



2023-25 Manitoba Hydro General Rate Application

Asset Management

May 2023

1. Midgard Introduction
2. Manitoba Hydro: Past, Present & Future
3. Asset Management, Asset Deterioration
4. Risk
5. Assets versus System Focus
6. Minimum System
7. Conclusions



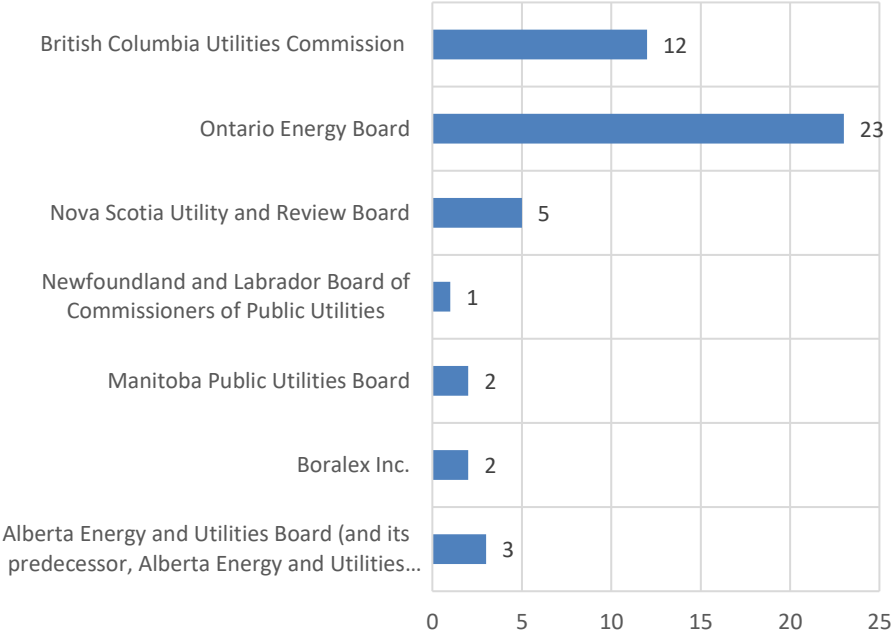
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Midgard Consulting

Co-founding Principals of Midgard Consulting Inc.

- **Mr. C. Oakley, P.Eng.**
 - Worked in the utility and energy business for 37 years
 - Expertise: utility regulation and energy policy, electric system planning, generation, transmission, distribution and communications project development, financing and operations
- **Mr. P. Helland, P.Eng., MBA**
 - Worked in engineering, regulatory and business consulting spheres for 26 years
 - Expertise: asset management, risk management, resource options planning, condition assessment, project development, project management and facilities siting

Regulatory Filing Experience - Asset Management



Regulatory Filing Activities: risk management and asset performance assessments, strategy and planning, CAPEX evaluation and analysis, technical and financial auditing, cost modelling, regulatory support

Sources:
Exhibit CC-8, Section 2.3
Midgard Response to MH/COALITION I-14



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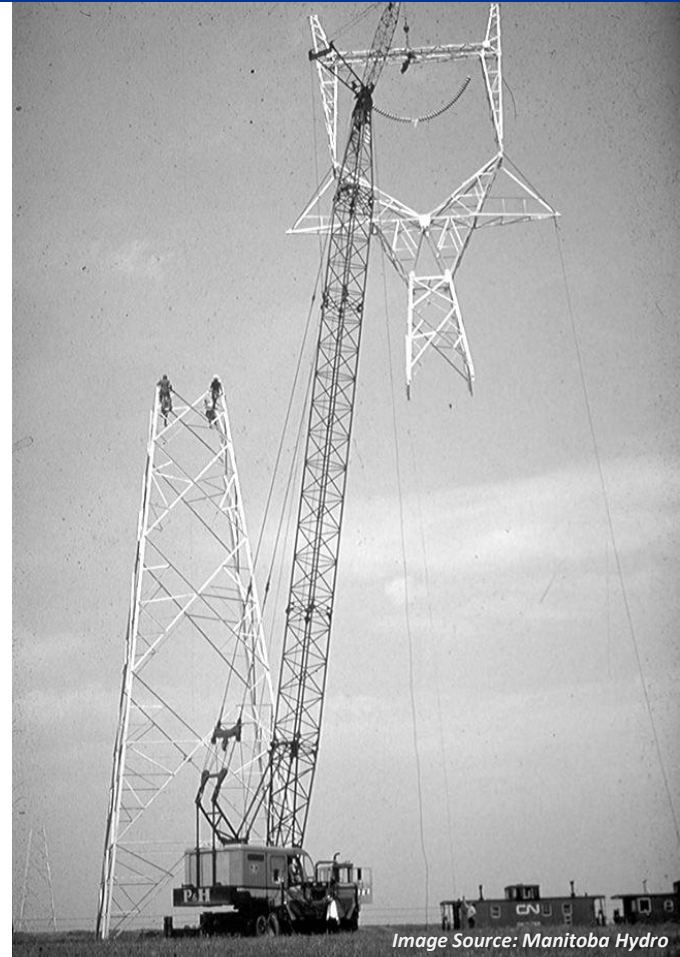
**The Past is Different than Today
(Yesterday's Growth is not Today's Growth)**

Manitoba Hydro's stated corporate mission is to:

"...help all Manitobans ... while ensuring safe clean, reliable energy at the lowest possible cost." [emphasis added]

Manitoba Hydro's asset management goal:

"Manitoba Hydro moved away from functional segments to a more integrated approach in which the Asset Management group is intended to optimize Manitoba Hydro's energy system across the entire asset management lifecycle to achieve the targeted levels of performance and risk at the lowest life cycle cost." [emphasis added]



BUT: Manitoba Hydro's six decades old capital investment strategy doesn't target lowest cost...

Manitoba Hydro's stated investment strategy:

"The clear benefit of building hydro for domestic need while using markets external to the province to optimize the investments was recognized more than sixty years ago.

...

[investments] which would be surplus to Manitoba's requirements for a considerable period and

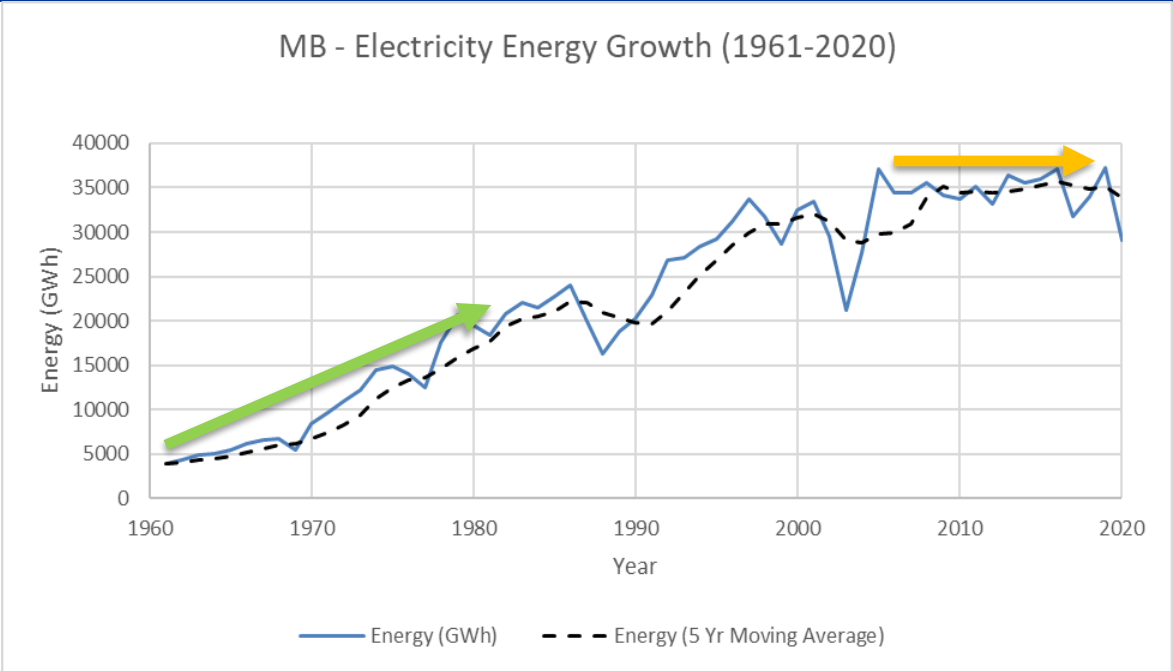
...

it must be developed for large markets outside Manitoba to take advantage of economies of scale."

[emphasis added]

Question: Is this over-investment capital investment strategy still appropriate?





Period	Compound Annual Growth Rates	
	Installed Capacity	Energy Generation
MB - Early Years (1961-1985)	5.73%	7.69%
MB – Modern Era (1986-2019)	1.36%	1.33%
MB – Recent 15 Years (2005-2019)	1.05%	0.04%



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Reliability Performance is Superior

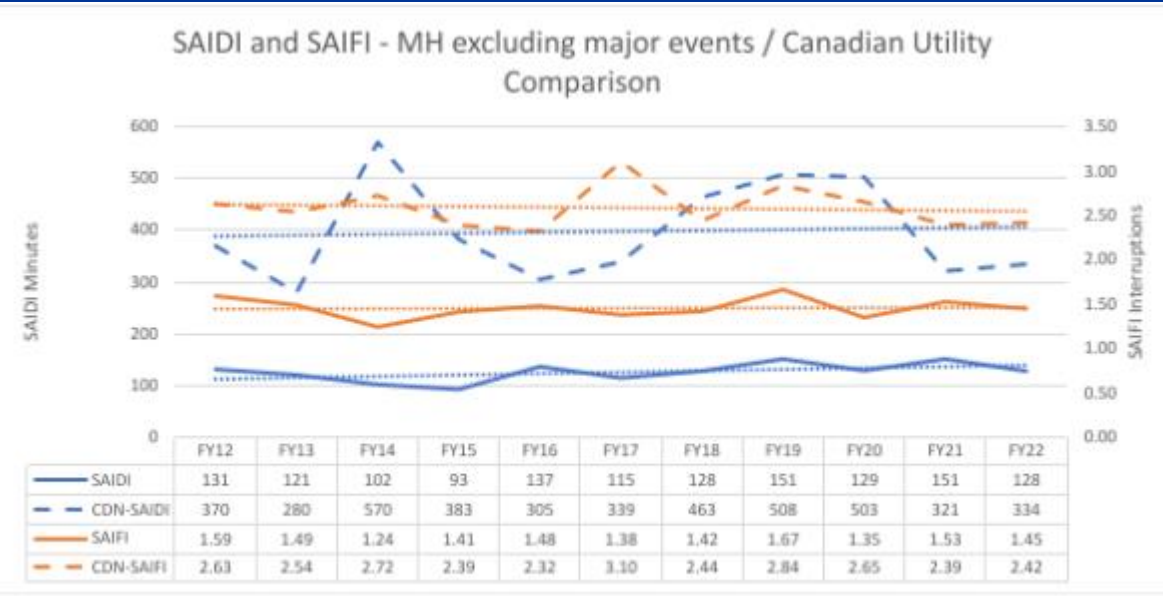
Past 10+ Year SAIDI and SAIFI Values - Yearly and 5 Year Running Average



SAIDI/SAIFI Changes:

- **Claim:** Due to asset aging and degraded condition of assets

BUT: Story Changes If Major Events Excluded

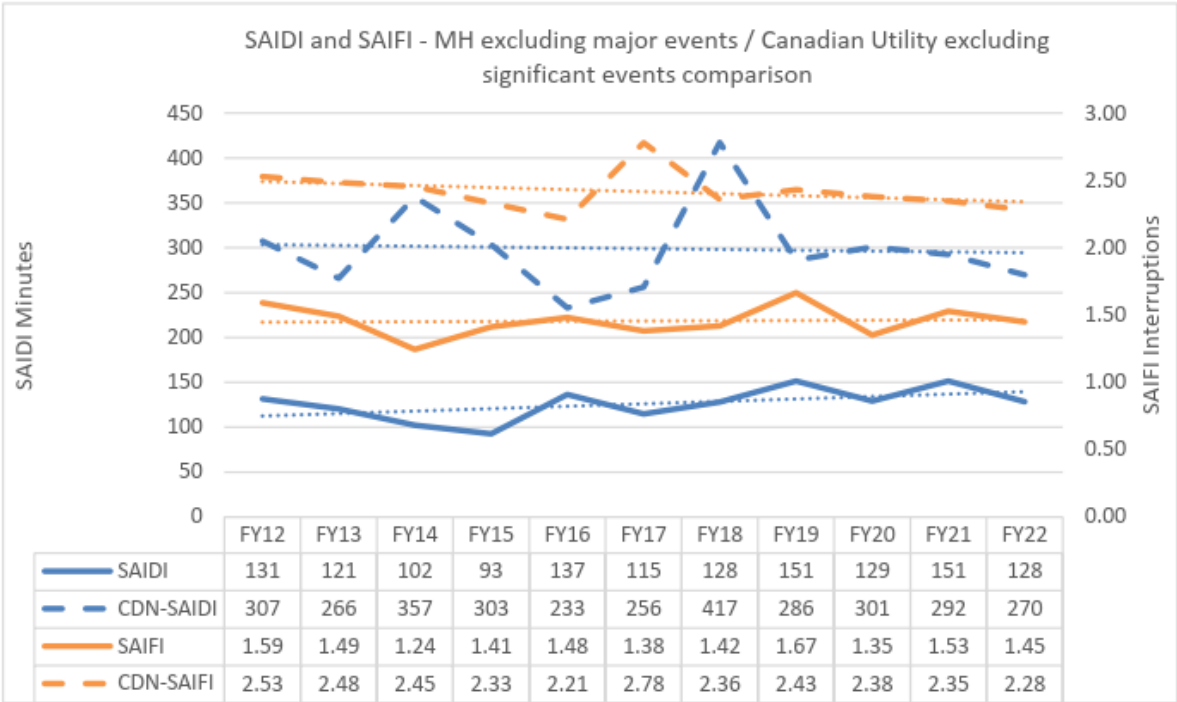


*The entire day was excluded for identified major event days

Exclude Major Events: External to Manitoba Hydro's control, Not Asset Condition Related (e.g., Forest Fires, Ice Storms, Floods, Earthquakes, Solar Flares, etc.)

Result: Overall reliability trends are not deteriorating appreciably based on asset condition





Result: SAIDI and SAIFI superior to Canadian peers

- SAIDI: 42% of peers (approx. 2.4x Better)
- SAIFI: 60% of peers (approx. 1.7x Better)

Source: COALITION-MH I-92a-d (Updated)

Evidence: Reliability centered on SAIDI/SAIFI

System Average Interruption Duration Index (SAIDI):

- SAIDI = Total Customer-Hours of Interruptions/Total Customers Served*

System Average Interruption Frequency Index (SAIFI):

- SAIFI = Total Customer-Interruptions/Total Customers Served*

**Total customers served represents the number of end customers the utility is delivering electricity to.*

Industrials: Sensitive to a range of transients, momentary outages and power quality deviations (some are extremely sensitive)

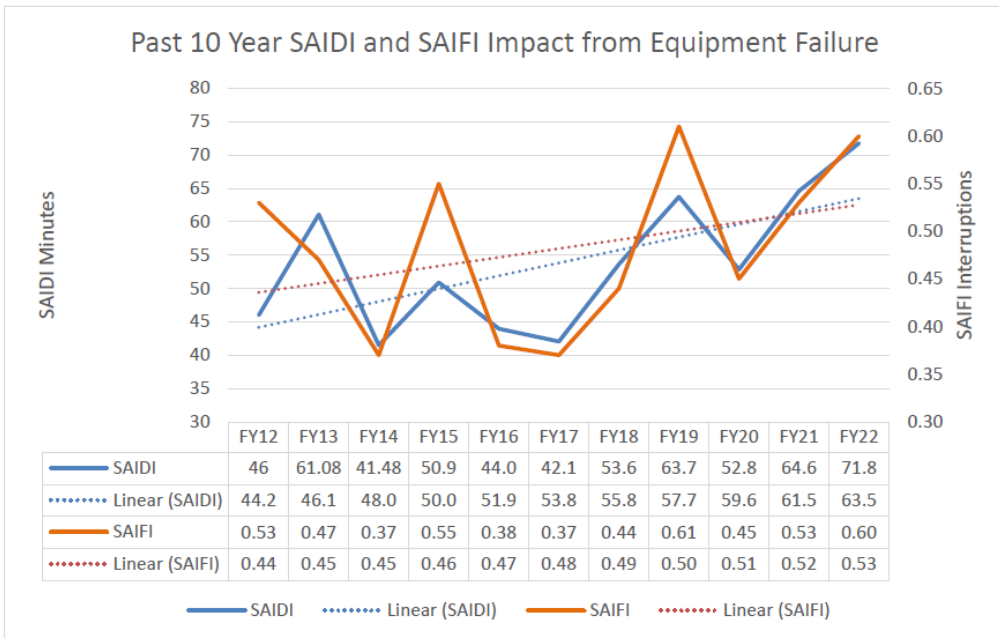
Issue: Different metrics and reliability performance outcomes desired by different ratepayer classes

- Residential: Existing superior SAIDI/SAIFI outcomes are acceptable; unwilling to pay more for better reliability outcomes
- Industrials: Desire enhanced reliability metrics beyond SAIDI/SAIFI, e.g., MAIFI (momentary outage tracking), power quality; Desire moderated by resulting rate impacts



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**But What About Deteriorating Asset
Condition?**

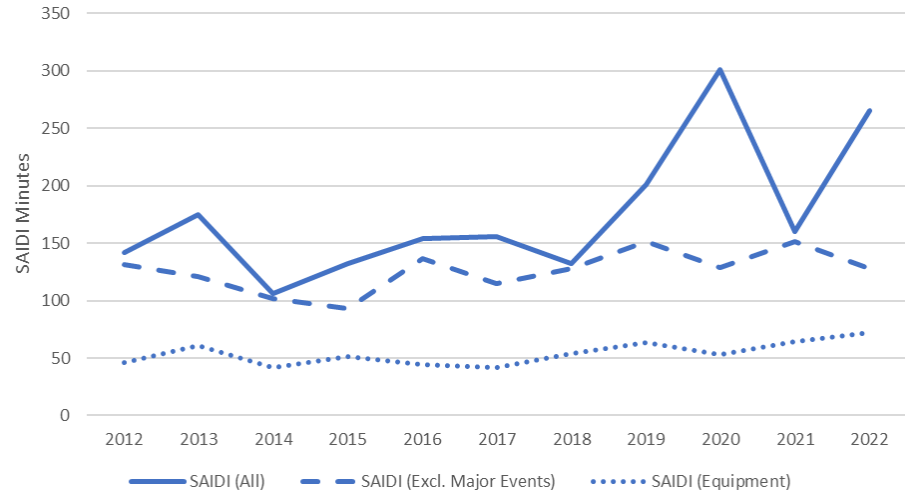


Observation: Equipment SAIDI/SAIFI trending higher.

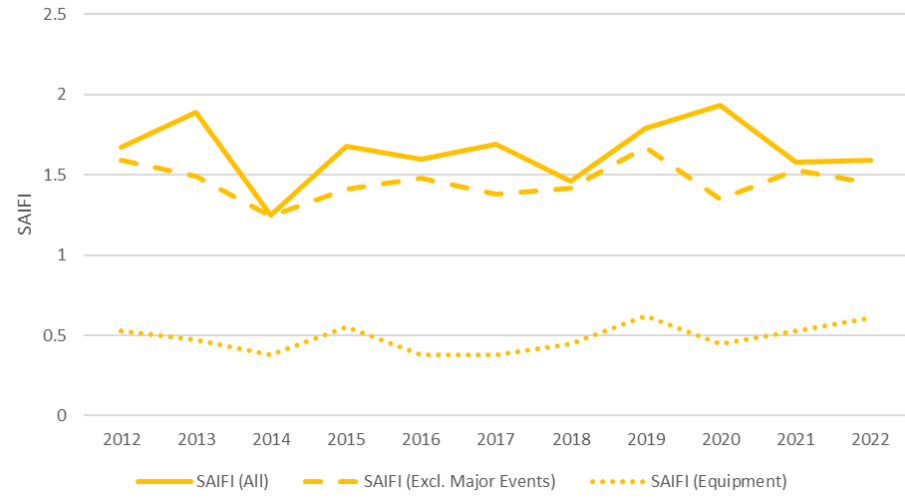
BUT

Question: Is the degradation material? Are the reliability trends noticeable by ratepayers?

Past 10 Year SAIDI



Past 10 Year SAIFI



SAIDI/SAIFI (Equipment): Approximately 40% (SAIDI) & 30% (SAIFI) metric contribution

- Other factors dominate, overshadowing equipment-related SAIDI/SAIFI trends
- High Inter-annual Variability: Challenging to detect trend of 0.01 interruptions/year and 1.2 minutes/year given size of inter-annual Major Event impacts

“...is influenced heavily by the significance of several major weather events that have occurred in recent years. Excluding these major events, such as significant wildfires and the October 2019 storm, results in T-SAIDI values for fiscal years 2019, 2020 and 2022 of 78.68, 42.75, and 100.48, respectively, which is more aligned with historic values...”

Manitoba Hydro’s T-SAIFI [without Major Events] has shown slight improvement in the last 10 years.”

[Emphasis added]

Source: Manitoba Hydro 2023/24 & 2024/25 General Rate Application, Tab 07, Page 11 of 51





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Asset Management

Manitoba Hydro Goals (Re-cap):

"...reliable energy at the lowest possible cost..."

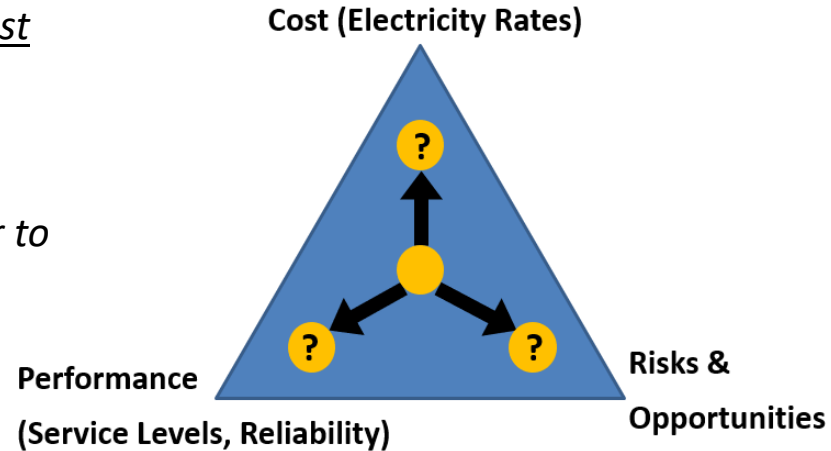
"...targeted levels of performance and risk at the lowest life cycle cost..." [emphasis added]

Asset Management:

ISO 55000: *"...managing risk and opportunity, in order to achieve the desired balance of cost, risk and performance." [emphasis added]*

BUT PUB/MH I-87a-d:

AM *"... maturity does not allow for precise mapping of capital expenditures to performance"*



AMCL: “A complete understanding of asset-related costs, risk and performance relies on adequate asset data”

- 1) MH Asset Management Maturity at “Awareness” (1.5 to 1.81 since last GRA)
- 2) Weakest Areas: Asset Information, Risk & Review, Decision Making
 - a. Asset information is constraining maturity (e.g., Decision Making)

GFMAM Groups		SCORE					
Group	Subject	Enterprise & Support Functions	EGen	ETx	EDx	GDx	Company Average (Weighted)
1	Asset Management Strategy & Planning	2.05					2.05
2	Asset Management Decision Making	1.79	1.83	2.25	1.75	2.22	1.83
3	Lifecycle Delivery Activities	2.03	2.02	1.89	2.34	2.14	2.09
4	Asset Information	1.32					1.32
5	Organisation & People Enablers	2.13					2.13
6	Risk & Review	1.42	2.00	3.00	2.00	3.00	1.45
Average (Weighted)		1.75	1.98	2.00	2.20	2.17	1.81

Manitoba Hydro is well below “Broad Conformance” with ISO 55001 Standard

Optimization Across Business Lines (IR CC/MH I-103):

“Current standardization gaps that limit the current comparability of risk across asset class are:

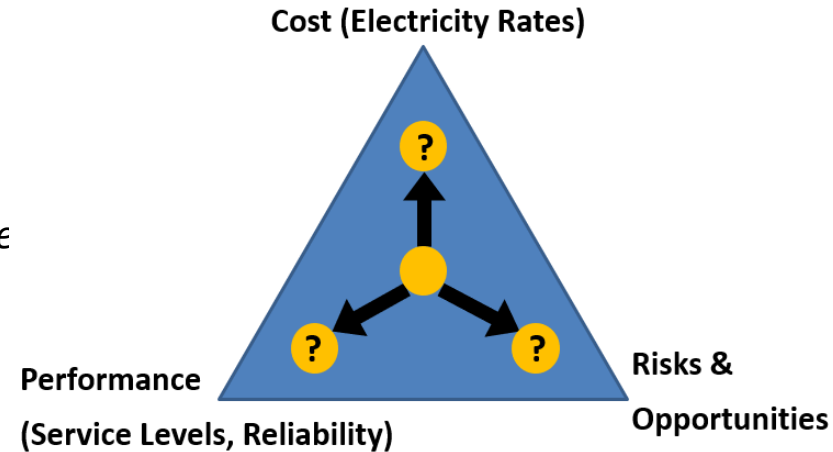
- *Asset health indices*
- *Asset criticality*
- *Risk analysis*
- *Risk evaluation*
- *Asset needs scoring prioritization*
- *Risk identification and monitoring*

There is currently no alignment of the Asset Class Strategies to the Asset Management system. As the original Asset Class Strategies were developed in relative isolation of each other, the content and purpose contained is not unified for the production and management of a corporate Asset Management Plan.”



AHI Data - MH States: (CC/MH I-100(b))

“Without all the AHI data ... asset failures may not be identified for intervention ... [which] can lead to reactive work, ... takes staff off planned activities, ... defers work on assets that were identified to require investments ... disrupt staff that are performing planned maintenance tasks ... A complete AHI inventory would allow a more optimized investment selection, leading to less in-service failures and, largely by that virtue, a lower average lifecycle cost.”



Result: Increased Cost & Risk, Degraded Performance



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**Target Reliability:
Ratepayer Desires Matter**



Manitobans “strongly favor keeping rates as low as possible over other aspects” MFR 12 Attachment 1 PDF 103





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Risk = Probability x Consequence

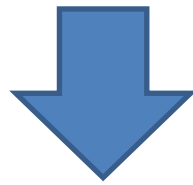
Transmission Poles

Tier I	Tier II Data Inputs
Pole strength	Pole strength
Pole physical condition	Top Split/Feathering
	Rot
	Decay
	Woodpecker Holes
	Animals
	Damage
Auxiliary accessories	Guy wire
	Cross arm
	Ground wire
	Leaning
Service records	Overall
	Age

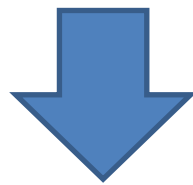
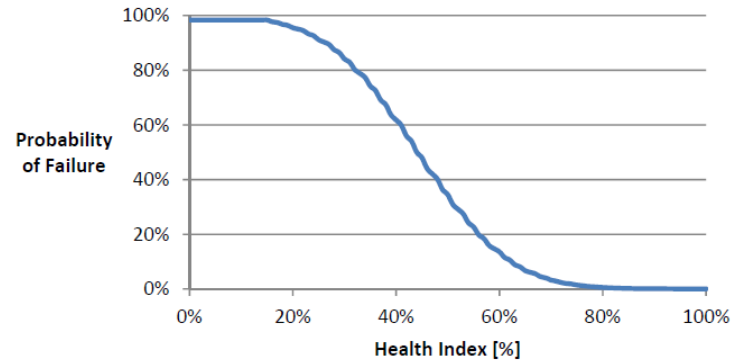


<http://solvingbirdproblems.blogspot.ca>
www.ukpowernetworks.co.uk

Asset Health Index



Probability of Failure vs. Health Index



Probability of Asset Failure



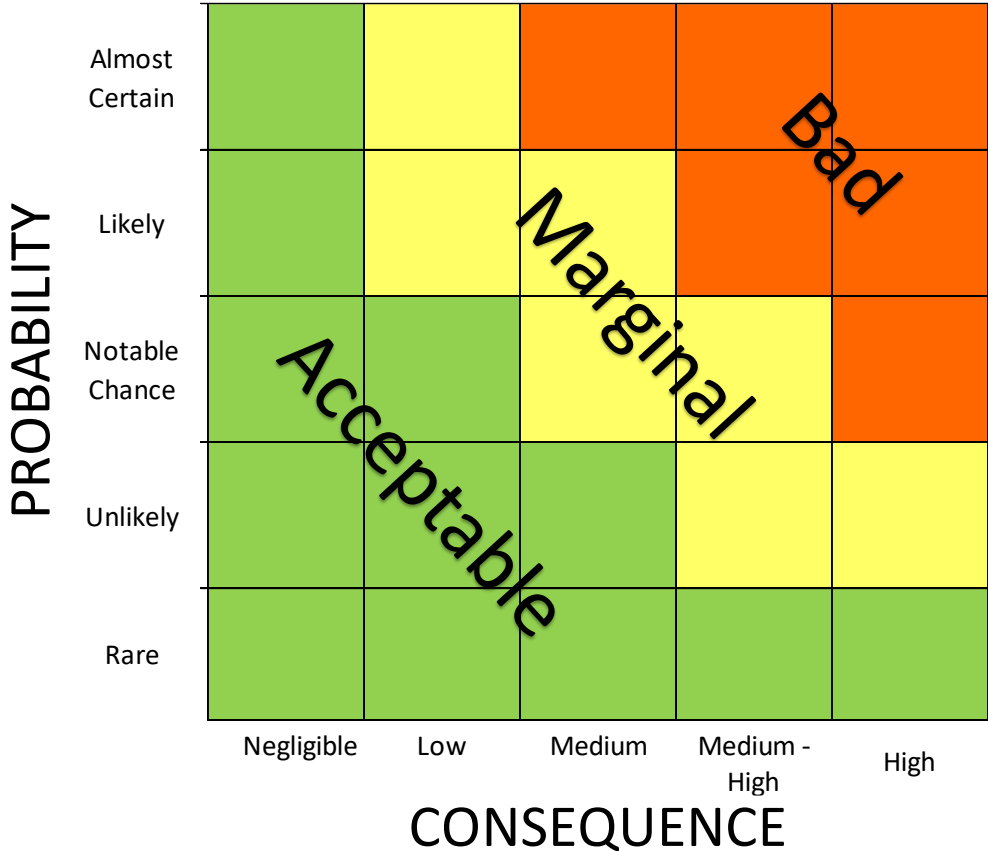
Asset Health Index

Many different consequence types:

- Financial
- Unserved Energy
- System Reliability
- Import/Export Capacity
- Environmental
- Safety
- Legal Compliance
- Reputation
- Etc.

BUT: today's discussion focuses on \$ and Reliability







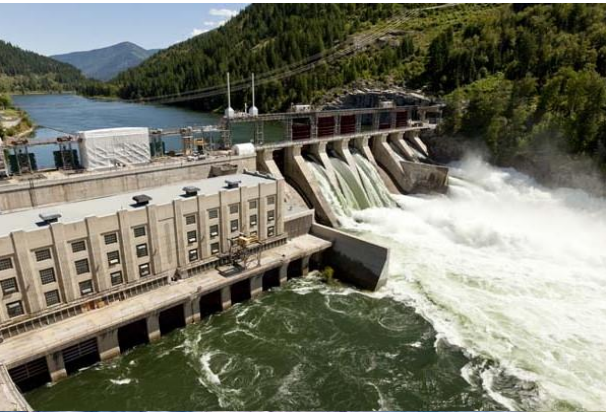
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Assets vs. System Focus

Asset Focus



System Focus



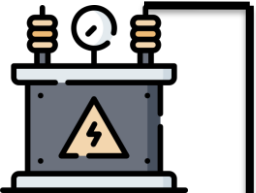
MH AM Policy: “Focus on the system rather than the individual asset”

But AMCL: “risk management practice focuses on asset failure risk instead of system failure”

Key: Not the asset, it’s the value the asset provides



Radial Supply



Transformer A



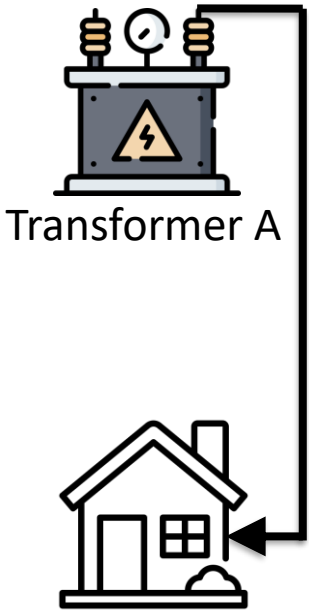
Asset Focus:

Replace Transformer A
Condition = Fair

System Focus:

Replace Transformer A
Condition = Fair

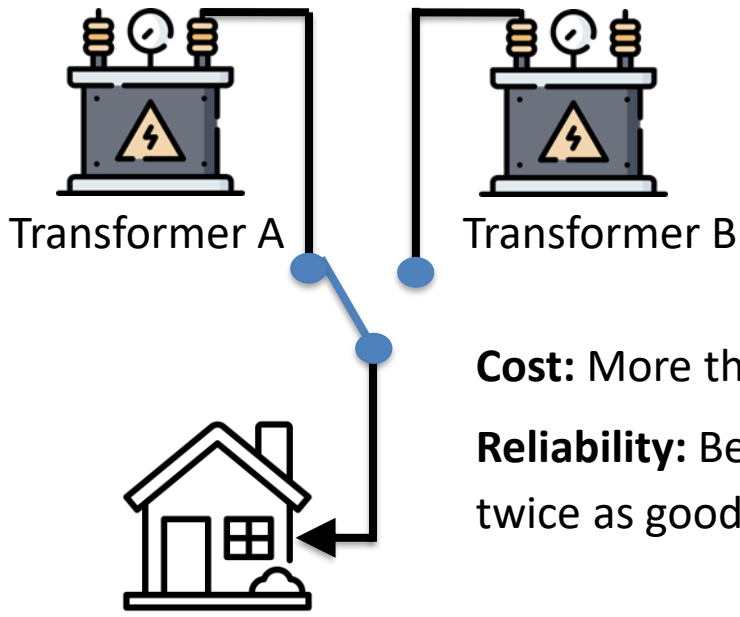
Radial Supply



Asset Focus:
Replace Transformer A
Condition = Fair

System Focus:
Replace Transformer A
Condition = Fair

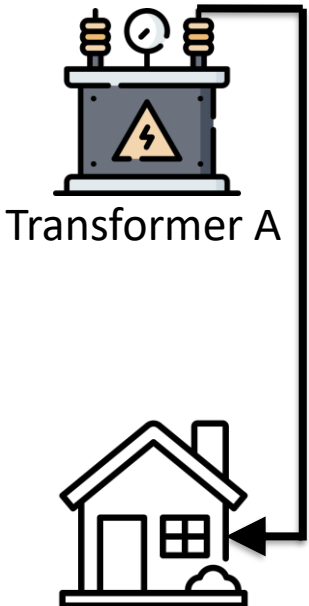
Redundant Supply



Cost: More than double

Reliability: Better, but less than twice as good

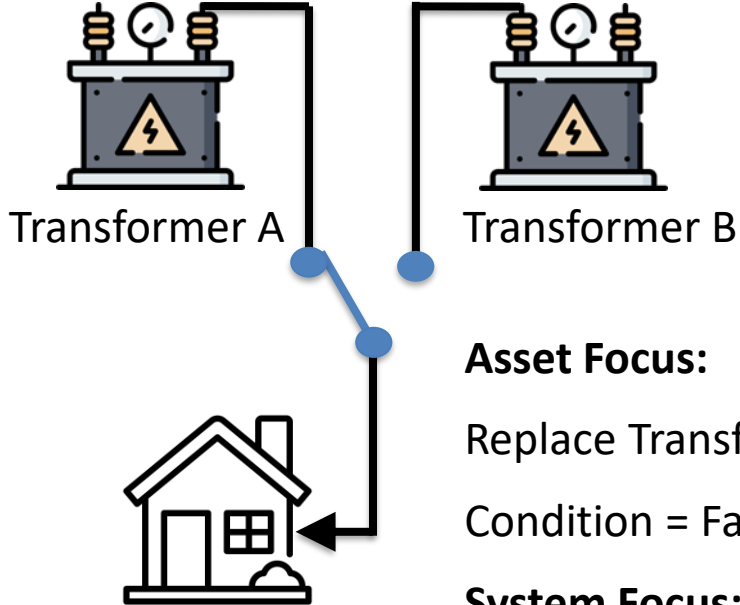
Radial Supply



Asset Focus:
Replace Transformer A
Condition = Fair

System Focus:
Replace Transformer A
Condition = Fair

Redundant Supply



Asset Focus:
Replace Transformer A & B
Condition = Fair

System Focus:
Replace Transformer A & B
Condition = Poor or Very Poor



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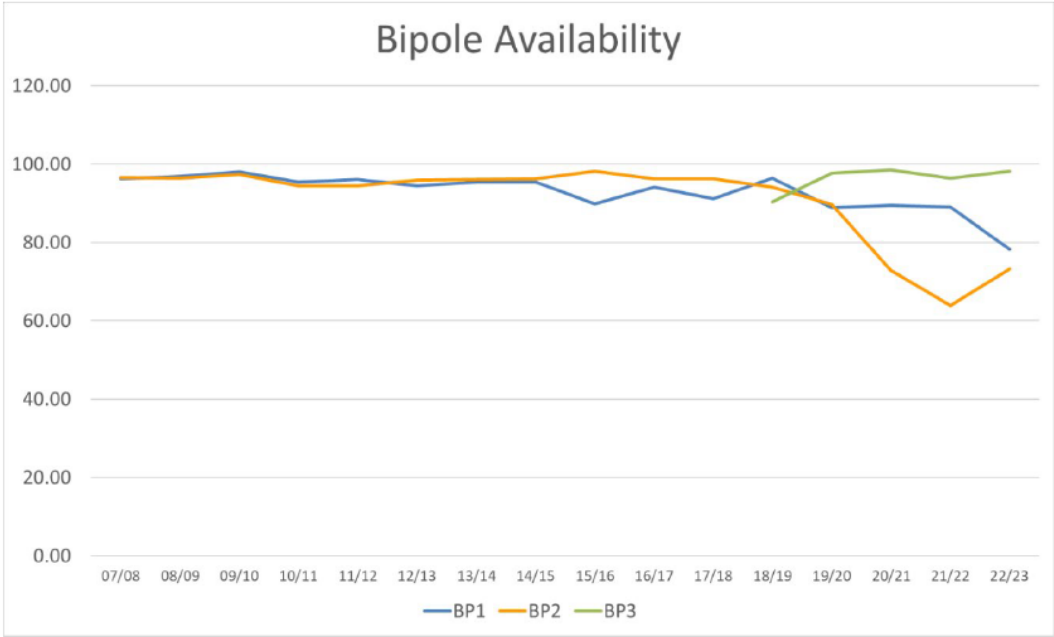
Pulling It Together: DC Bipole Example

Manitoba Hydro: *“Trends in recent years have shown HVDC ... reliability is declining ... as shown in Figure 7.6 ...”*

Midgard:

“...the operative question becomes determining whether Bipole availability reductions are actually causing system and ratepayer impacts ...”

Figure 7.6 Reliability of HVDC System



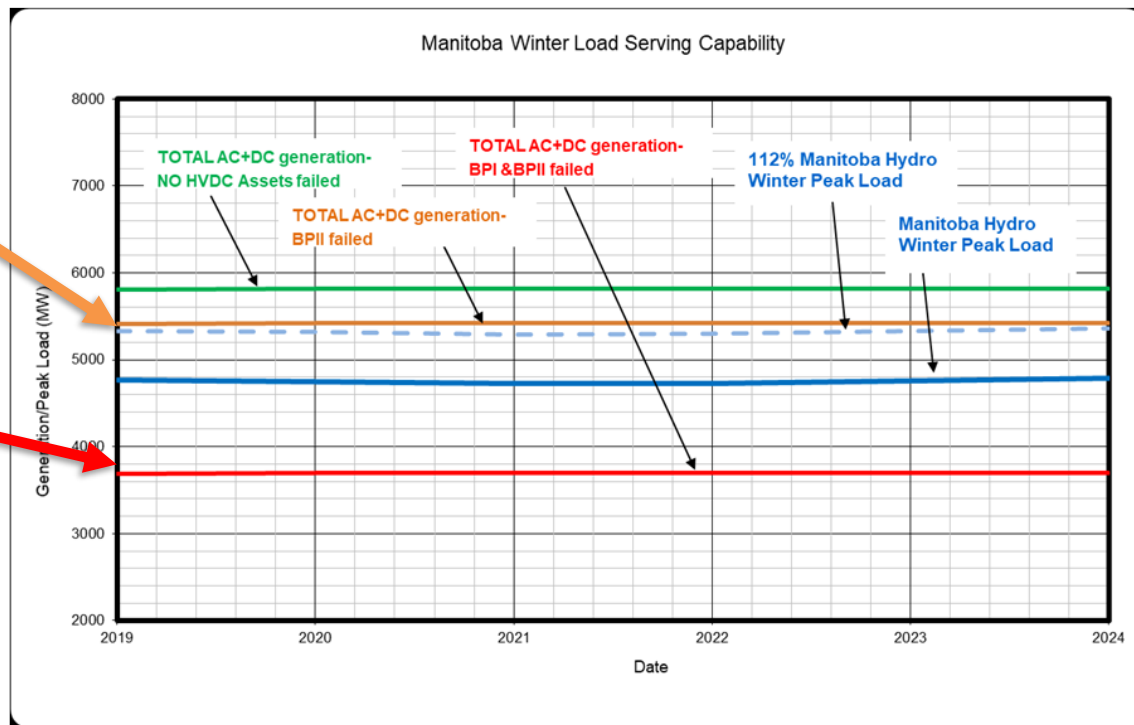
MH Response to CC/MH I-99(e):

With Bipole II failed, all load can be served on peak with zero imports

With Bipole I & II failed, MH could still supply load through most of the year without imports

Per PUB-24: If Bipole I failed, all load can be served on peak with some imports

Conclusion: Different story when looking at the system impacts vs. individual assets





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Minimum System Concepts

Manitoba Hydro Stated Goals (Re-cap):

“...targeted levels of performance and risk at the lowest life cycle cost...”

Manitobans Stated Desire (Re-cap): (MFR 12 Attachment 1 PDF 103)

Strongly favor keeping rates as low as possible over other aspects (e.g., reliability)

PUB Order 20/07:

“It is has been MH’s recent policy and practice to make investments in generation and transmission with the export market in mind...”

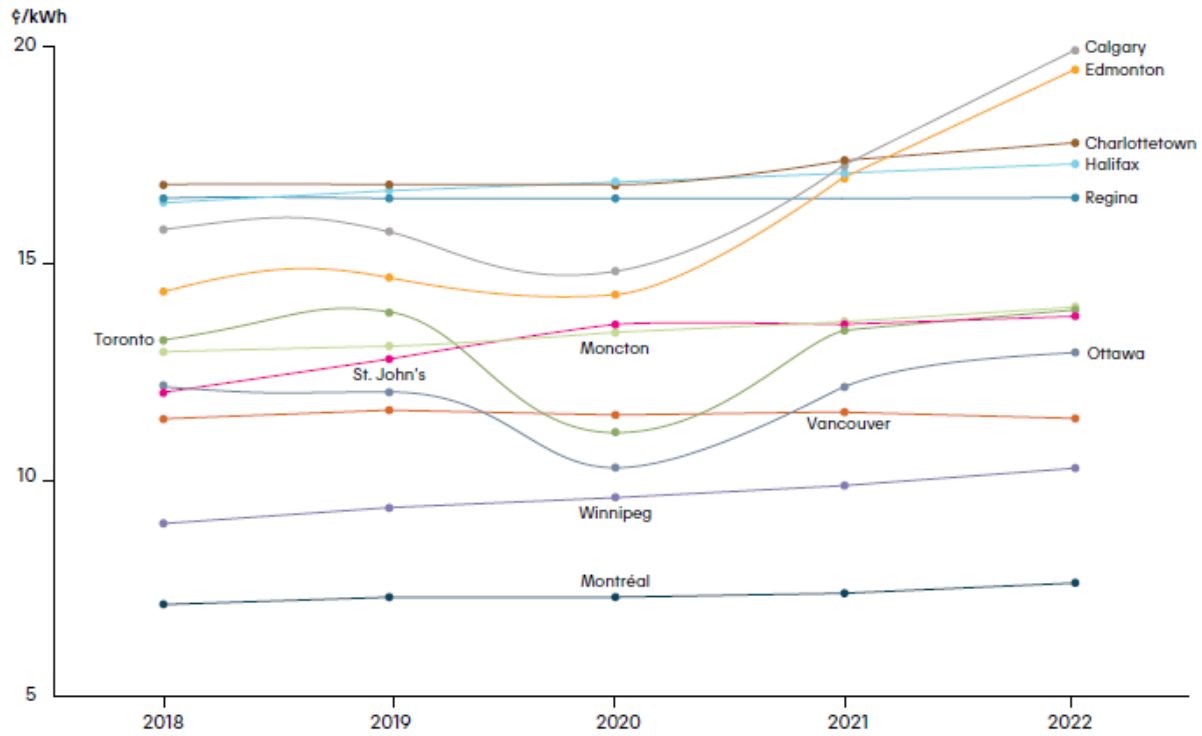
2014 NFAT Report (RE: Keeyask, MMTP & Bipole III):

“...domestic customers are required to make up the [export] shortfall through rates...”

Question: Are ratepayers paying for a system that is more costly than would be needed to reliably meet domestic requirements?

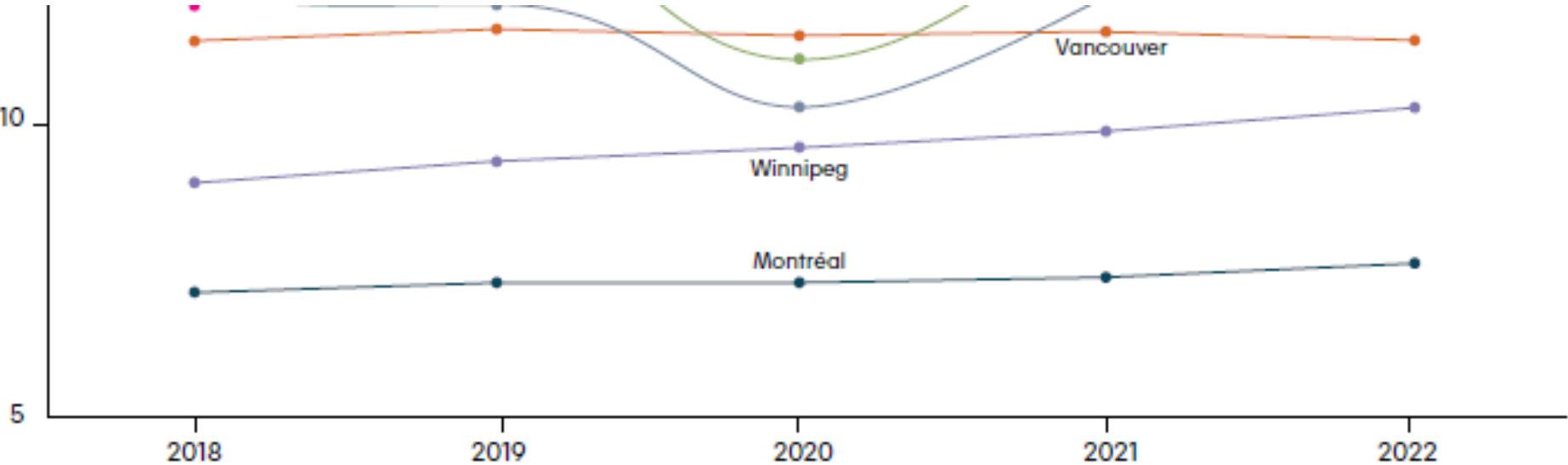
MAJOR CANADIAN CITIES

OVERVIEW OF CHANGES IN AVERAGE PRICES FOR RESIDENTIAL CUSTOMERS (IN ¢/kWh) - 2018-2022^{1, 2, 3, 4}



Source: Hydro Quebec – 2022 Comparison of Electricity Prices in Major North American Cities

Manitoba Hydro’s appropriate “cost” peers are the two other major storage hydroelectric jurisdictions in North America: BC Hydro & Hydro Québec



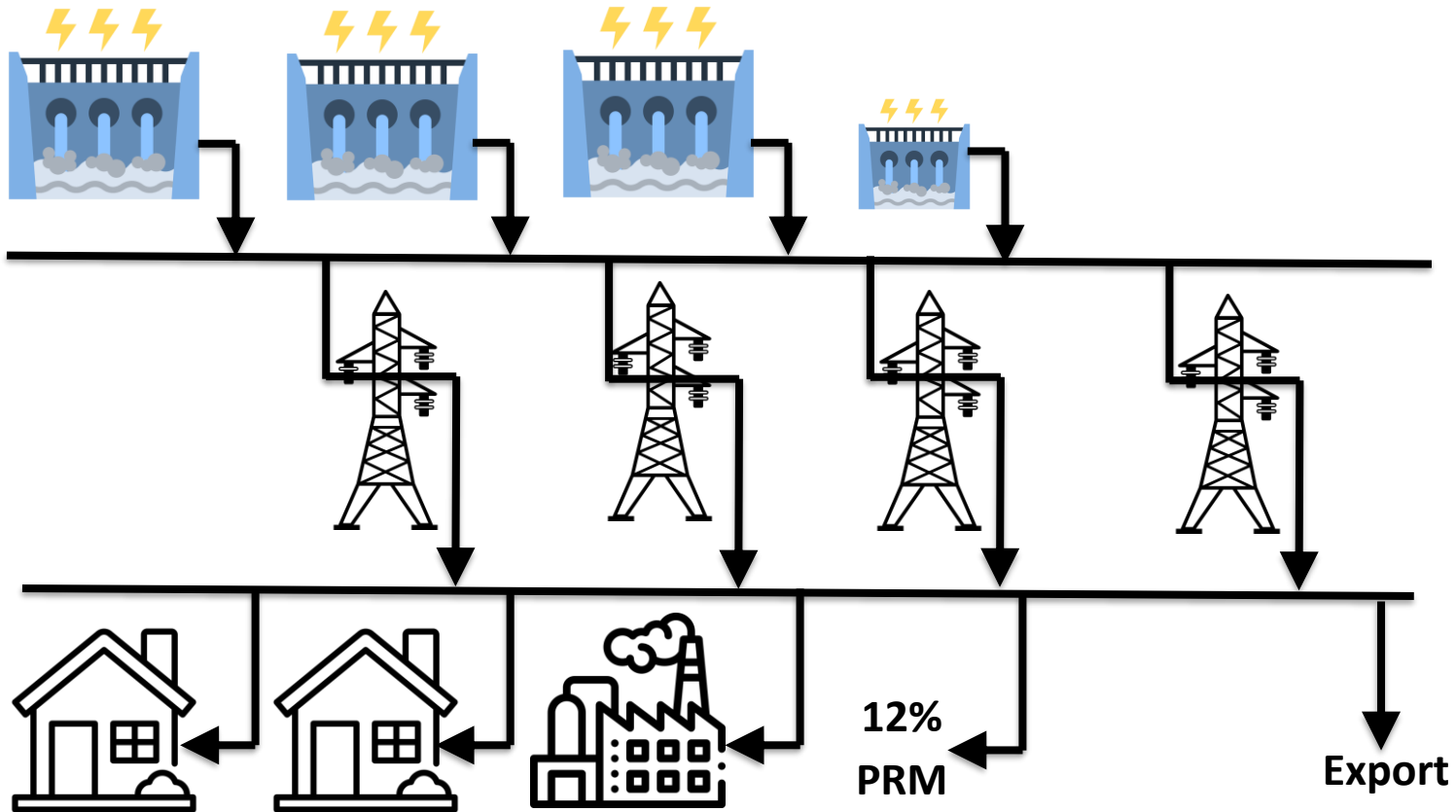
Source: Hydro Quebec – 2022 Comparison of Electricity Prices in Major North American Cities

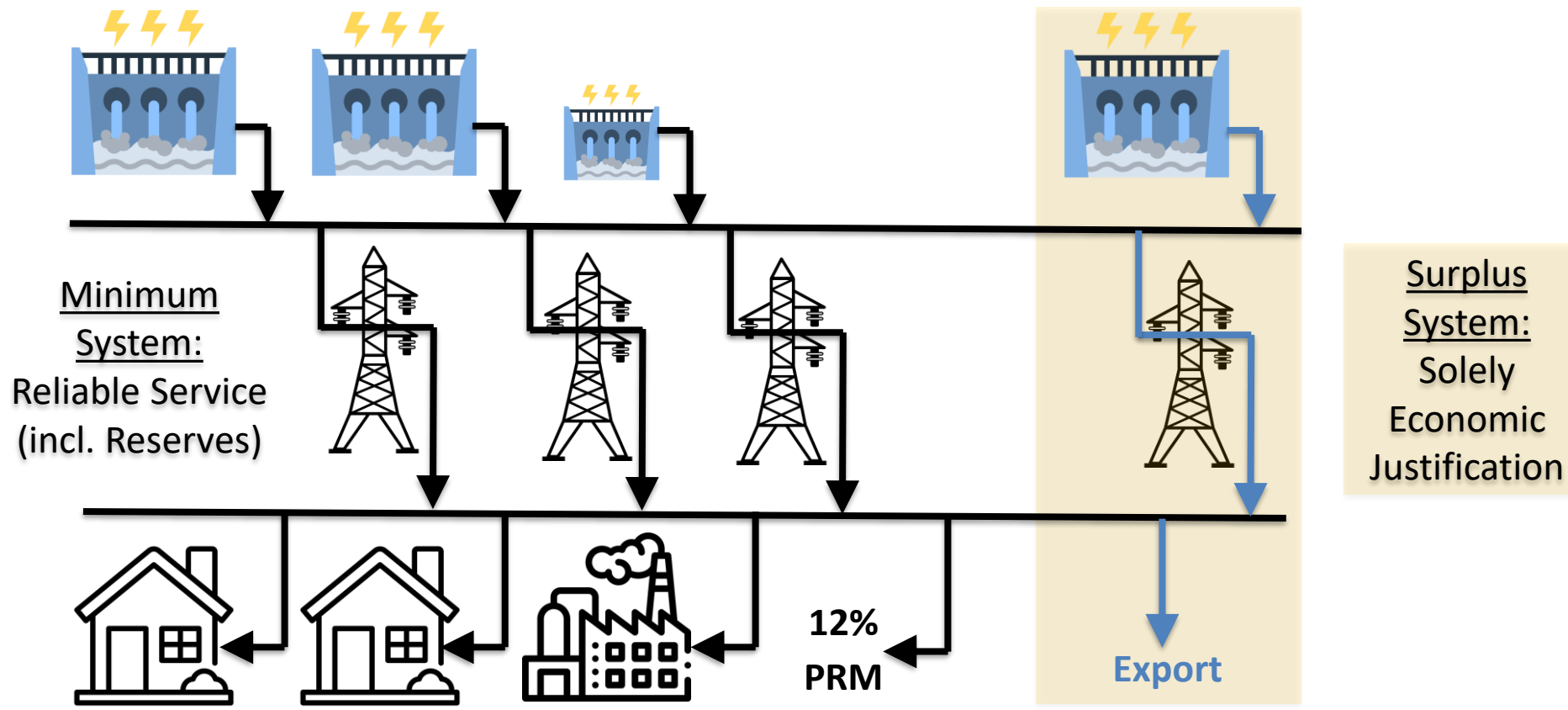


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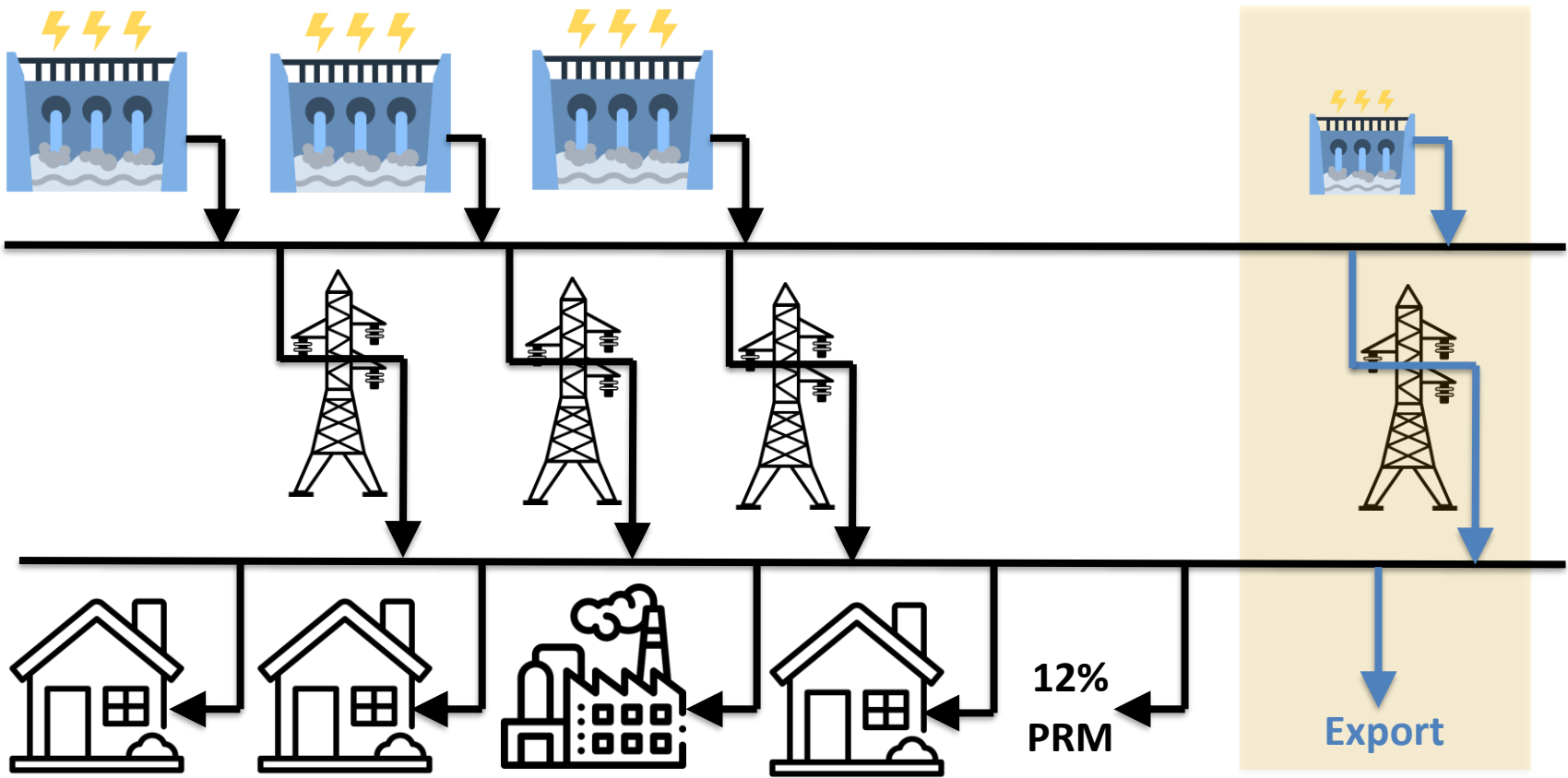
Minimum System Example

Transparency: What is required to serve domestic load? What is economically driven?





As System Changes: Minimum System Adapts



<https://www.flaticon.com/free-icons/power-transformer> title="hydro power icons", "residential icons", "power icons", "production icons" by Freepik – Flaticon

MH has Surplus System for firm and non-firm exports (even in poor water years)

MH claims it is unable to identify its Minimum System

Therefore, MH can't appropriately justify proposed capital investments

- Investments to maintain reliability are only justified for the minimum system.
- Surplus system investments must stand or fall solely on their economic merits

Establishing the Minimum System Enables:

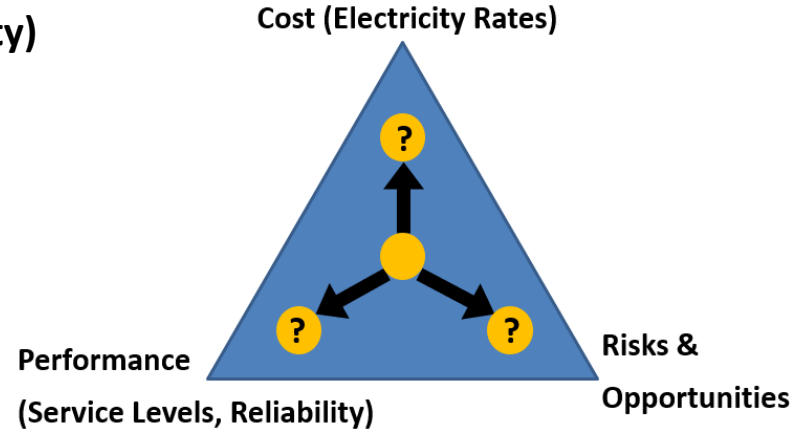
- **Transparency** between reliability and economic investments
- **Transparent justifications** for each type of investment (either reliability analysis or business case)
- Without minimum system, **“least cost” system is unknown**
- Determining minimum system **enables “System Focus”** in Asset Management



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10% BOC Reduction

- 1) **60 Year Investment Strategy is Outdated**
- 2) **SAIDI/SAIFI Performance is Superior**
- 3) **Ratepayers Values Rates over Other Aspects (e.g. Reliability)**
- 4) **Asset Aging As Expected**
- 5) **AM Maturity Constrained (3 Key Areas)**
 - **Asset Health Indices not fit for purpose**
- 6) **System Not Optimized**
 - **O&M vs. Capital, Across Business Lines**
- 7) **Lack of System Focus**
 - **Deferrals – Potential candidates: DC Bipoles, Pointe Du Bois, Grand Rapids Unit 4 etc.**
- 8) **Minimum System**
 - **Invest in Domestic rather than Surplus System**
- 9) **Not Least Cost System**





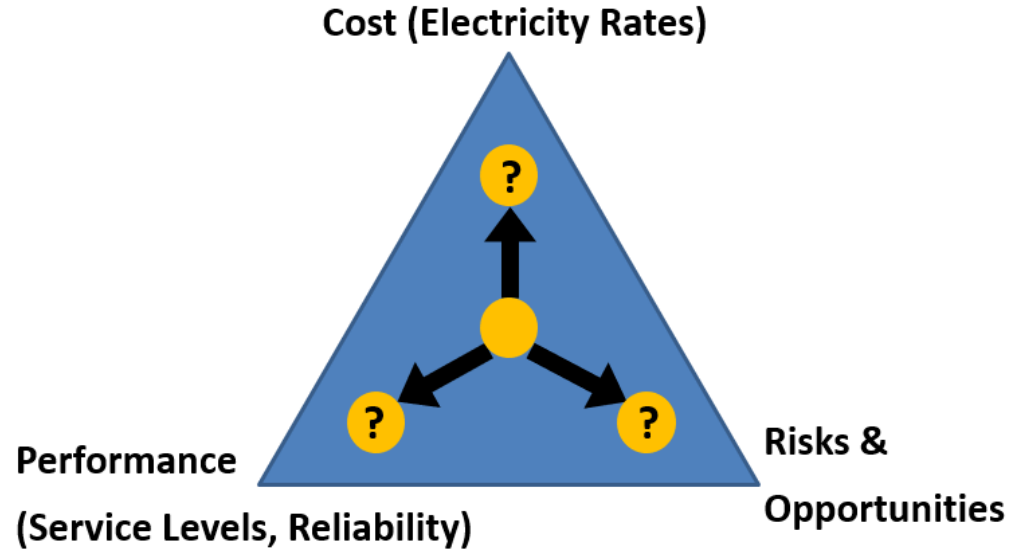
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Recommendations & Conclusions

- 1) Manitoba Hydro Asset Management Maturity at “Awareness” stage
 - a. A Journey (1.5 to 1.81 since last GRA)
 - b. Weakest: Asset Information, Risk & Review, Decision Making
- 2) Electrical System: Transitioning from Growth to Sustainment
 - a. Need to Separate Domestic from Export Requirements
 - b. Can’t grow quickly to absorb “Poor” Decisions
- 3) Consequence: Overbuilt Domestic System, Not Least Cost System

GFMAM Groups		SCORE					Company Average (Weighted)
Group	Subject	Enterprise & Support Functions	EGen	ETx	EDx	GDx	
1	Asset Management Strategy & Planning	2.05					2.05
2	Asset Management Decision Making	1.79	1.83	2.25	1.75	2.22	1.83
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4	Asset Information	1.32					1.32
5	Organisation & People Enablers	2.13					2.13
6	Risk & Review	1.42	2.00	3.00	2.00	3.00	1.45
Average (Weighted)		1.75	1.98	2.00	2.20	2.17	1.81

- 1) Recognize that more Sustainment, less Growth, is the future
- 2) Improve Asset Information, Risk, Asset Health Indices and Decision Making Processes
 - a. Per AMCL+ Report
- 3) Ratepayer Desires (Value/Cost) Matter
- 4) System Focus (rather than Asset Focus)
 - a. Ratepayer outcomes drive investments
- 5) Separate Domestic vs. Export Needs
 - a. Domestic: Minimum System
 - b. Export: Surplus System
- 6) 10% BOC Reduction





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Appendix / Supplementary Slides



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Copperleaf C55

- C55 can be an effective tool
 - But, only as good as its inputs
- Asset Information is the area of least maturity at MH (per AMCL)
 - Limits overall AM maturity
 - Limits C55

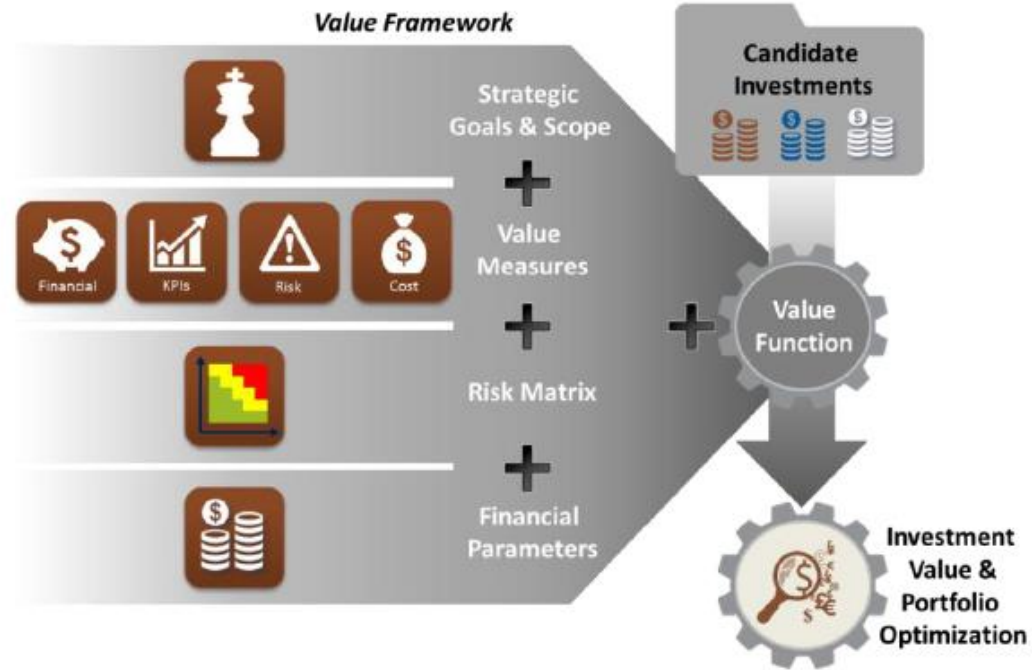


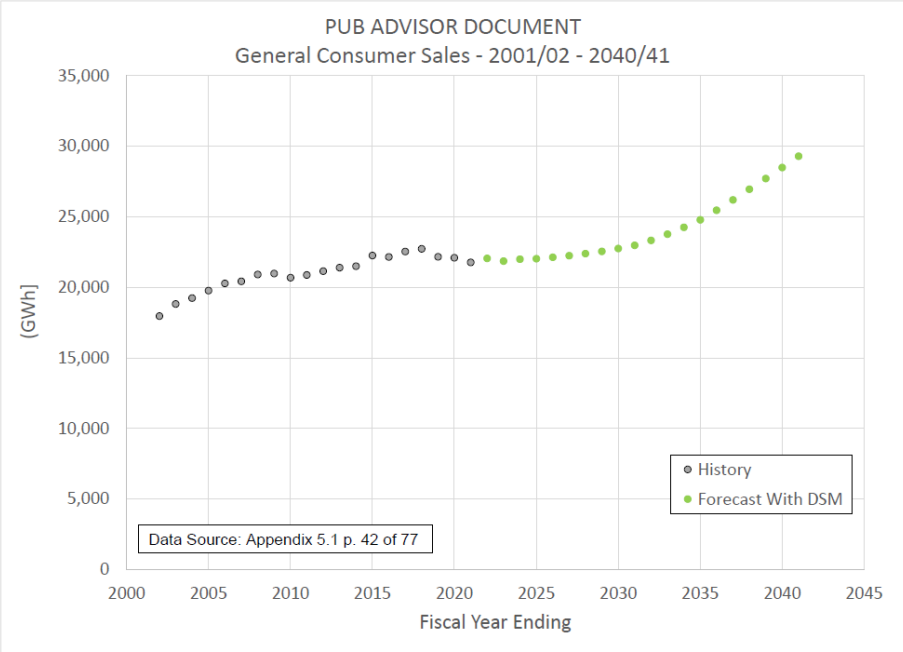
Figure 2 - Value Framework



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PUB Briefing Note

- 1st 10 Years (0.46%) Comparable to Last 10-15 Years (0.46%, Range: 0.33%-0.82%)
- Back End Loaded Growth: 2037-2041 = 2.83%
- Context: Pre-1985 Growth Rate: 7.69%, Modern: 1.33%



Period	FYE	CAGR Energy
20 Year	2002-2021	1.02%
15 Year	2005-2019	0.82%
15 Year	2007-2022	0.46%
10 Year	2011-2020	0.63%
10 Year	2012-2021	0.33%
Forecast Period	FYE	CAGR Energy
10 Year	2022-2031	0.46%
15 Year	2022-2036	1.04%
20 Year	2022-2041	1.51%
10 Year	2032-2041	2.56%
5 Year	2037-2041	2.83%

Example Project:

Plan: 10 years to full absorption.

Reality: 10% overbuilt

Historic (pre-1985) Growth – 7.69%

Result: Additional 1.3 years

Modern Era - 1.33%

Result: Additional 7.2 years (25% cost increase in 1st 25 years)

Observation: A strategy that made economic sense 60 years ago is costly today.

Comparison: Forecast Growth of 0.46% (10 year) & 1.04% (15 year) would increase ratepayer costs compared to 1.33% used in report analysis.

