
2042-2045: 300 MW x 4 hr, Lithium-ion
2044: 55 MW, Solar w/ 50 MW x 4hr, Storage

Power Generation Blend depends on demand, base load and available resource – modified daily to meet needs.



So, with increased demand on Green Energy what does this mean for hog fuel supply?

1. Hog fuel has evolved from **waste** to commodity in recent years
2. Emission permit constraints and green REC – Clean forest based fiber (no demolition debris)
3. Mill Residual hog fuels – available with limiting factors:
 - a) Lumber market drives mill production
 - b) COST Effective transportation lanes
 - c) Log supply – mill availability
 - d) Boiler efficiency: hog vs. gas for steam?
4. In-woods slash pile grinding
5. Whole log chipping
 - a) Cull logs, hardwood, etc.



Thermal Fuel Comparison

- 1 Ton of Coal = 1.51 MWh
 - 0.66 Ton/MWh
 - ~8500 BTU/lb
- 1 BDT of Woody Hog = 1.32 MWh
 - 0.75 BDT/MWh
 - ~4250 BTU/lb (green)
 - ~8500 BTU/lb (dry)

Efficiencies depend upon MC%, fuel consistency and handling properties, available volumes, distribution and combustion properties/chemistry

What makes good hog fuel?

- “Bone Dry” BTU value ~8500
- MC% 48-52
 - Timely delivery of product = lower MC% and better BTU.
- High percentage of bark and solid wood vs. “fines”
- Consistent sizing: 3”x3”x3”
- Steady, dependable production on-time delivery
 - 500,000+ GT. Let us manage your pile for you. Age, MC% creep=legacy
- Quality manufacturing and loading procedure
 - Bin vs. Pile
 - Winter- frozen fuel, causes damage to trailers, binds up, take more volume to produce BTU value
- No rocks, asphalt, or metal contamination
- Solid communication throughout. Ensure a long term partnership

1.) Hog fuel as a market commodity

- Interest in Green Energy Generation on the rise
- “In-house” Steam boiler fuel
- beauty bark as low cost landscape cover
- “Return to Fuel” value appreciation is dependant upon
 - MC% (sweet spot 48-50%)
 - Free of metal, trash and Rocks
 - Specie and processing
 - Flow
 - Dependable steady flow
 - Business partnering: LEAN process
- Transportation challenges

2.) Green Energy Economics

- Dispatch price drives generation needs. Winter - Summer
- Renewable Energy Credit (REC) generation demand
 - 1 MWh generation = 1 REC
 - CA RECs \$8-\$10
 - WA RECs \$2-\$4
- Inventory Targets
 - Aging sweet-spot: BTU loss/Mixing gain
 - Forced burn to manage surplus
- Peak hours – Base Load. No sun or wind = no power.
 - Alternate Energy sources need **battery storage** to offset cycling and peak
- REC requires sustainable wood fiber. No “old growth”, no resins, paint etc.

3.) Mill Residual Supply

- KFGS provides steady take-away into green combustion
 - 24-7 unloading facility
 - Eliminate costly piling and bottlenecking, spotty alternatives, steady cash flow.
 - Why keep it in a pile on your site?
 - Offers steady, dependable revenue
 - Provide solution based flexibility
- Lumber production drives availability
 - Housing starts
 - CLT, LVL increased market share
 - Export/import dynamics – cross border market economics
- Effective, reliable trucking is key to movement and an important partner
- Log supply (Log to Hog)
 - Drives output schedule
 - Mill closures and/curtailments
- LEAN analysis.
 - Better efficiency to burn hog than gas??? 1# steam = 1,000 btu
 - Focus/investment on core business of lumber manufacturing

Reliable Efficient Transportation Key to Success

- Wheels must turn so we can burn
- Professional dispatch – maximize service and cost effectiveness
- Safe, timely turnaround <20 mins
 - Investment in fuel yard improvements
- Clear 3 way communication
 - Consistency, Process, Adapt
- Little changes to supply chain can result in big variances in supply.
 - Adaptation and commitment
- Winter freeze conditions = Spring cleanup = contamination risk
- Driver training and retention depends on overall strength of the economy viability



Other pieces of the puzzle...

- Changes in Green energy legislation
- State Power Commissions
- Power Markets – Western Energy Imbalance Market (EIM)
- Avista corporate green initiatives and targets
- Future bio fuel markets and supply
- Biochar/fly ash land application opportunity
- Hog fuel alternatives – demolition debris, pellets, ag waste
- Other

Forest Collaboration – Agency Fiber

- Recession proof green baseload energy for forest dependent communities
- Lots of meetings, outreach, funding requests, slow but steady....
- Forest based solutions: It starts at the stump....
 - Increased fiber supply
 - Fire mitigation
 - Subsidy from landowner/agency for transportation vs. slash burning
 - Good Neighbor Authority
- Keeping resource conversion local
 - Jobs
 - Sustainability
 - Economic independence

In woods fuel development

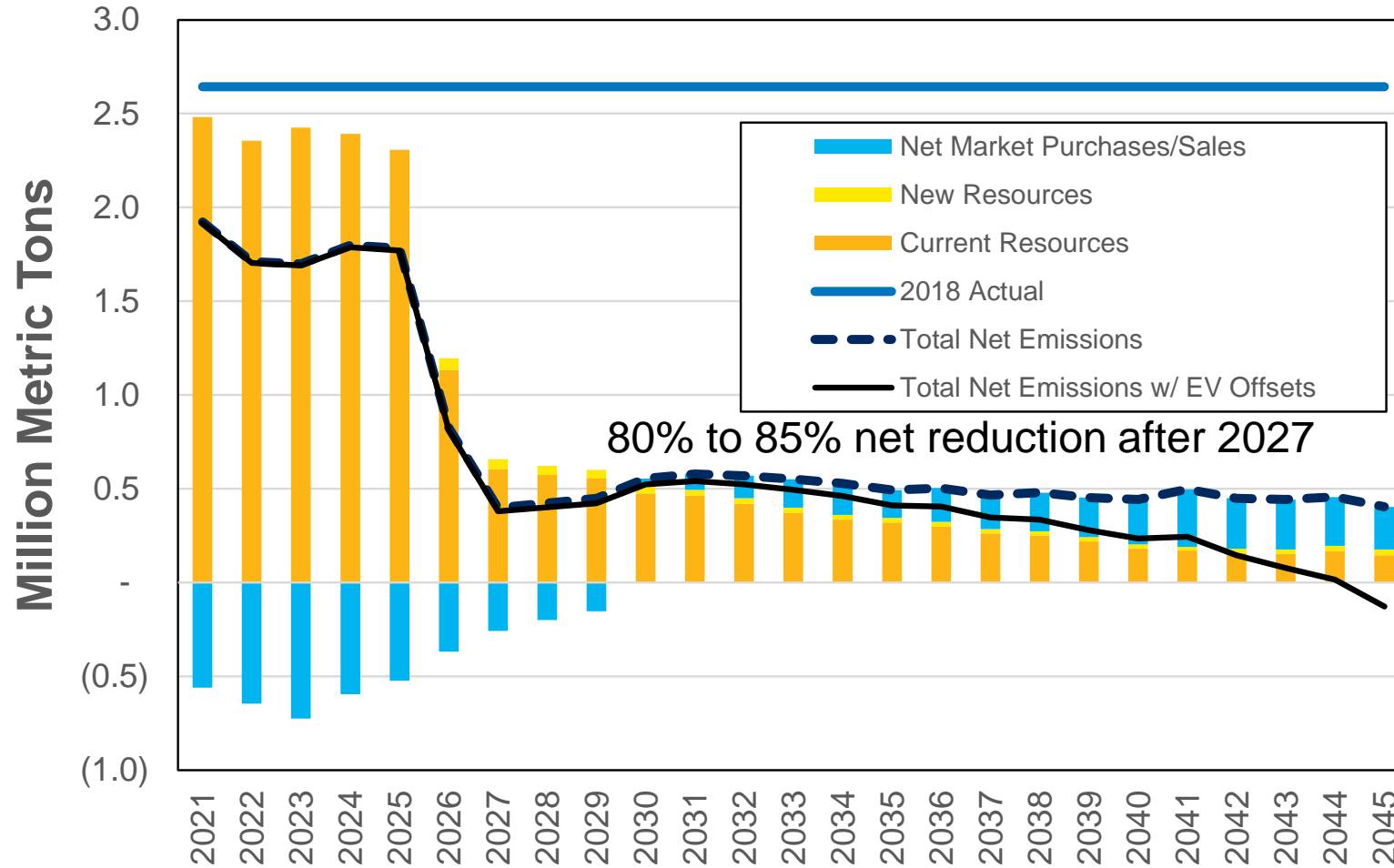
- 5 million acres of Federal, state, provincial, tribal and private timberlands.
- Currently support one full time in-woods grinder to convert slash piles into hog fuel. Low moisture but typically prone to dirt contamination
- Value of hog fuel to cost of grinding can require some landowner subsidy
- Fire reduction harvest operations could benefit from viable biomass energy market such as KFGS
- Capture un-merchantable fiber in slash piles, reduce air emissions from slash burning
- FESBC funds effort at OK Falls, BC – “Create jobs and fight Climate change”
- Cull pulp logs, tops and hardwood pulp logs into fuel log yard for processing

Wind turbines made out of LVL? More green = more hog fuel



End result: Reduced Greenhouse Gas Emissions

(We've already come a long way since the Wigwam burner era!)



Note: Electrification of transportation lowers Avista's emissions below zero

QUESTIONS....

Greg Frohn

Thermal Fuels Manager

509-209-4544

greg.frohn@avistacorp.com