

# RESOURCE OPTIONS UPDATE

## WOOD BASED BIOMASS

DRAFT FOR COMMENTS

**BC hydro** 

FOR GENERATIONS

July 2, 2015

# BACKGROUND & OBJECTIVES

BC Hydro and FortisBC are updating its Resource Options Inventory for use in long term planning (information should be treated as indicative with uncertainty range behind estimates)

Objectives for today:

- Report out to industry experts draft results of the characterization of BioEnergy resource option
- Explain what updates have been made since meeting in March
  - Fiber Availability
  - Delivered Fiber Costs
  - Project Costs and Technologies
  - Additional opportunities in Metro Van

# FIBER AVAILABILITY

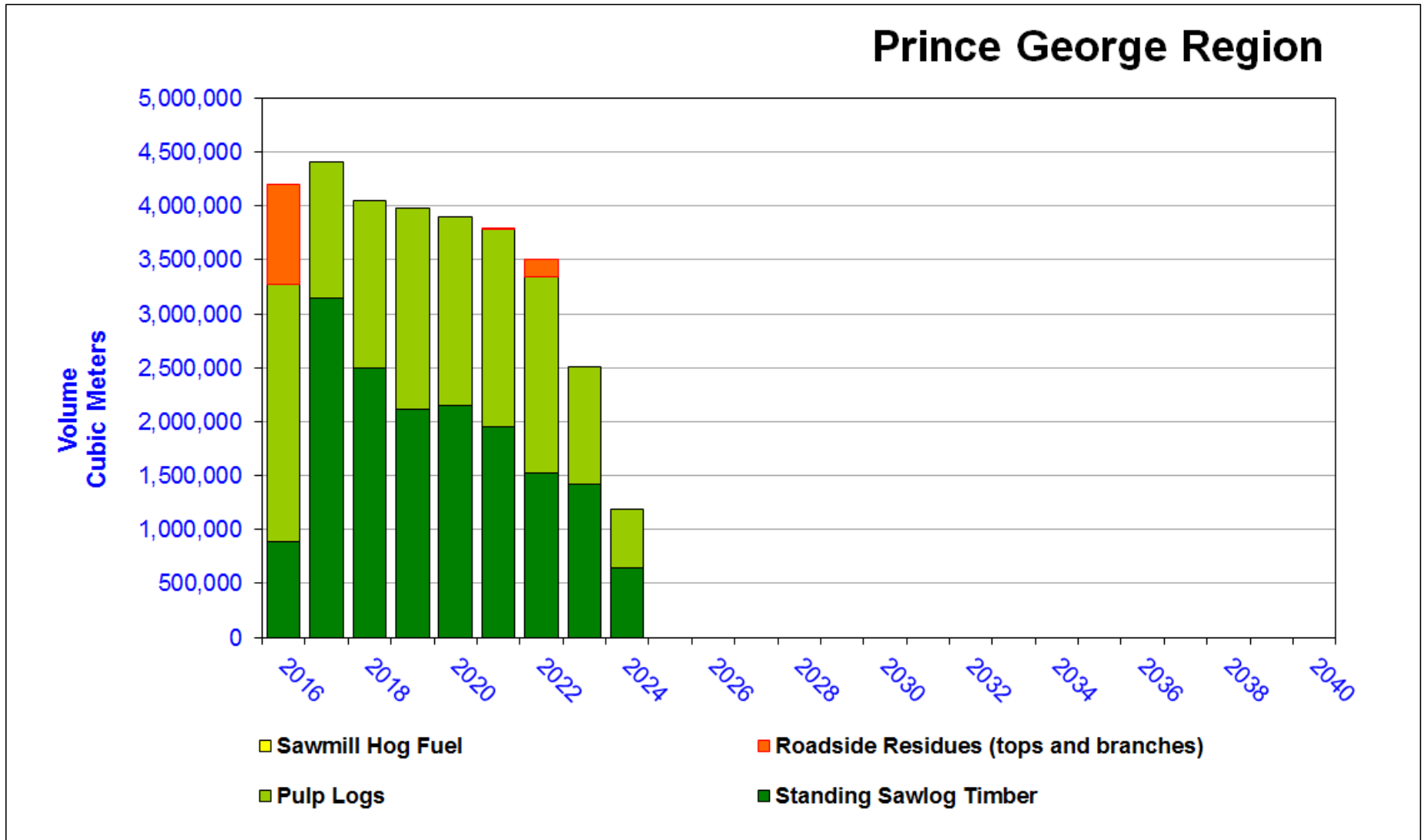
## WHAT'S CHANGED SINCE MARCH?

- Updated AAC (e.g. reduction in Morice, Williams Lake TSA etc)
- Updated pellet plant and mill operating rates
- Increased log exports from the Coast
- Re-start of Kitwanga sawmill on 1 shift
- Removed fiber requirements expected from future load displacement projects from Demand Side Management initiatives

### RESULTS:

- General picture of fiber availability stays the same
- Available fiber further reduced

# RESULTS – PRINCE GEORGE REGION



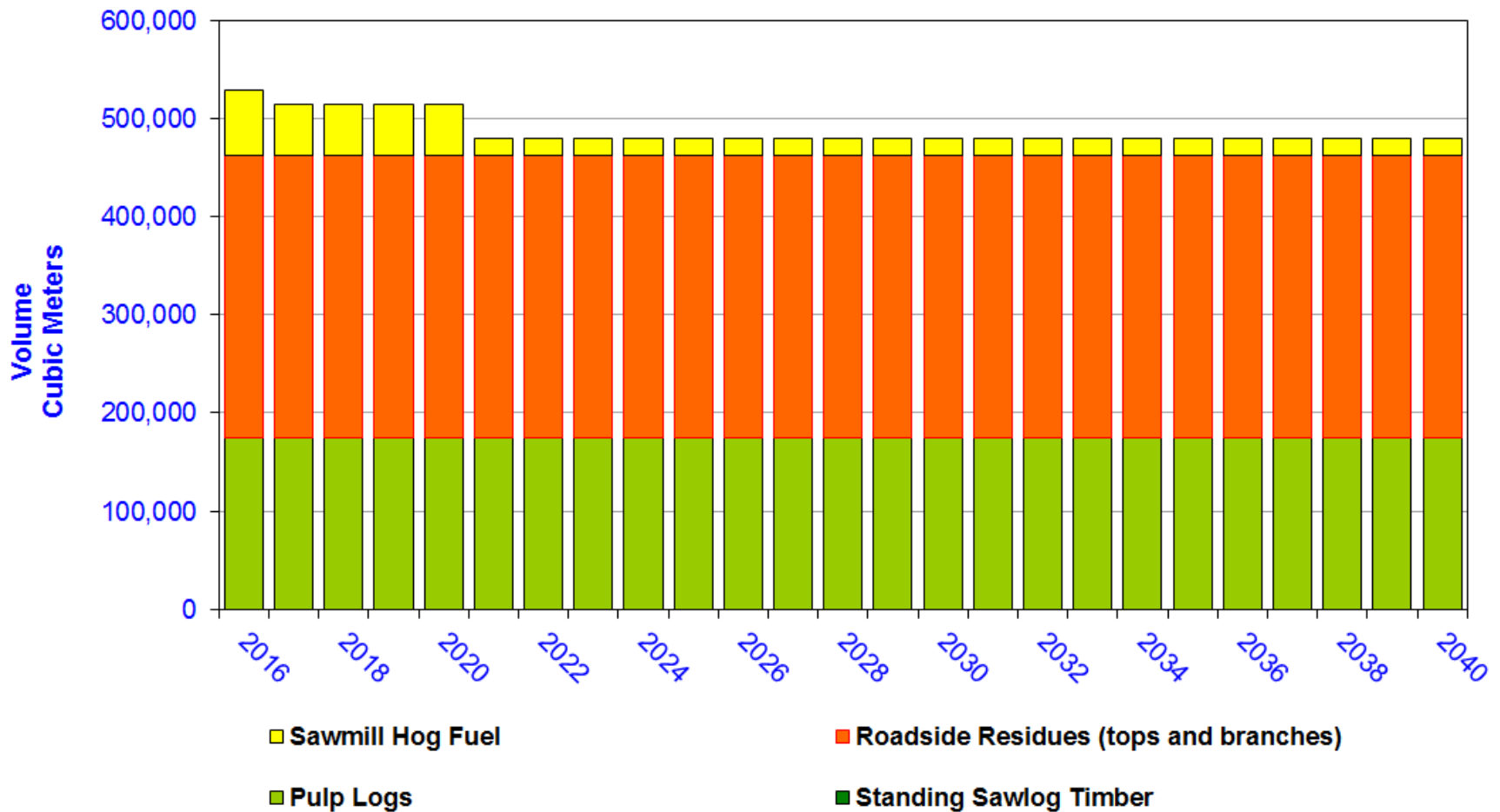
# RESULTS - COAST REGION

## Coast Region



# RESULTS – SOUTH PEACE REGION

## South Peace Region



# FIBER AVAILABILITY

- 2 periods: 2016 to 2025 (to match AAC fall down), 2026 to 2040 (to coincide with mid-term timber supply)
- 4 fiber categories:
  - Sawmill woodwaste/hog fuel: avg over the 9 year and subsequent 15 year period
  - Roadside woodwaste waste from normal harvesting operation: lowest 3 year running avg for the 9 year and subsequent 15 year period
  - Standing pulp logs primarily waste from Mountain Pine Beetle epidemic: lowest 3 year running avg for the 9 year and subsequent 15 year period
  - Standing timber: avg over the next 9 year and subsequent 15 year period

# FIBER AVAILABILITY

Region	Estimated Biomass Available Annually (cubic metres/year) by Period and Region							
	2016 - 2025				2026 - 2040			
	Sawmill hog fuel	Roadside logging residues	Pulp logs	Standing sawtimber	Sawmill hog fuel	Roadside logging residues	Pulp logs	Standing timber
Coast	7,000	879,000		259,000	66,000	923,000		
East Kootenay		171,000		1,000		171,000		
West Kootenay	372,000	325,000			388,000	331,000		
Kamloops/Okanagan				139,000				
Cariboo		30,000		313,000		30,000		
Prince George			181,000	1,632,000				
Mackenzie		52,000	83,000	496,000		50,000		
South Peace	16,000	288,000	175,000		16,000	288,000	175,000	
North-east				1,625,000				1,625,000
East Prince Rupert		1,000	350,000	486,000	16,000	1,000	351,000	86,000
West Prince Rupert	38,000	30,000	114,000	3,048,000	38,000	30,000	115,000	3,031,000
North-west				192,000				152,000



# DELIVERED FIBER COST

- Average log haul distance: relative to location of the working forest to the existing sawmills (for conversion to sawmill residues) or to the assumed fiber delivery points
- Average roadside waste haul distance : existing pellet plant experiences to working forest
- Average sawmill hog fuel distance and cost based on availability of surplus and distance to assumed fiber delivery points

# DELIVERED FIBER COST

## WHAT'S CHANGED SINCE MARCH

Increased cost to reflect stakeholder input that the original estimate was too low:

- Sawmill woodwaste: increased market price for the Coast
- Roadside residues: hauling cost increased based on geography and level of existing competition in each region
  - Mackenzie: hauling cost doubled
  - \$10/ODt increase for regions with competition
  - No change for regions with no competition

# DELIVERED FIBER COST

\$/OVEN DRY TONNE (INCLUDING AVERAGE TRANSPORTATION COST)

Region Name	Standing Green Timber	Standing Pulp logs	Roadside Residues	Sawmill Hog Fuel
West Prince Rupert	174	134	75	25
East Prince Rupert	150	116	77	28
North-West	187	144	75	25
Prince George	162	125	77	41
South Peace	150	116	75	45
North East	187	144	67	5
Cariboo	162	125	72	39
E. Kootenay	162	125	80	25
W. Kootenay	174	134	80	35
Kamloops/Okanagan	162	125	83	49
Mackenzie	150	116	87	15
Coast - Island	199	134	77	28
Coast - Mainland	199	134	77	35

- Standing Green Timber: cost excludes stumpage but includes \$15/ODt conversion
- Standing Pulp logs: cost includes stumpage of \$0.25/cubic metres + \$15/ODt conversion
- Sawmill: market value

# BIOENERGY PROVEN TECHNOLOGIES

Technologies	Capital Cost range (\$/kW)	Project life (yrs)	ODt/ MWh	Lead time (months)	Typical size (MW)	Additional considerations
Steam plant Cogen	Varies	20-25	0.2 (power only) AMECFW	48, but 24 major spending	Varies	Typically used in larger pulp and paper mills where steam is used for process as well as generation. Difficult to find steam host for new projects.
Steam plant (Fixed/travelling grate) Standalone	\$5,000 \$4,500 SH input \$5,400 AMECFW	20-25	0.72 IFS 0.8 AMECFW	48, but 24 major spending	~40 IFS AMECFW	
Steam plant (Bubbling or circulating fluidized bed) Standalone	\$5,500 SH input \$5,700 AMECFW	20-25	0.65 SH input 0.7 AMECFW	48, but 24 major spending	50+ SH input	Require larger and steady state fiber supply
Organic Rankine Cycle (add-on to existing process)	\$4,000 BCH	20-25	Varies	36, but 24 major spending	~5 (2 to 15)	Typically used in Sawmills where heat can be used for kiln drying as well as generation
Organic Rankine Cycle Standalone	\$7,000 SH input \$5,000 AMECFW	20-25	1.1 AMECFW 1.45 SH input	36, but 24 major spending	~5 (2 to 15)	Ideal for strategic location where availability for low cost fiber is limited

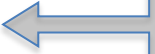
AMEC advised after the meeting that this number is changed to 0.78

# BIOENERGY PROJECT ECONOMICS

- Common assumptions used by BCH for IPP projects
  - Cost of capital & interest during construction: 7% real
- Capital cost: \$ 5.0 million/ MW gross
- Project lead time: 4 years but construction and major capital spending in the last 2 years (spending split 50/50)
- Project life: 20 years
- Typical plant size: ~40 MW gross (~36.8 MW net, with 8% internal use)
- Capacity factor: 91% (36.8 MW x 8760 hrs x 0.91 = 290 GWh/year)

- Annual cost (incl. labor and equipment) :
  - 3.5% of capital cost (~175k/MW gross per year or 7 million\$ for a 40 MW plant)
  - Alternative: AMECFW: 120\$/kW(fixed) + \$19/MWh(variable) (totaling 10.4 million\$ for a 40 MW plant)
- Resulting Project Cost **excluding** delivered fiber cost: **\$ 90 /MWh**

The spending profile was modified post meeting to 2.5%, 2.5%, 45%, 50% after the meeting to reflect that some \$ needs to be spent earlier on



AMEC advised after the meeting that this number is changed to \$11/MWh



This number is changed to 8 million \$ when \$11/MWh is used



# BIOENERGY PROJECT ECONOMICS

- 2.45 cubic metres of wood = 1 oven dry tonnes at 0% moisture
- 0.72 oven dry tonnes to 1 MWh of electricity
- Fuel mix: (1) Ignored fiber that is only available for the near term (2) If a source of fiber is available in both periods, the lower potential is used (3) Grouped remaining fiber as shown below
- Region where there is high potential, represented as projects ~40 MW each

Period	2016 - 2025								2026 - 2040							
	Sawmill Waste		Roadside Residues		Pulplogs		Standing Timber		Sawmill Waste		Roadside Residues		Pulplogs		Standing Timber	
Biomass Type	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)	GWh/Year	Delivered Fiber Cost (\$/MWh)
Region																
Coast - Mainland	4	\$25	499	\$55			147	\$143	37	\$25	523	\$55				
East Kootenay			97	\$58							97	\$58				
West Kootenay	211	\$25	184	\$58					220	\$25	187	\$58				
Kamloops/Okanagan							79	\$117								
Cariboo			17	\$52			178	\$117			17	\$52				
Prince George					102	\$90	925	\$117								
Mackenzie			30	\$63	47	\$84	281	\$108			29	\$63				
South Peace	9	\$32	163	\$54	99	\$84			9	\$32	163	\$54	99	\$84		
North-east							921	\$134							921	\$134
East Prince Rupert			1	\$55	198	\$84	275	\$108	9	\$20	1	\$55	199	\$84	49	\$108
West Prince Rupert	21	\$18	17	\$54	65	\$97	1728	\$125	21	\$18	17	\$54	65	\$97	1718	\$125
North-west							109	\$134							86	\$134

# RESOURCE OPTIONS REPRESENTATION

These numbers are subject to change after feedback from meeting is considered.



Unit Energy Cost = Project Cost + Delivered Fiber Cost


Projects	Projects	GWh	Unit Energy Cost (\$/MWh)
WBBio LM SR	Coast: Sawmill Waste & Roadside Residue	503	145
WBBio EK RR	East Kootenay: Roadside Residue	97	148
WBBio WK SW	West Kootenay: Sawmill Waste	211	115
WBBio WK RR	West Kootenay: Roadside Residue	184	148
WBBio CB RR	Cariboo: Roadside Residue	17	142
WBBio MAC	Mackenzie: Roadside Residue	29	153
WBBio SP SR	South Peace: Sawmill Waste & Roadside Residue	172	143
WBBio SP PL	South Peace: Pulplogs	99	174
WBBio NE ST 1	North-East: Standing Timber	307	224
WBBio NE ST 2	North-East: Standing Timber	307	224
WBBio NE ST 3	North-East: Standing Timber	307	224
WBBio EPR SRP	East Prince Rupert: Sawmill Waste & Roadside Residue & Pulplogs	208	171
WBBio EPR ST	East Prince Rupert: Standing Timber	49	198
WBBio WPR SW	West Prince Rupert: Sawmill Waste	21	108
WBBio WPR RR	West Prince Rupert: Roadside Residue	17	144
WBBio WPR PL	West Prince Rupert: Pulplogs	65	187
WBBio WPR ST 1	West Prince Rupert: Standing Timber	429	215
WBBio WPR ST 2	West Prince Rupert: Standing Timber	429	215
WBBio WPR ST 3	West Prince Rupert: Standing Timber	429	215
WBBio WPR ST 4	West Prince Rupert: Standing Timber	429	215
WBBio NW ST	North-West: Standing Timber	86	224

The identified potential for Bioenergy is uncertain as the availability of wood based biomass is subject to consumption from existing industries as well as other higher value future potential uses such as bio-diesel, District Energy etc.

# FIBER AVAILABILITY METRO VAN

- Additional 139 GWh equivalent of **clean wood** could be sourced from landfill, at market price of hog fuel/sawmill waste (~\$25/MWh delivered)
- GWh could increase to 479 GWh, the difference comes with uncertainty associated with emission permitting as well as clean energy qualification.
- Waste wood is expected to increase over time. Current use limited to heat or power generation, higher value use is an active research area.

Added the words "special" post meeting to address the fact that permit is still required for burning clean wood



Sources of waste wood	Annual volume as of 2013 in Metro Van (metric tonnes, wet weight about 25% moisture content)	GWh/year	Considerations
Clean wood from Landfill	133,700	139	can be used without a special permit
Treated, painted & composite woods from Landfill	188,200	196	requires special air emission permit
Recycled mixed wood from recycling facilities	434,300 less 250,000* less 46,075** net: 138,225	net: 144	some types require a special permit but the split between different types is not known***

\* refuse derived fuel accounted for in IFS's model

\*\* 25% of the remaining is sourced from industrial facilities like lumber mills and plywood manufacturers

\*\*\* wood recycled from mixed loads requires a permit; other types of clean recycled wood can be used without a permit if it was separated at the source and delivered to a recycling facility or user (e.g. clean construction waste and clean dimensional lumber from deconstruction/selective disassembly)



# HOW TO CONNECT

## Contact information

- Kathy Lee [Kathy.Lee@bchydro.com](mailto:Kathy.Lee@bchydro.com)
- IRP inbox [integrated.resource.planning@bchydro.com](mailto:integrated.resource.planning@bchydro.com)

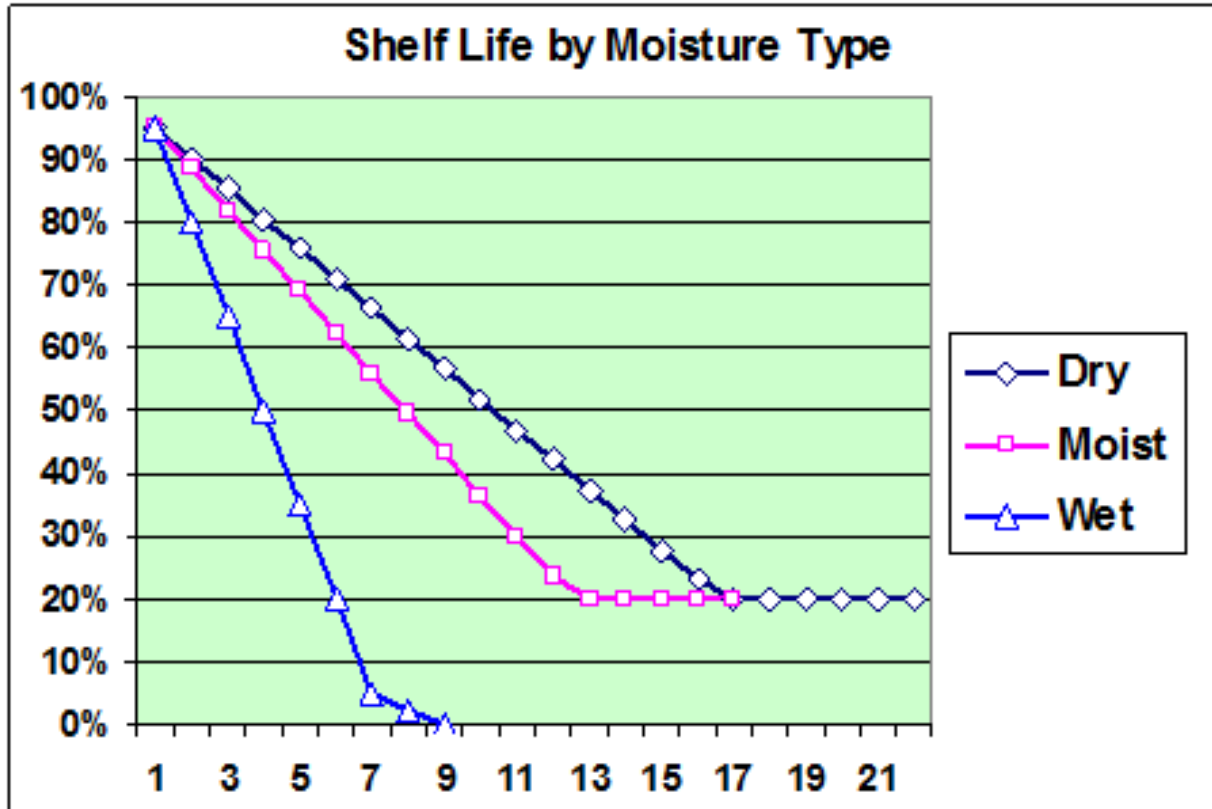
## General information and engagement materials

- [www.bchydro.com/generationoptions](http://www.bchydro.com/generationoptions)

THANK YOU FOR YOUR INPUT

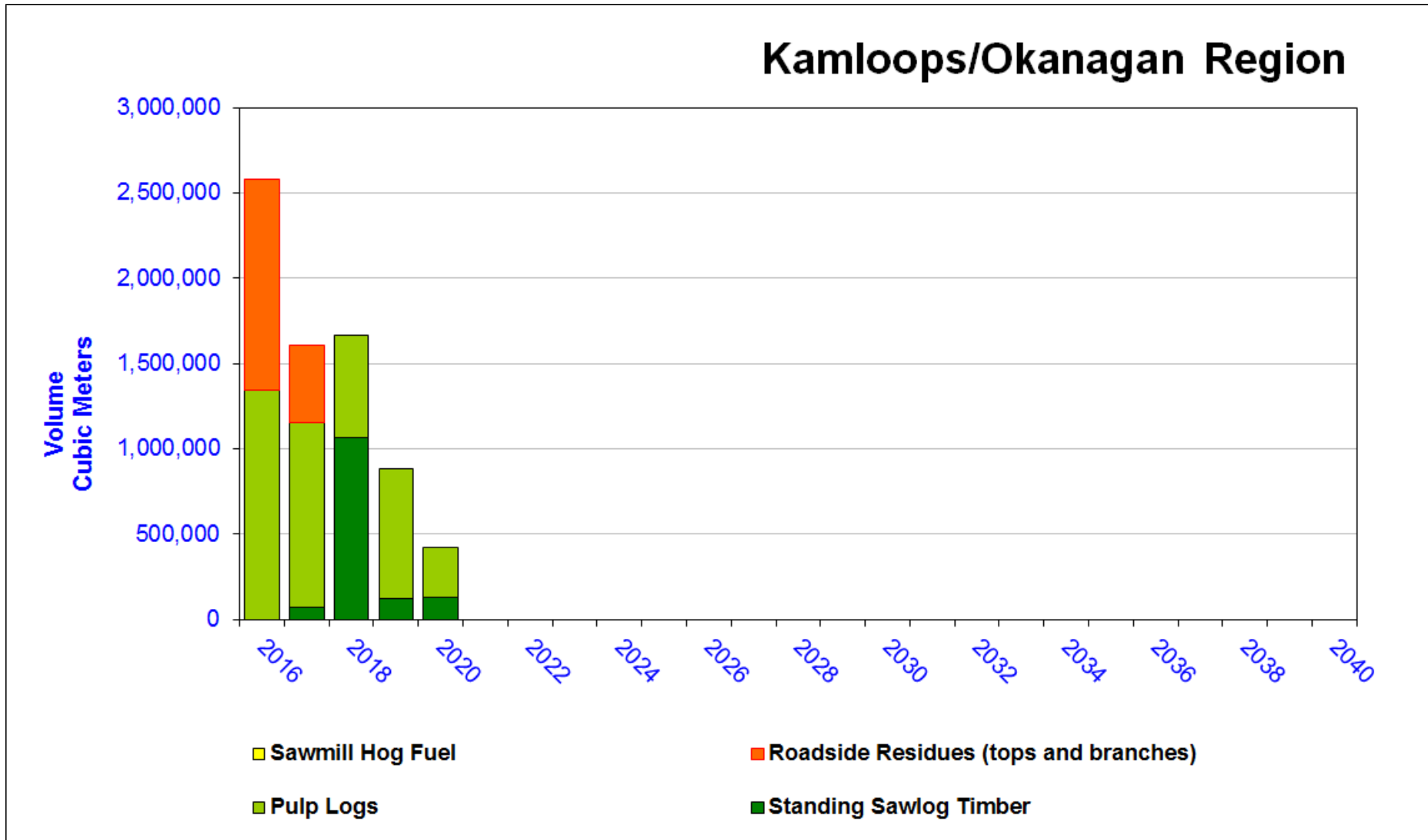
# BACKUP SLIDES

# SHELF LIFE



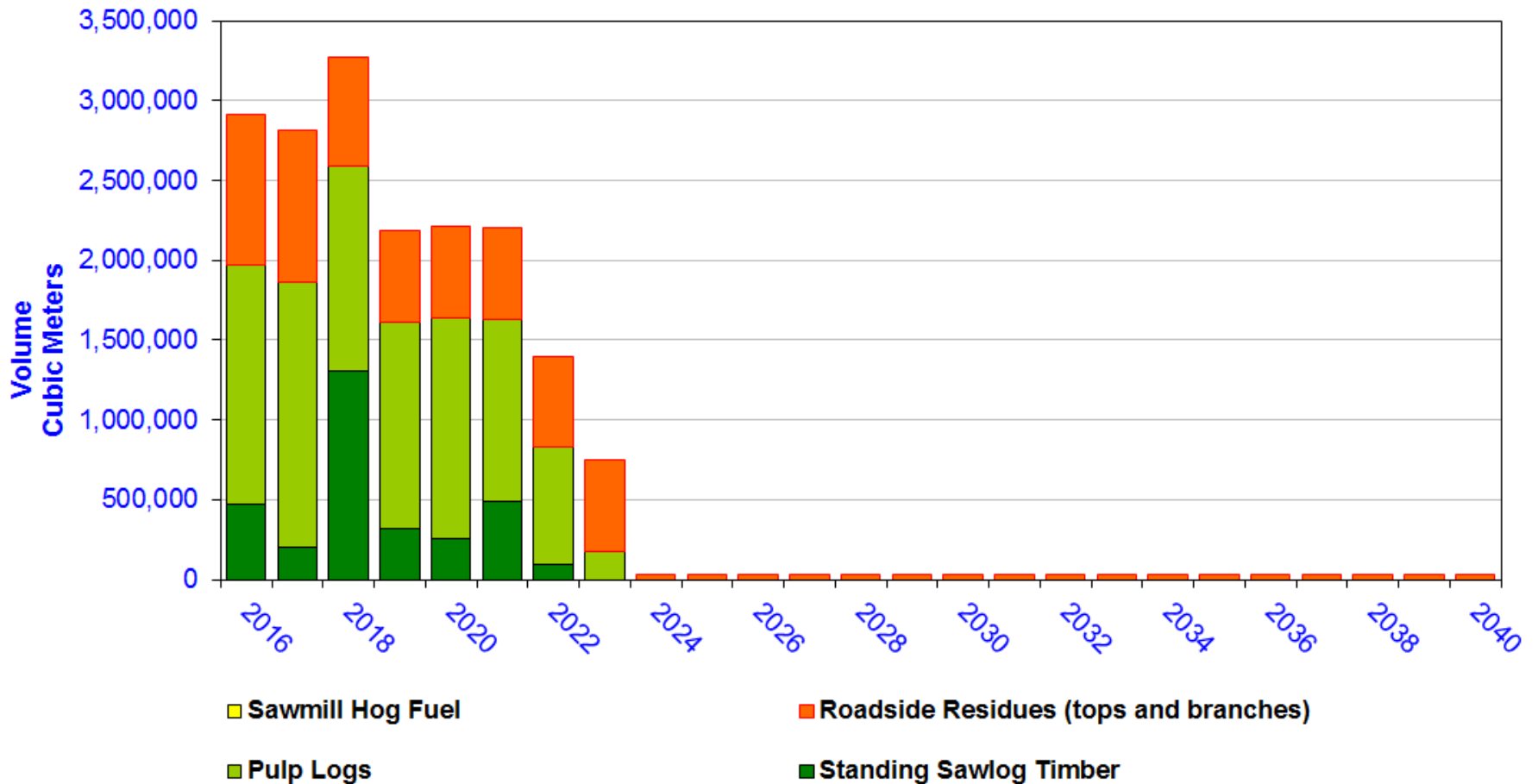
This table was applied to all stands assumed harvested as part of the AAC that contributes to the MPB partition *starting in the year in which 90% of the pine within the Forest Management Unit (FMU) was killed*. Prior to that point, it is assumed that all stands (dead or not) contain 95% sawlogs. However, once the MPB “shelf-life clock” starts, there are diminishing percentages of sawlogs, based upon the proportion of pine within each FMU and the length of time that passes after the pine has died.

# RESULTS – KAMLOOPS/OKANAGAN REGION



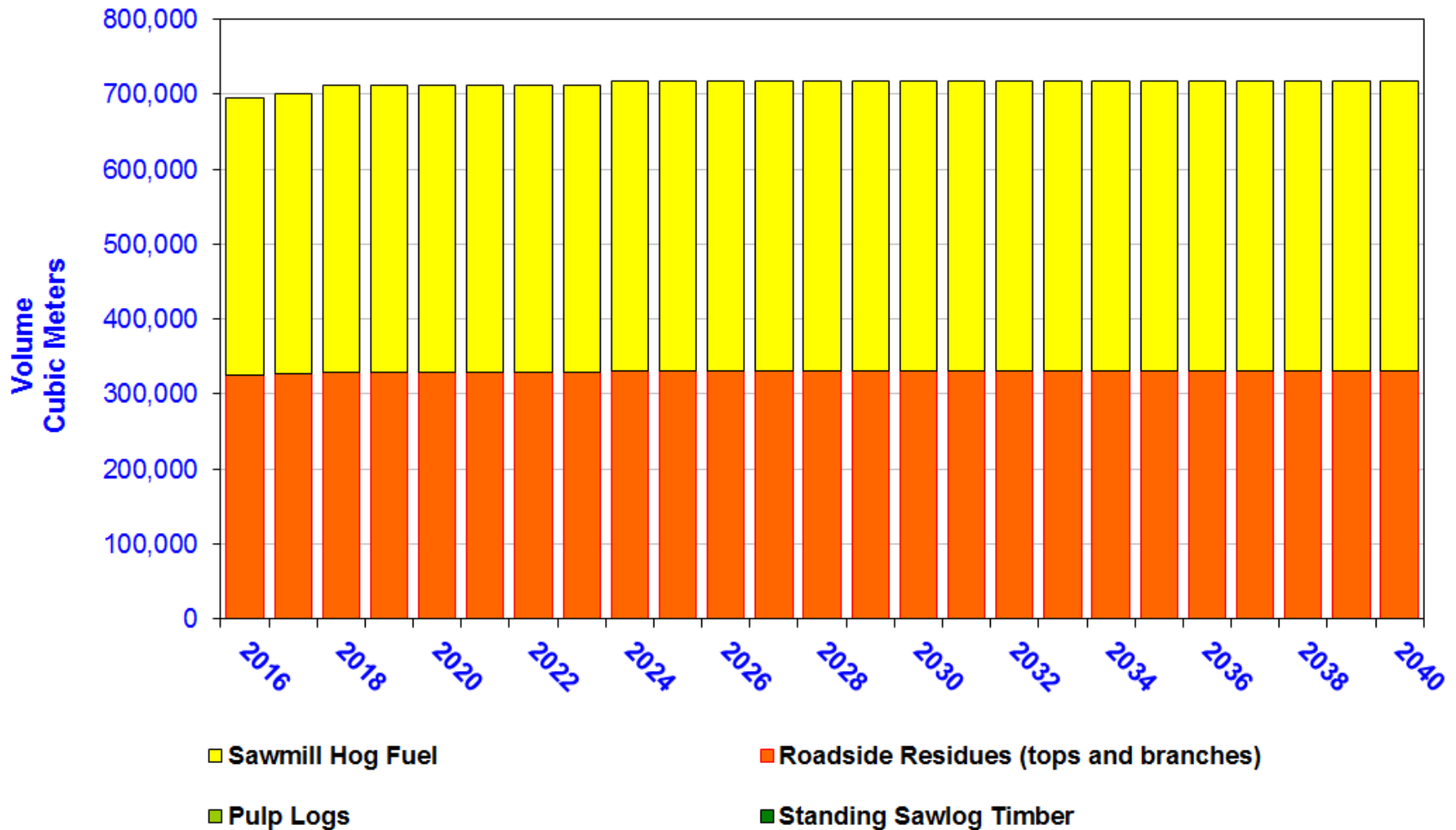
# RESULTS – CARIBOO REGION

## Cariboo Region



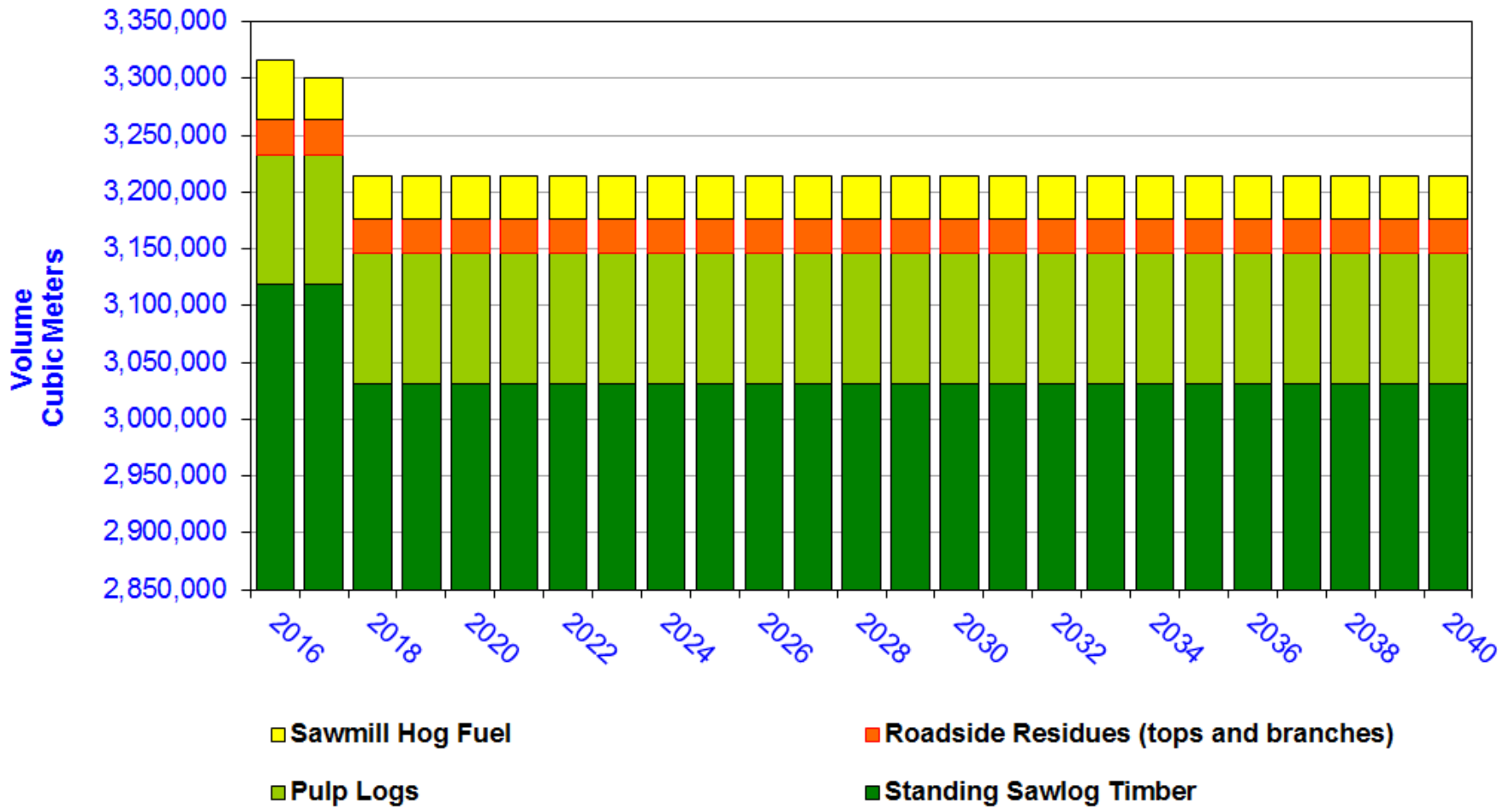
# RESULTS – WEST KOOTENAY REGION

## Annual Biomass by Type - West Kootenay Region



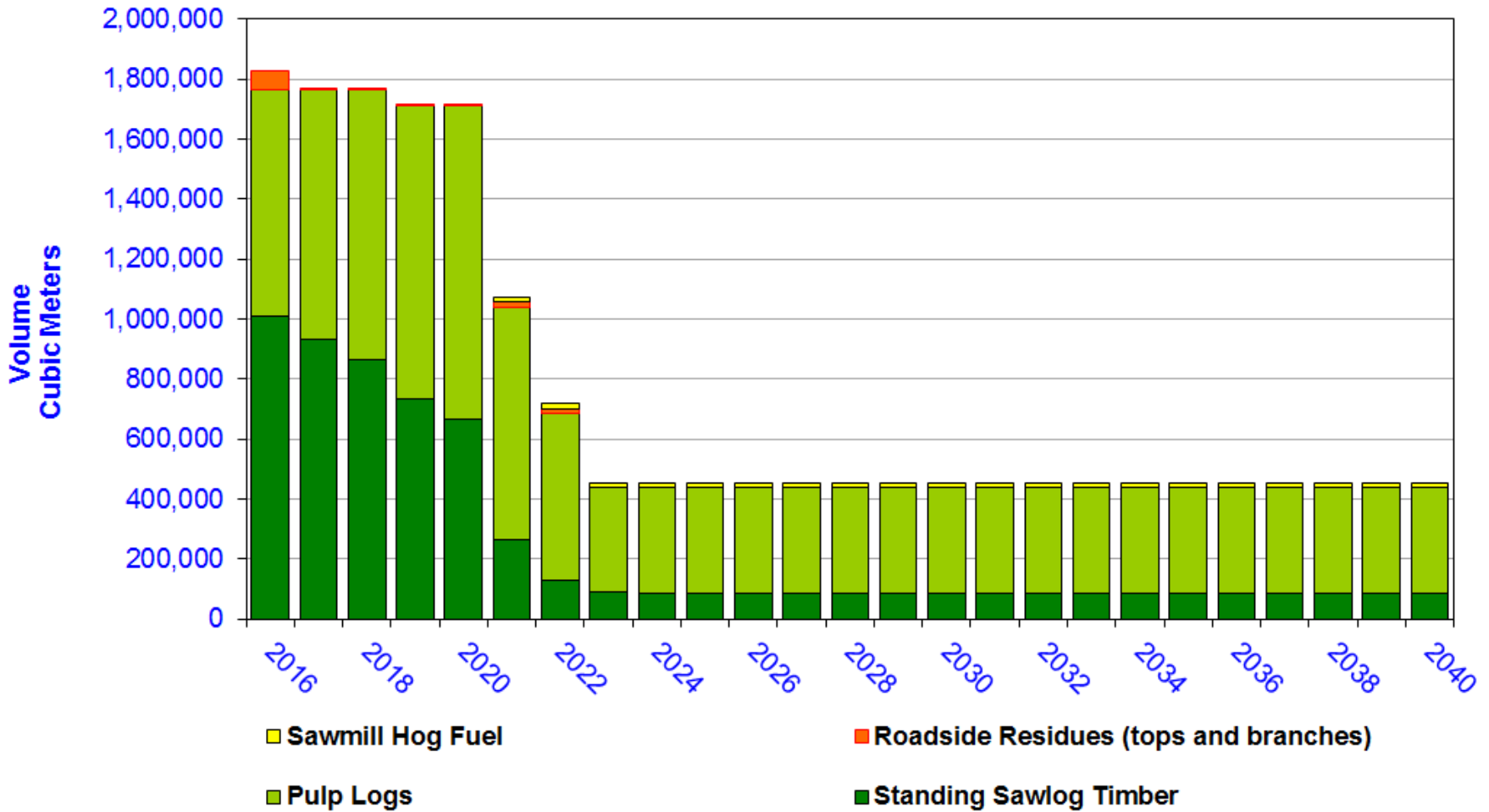
# RESULTS – WEST PRINCE RUPERT REGION

## West Prince Rupert Region



# RESULTS – EAST PRINCE RUPERT

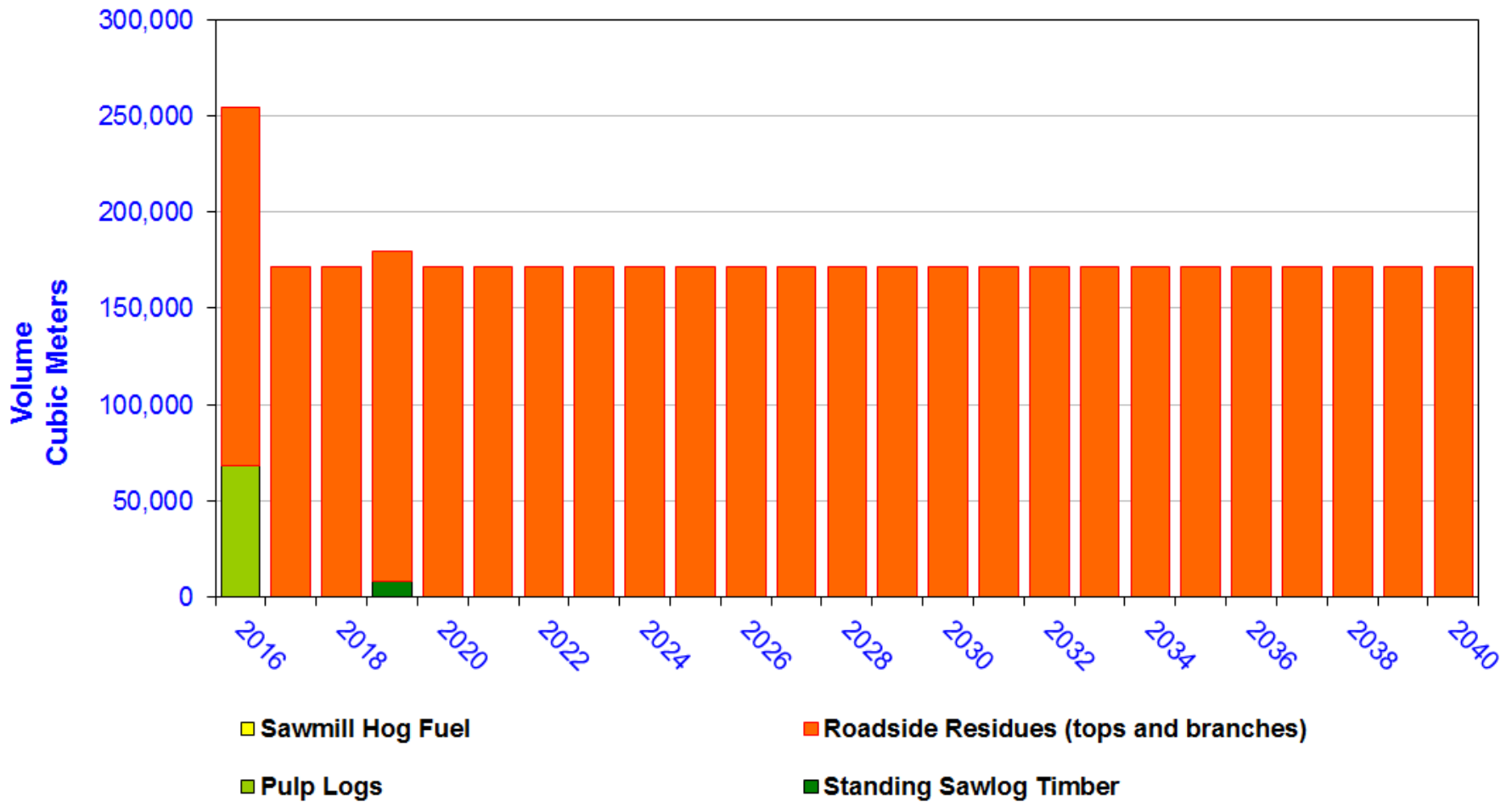
## East Prince Rupert Region





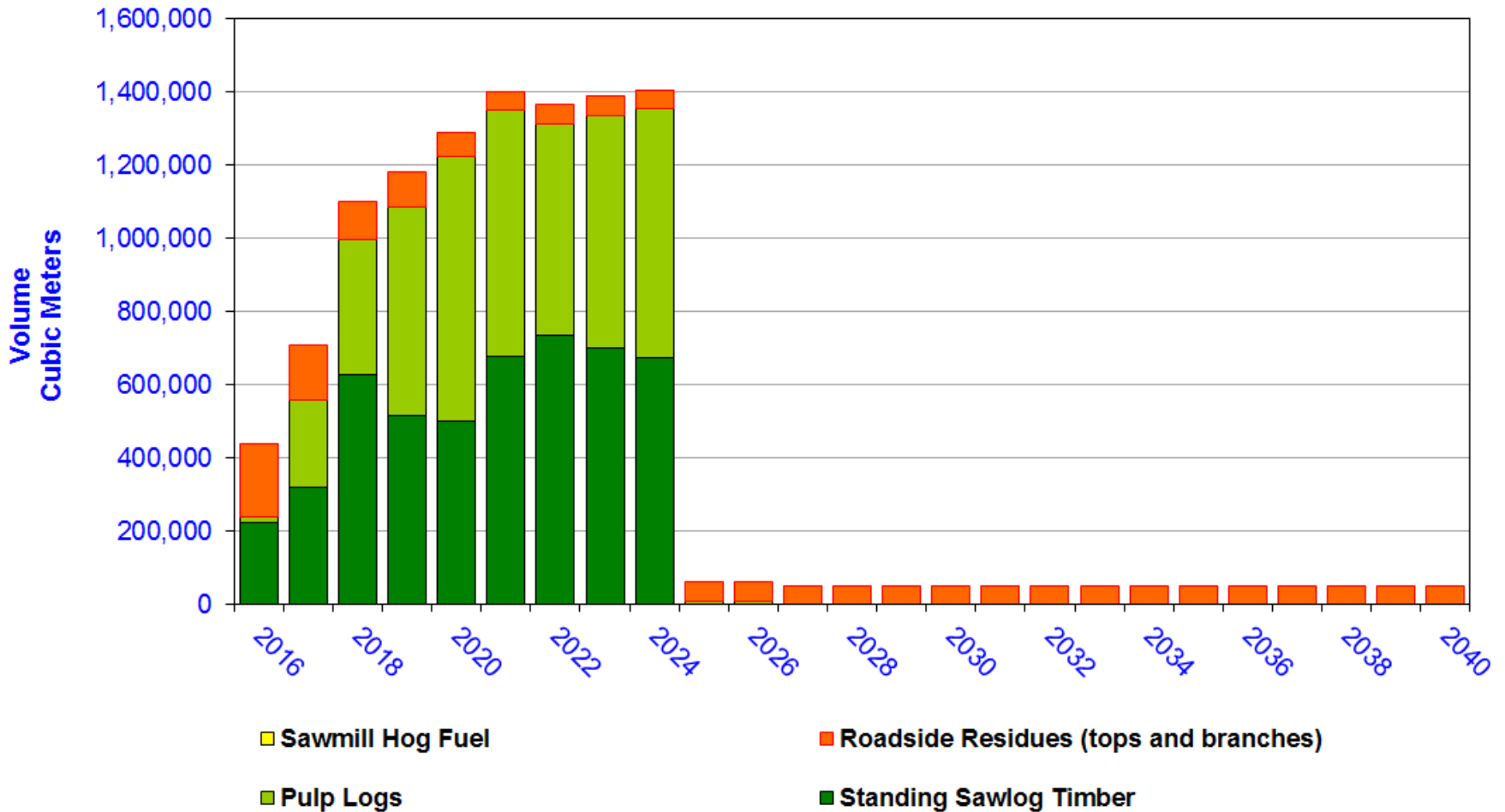
# RESULTS – EAST KOOTENAY

## East Kootenay Region



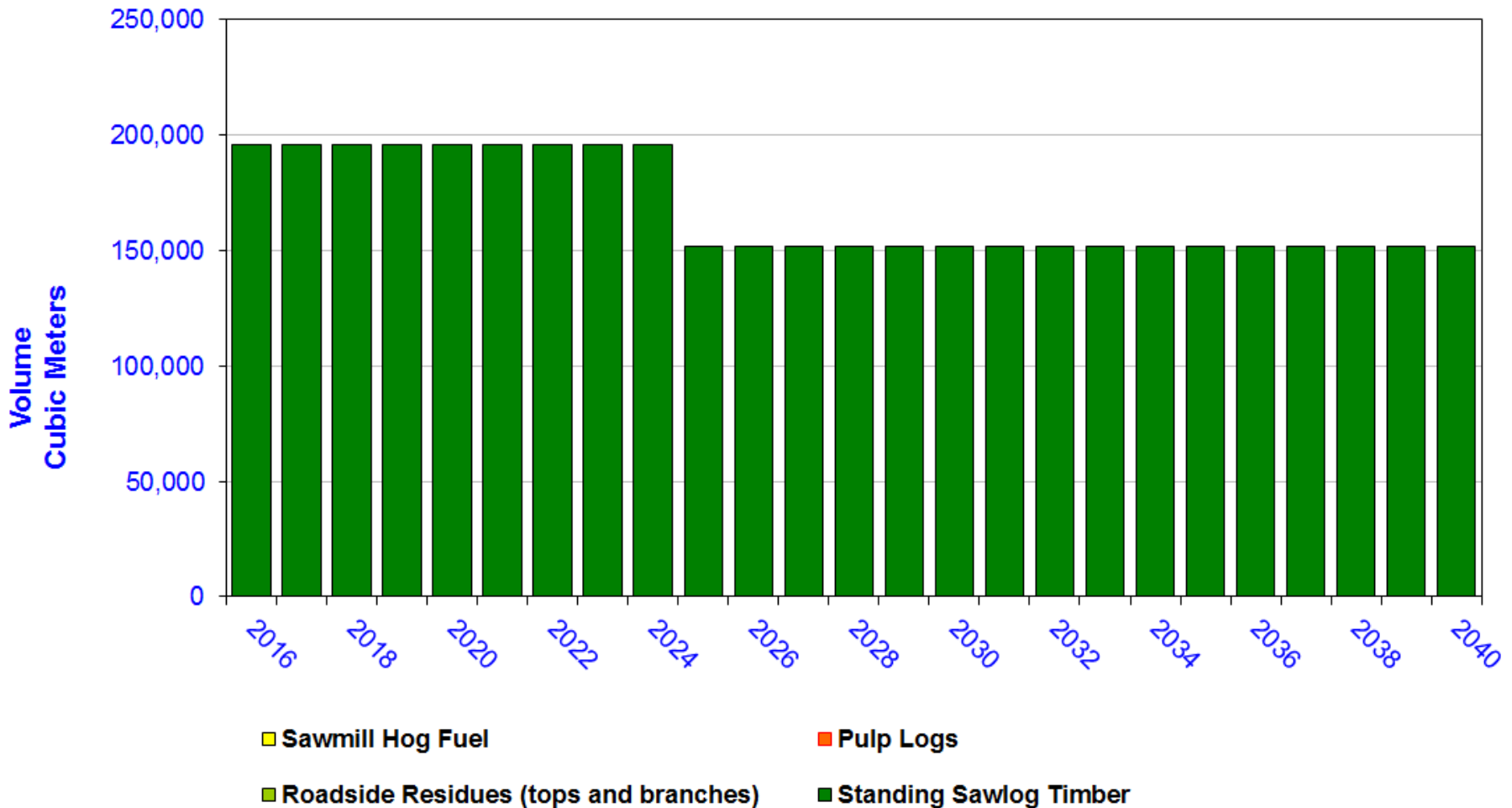
# RESULTS – MACKENZIE

## Mackenzie Region



# RESULTS – NORTH WEST

## Annual Biomass by Type - North West Region



# RESULTS – NORTH EAST

## North East Region

