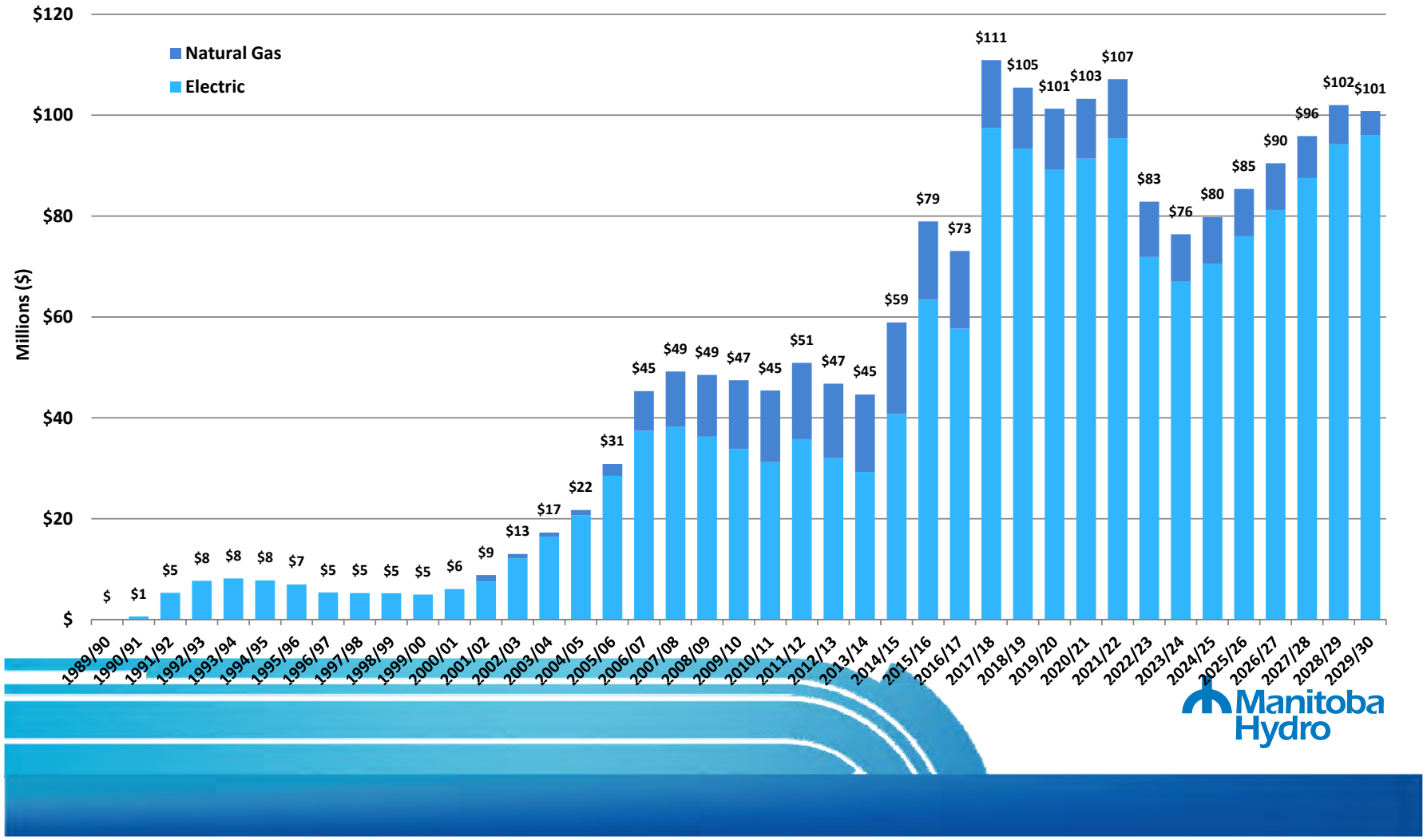
2015 Power Smart Plan

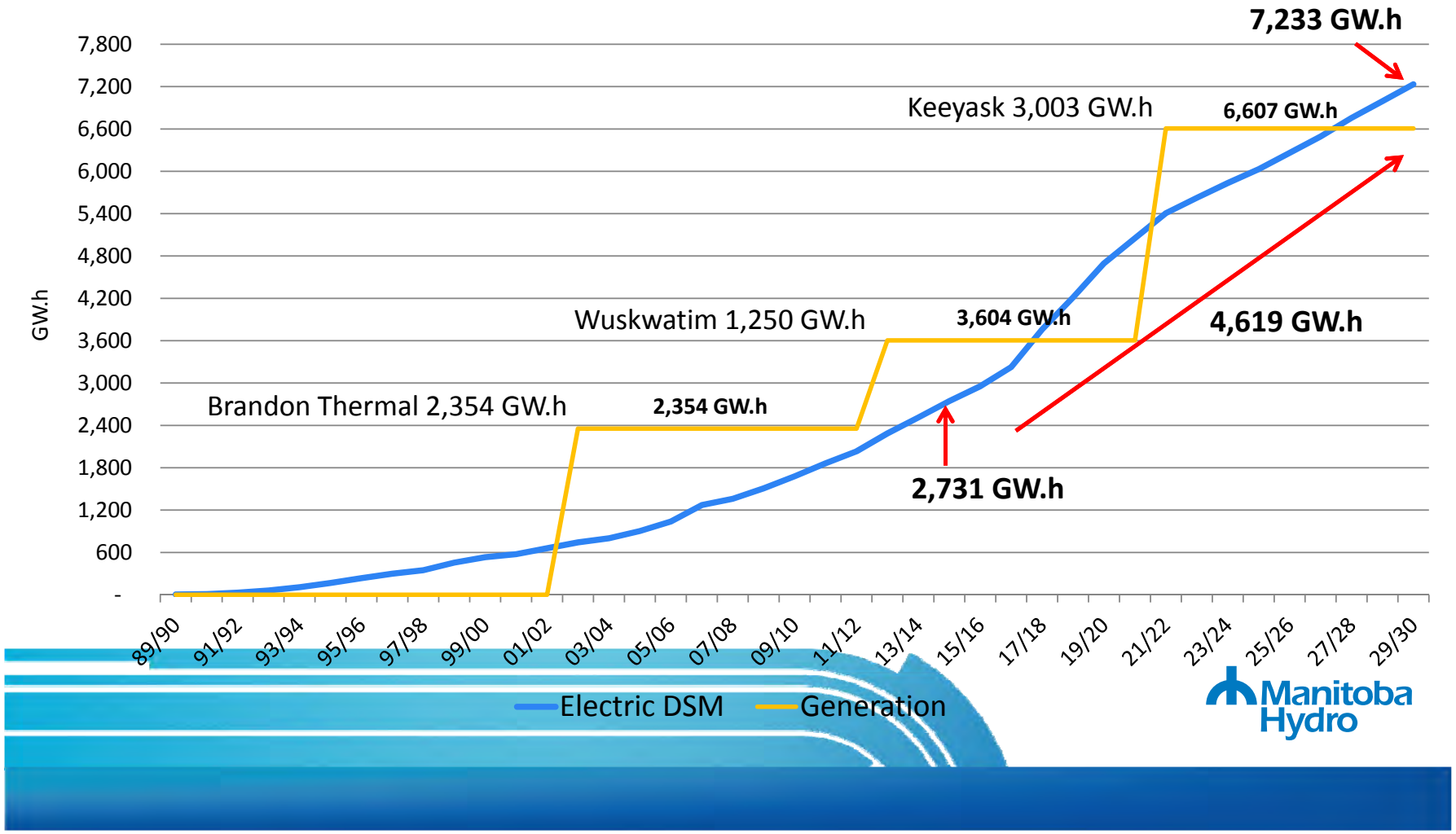
December 7, 2015

Available in accessible formats upon request

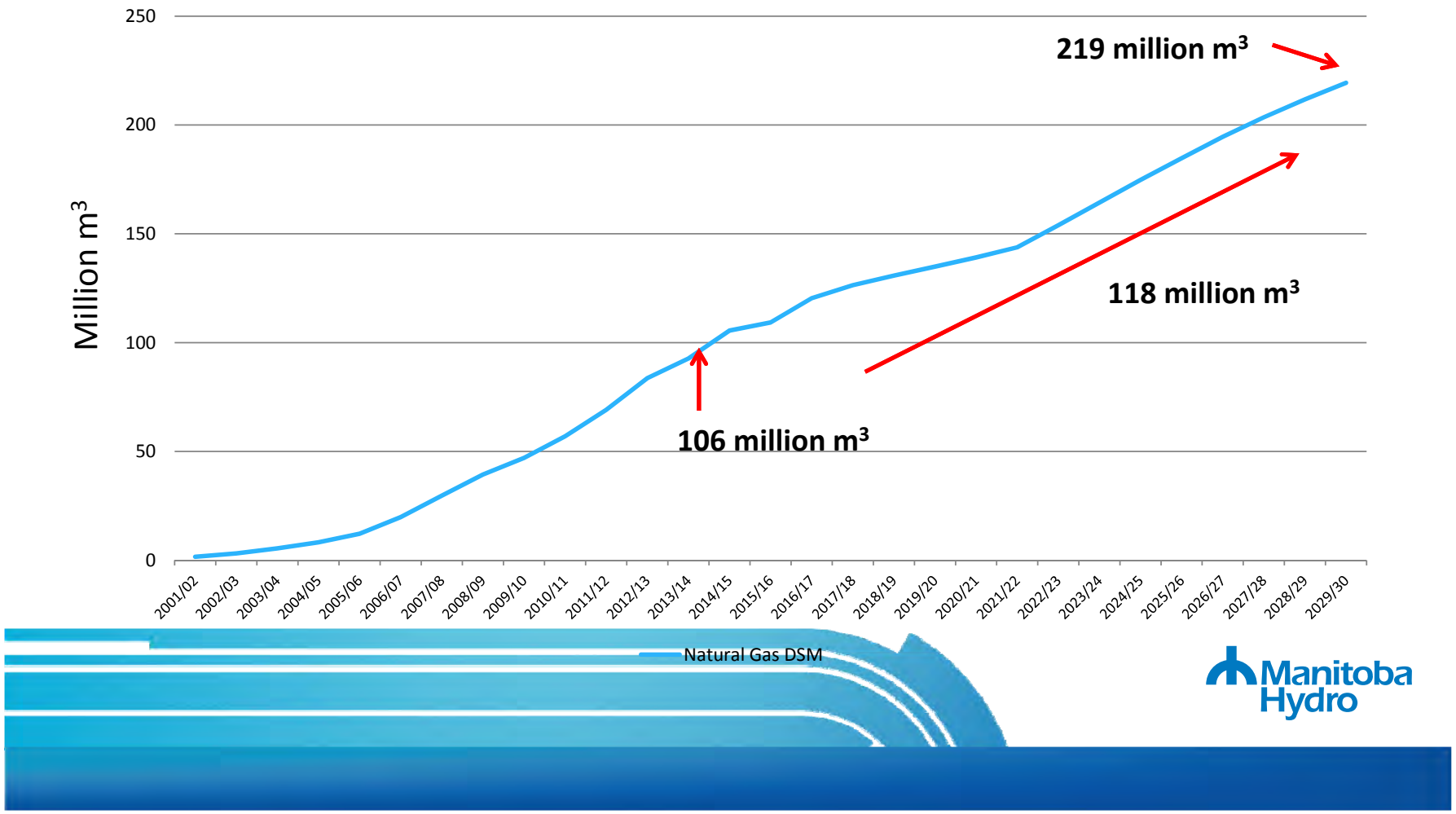
Utility DSM Budget



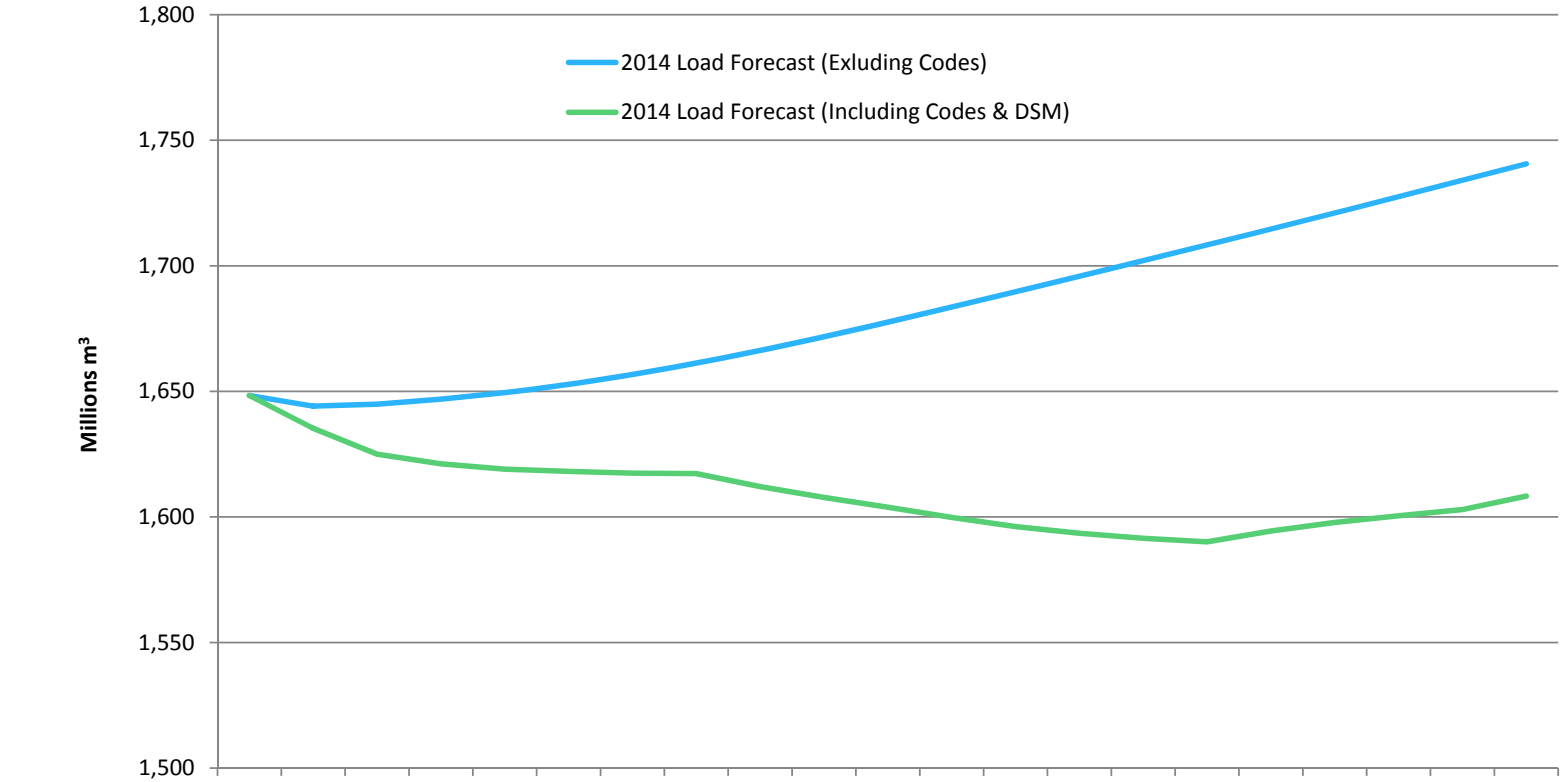
Electric DSM - Long Term Strategy



Natural Gas DSM



Natural Gas Volume



Manitoba Hydro

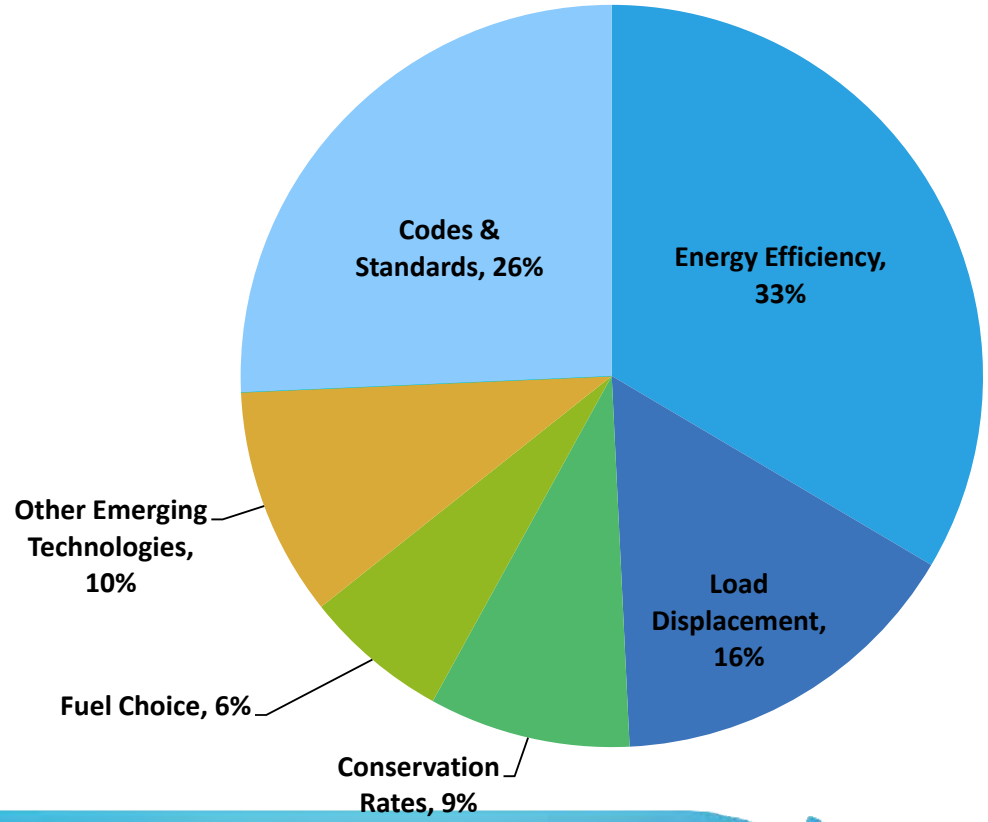
2015 Power Smart Plan

	2015 – 2030 PS Plan (15 years)	2014 – 2029 PS Plan (15 years)	Change
MW	1,288	1,136	+152
GW.h	4,619	3,978	+641
Million m^3	118	108	+10
Utility Cost (nominal)			
Electric	$1.2 B	$0.9 B	+$304M
Natural Gas	$161 M	$174 M	-$13 M
TOTAL UTILITY COST	$1.4 B	$1.1 B	+$291M
TOTAL DSM COST	$2.6 B	$1.9 B	+$727 M

Manitoba Hydro

Electric Energy Savings Breakdown

at 2029/30



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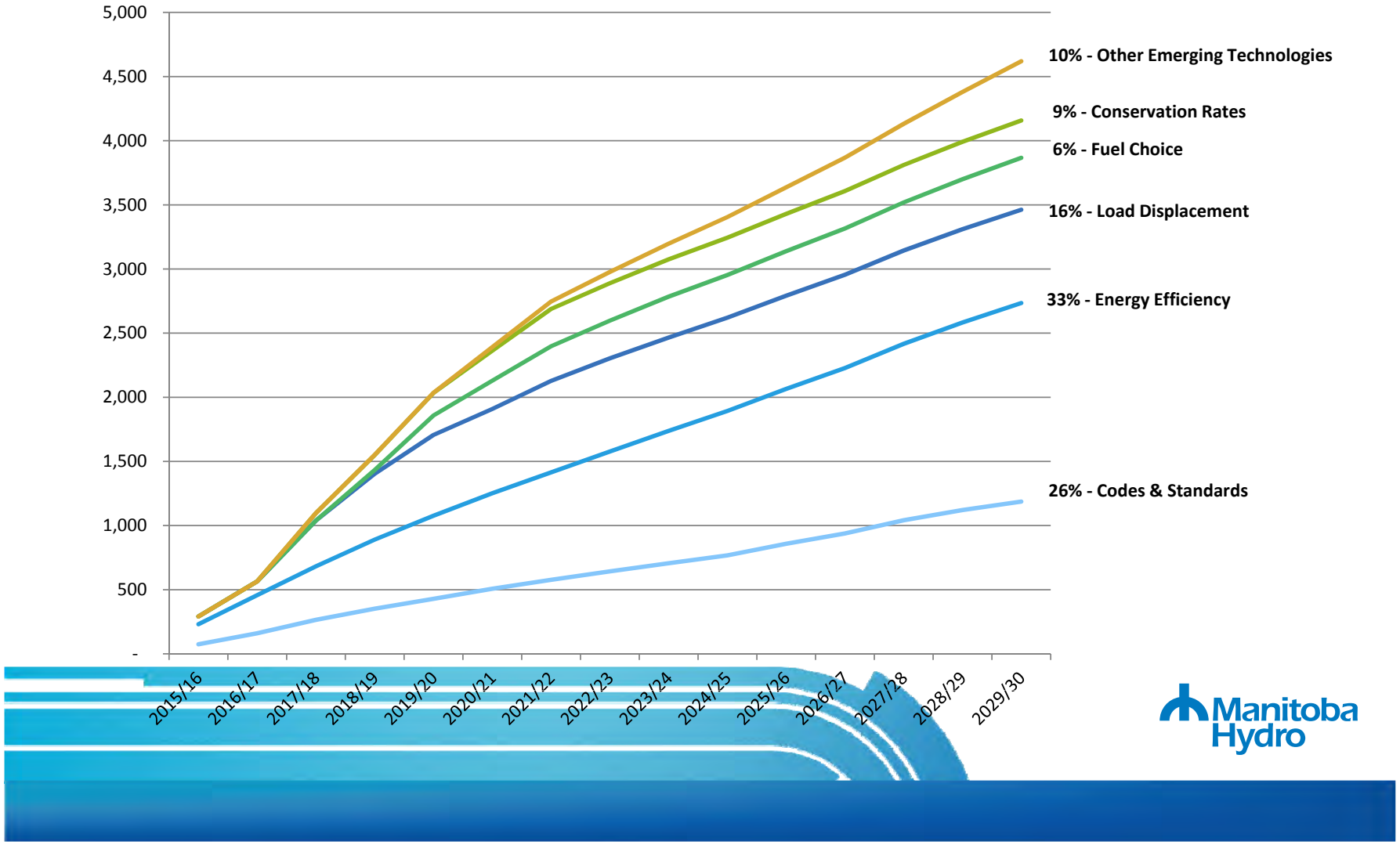
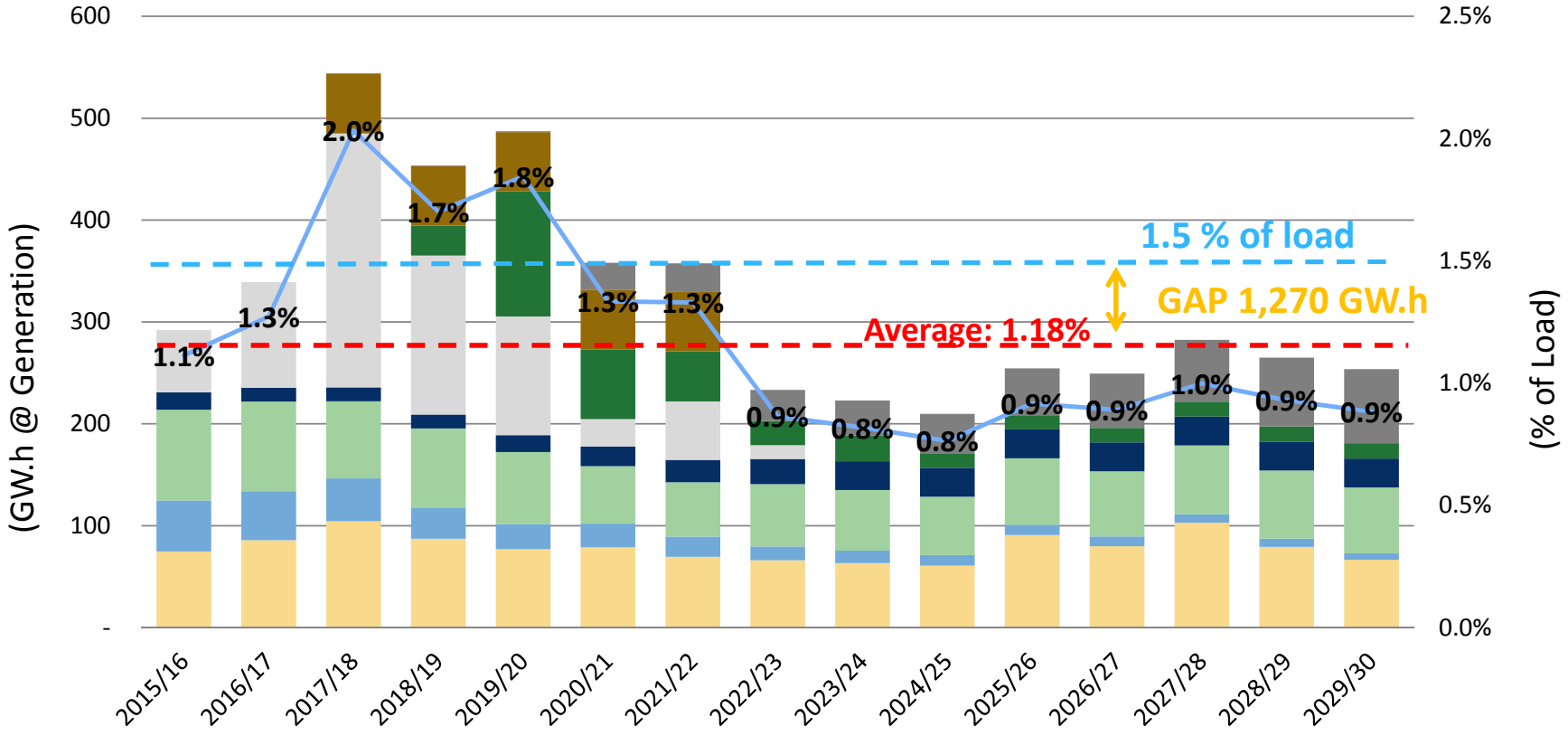
Electric Energy Savings Breakdown



Annual Electric Savings

Percent of Annual Load



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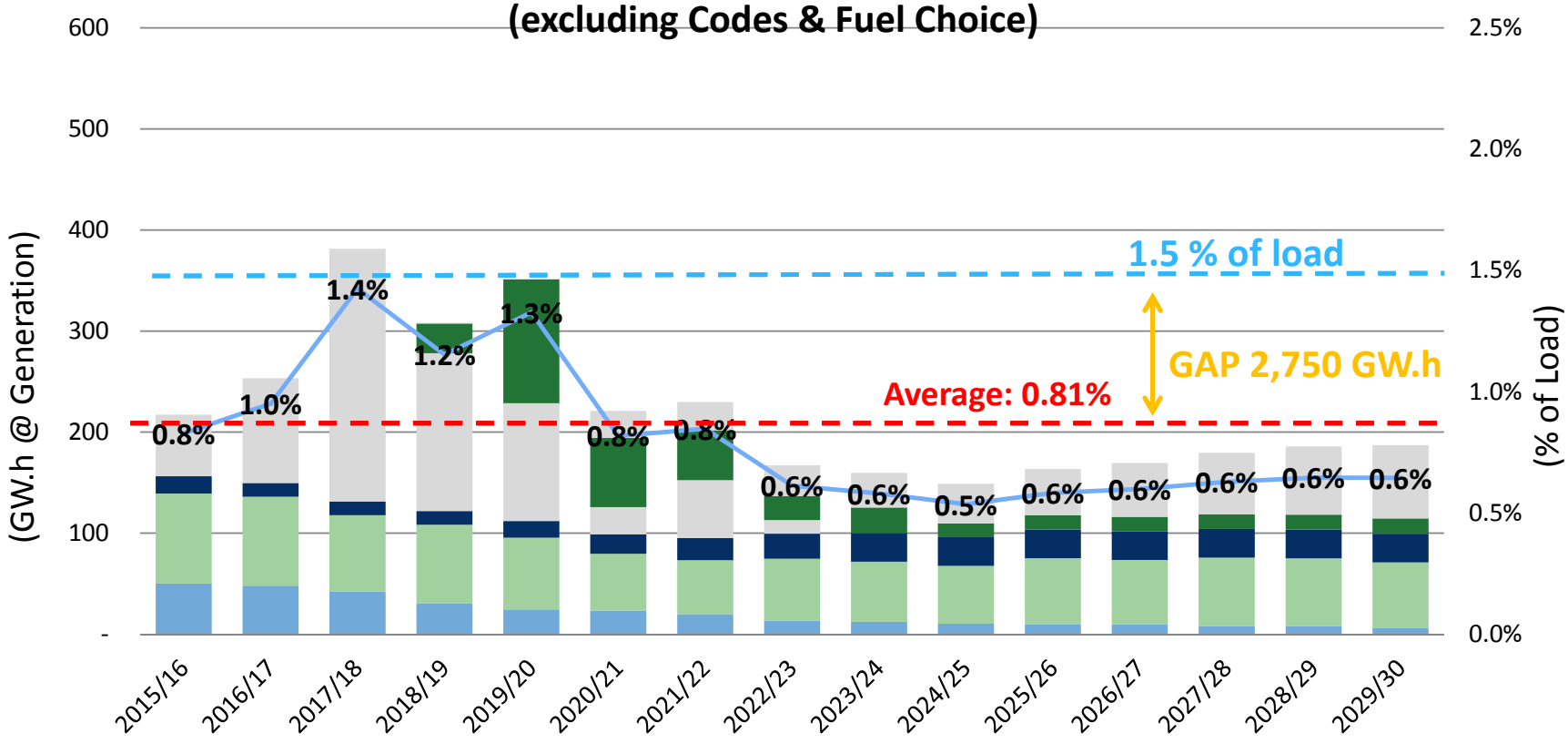
Annual Electric Savings

Percent of Annual Load

(excluding Codes & Fuel Choice)



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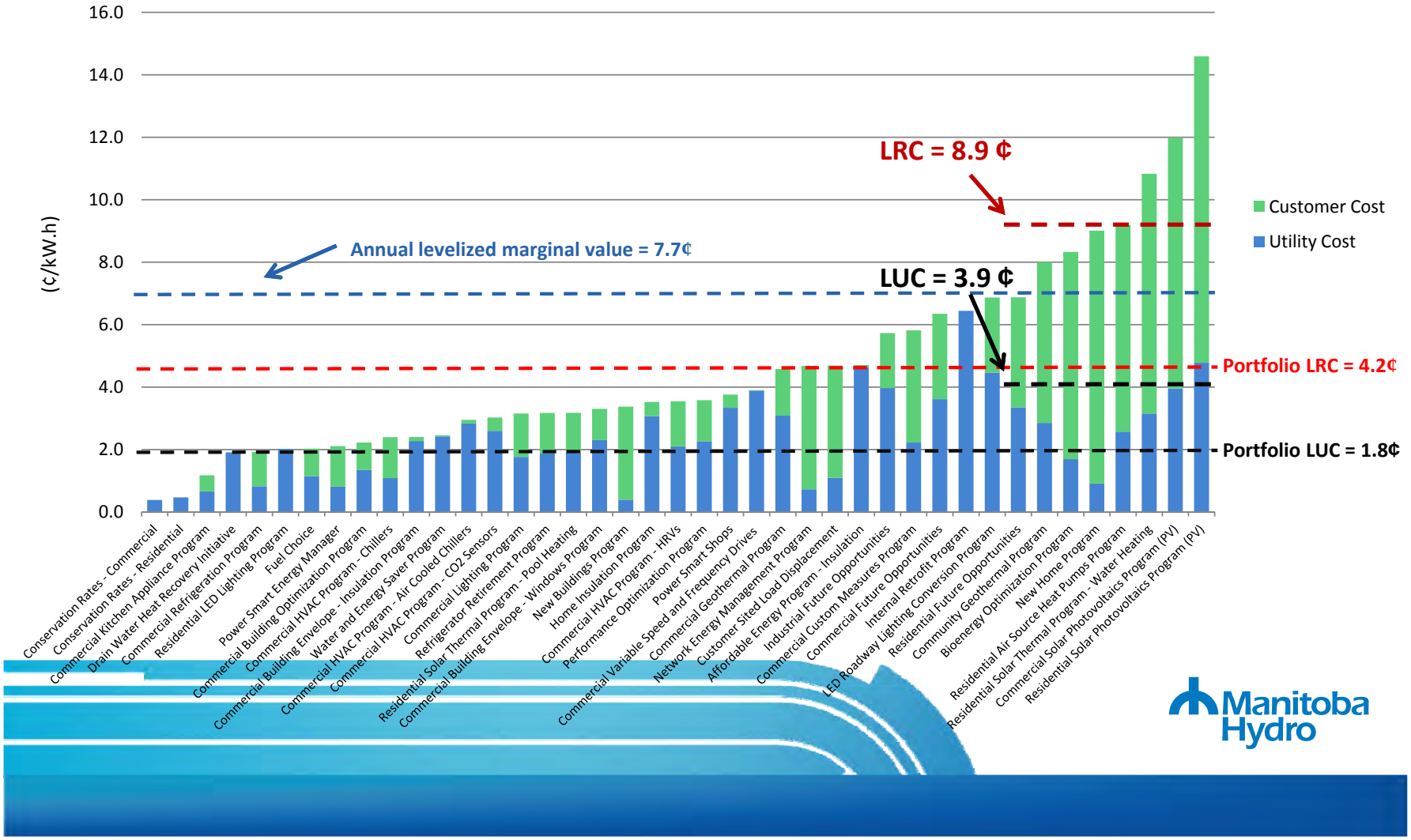
2015 Power Smart Plan

Electric Levelized Cost

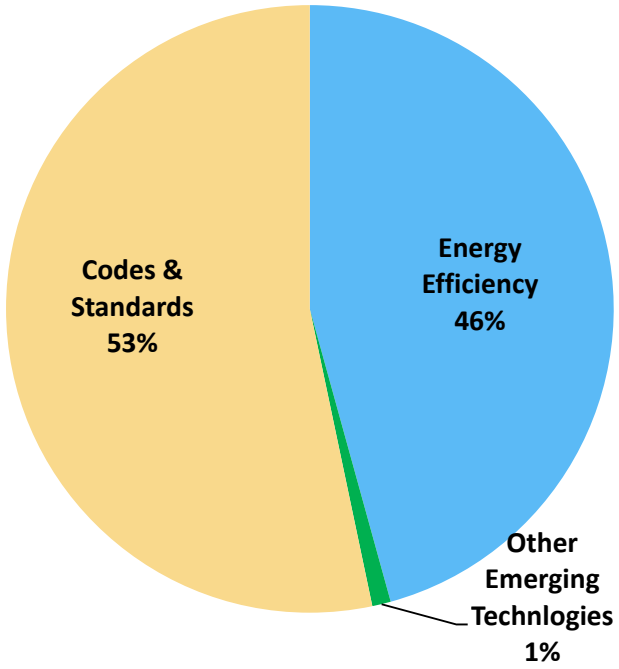


2015 Power Smart Plan

Electric Metrics	
Levelized Resource Cost	4.2 ¢/kW.h
Levelized Utility Cost	1.8 ¢/kW.h
TRC Benefit/Cost Ratio	2.3
RIM Benefit/Cost Ratio	1.0
% of Load Growth	60%

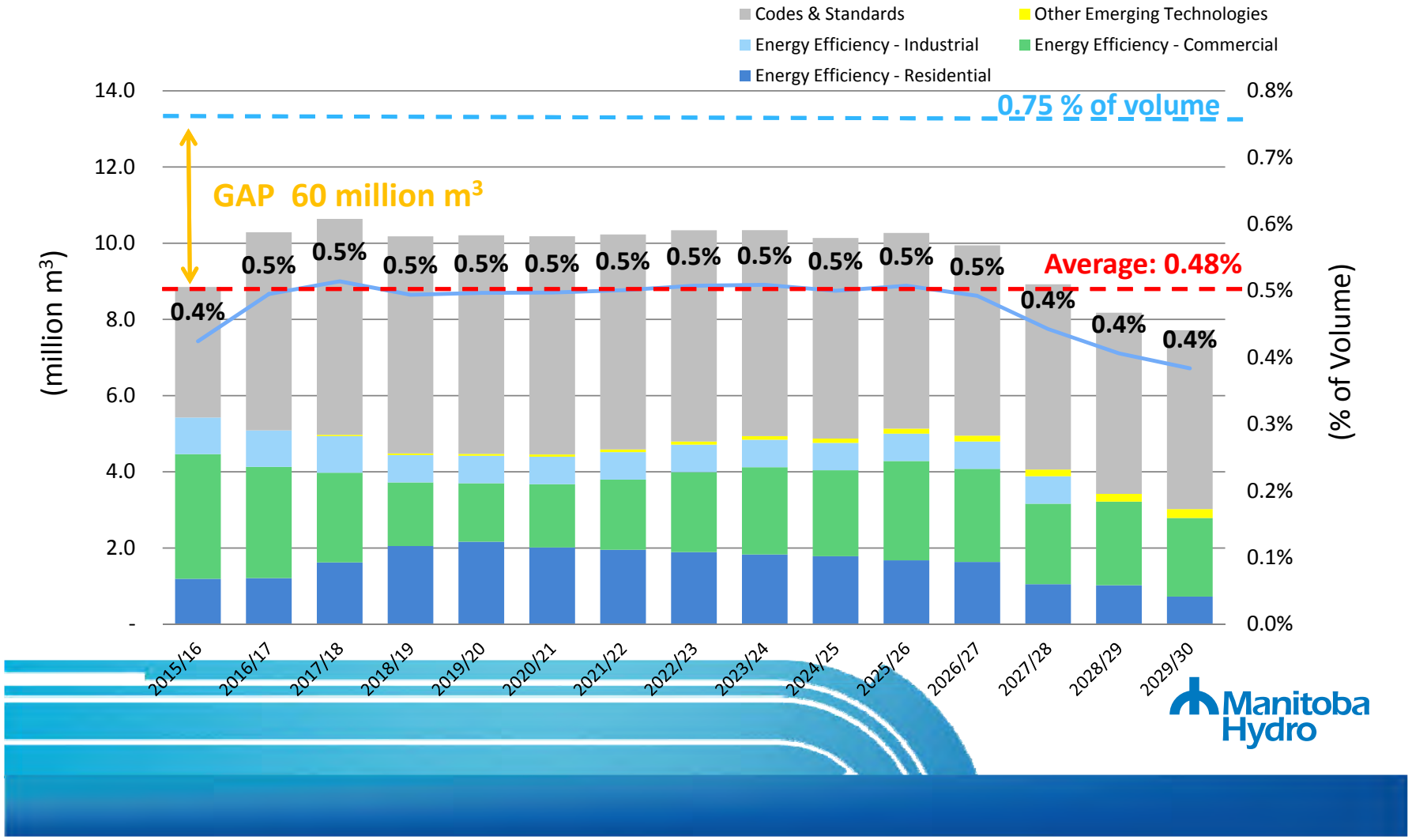
Natural Gas Savings Breakdown

at 2029/30



Annual Natural Gas Savings

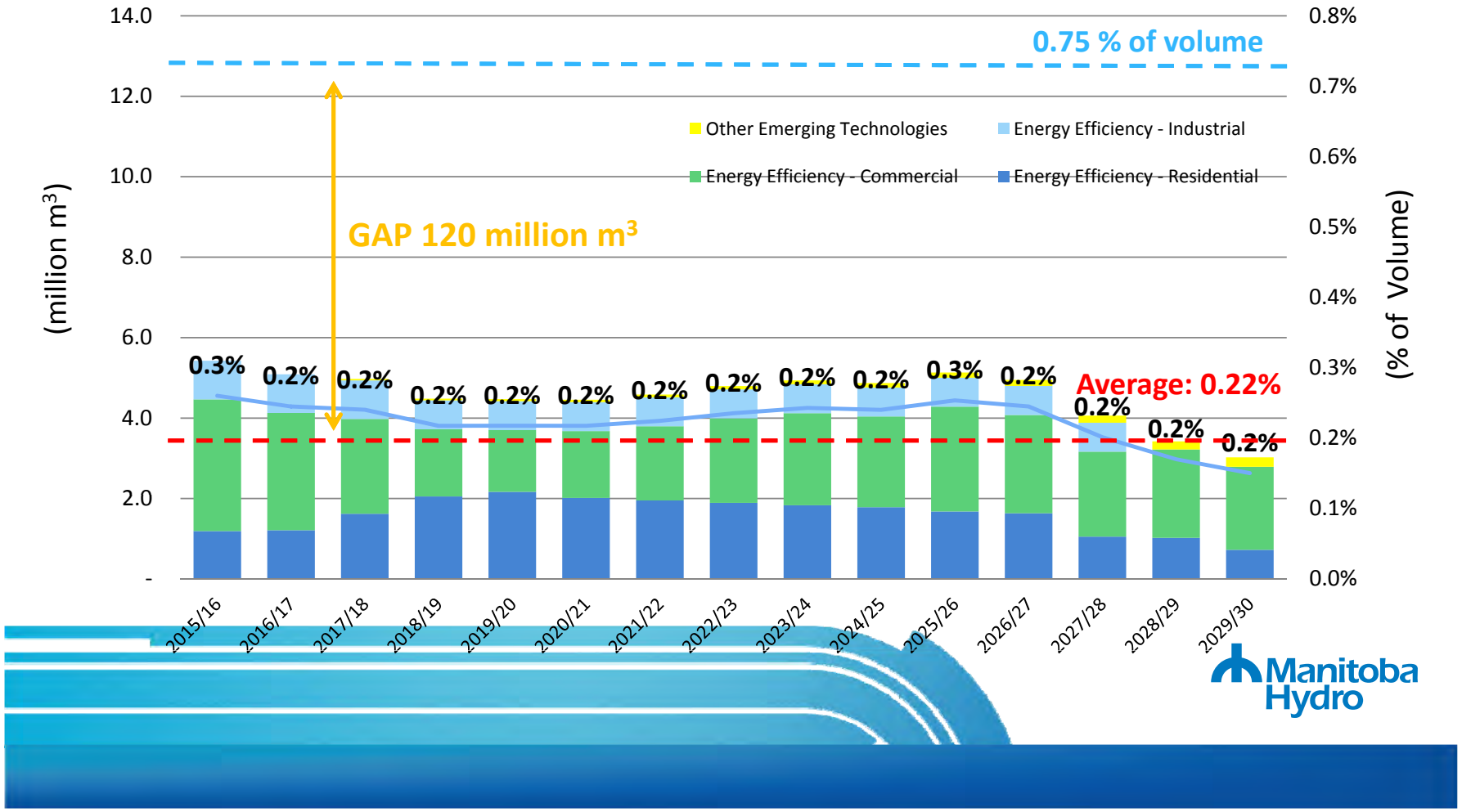
Percent of Annual Volume



Annual Natural Gas Savings

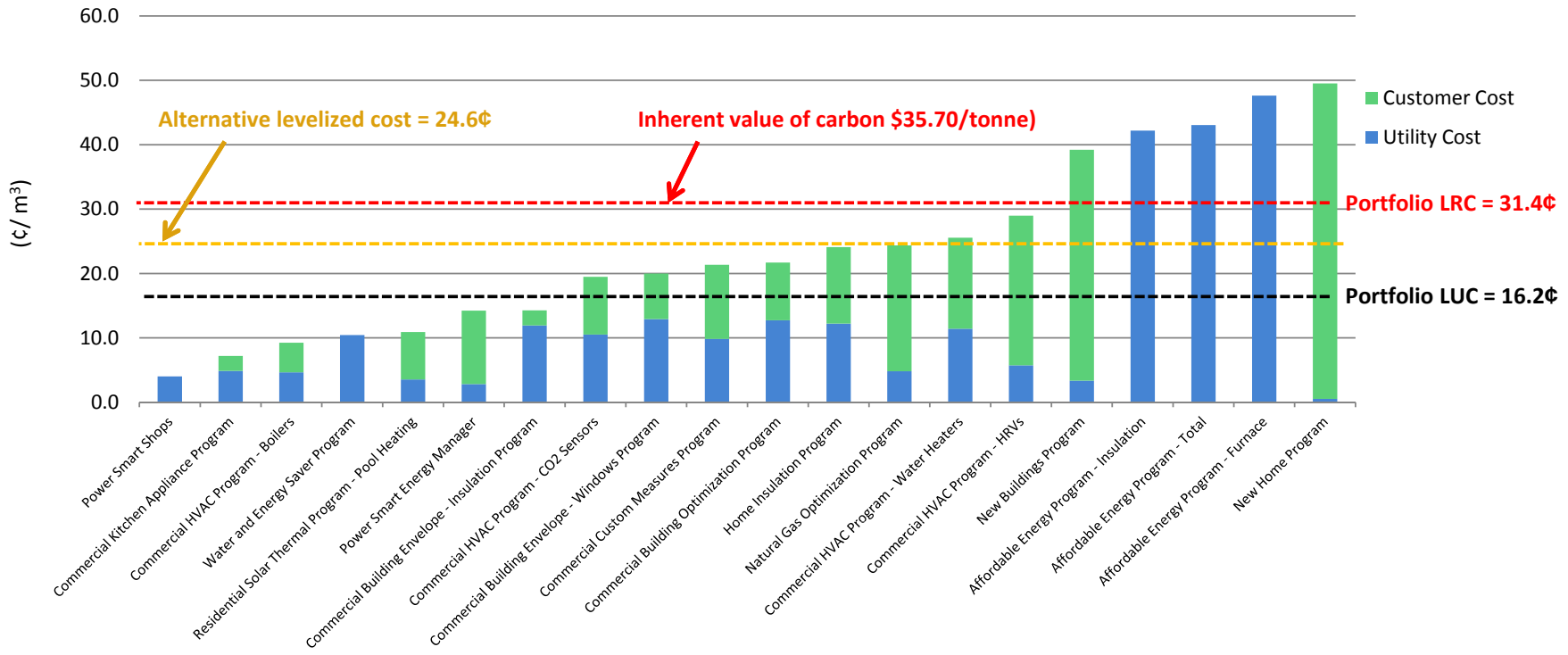
Percent of Annual Volume

(excluding Codes)



2015 Power Smart Plan – 15 Year

Natural Gas Levelized Costs



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2015 Power Smart Plan – 15 Year

Natural Gas Metrics	
Levelized Resource Cost	31.4 ¢/m^3
Levelized Utility Cost	16.2 ¢/m^3
TRC Benefit/Cost Ratio	1.0
RIM Benefit/Cost Ratio	0.6
% of Volume	6.9%

Risk Management

- Traditional DSM activities present low risk
- Other categories of DSM present more risk:
  - Conservation Rates – Regulatory approval
  - Fuel Choice – Contrary to Clean Energy Strategy
  - Load Displacement – Company investment decisions
  - Emerging Technologies – Uncertainty re: product development, costs and adoption

Power Smart: A Long Term Strategy

Infancy
(Emerging Technologies)

Growth
(Commercialization)

Maturity
(Market Adoption)

Market Penetration

Time

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Power Smart: A Long Term Strategy

Infancy
(Emerging Technologies)

Market Penetration

- Research
- Demonstrations
- Policy levers
- New standards
- Capacity building
- Financing

Time

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Power Smart: A Long Term Strategy

Growth
(Commercialization)

Market Penetration

Time

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Power Smart: A Long Term Strategy

- Consumer awareness and education
- Incentives and/or financing to assist with first cost
- Channel relationship strategy

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Power Smart: A Long Term Strategy

Maturity
(Market Adoption)

Market Penetration

Time

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Power Smart: A Long Term Strategy

- Minimum Energy Performance Standards
- Provincial Regulations
- New Building Code
  - Energy efficiency as a code objective in 2011

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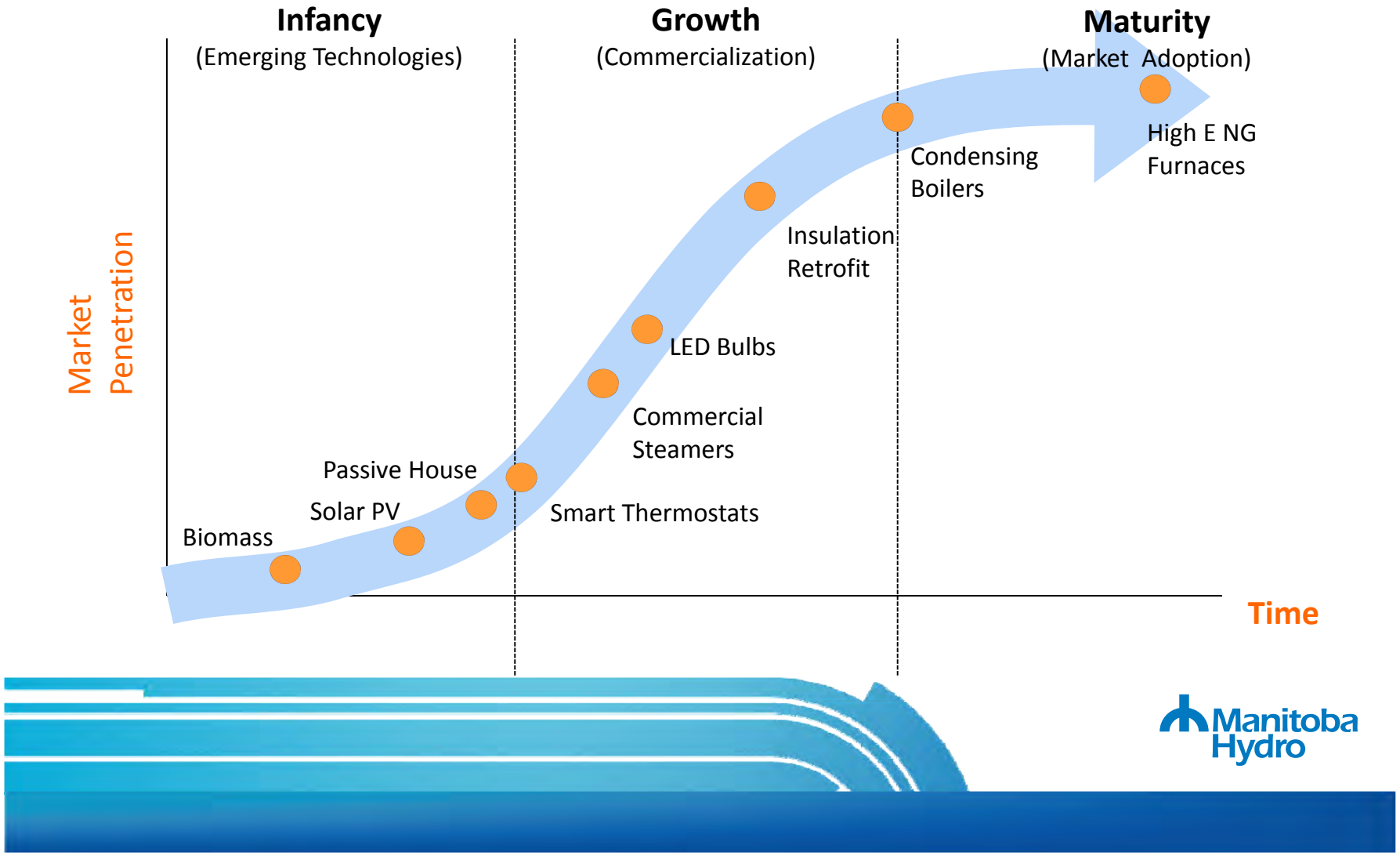
Power Smart: A long term strategy



Questions?

Emerging Energy Technologies

December 7, 2015

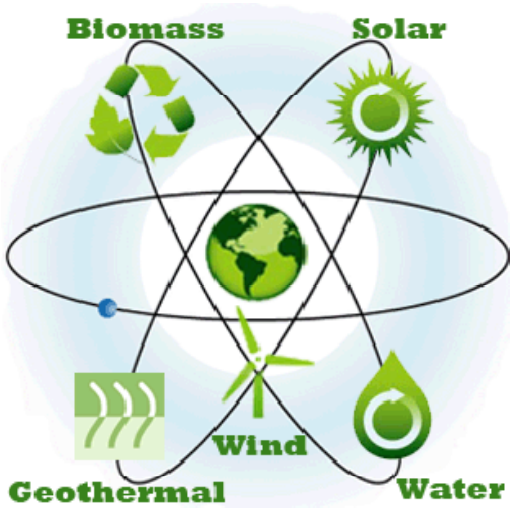
Manitoba Hydro Expertise

Understanding and Innovation

Customer Engineering Services
-Technical Experts

Marketing Programs
- Market Experts

Energy Service Representatives & Sales Staff
- Customer Focused (Energy Services, Power Quality, Energy Conservation, Fuel Optimization)
- Province Wide Coverage



Manitoba Hydro

Energy Consumption & Supply

Demand-Side Management Resource

Utility-Scale Generation Resource

Revenue Meter

Energy Use

Energy Production

Energy Utilization and Efficiency

- **Implementation of Mainstream Opportunities**
- **Evolution of Emerging End-Use Technologies**

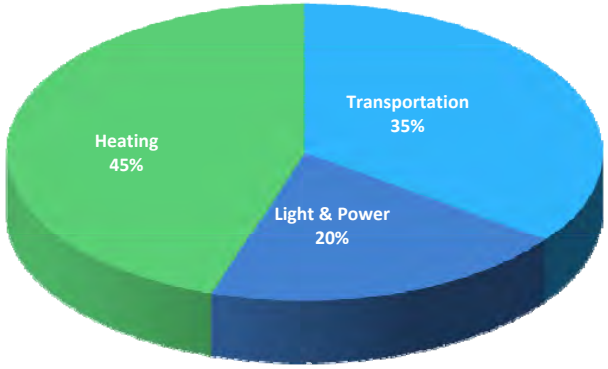
Distributed Generation

- **Customer-Sited Load Displacement**
  - Owned/Operated by Customers or Utilities
  - Interconnected to Grid
  - Incentives, Net Metering, Feed-In Tariffs
- **Emerging Distributed Technologies**
  - Solar Photovoltaic and Thermal
  - Biomass Thermal and Power
  - Small Wind and Small Hydro
  - Hybrid Battery Storage

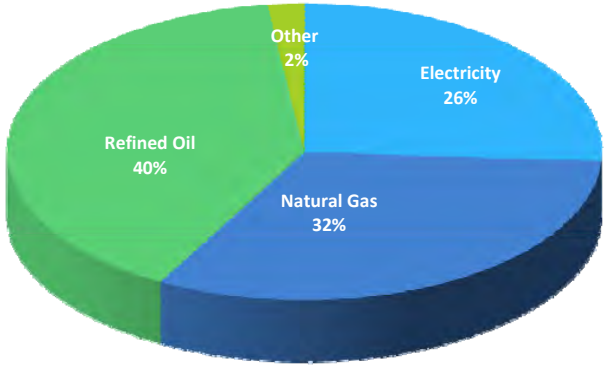
Manitoba Hydro

Energy Consumption in Manitoba

By Use



By Fuel



- 65% of Domestic Energy Consumption is Provided by Manitoba Hydro
- 72% of Energy Consumed in Manitoba is Imported and Non-Renewable
- Heating and Transportation - 80% of Energy Use
- Heating: 18% of Electric Use and 80% of Natural Gas Use

Defining Emerging Technologies

Primary Technologies
(Near Term Opportunity)

Commercially Available and Mature

Not widely adopted within mainstream markets

Secondary Technologies
(Longer Term Opportunity)

Commercially Unavailable or Immature

No widespread adoption globally, may or may not emerge within planning horizon

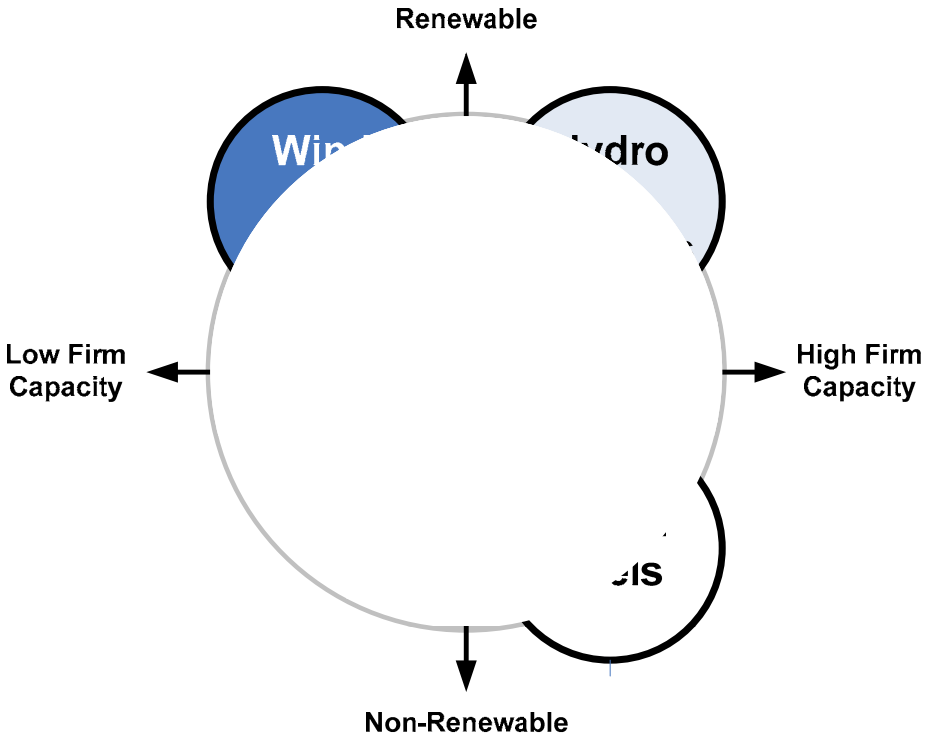
Manitoba Hydro

Alternate Renewable & Distributed Energy Resources

Biomass / Solar / Wind

Hybrid Energy Storage Systems

Renewable Emerging Technologies for Heating and Electricity Generation



Renewable Energy Resources

- Focus on Sustainability
- Emphasis on GHG Neutrality
- Combined Heat and Power
- Distributed Energy Technologies
- Impact on Manitoba Hydro System

Alternative Resource Options

- Biomass
- Geothermal
- Solar Photovoltaic
- Solar Thermal
- Small Wind & Hydro

Opportunity for Alternative Heating

- **Natural Gas Heating**
  - 1.6 - 1.7 Billion m^3 annually (Electric equivalent of 17,000 GWh)
  - Opportunity: Provincial Emission Reductions
  - Challenge: Low Cost Option

- **Electric Heating**
  - 4,000 – 4,500 GWh annually
  - Opportunity: Use of Alternatives (geothermal, biomass or solar heating)
  - Challenge: High Alternative Cost

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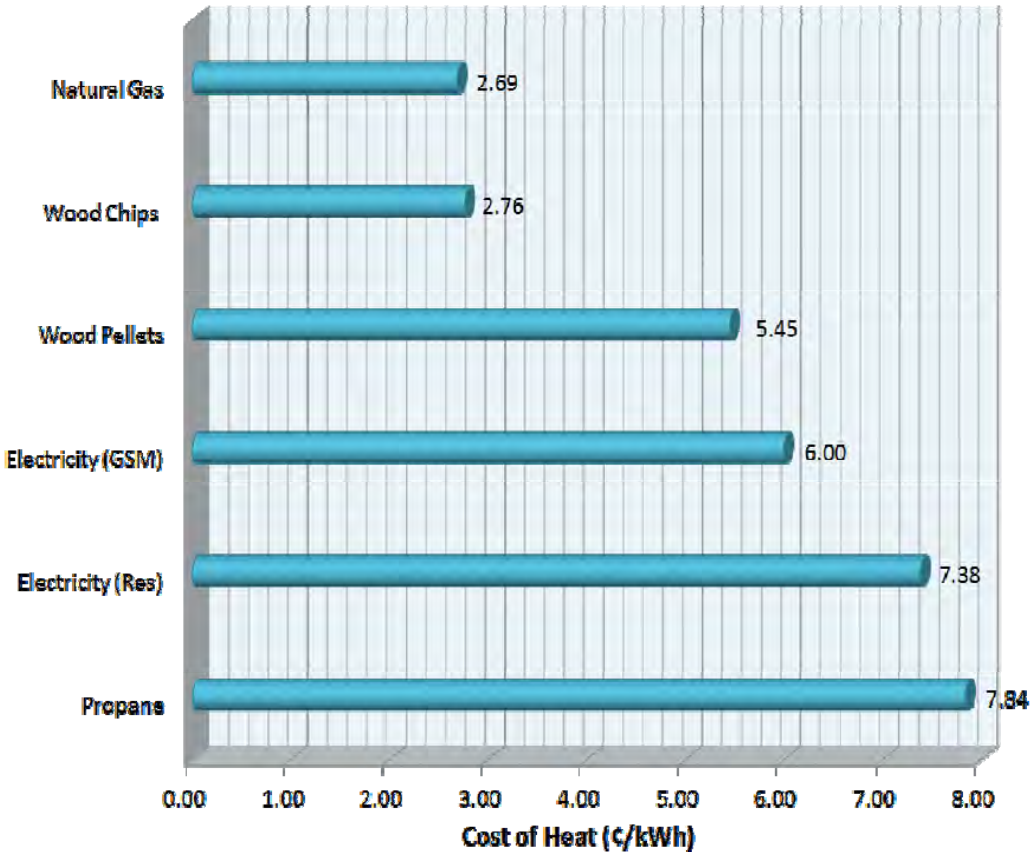
Heating Energy Alternatives



- **Biomass Opportunity**
  - Requires a consistent , high quality supply of chips/pellets
  - Industry Not Developed in Manitoba
- **Geothermal/Air Source**
  - High Initial Costs
  - Non Competitive Industry
- **Emerging Solar Alternative**
  - High Initial Costs
  - Storage required to maximize benefit of non-firm resource

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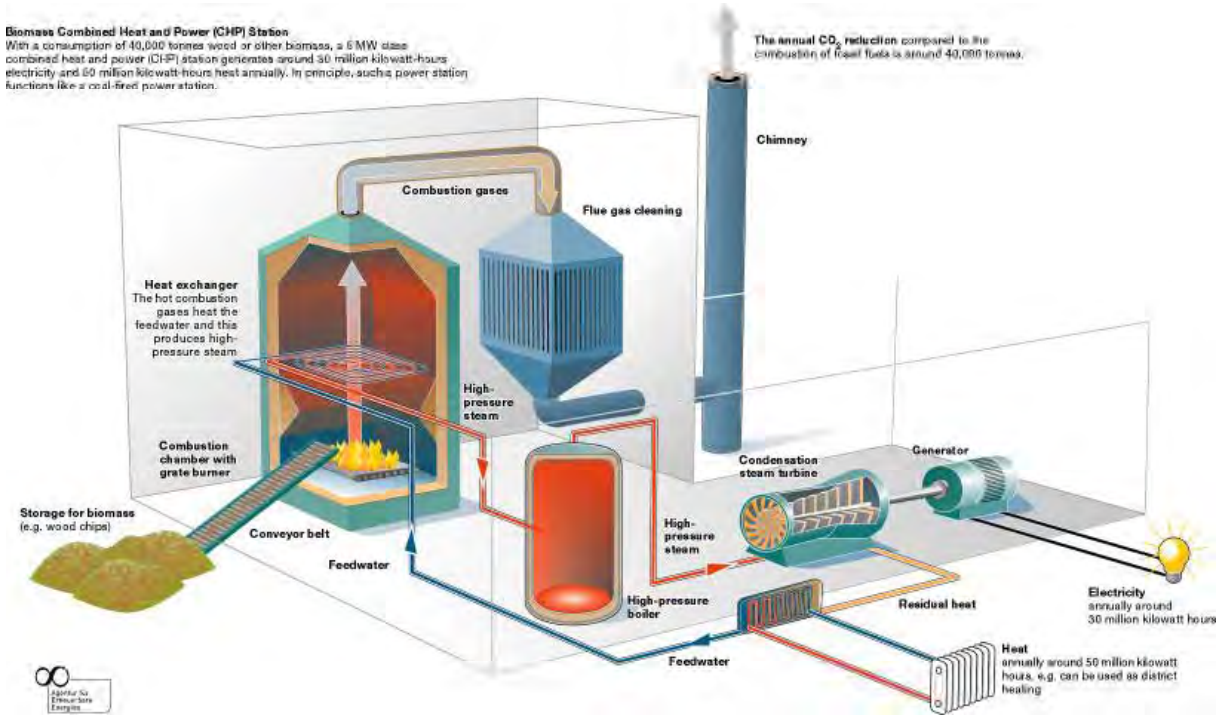
Biomass Future for Manitoba is Emerging Today

- **Provincial Legislation** banning the use of coal for space and hot water heating (2017)
- **Wood Chips and Pellets** produced from forestry waste and crop residue is a competitive heating fuel
- **30 plus Hutterite Colonies** are using or planning to use biomass boilers for district heating systems
- Typically **displace 1 to 2 MW** of electric or natural gas heating

Manitoba Hydro

Biomass Programming at MB Hydro

- **Load Displacement Program (590 GWh)**
  - Industrial and Municipal Waste and By-Product Streams
  - Combined Heat and Power for Largest Industrial Customers



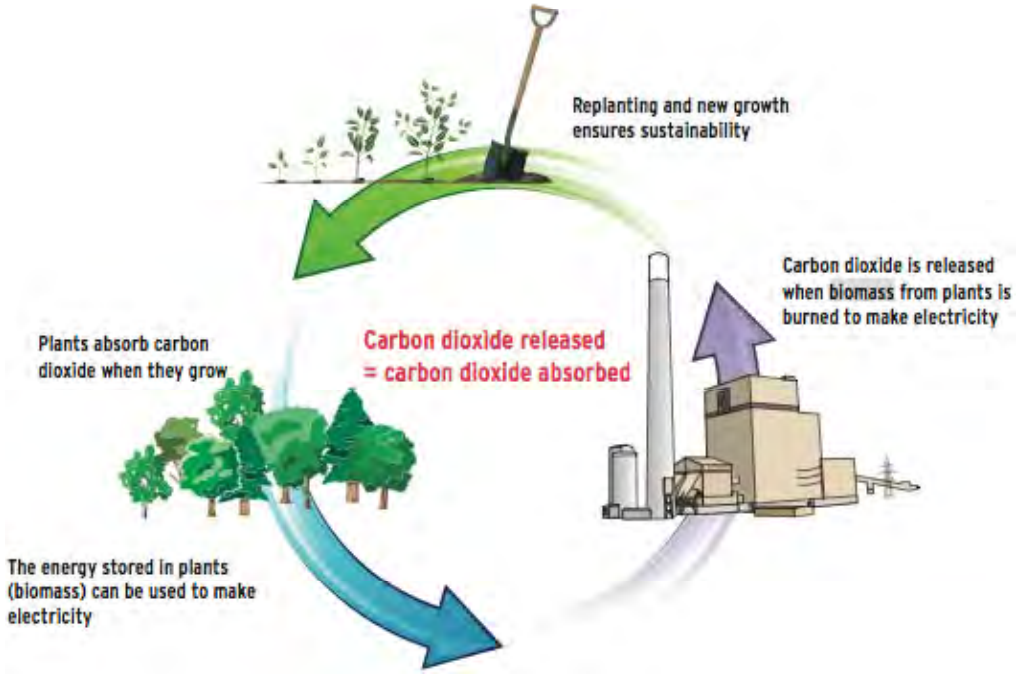
Biomass Programming at MB Hydro

- **Bio-Energy Optimization Program (130 GWh)**
  - Combined heat and power systems using biomass fuel
  - Smaller industrial and commercial operations
- **Opportunity for Electric Heat Displacement in 200 Schools**
  - Located in non-gas areas across rural Manitoba
  - High electric heating costs in excess of 8 to 9 cents / kWh
  - Approx 65 GWh of electric heating load
- **Manitoba Production of Biomass Fuel Pellets**
  - Discussions with la Coop Federee - $7.0 Billion Quebec company
  - Local availability and fuel quality, with potential export opportunity

Manitoba Hydro

Biomass Relevance to MB Hydro

- **Potential Benefits for Manitoba Hydro and Province**
  - Reduced electric load growth in rural areas
  - Lesser demand for new natural gas infrastructure in non-gas available areas
  - Supportive of Provincial Climate Change Strategy in long-term



Biomass Relevance to MB Hydro

- **Estimated Technical Potential in Manitoba**
  - 1.00% annual reduction in residential/commercial electric heating load
  - 640 GWh reduction in electric heating load
  - 0.25% annual reduction in commercial natural gas heating load
  - 25.0 million cubic metre reduction in natural gas heating load

- **Contribution to Local Economic Growth**
  - Annual biomass requirement of 500,000 tonnes
  - An estimated market value of $60 – $90 Million within 15 years
  - Creates Green Jobs

Manitoba Hydro

Distributed Solar PV Resources

- **Solar PV Technology – Mature and Improving**
  - 1,210 MW of installed capacity in Canada (CanSIA 2013)
  - Over 150 GW of installed PV capacity globally (IEA 2014)

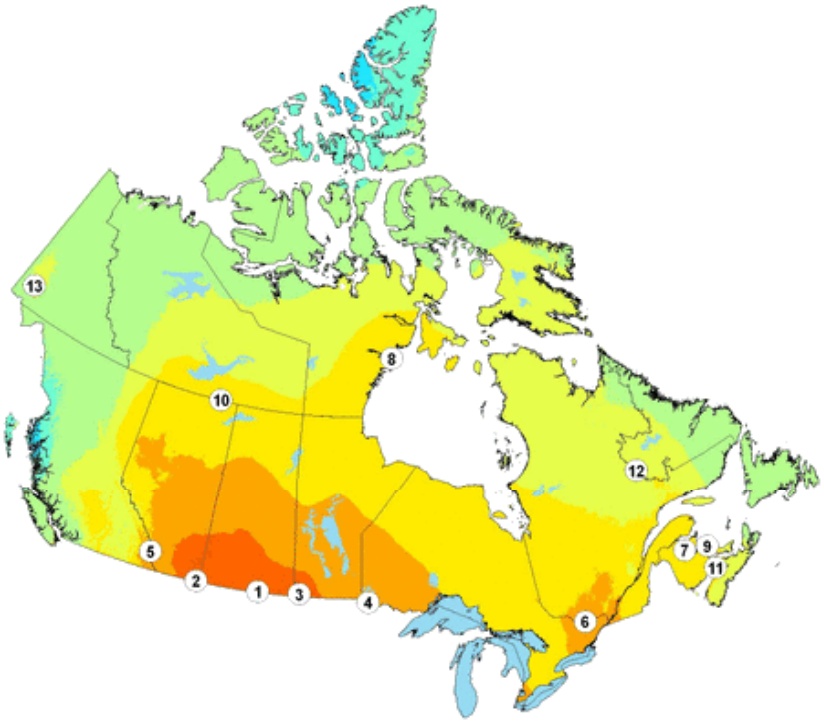
Distributed Solar PV Resources

- **Current Solar PV Costs in Manitoba**
  - **Residential: $4.00 - $5.00/$W_{DC}$** **Commercial: $3.25 – $4.00/$W_{DC}$**
  - **$0.25 per kWh (levelized)** **$0.20 per kWh (levelized)**

- **Future of Solar PV**
  - Anticipate a 40% to 45% price reduction
  - Government Policy, Customer Acceptance
  - Energy Tariffs, Exchange Rates
  - Feed-in-Tariffs, Net Metering, Time-of-Use
  - Declining Energy Output with Age
  - Utility Cost Recovery Models

Applicability to Manitoba

- **Manitoba's Solar Resource**
  - 1,317 kWh per kW in Winnipeg
    - 15% capacity factor
  - Los Angeles & Las Vegas
    - 19 % – 21% capacity factor
  - Higher than Toronto (14%)
- **Manitoba Impacts**
  - 4 kW equates to 5,000 kWh
    - 40% of electric use in residential natural gas heated homes
- **Manitoba Challenges**
  - Vendor network
  - Winter operation (snow & ice)
  - Lower solar angle implies greater shading and lower power density



Manitoba Hydro

Thermal Solar Heating Resource

- **Solar Thermal Heating Opportunities and Demonstrations**
  - Hot water heating, ventilation preheating, space and pool heating
  - Many potential Residential and Commercial applications
  - Both passive and active technologies are available
- **Solar Research – Red River College**

Thermal Solar Heating Resource

- **Pequis First Nation Solar Hot Water Pilot Program**
  - Targeting 20 First Nation Community Homes
  - Community-Based Initiative with Training/Local Jobs
- **Passive Solar System**
  - Space / Hot Water Heating
  - Hot Water Storage (extra tank)
  - Wall or Roof Mounting
- **Installation Costs/Savings**
  - $6,000 to $7,000
  - 1,840 kWh / Year
  - Performance Monitoring

Relevance to Manitoba Hydro

- **Significant Potential Opportunity**
  - **Distributed Solar Generation**
    - Residential installations: 2 to 10 kW
    - Commercial installations: 10 to 500 kW
  - **Estimated Technical Potential in Manitoba**
    - 190 to 570 MW Peak Capacity
    - 250 to 750 GWh Annual Energy (1% - 3% of current consumption)
    - Forecast Adoption: starting in early 2020's maturing in early 2030's
- **Grid Integration Challenges**
  - **Peak Output During Daylight Hours**
    - summer air conditioning peak
  - **Low Capacity Factor in Winter**
    - winter system peaks
  - **Recovery of Integration Costs**
    - Rate structure compatibility
    - Revised Cost-of-Service models

Distributed Small Wind

- **Five Small Wind Installations within Manitoba**
- **Technical Potential (3.7 kW Rural Farm Systems)**
  - 200 GWh annual energy (all rural installations)
  - Presently deemed to be uneconomical in Manitoba
- **Next Steps**
  - Future cost projections via consultant studies

Manitoba Hydro

Energy Storage Technologies

- **Energy Storage Does NOT Create New Energy**
  - Optimizes the usage and capability of variable renewable energy
  - Capitalize on time-of-use rate structures offered some utilities
  - Usefulness decreased by net metering programs
- **Energy Storage Can Take Many Forms**
  - Thermal Storage Systems
    - Thermal Walls, Hot Water and Ice Storage
    - Mature technologies with proven history
    - Poor market acceptance and understanding
  - Battery Systems (Tesla PowerWall)
    - Market hype is driving consumer interest
    - 8 – 10 cents per kWh above cost of stored energy
    - Not cost-effective with current battery technologies

Manitoba Hydro

Tesla POWERWALL

DENVER BUSINESS JOURNAL

TESLA'S POWERWALL: HOW IT WORKS

A home battery system that charges using electricity generated from solar panels, or when utility rates are low, and powers your home in the evening. It also can provide a backup electricity supply.

Residential sizes available:
10 or 7 kilowatt hours

Price: $3,500 (10 kw) and $3,000 (7 kw), not including installation or inverter.

SOLAR PANELS
Installed in an array on roof, convert sunlight into electricity.

HOME OUTLETS

DC

POWERWALL UNIT
Includes a rechargeable lithium-ion battery, a liquid thermal management system, a battery management system and a smart DC-DC converter for controlling power flow.

DC

AC

INVERTER
Converts direct current (DC) electricity from solar panels or a home battery into the alternating current (AC) used in a home's electrical system.

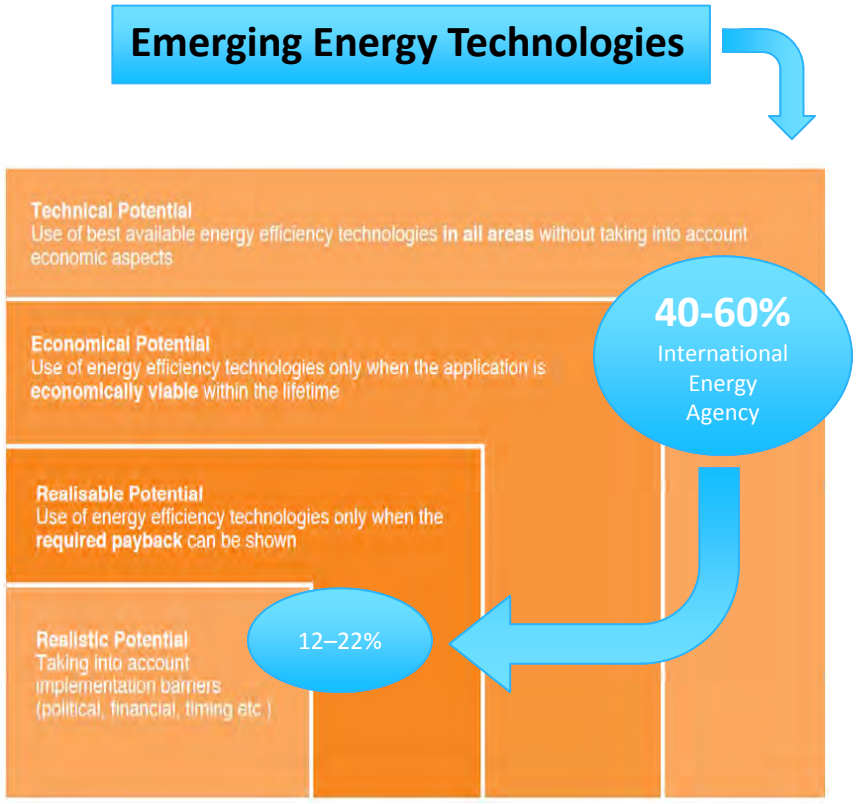
ELECTRICAL BOX

Source: Tesla Motors

Emerging Energy Efficiency and Energy Management Technologies

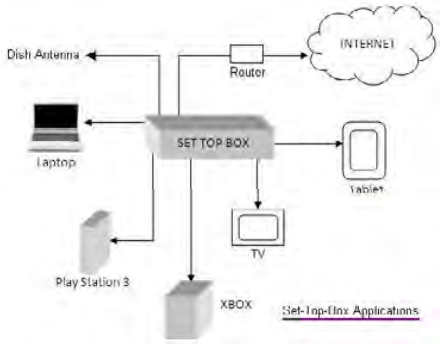
Intelligent Energy Management Extends Beyond Energy Efficiency

Energy Efficient Technologies



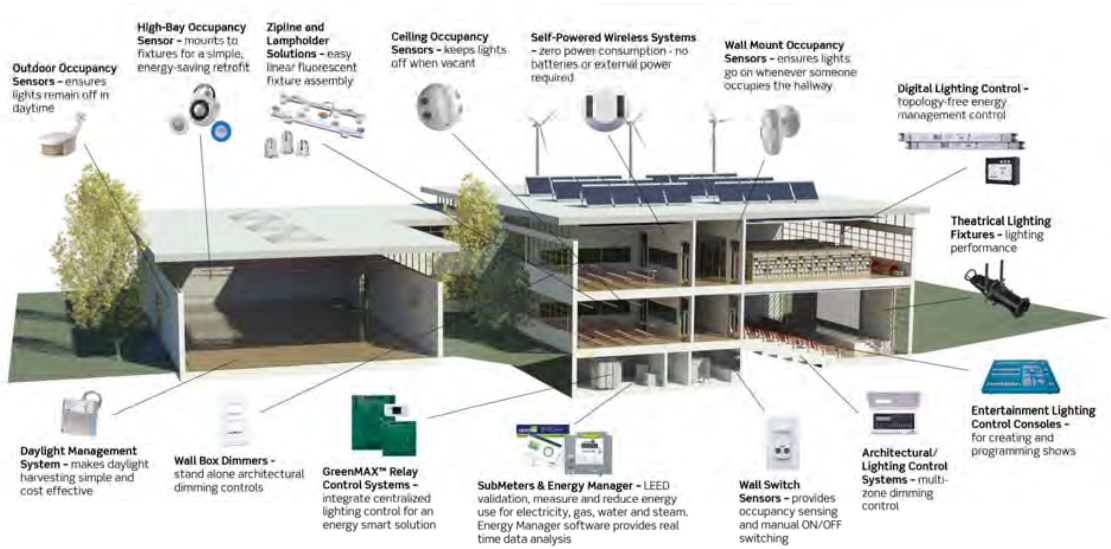
Energy Efficiency Enhancements

- **Energy Efficiency Performance Standards / Regulation**
  - Standards Development for Federal/Province Energy Efficiency Regulations
- **Advancements in Consumer Appliances**
  - Common household appliances with intelligence
  - Integrated wireless capabilities
  - Reduced standby energy losses
  - Energy management ready



Emerging Lighting Technologies

- **Future Development**
  - Lamp Efficiency
    - Materials, Construction, Output
  - Lighting Controls
    - Ambient Lighting
    - Adaptive Lighting Controls
    - Integrated Building Controls
  - Spectrum LED lamps
    - Horticultural, Specialty Purpose
- **Generational Steps**
  - Extremely fast cycles
  - 20% savings per step
  - 480 GWh annual savings
  - 2% to 3% of total load
  - Interactive heating effects



Sustainable Behavioral Change

- **Behavioral Change**
  - Savings potential of 5% to 10%
  - Not sustainable with current technology
- **Adaptive Learning Devices**
  - Adapt to Human Behavior
  - Data Analytics/Augmented Reality
  - Optimize Building Operation
- **Internet of Things (M2M)**
  - Wireless and Wearable Sensors
  - Device Interconnectivity
  - Intelligent Energy Management

NEST Thermostat
Programmable, Self-Learning, Sensor-Driven WiFi Enabled Device

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Energy Efficiency in Manitoba

Manitoba Hydro

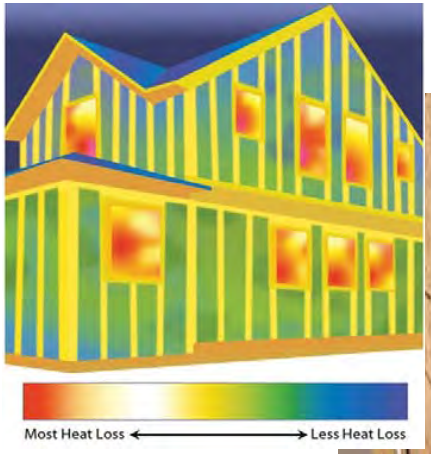
Heating/Cooling Technologies

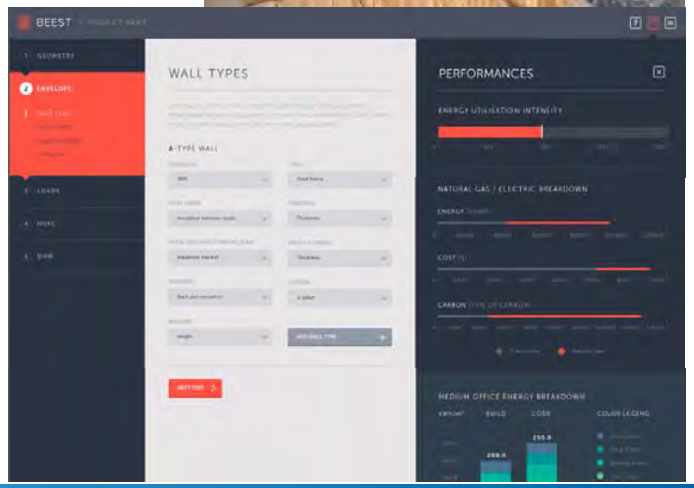
- **Efficiencies of Heating/Cooling Sources are Quite High**
  - Natural Gas Furnaces – 92% to 95%
  - Electric Heat Furnaces – 100%
  - Geothermal - SCOP of 2.0 to 2.5 (electric input 50% - 60%)
  - Air Source - SCOP of 1.5 (electrical input 30% - 35%)
  - Air Conditioning – SEER 15 and higher
- **Thermal Heating/Cooling Requirements are Related to;**
  - Building Type and Use, Envelope Construction, Air Tightness, Outside Temperatures and Conditions, Internal Heat Gains, Solar Heat Gain
  - Building Design, Materials, Construction, Commissioning/Operating Practices
  - Enhancements to the Federal/Provincial Energy Codes for Building

Manitoba Hydro

Enhanced Building Technologies

- **Thermal Bridging**
  - Standard construction practices encourage thermal bridging
  - Energy efficient wall assemblies eliminate bridging
  - 25% reduction in heating requirement
- **Energy Modeling**
  - Web-based modeling for home and commercial builders
  - Current CSA project to support future energy code enhancements
  - Energy efficiency improvements integrated at the design stage





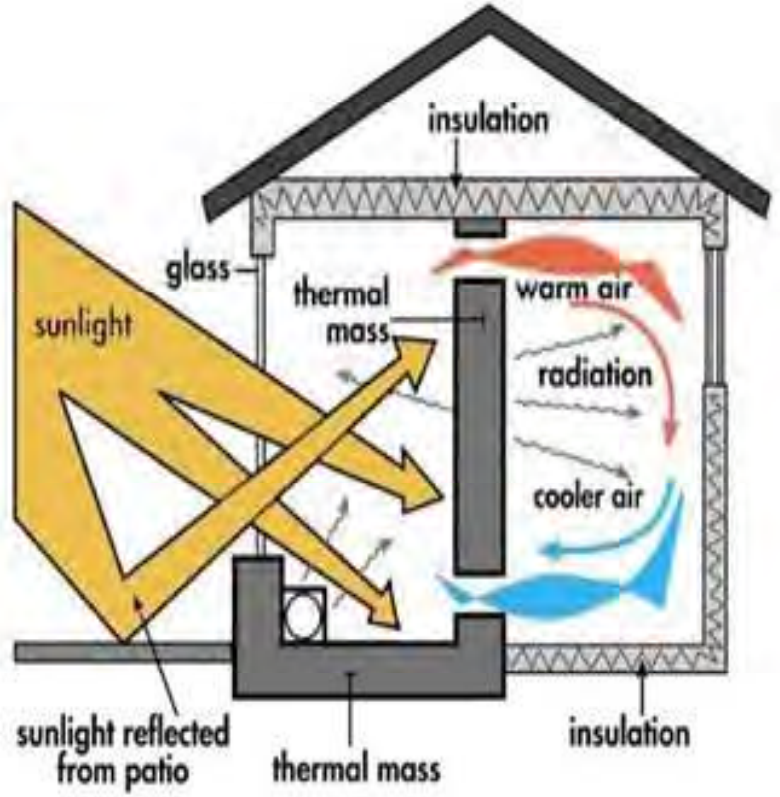
Passive Solar Homes

Passive Building Designs

- Orientation – Maximize Radiance
- Insulation – Reduce Losses/Gains
- Thermal Storage – Load Shaping
- Air Movement – Uniform Temp
- Curtain Walls – Thermal Mgmt

Passive Solar Concept

- Reduce utility bills for heating and cooling by 30% - 50%
- Electric Heat – 3,500 to 6,000 kWh
  - 3% – 5% of MB consumption
- Gas Heat – 700 to 1,150 m^3
  - 10 – 15% of MB consumption



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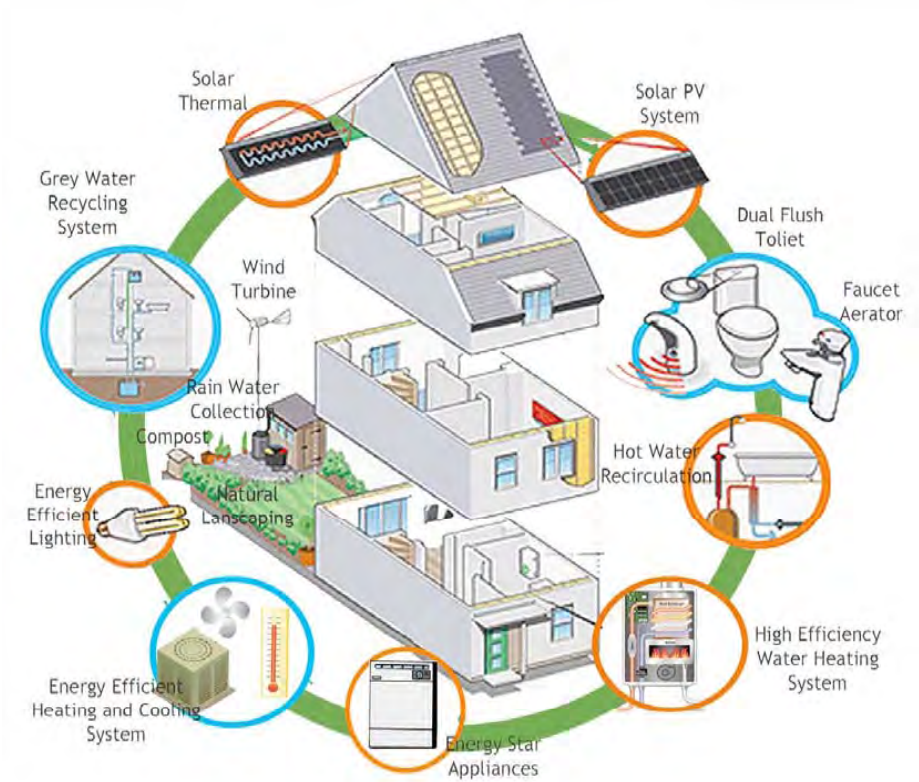
Net Zero Homes

Technology Integration

- Energy Efficiency
- Heat Recovery
- Distributed Generation
- Water Conservation

Net Zero and the Utility

- Co-Dependent Tie Between Utility Grid and Customer
- Net Metering Addresses Energy Flow with Utility
- Regulation for Utility Cost Recovery Still Undecided

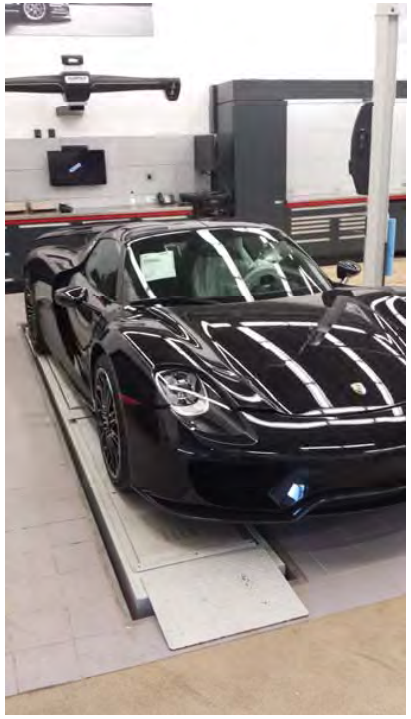


Sustainable Communities

- **Role of the Utility**
  - Distributed Generation
  - District Heating
  - Micro-Grids
  - Transportation
- **Cost Recovery Models**
  - Non-Traditional Relationship
  - Utility Regulation Models
  - Revised Rate Structures

Manitoba Hydro

Electric Transportation



4 x More Efficient than
Diesel-Power Transit Buses

Manitoba Hydro

DSM Meeting

April 20, 2016

Manitoba Hydro

DSM Meetings

- Manitoba Hydro expectations
- Participant expectations

DSM Status Update

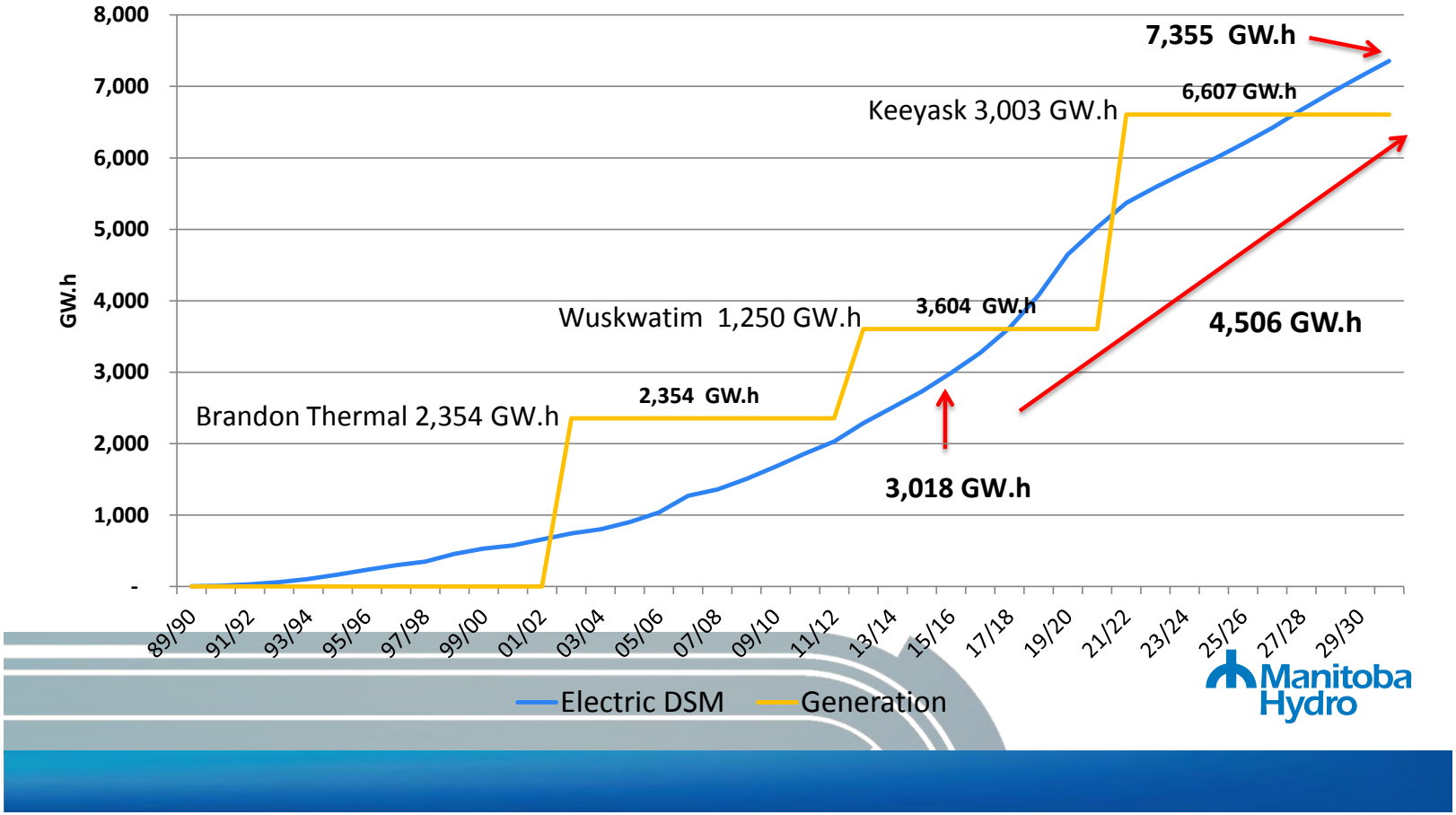
Dunsky Energy Consulting

- Engaged Dunsky for 2-year period
- Assist in optimizing Power Smart offering
- Currently undertaking a jurisdictional scan of DSM plans

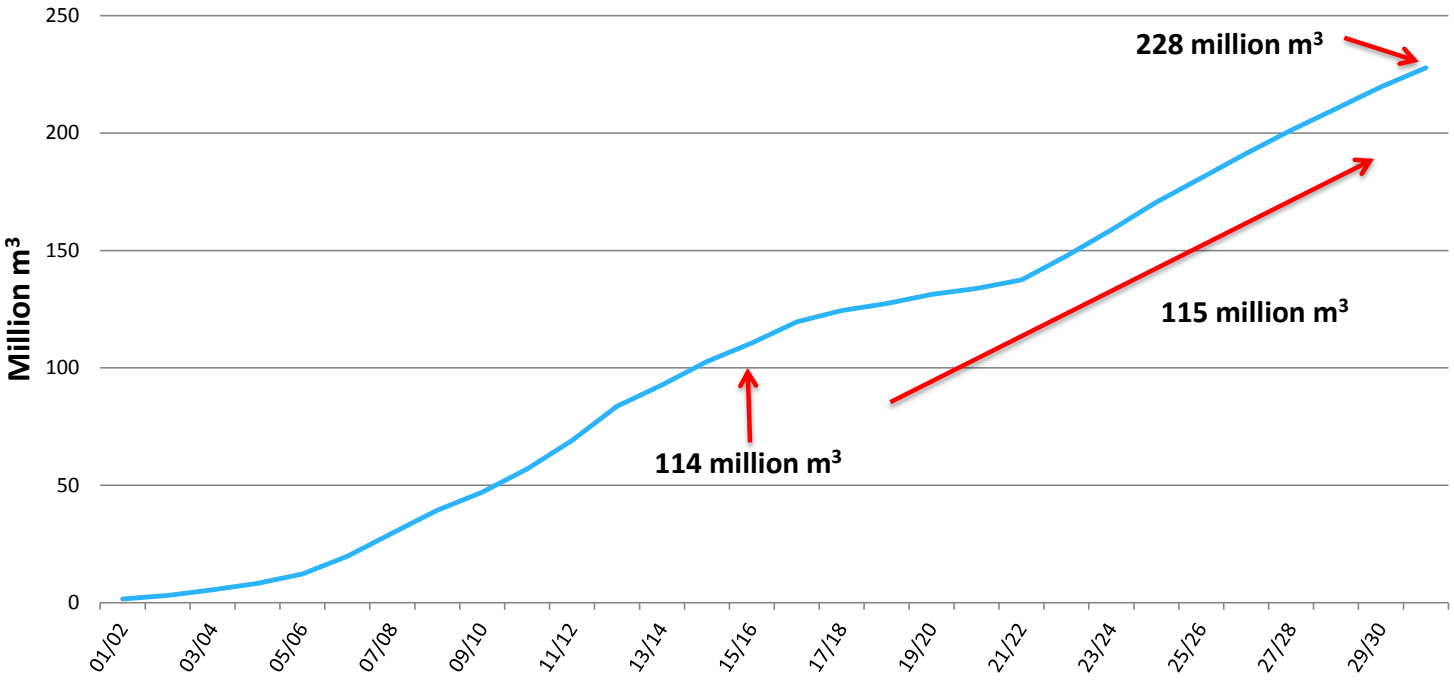
2016 Power Smart Plan

- Created 1 year plan and provided to Province in March
- Created draft 15 year plan

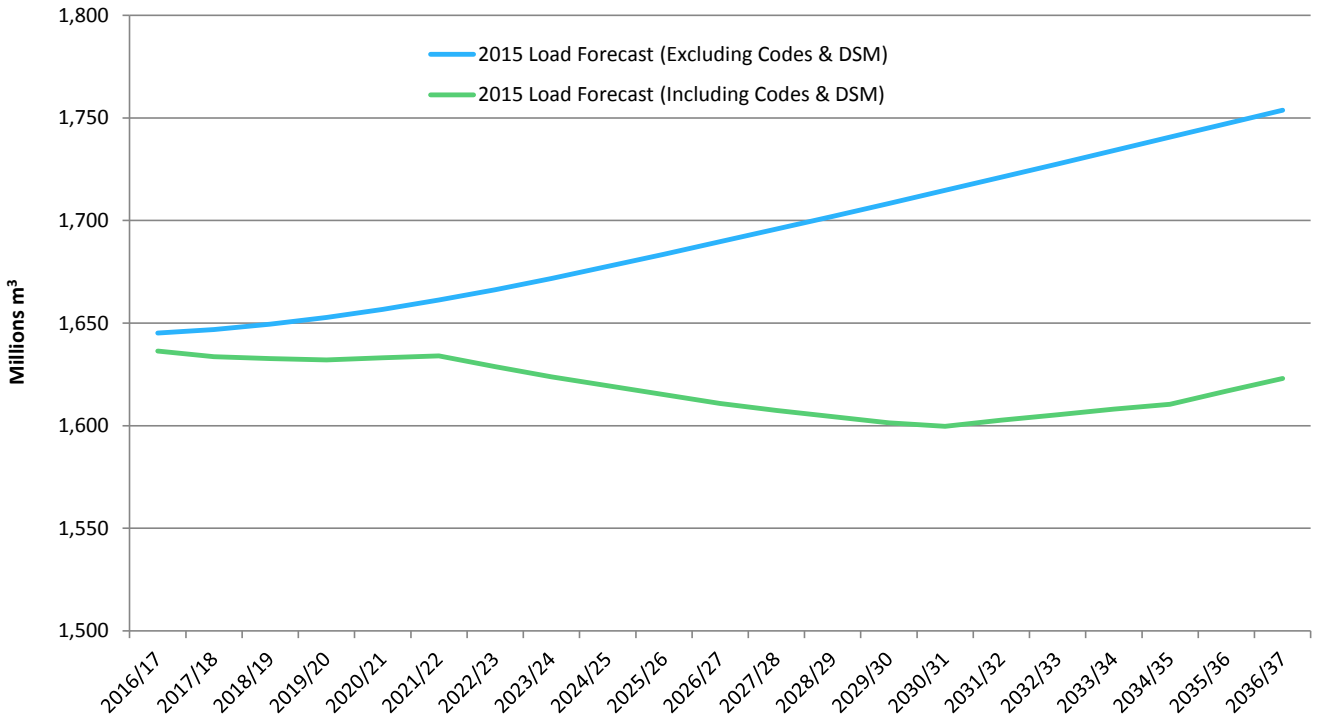
Electric DSM - Long Term Strategy



Natural Gas DSM



Natural Gas Volume



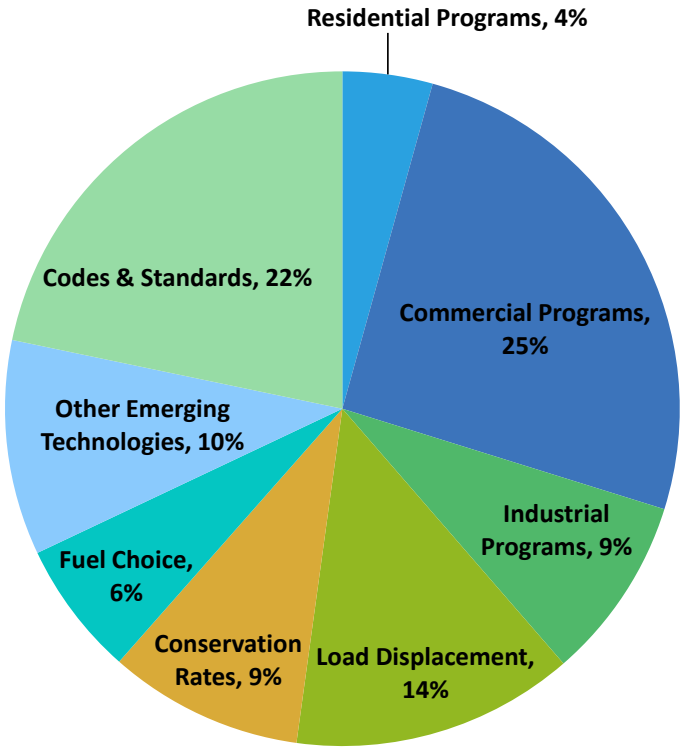
Manitoba Hydro

2016 Power Smart Plan

	2016 – 2031 PS Plan (15 years)
MW	1,232
GW.h	4,506
Million m^3	115
Utility Cost (nominal)	
Electric	$1.2B
Natural Gas	$0.2 B
TOTAL UTILITY COST	$1.4 B
TOTAL DSM COST	$2.6 B

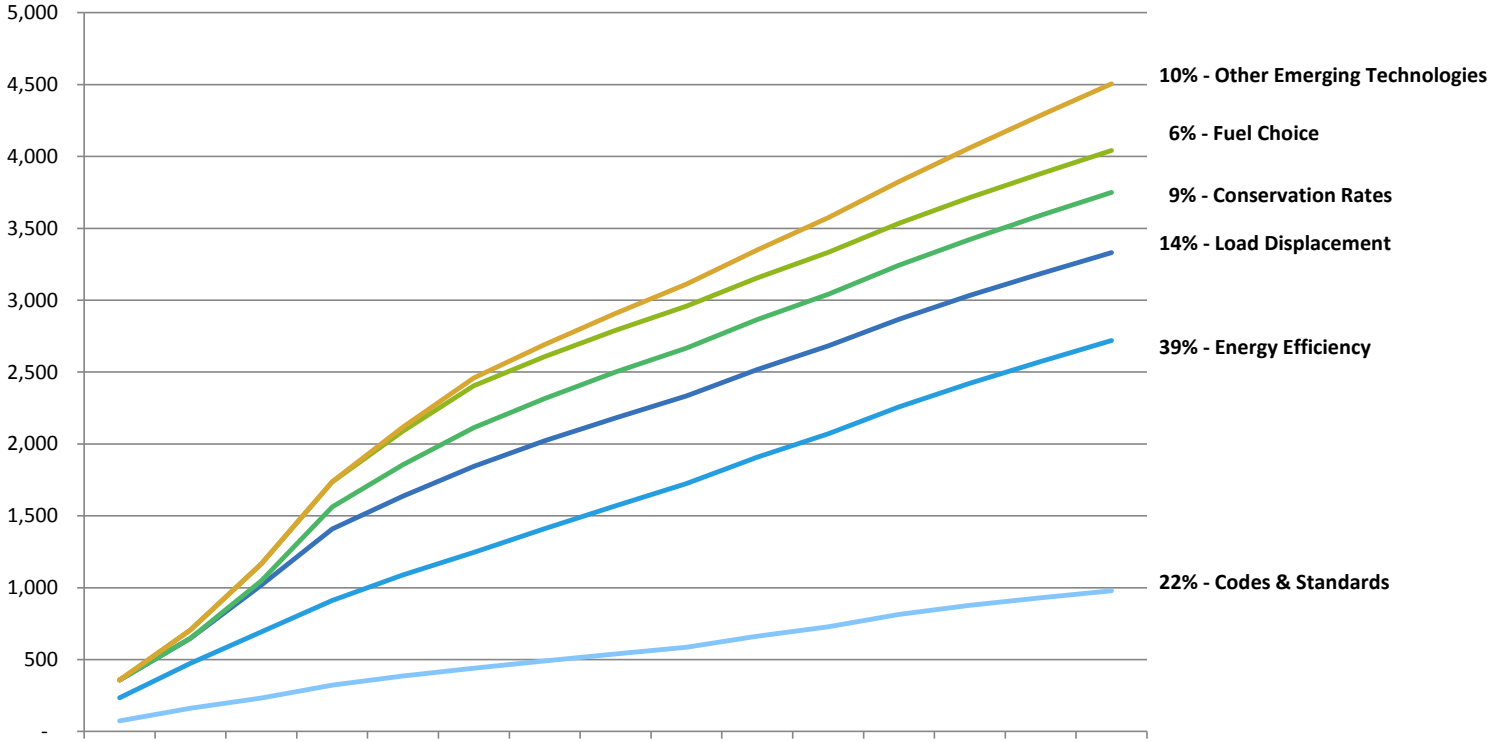
Manitoba Hydro

Electric Energy Savings Breakdown



Manitoba Hydro

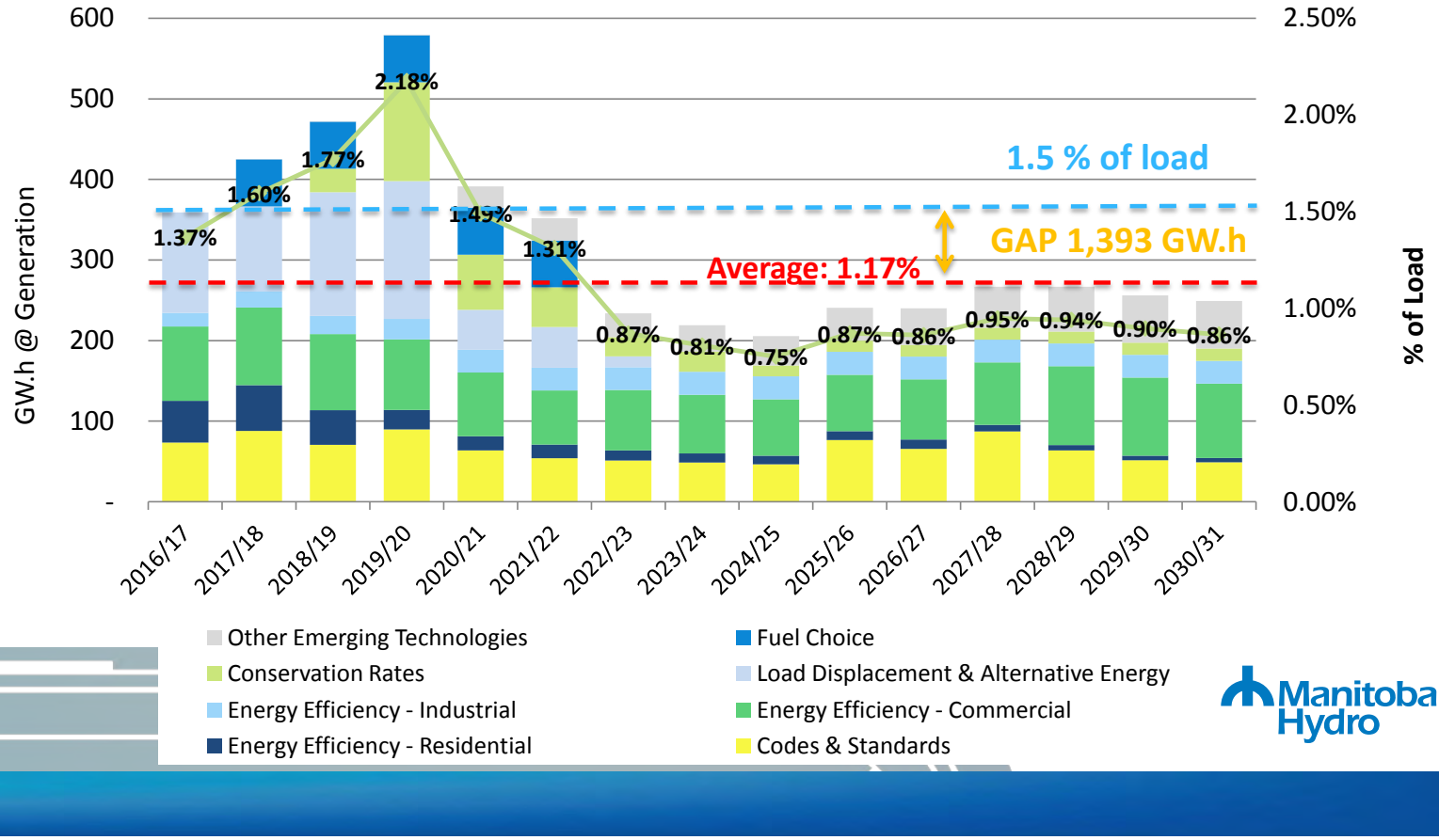
Electric Energy Savings Breakdown



Manitoba Hydro

Annual Electric Savings

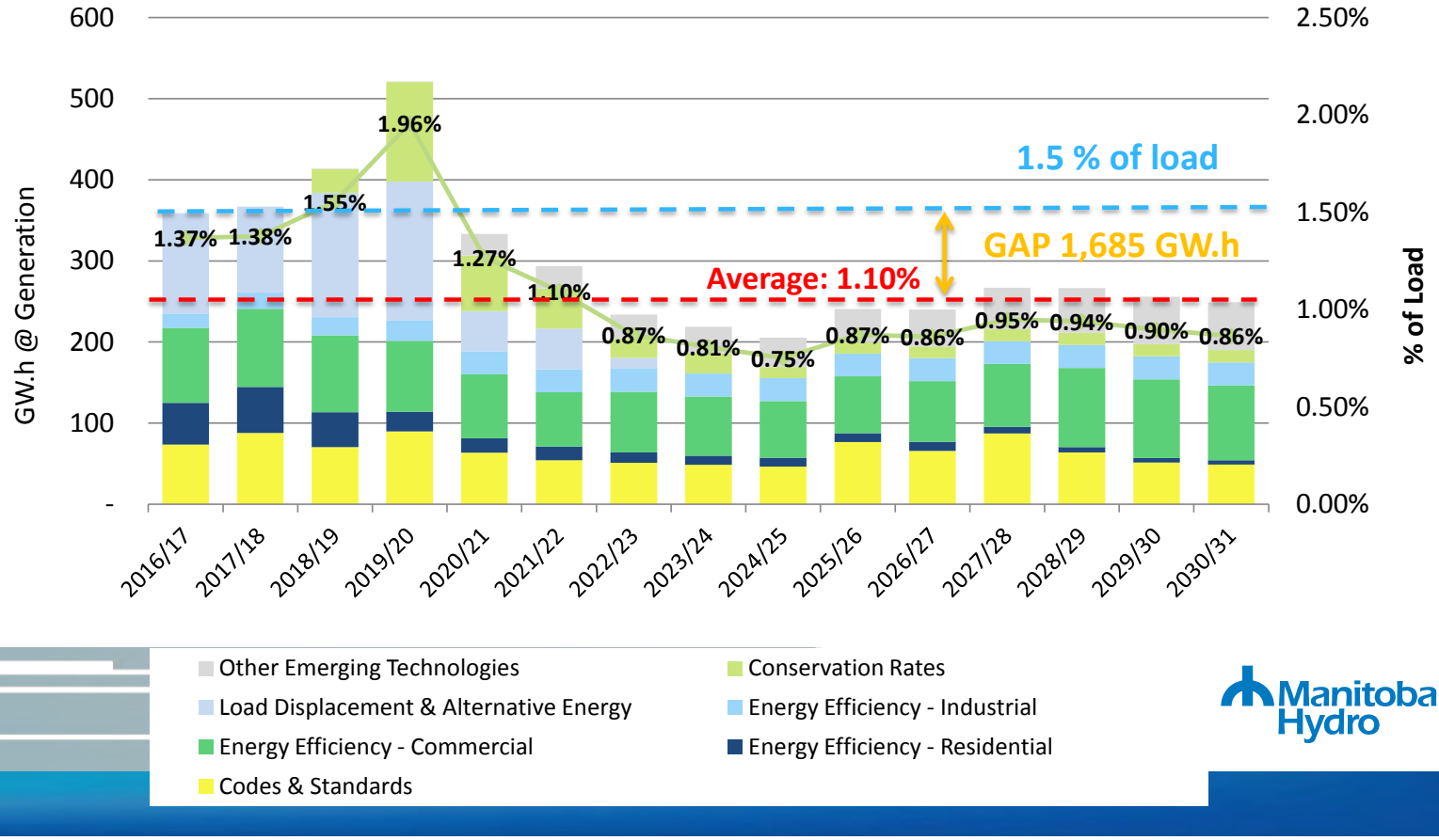
Percent of Annual Load



Annual Electric Savings

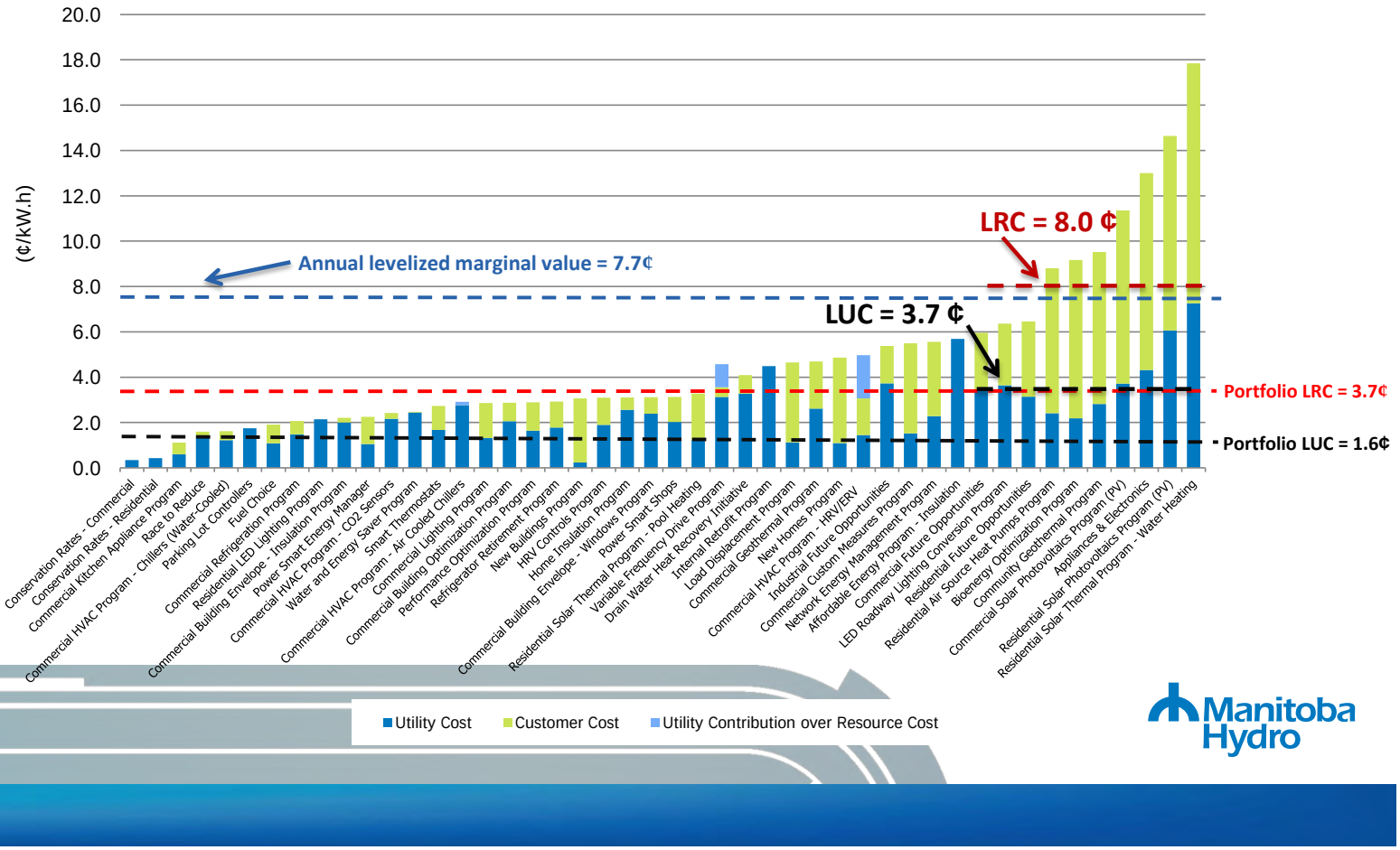
Percent of Annual Load

(Excluding Fuel Choice)



2016 Power Smart Plan

Electric Levelized Cost

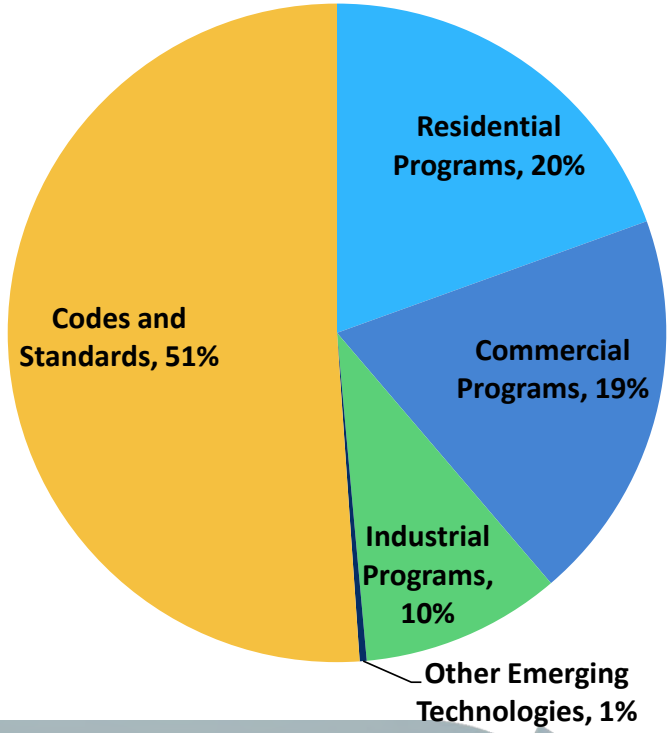


Manitoba Hydro

2016 Power Smart Plan

Electric Metrics	
Levelized Resource Cost	3.7 ¢/kW.h
Levelized Utility Cost	1.6 ¢/kW.h
TRC Benefit/Cost Ratio	2.5
RIM Benefit/Cost Ratio	1.1
% of Load Growth	60%

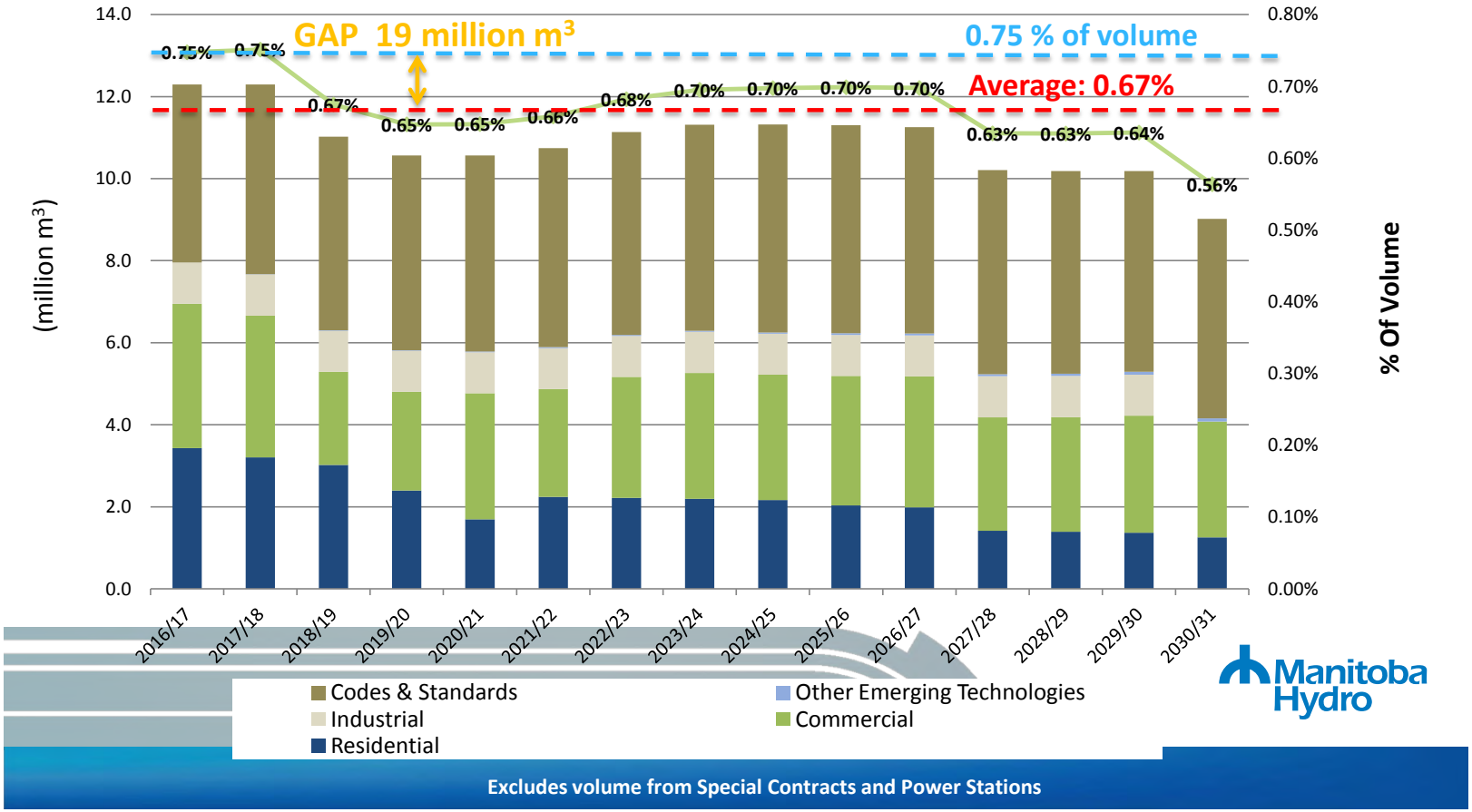
Natural Gas Savings Breakdown



Annual Natural Gas Savings

Percent of Annual Volume

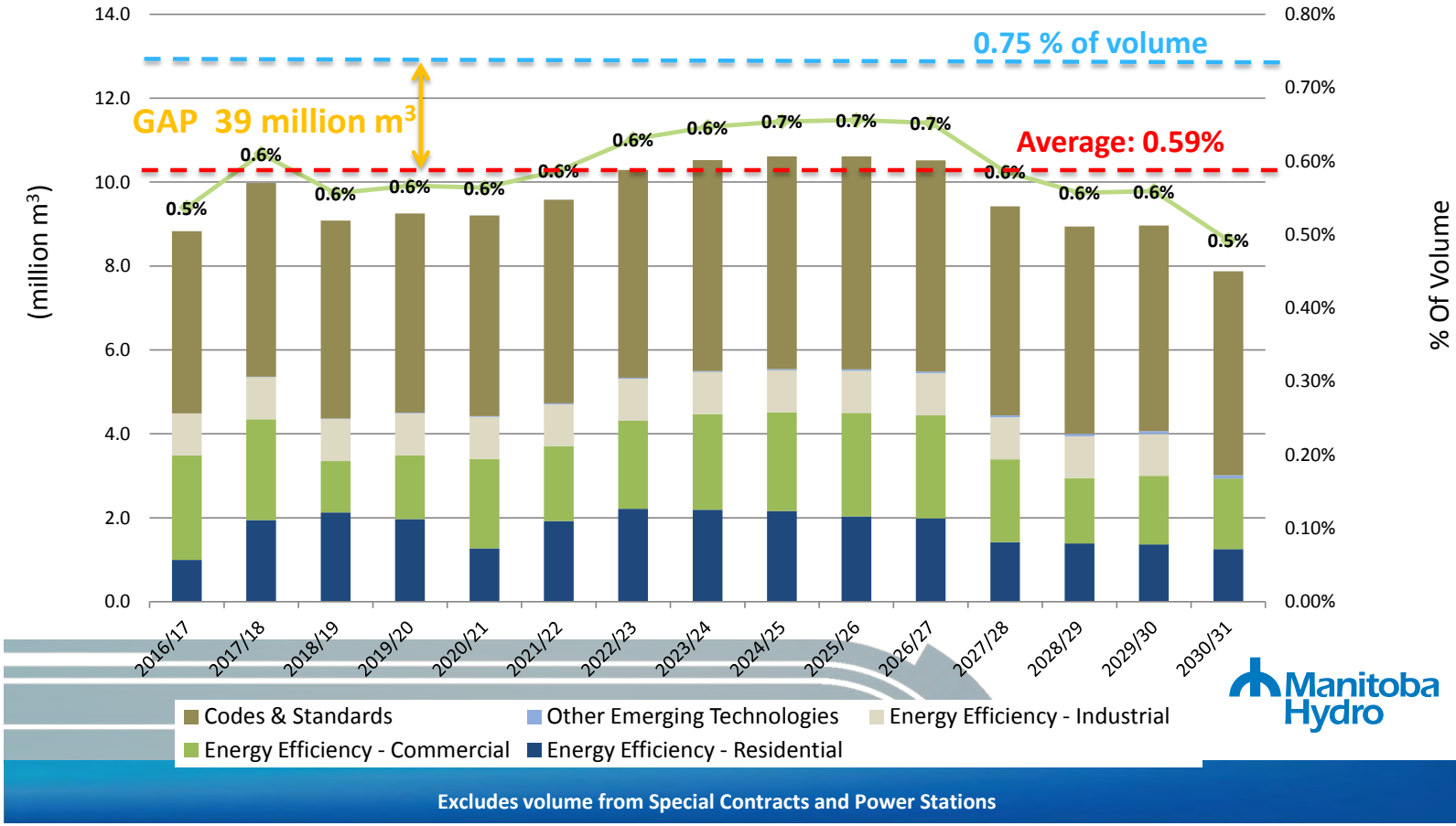
(excluding impacts from Fuel Choice and Interactive Effects)



Annual Natural Gas Savings

Percent of Annual Volume

(excluding impacts from Fuel Choice, including Interactive Effects)

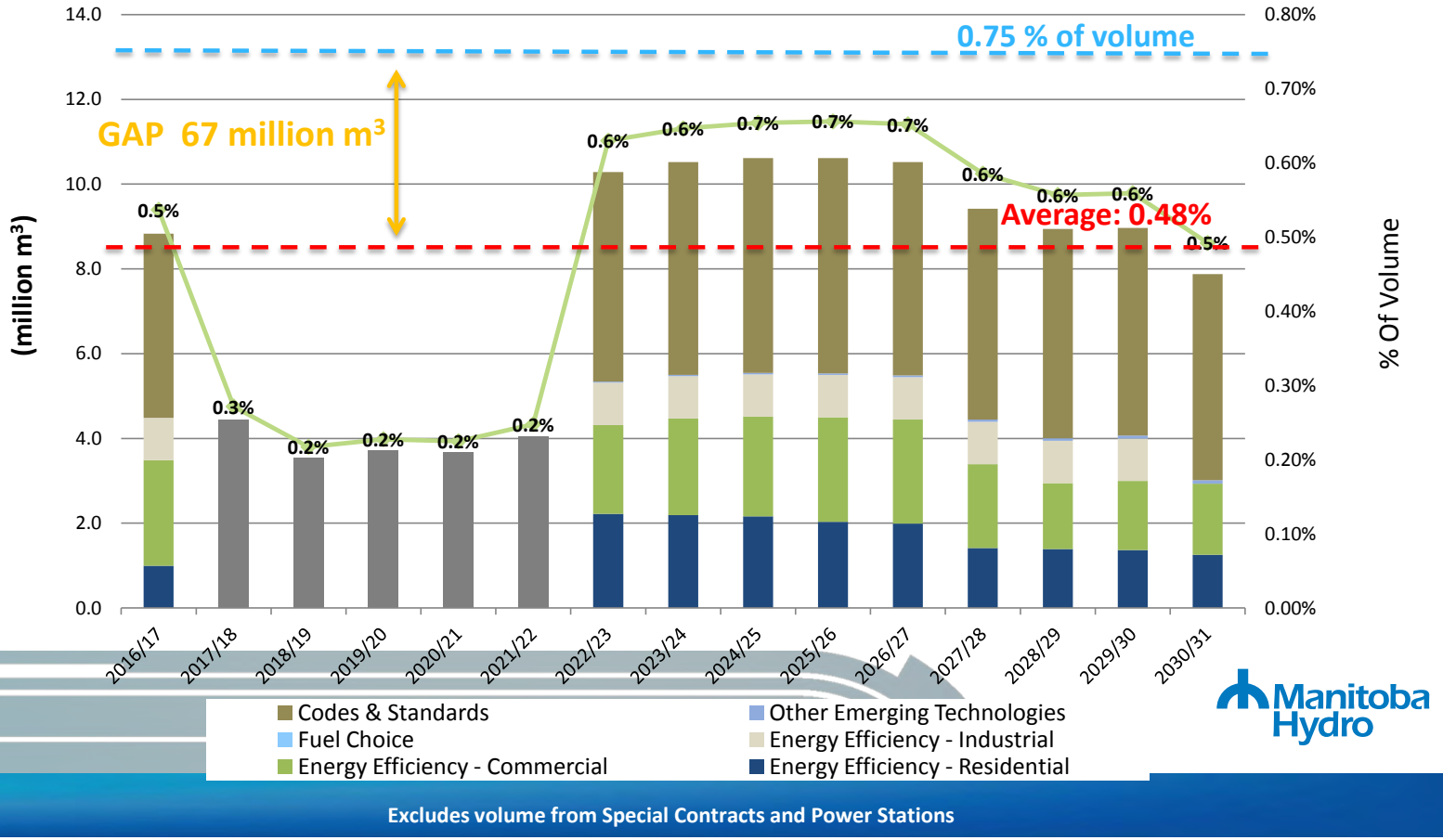


Excludes volume from Special Contracts and Power Stations

Annual Natural Gas Savings

Percent of Annual Volume

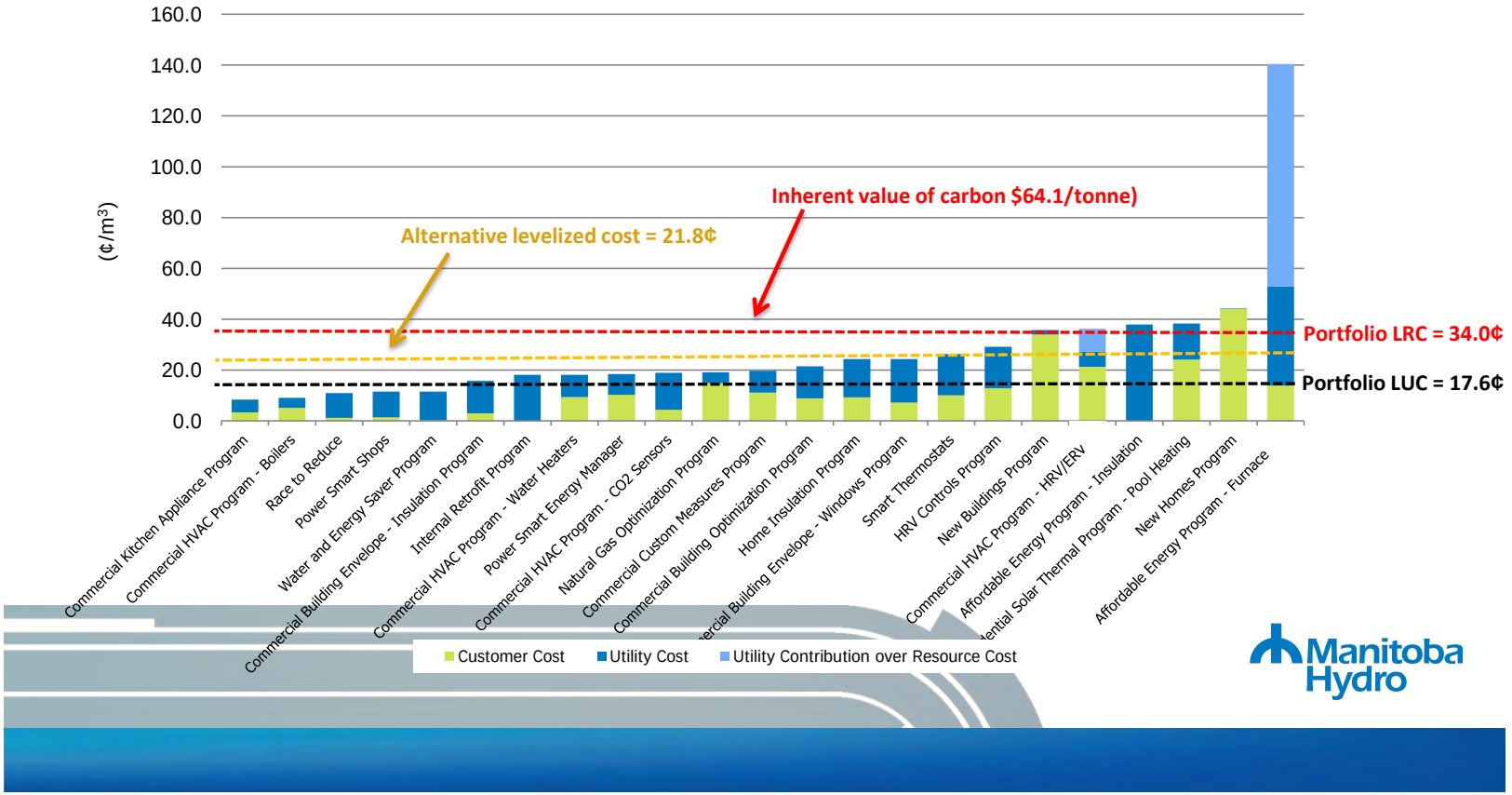
(Including impacts from Fuel Choice and Interactive Effects)



Excludes volume from Special Contracts and Power Stations

2016 Power Smart Plan – 15 Year

Natural Gas Levelized Costs



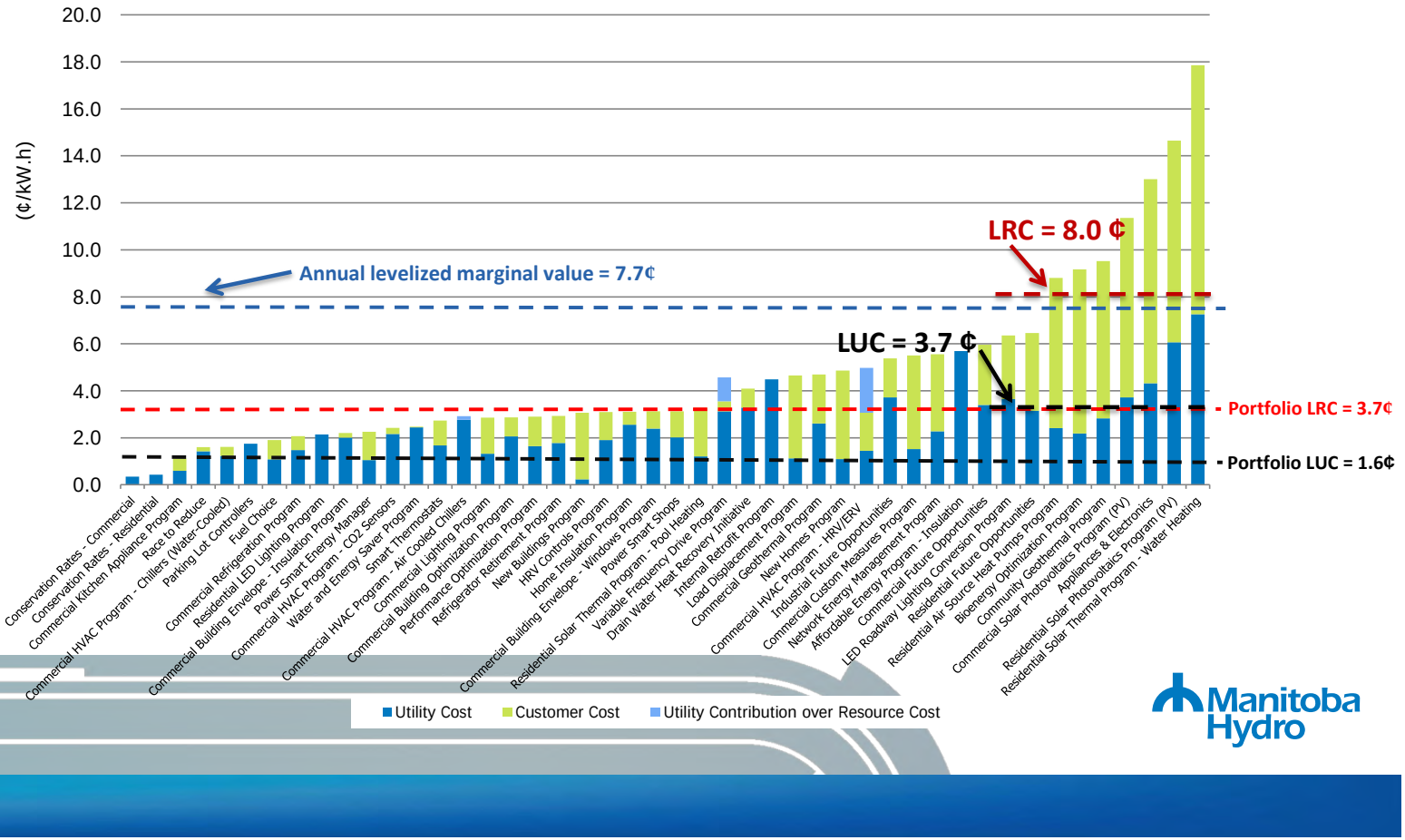
Manitoba Hydro

2016 Power Smart Plan – 15 Year

Natural Gas Metrics	
Levelized Resource Cost	34.0 ¢/m^3
Levelized Utility Cost	17.6 ¢/m^3
TRC Benefit/Cost Ratio	0.8
RIM Benefit/Cost Ratio	0.5
% of Volume	7.2%

2016 Power Smart Plan

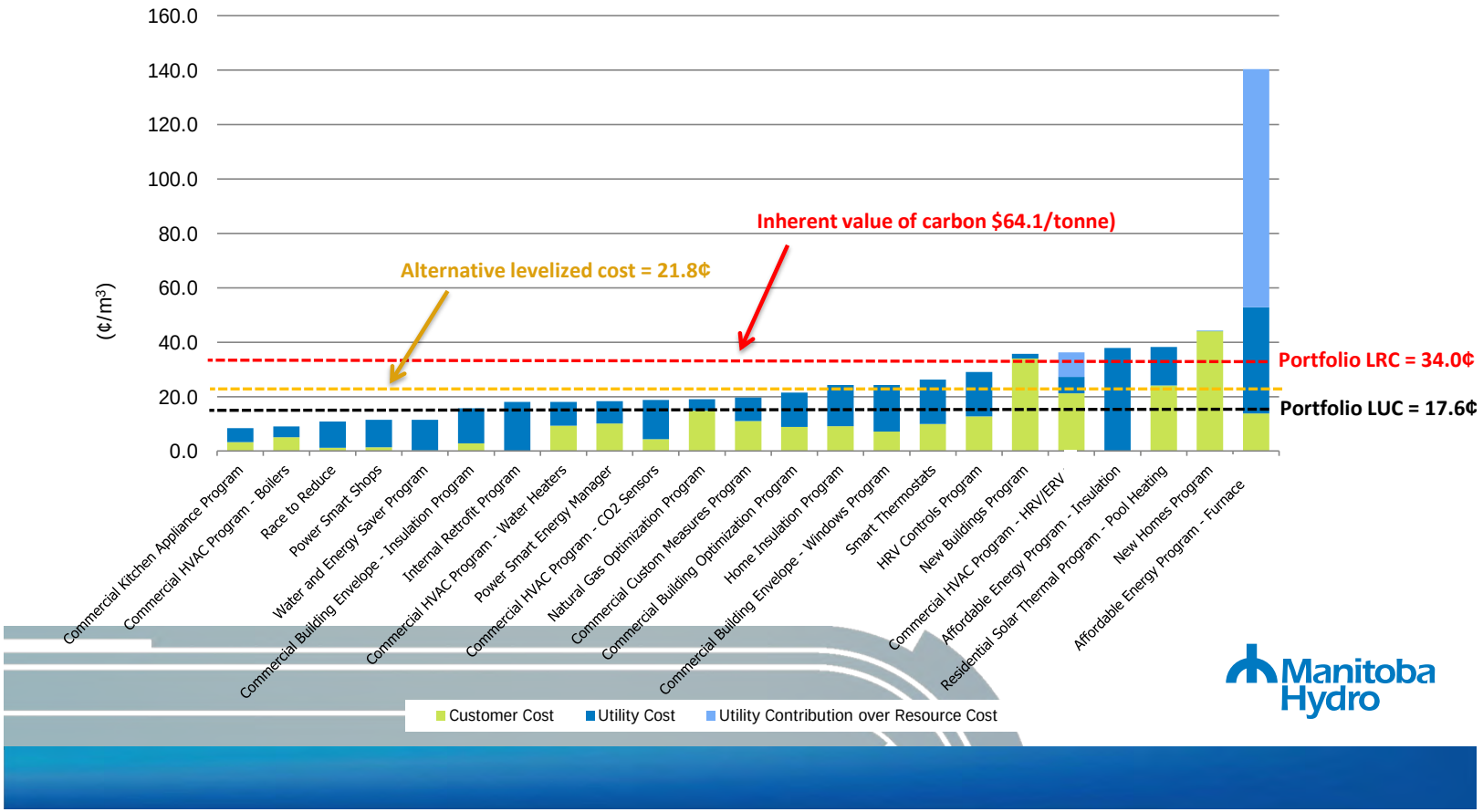
Electric Levelized Cost



Manitoba Hydro

2016 Power Smart Plan – 15 Year

Natural Gas Levelized Costs

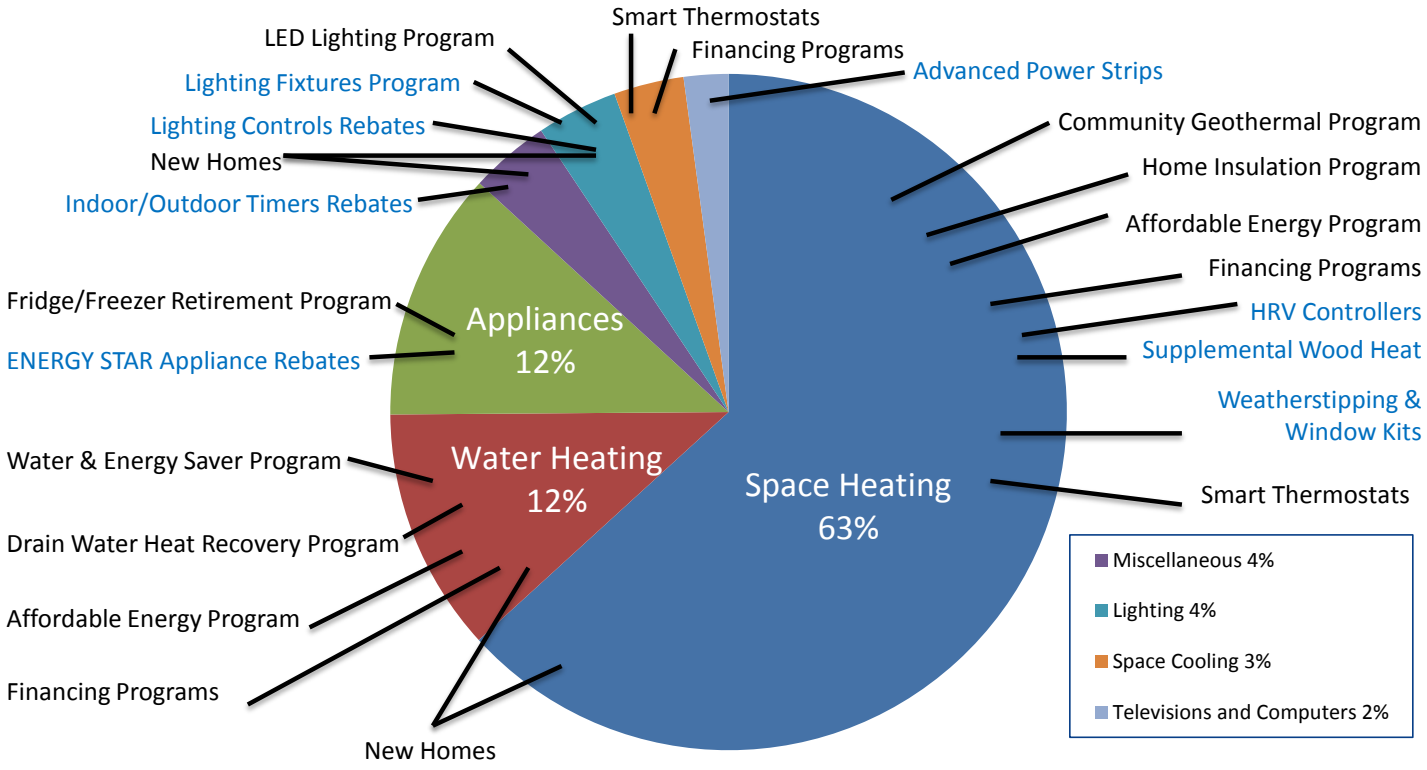


Residential Programs

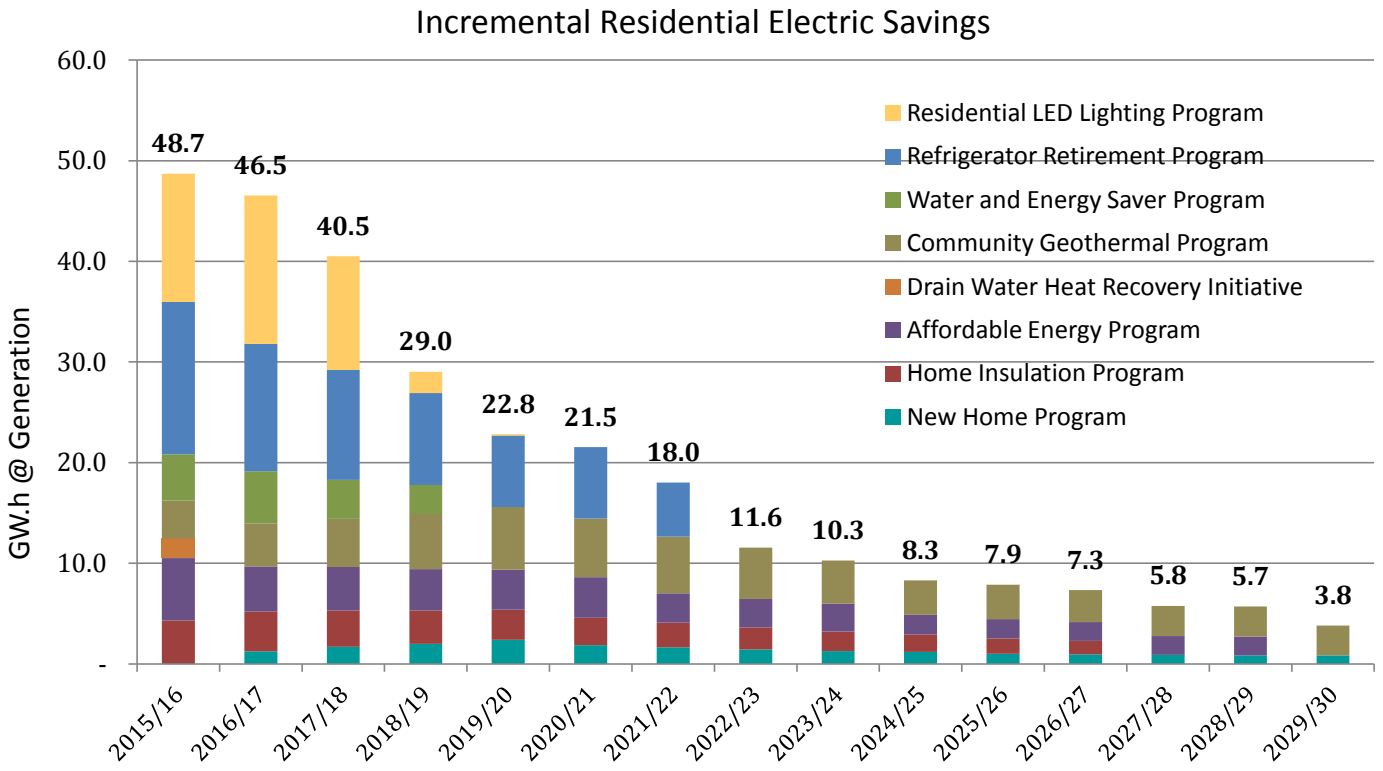
Tracy Sterdan

Residential Programs Supervisor

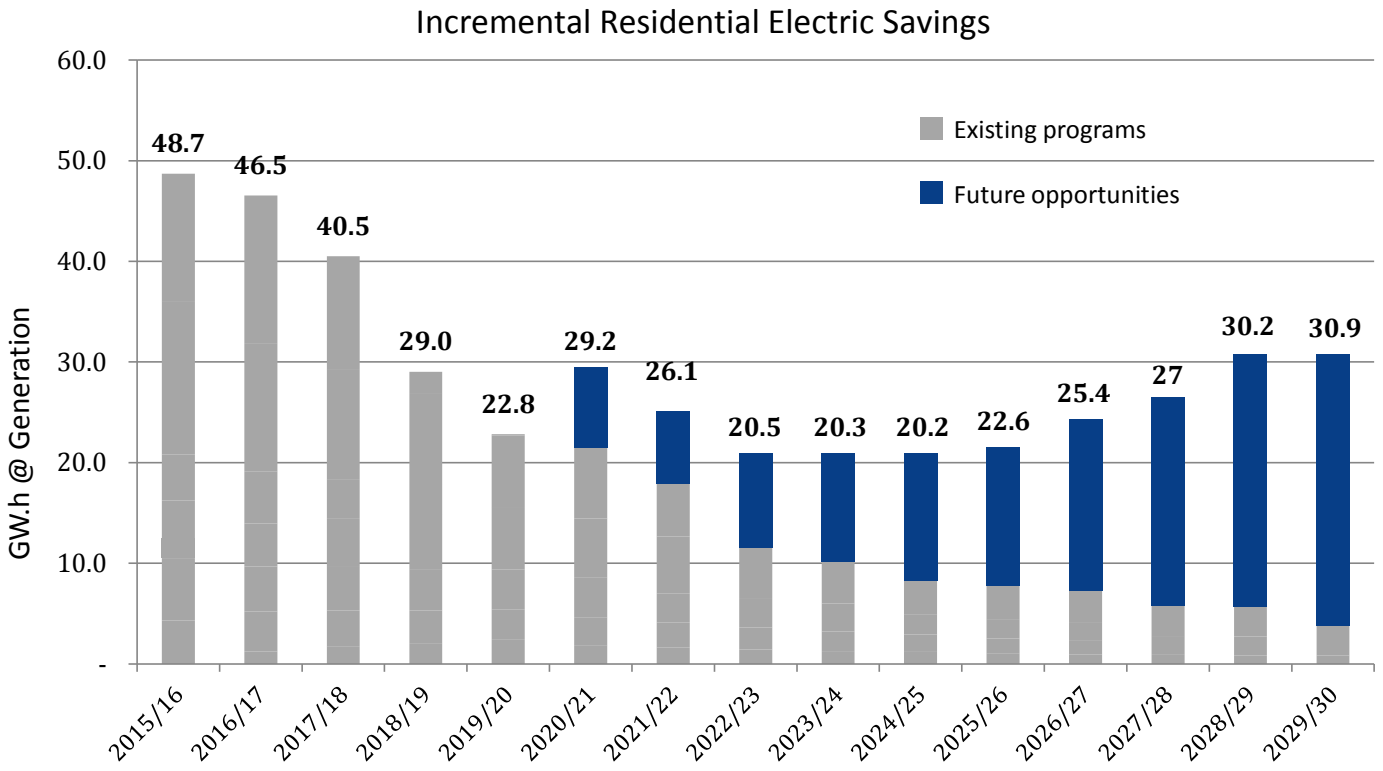
Residential Programs



Residential Programs

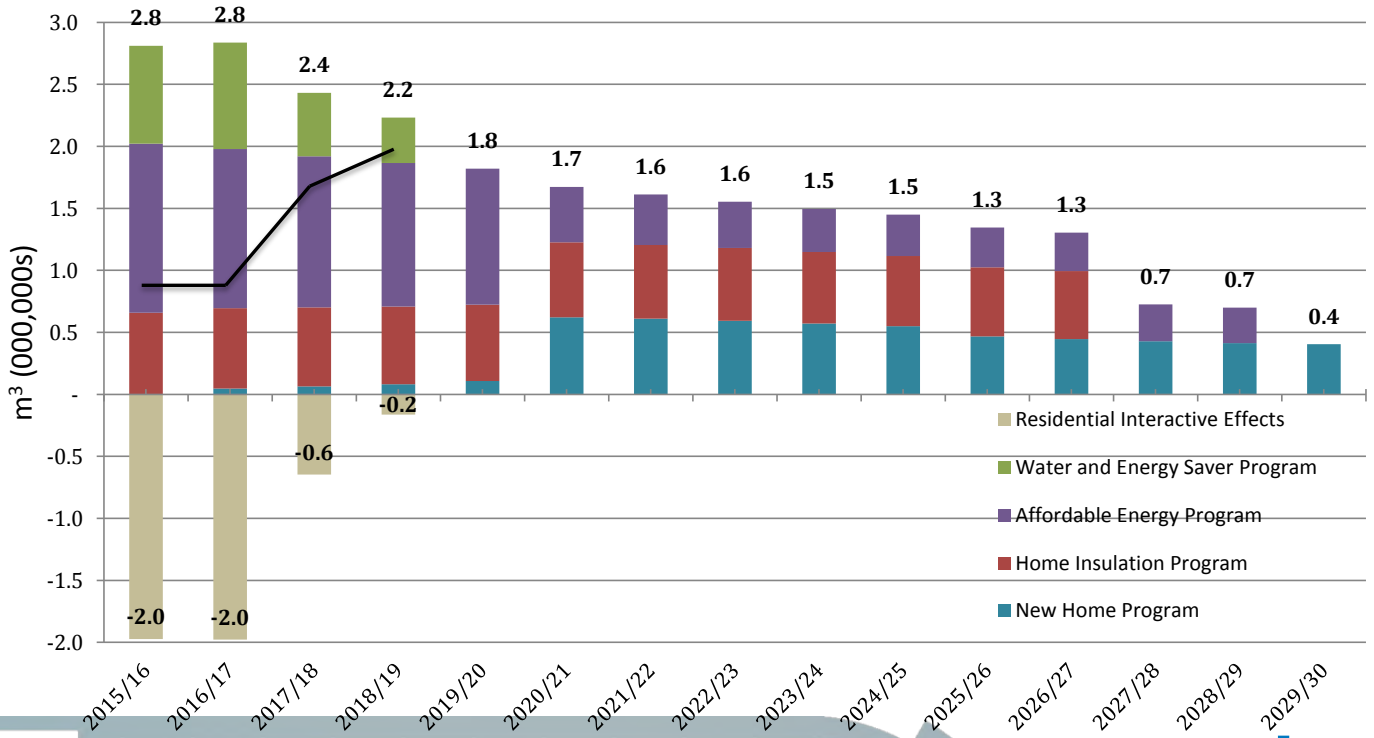


Residential Programs



Residential Programs

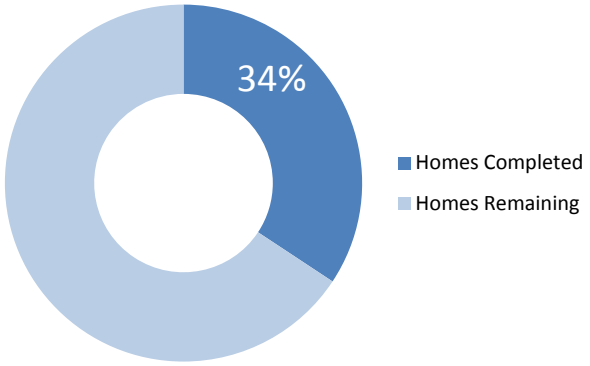
Incremental Residential Natural Gas Savings (Including Interactive Effects)



Residential Programs

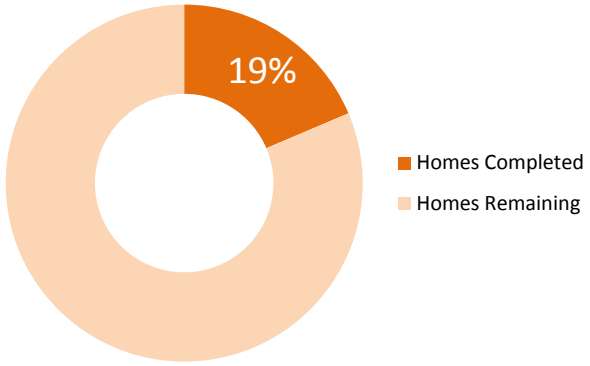
Home Insulation Program Market Share

Electric



Total Market	35,000 homes
Completed	12,000 homes

Natural Gas

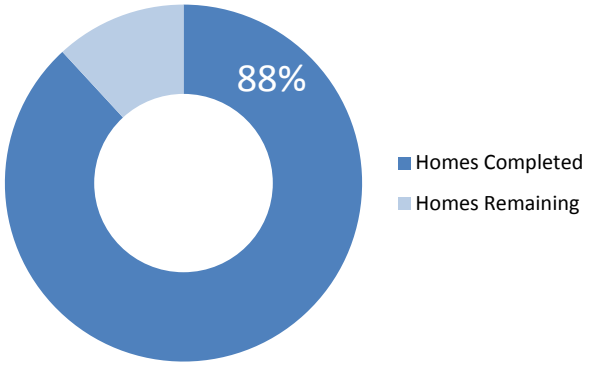


Total Market	129,000 homes
Completed	24,000 homes

Residential Programs

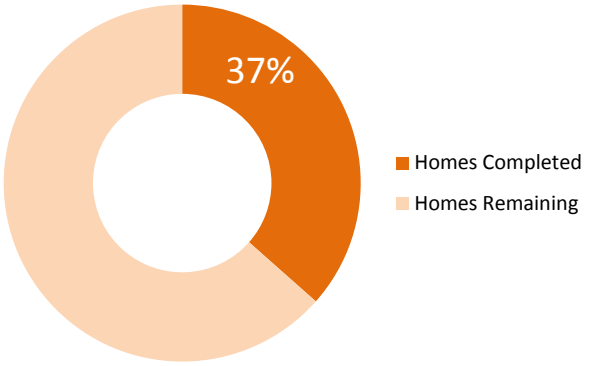
Home Insulation Program Market Share

Electric



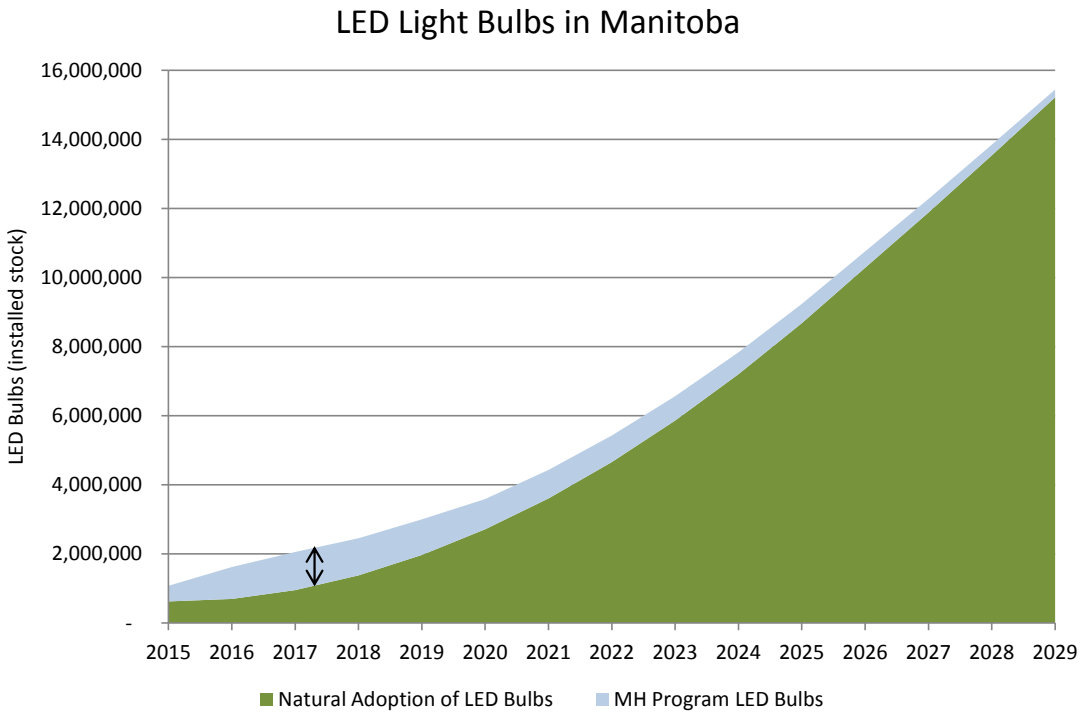
Total Market 35,000 homes

Natural Gas



Total Market 129,000 homes

Residential Programs



Earth Energy & Emerging Technologies

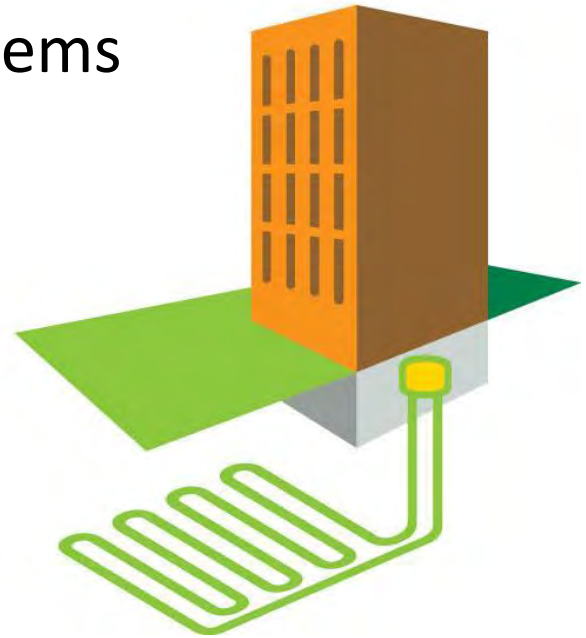
Jana-Rae Brunel

Earth Energy & Emerging Technologies Supervisor

Manitoba Hydro

Emerging Technologies

- Geothermal heat pump systems
- Solar hot water heating
- Air source heat pumps
- Solar PV



Solar PV

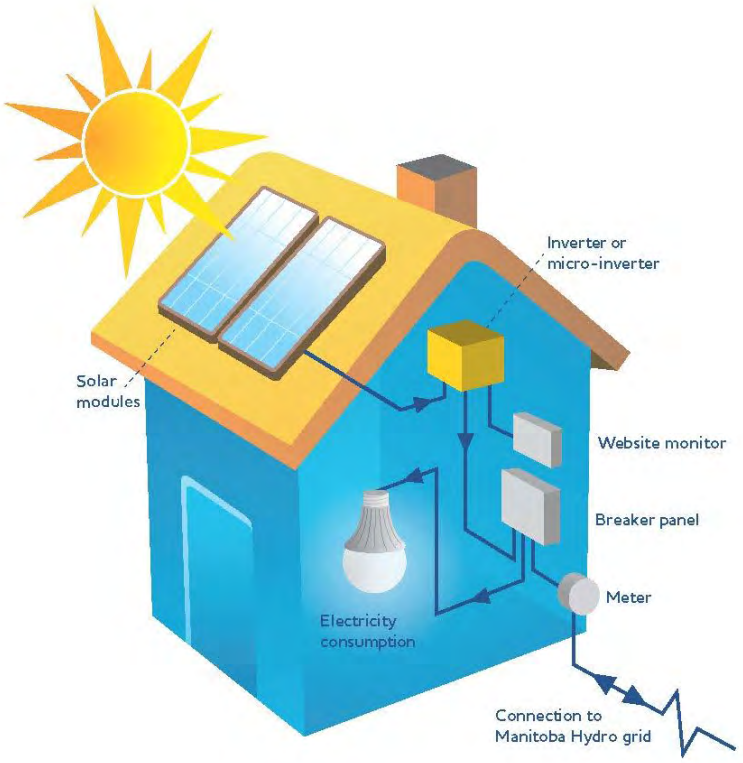
Join Us!

Earth Day Media Event

April 22nd @ 10am

Manitoba Canoe and Kayak Club

80 Churchill Drive



Manitoba Hydro

Community Energy Plans

- Guide for communities to undertake energy efficiency upgrades
  - The Pas
  - Dauphin

Manitoba Hydro

Community Geothermal Program






Manitoba Hydro

Community Geothermal Program

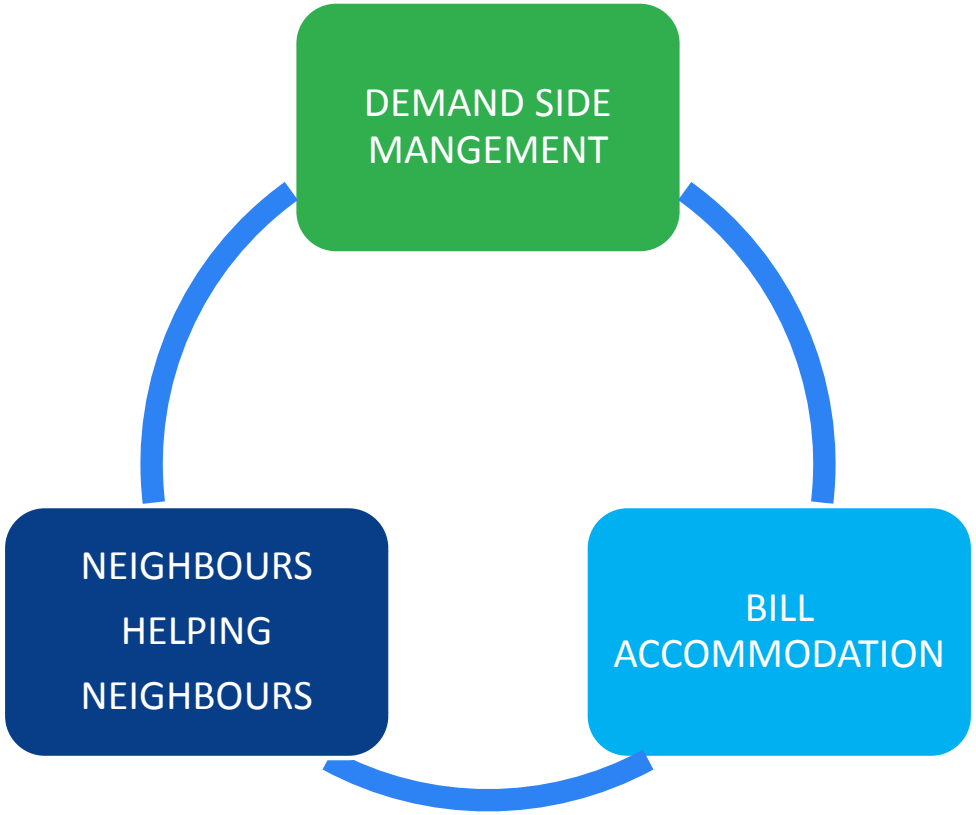
- 4 First Nations currently participating
  - Peguis First Nation
  - Fisher River Cree Nation
  - Long Plain First Nation
  - Sagkeeng First Nation
- 2 new First Nations in 2016
  - Waywayseecappo
  - Keeseekoowenin
- 60 new homes with secured federal funding

Affordable Energy Program

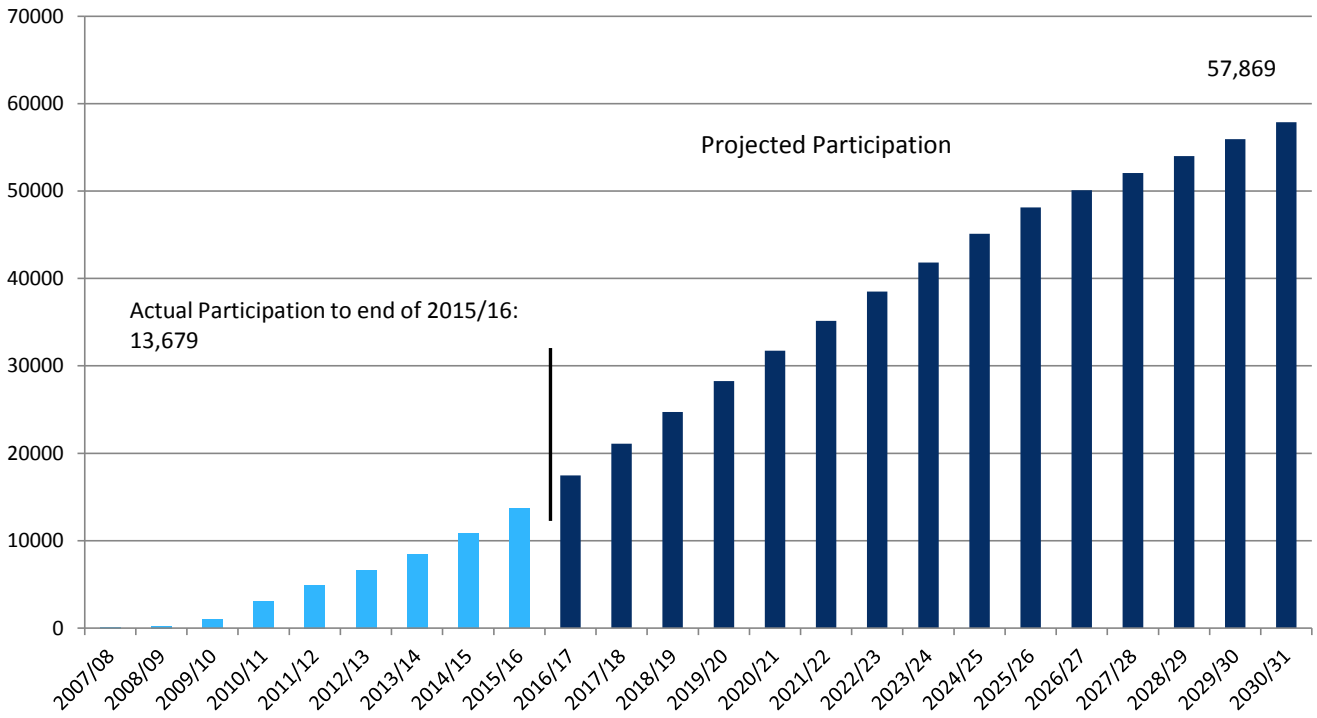
Colleen Galbraith

Manitoba Hydro

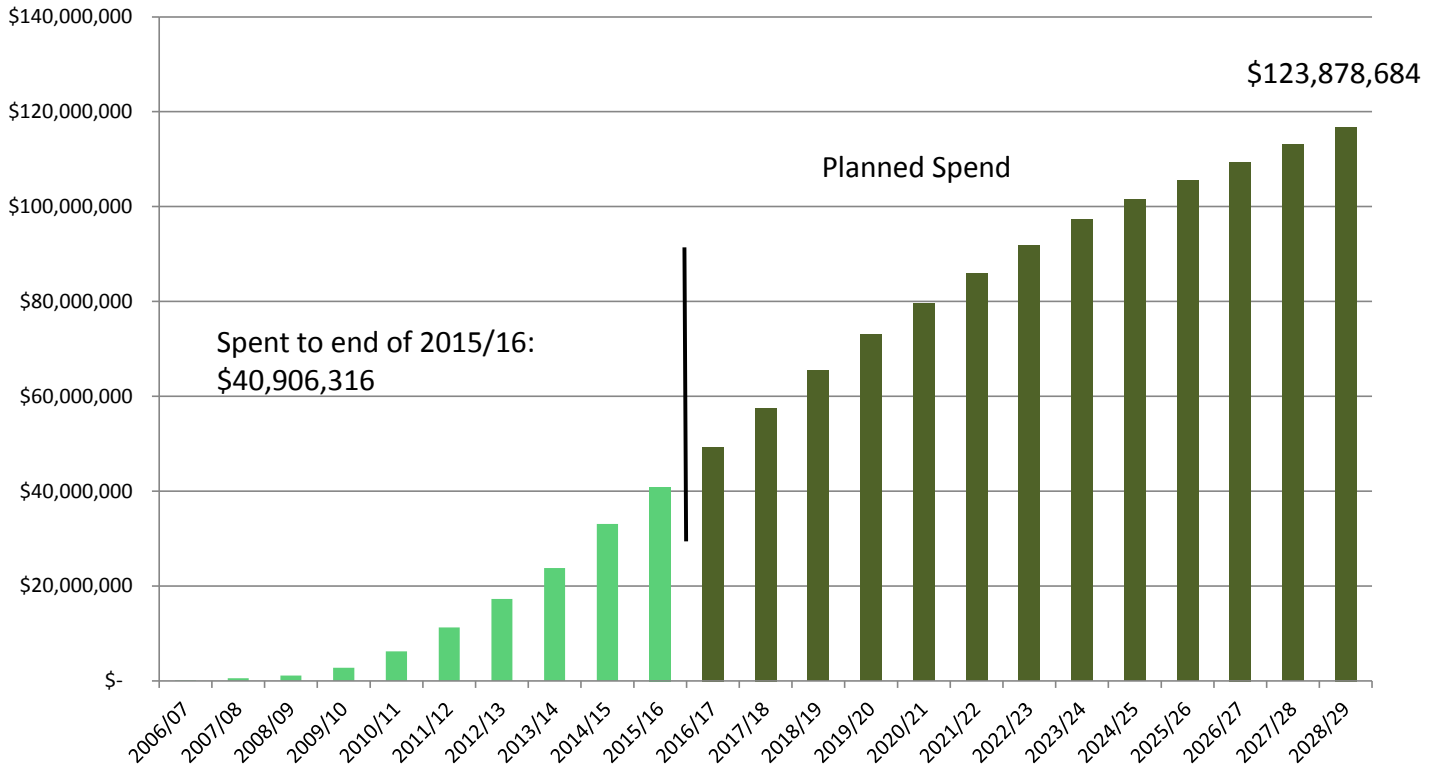
Affordable Energy Program



Affordable Energy Participation



Affordable Energy Spend



Manitoba Hydro

Free Insulation Upgrades

Insulation Cost Range	Number of Customers
$0.00 - $999.99	2167
$1,000.00 - $1,999.99	2956
$2,000.00 - $2,999.99	824
$3,000.00 - $3,999.99	579
$4,000.00 - $4,999.99	553
$5,000.00 - $5,999.99	471
$6,000.00 - $6,999.99	311
$7,000.00 - $7,999.99	225
$8,000.00 - $8,999.99	142
$9,000.00 - $9,999.99	119
$10,000.00 - $10,999.99	43
$11,000.00 - $11,999.99	38
$12,000.00 - $12,999.99	24
$13,000.00 - $13,999.99	17
$14,000.00 - $14,999.99	6
$15,000.00 - $15,999.99	4
$16,000.00 - $16,999.99	4
$17,000.00 - $17,999.99	2

As of Mar. 31, 2016

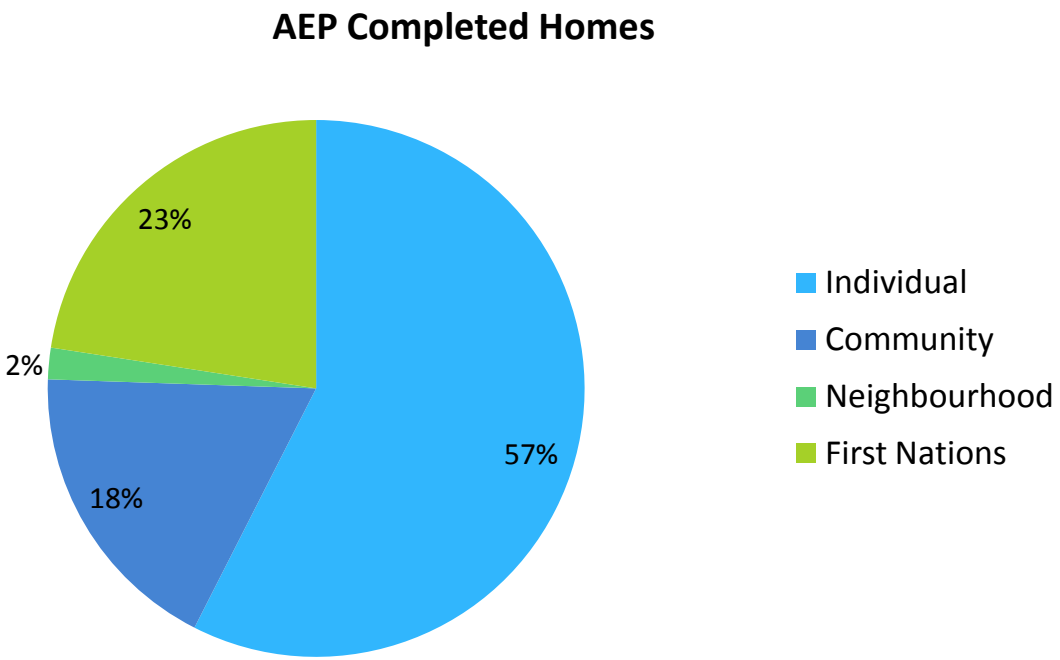
Manitoba Hydro

Furnace Replacement Program

- PUB Board Order 99/07 to provide $3.8 million annually from the SGS Natural Gas Rate Class.
- 4,599 standard natural gas furnaces upgraded through AEP.
- Customer co-payment:
  - $19/month over five years ($1140) to August 2013
  - $9.50/month over five years ($570) as per PUB

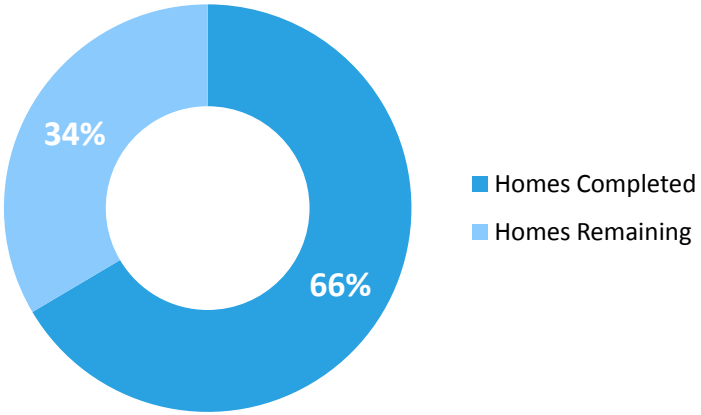
FURNACE REPLACEMENT PROGRAM FUNDING (Millions $)		
Funding from SGS Customer Class	$	32.8
Disbursements	$	(13.6)
Ending Balance at March 31, 2016	$	21.0

Participants by Delivery Channel



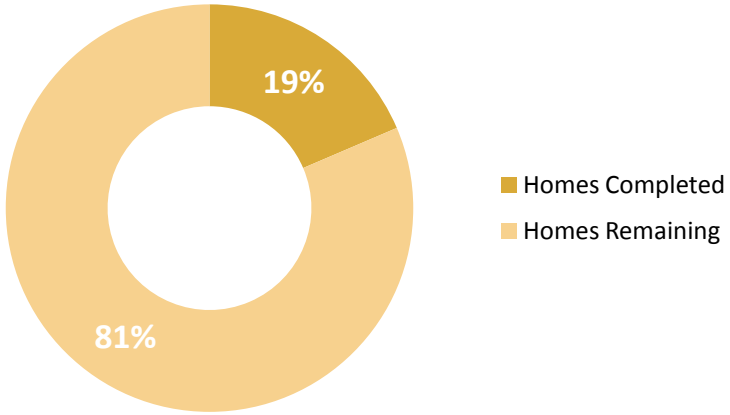
First Nations Delivery Channel

Insulation



Total Market	3,279 Homes
Completed	2,180 Homes

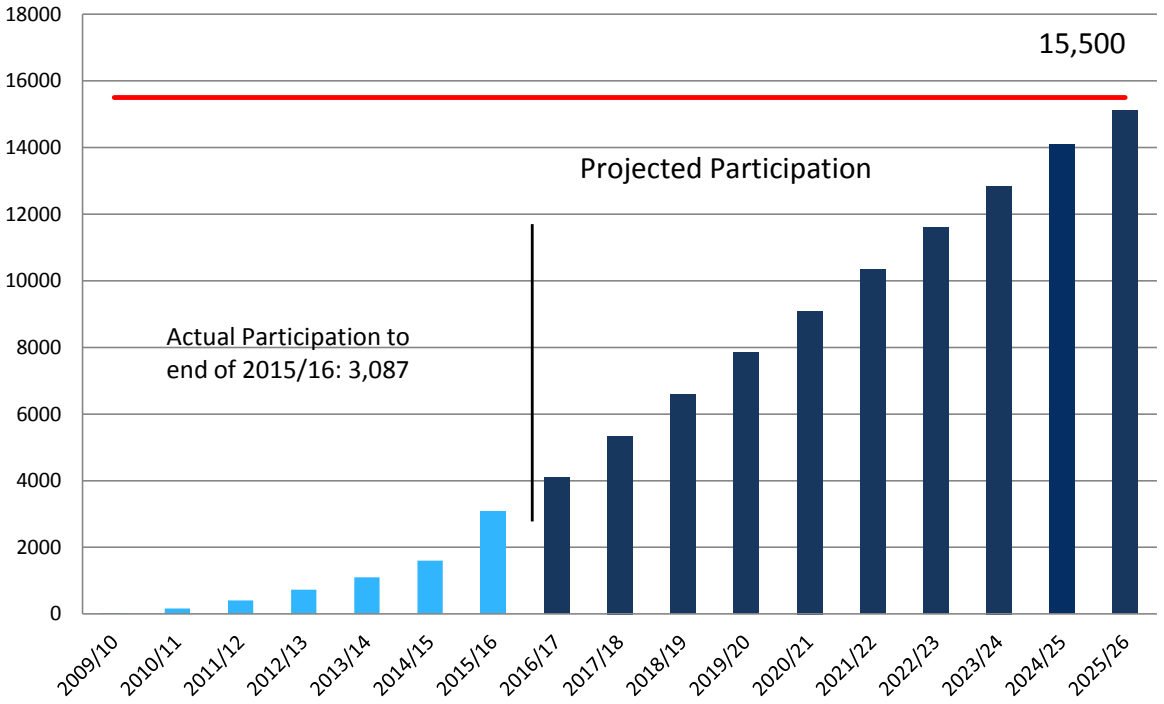
Direct Install



Total Market	15,500
Completed	2,877 Homes

Manitoba Hydro

First Nations Participation



Manitoba Hydro

Commercial Programs

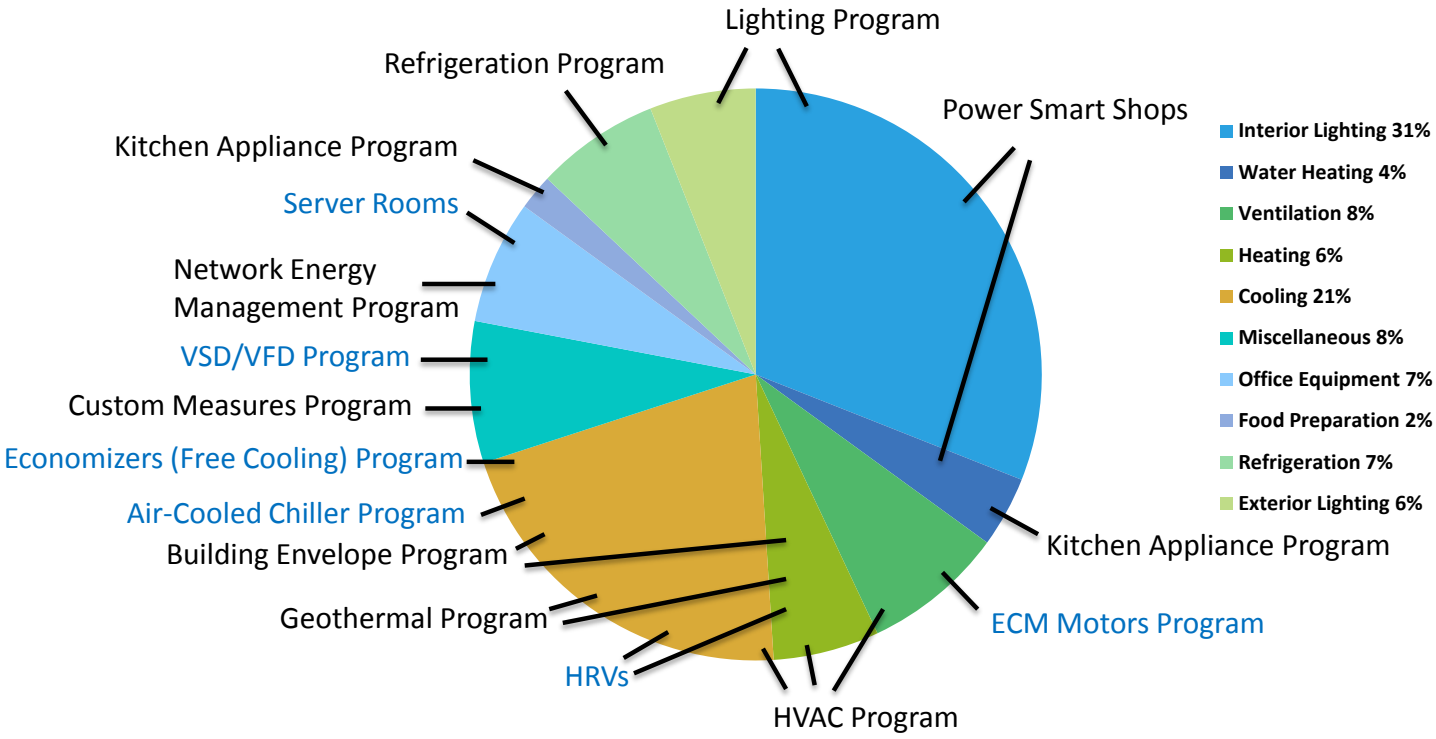
Roberto Montanino

Commercial Programs Supervisor

Manitoba Hydro

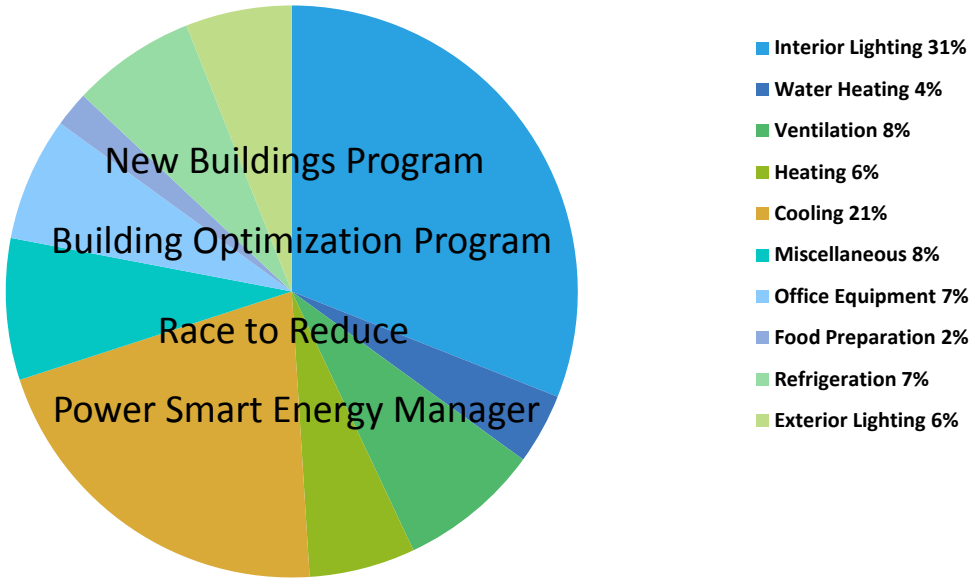
Commercial Programs

Commercial Electricity Use by End Use



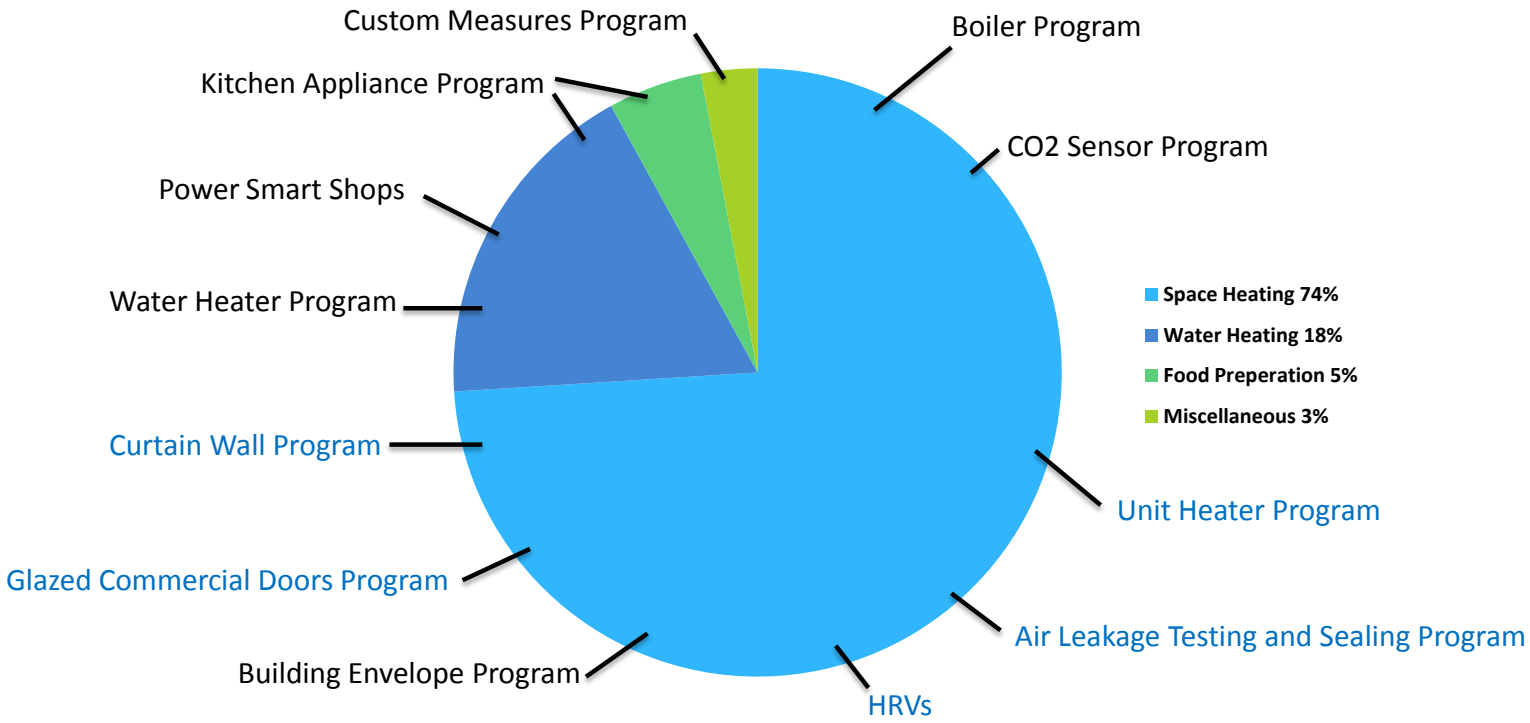
Commercial Programs

Commercial Electricity Use by End Use

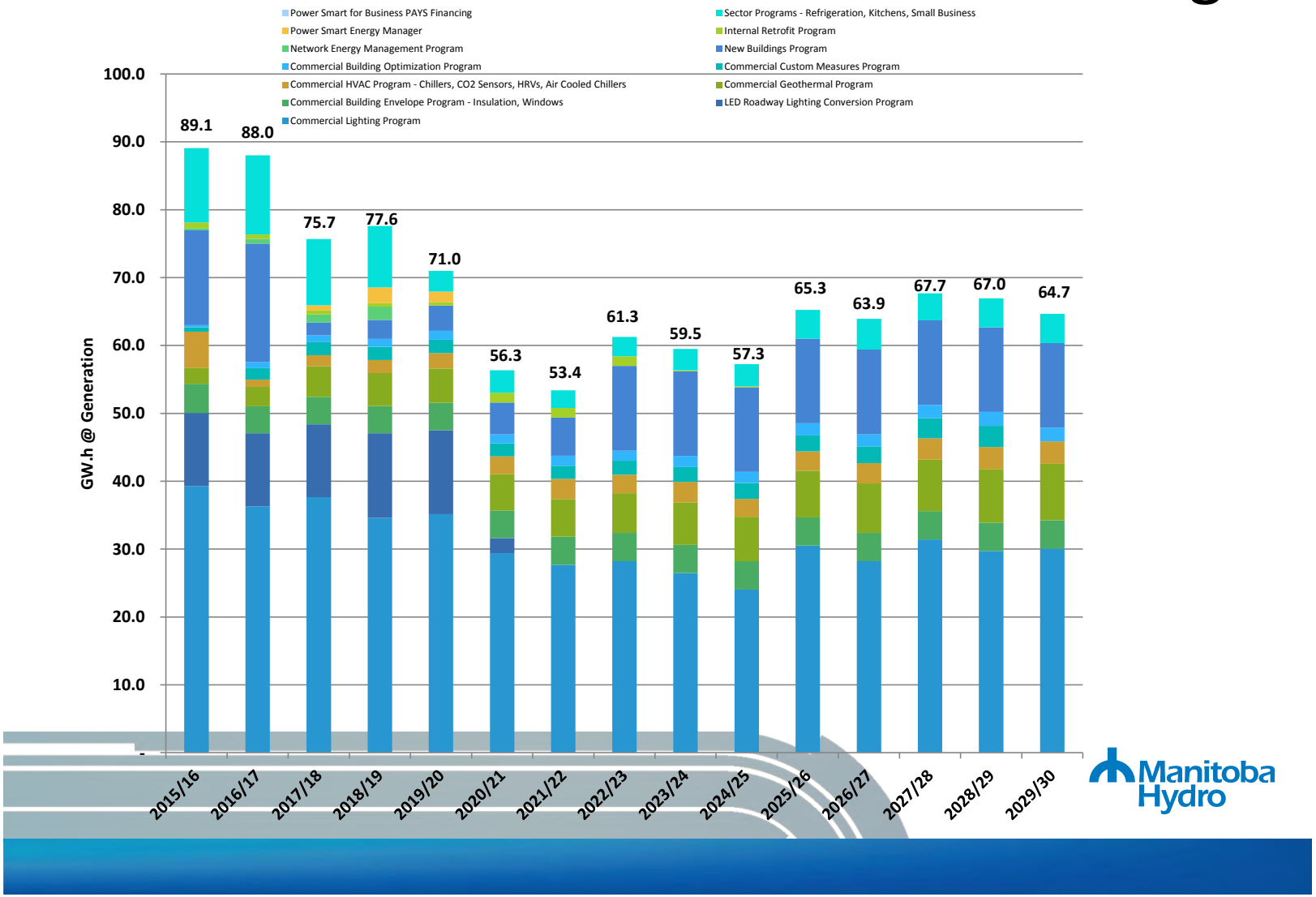


Commercial Programs

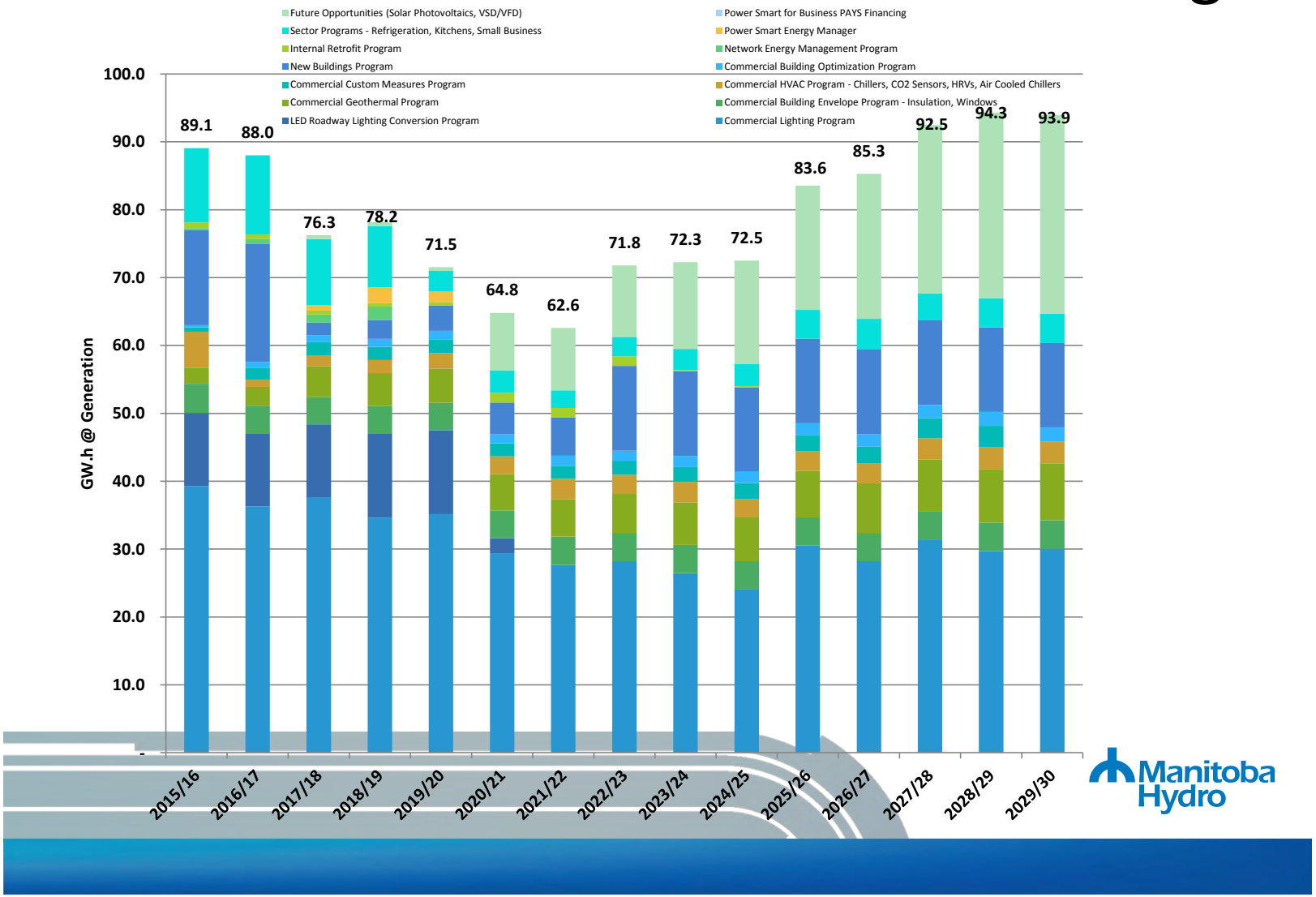
Commercial Natural Gas Use by End Use



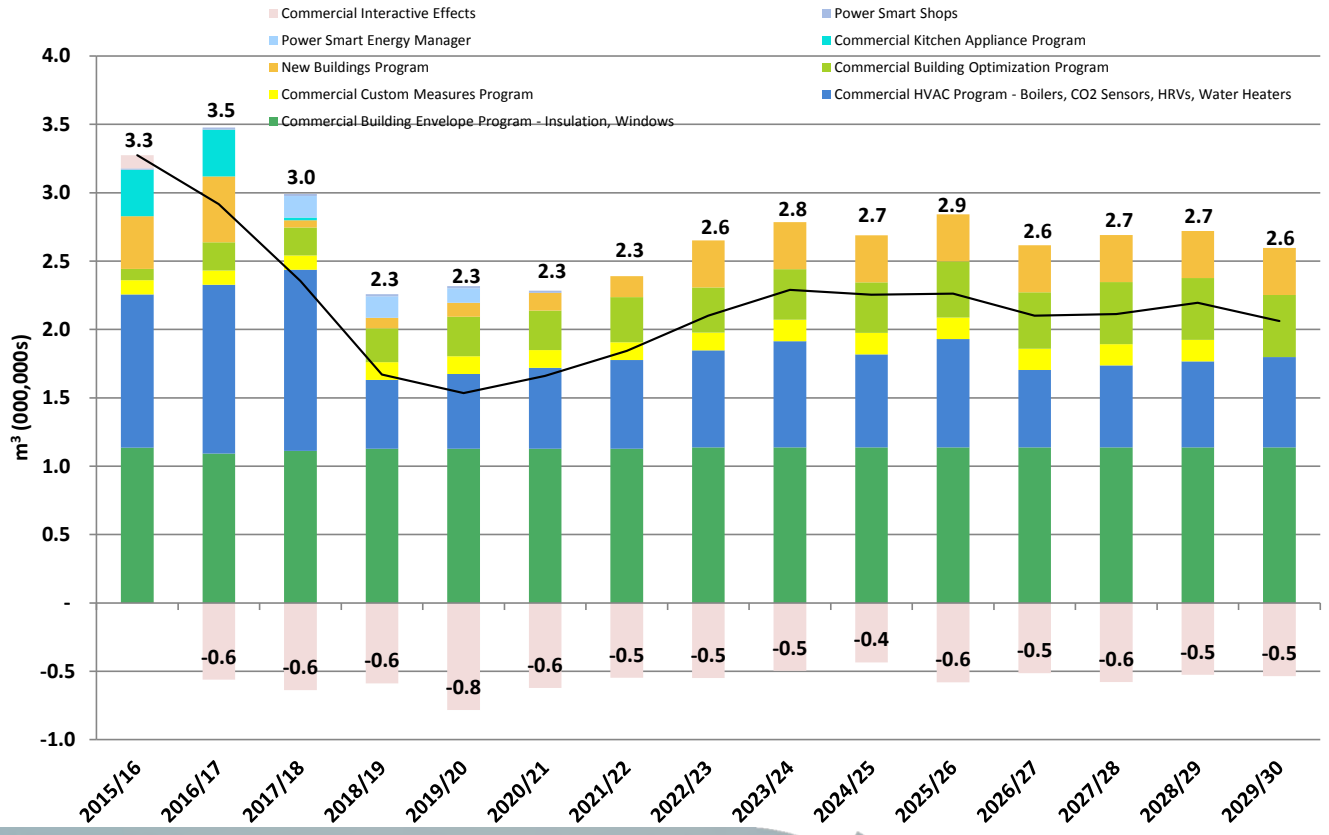
Incremental Commercial Electric Savings



Incremental Commercial Electric Savings



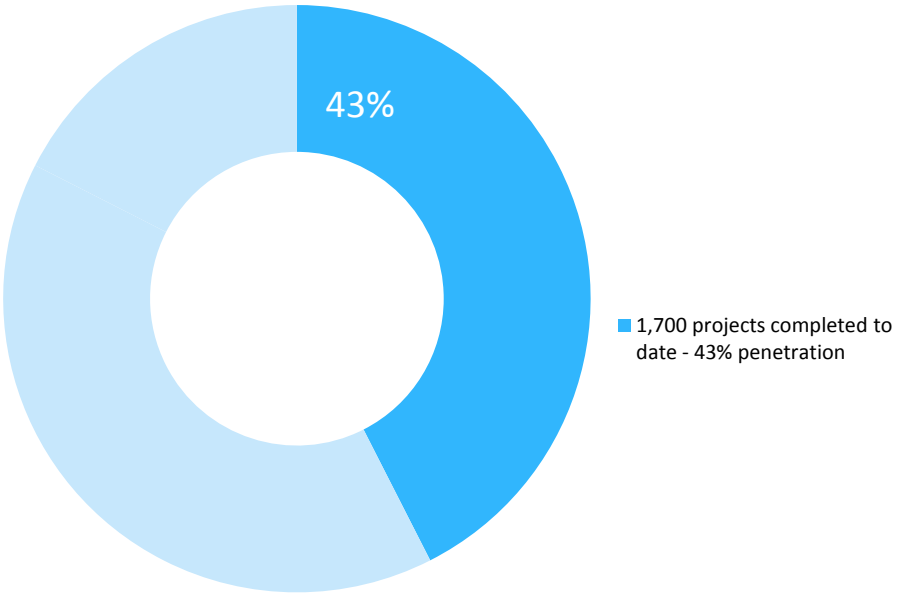
Incremental Commercial Natural Gas Savings



Manitoba Hydro

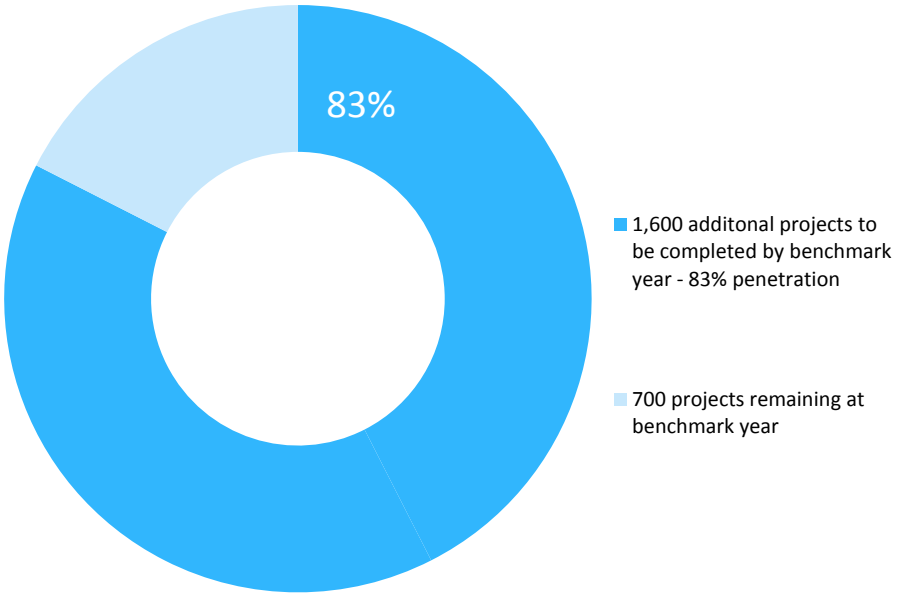
Commercial Programs

Commercial Refrigeration Program - Market Share



Commercial Programs

Commercial Refrigeration Program - Market Share



Industrial Programs

Enhanced Performance Optimization Program

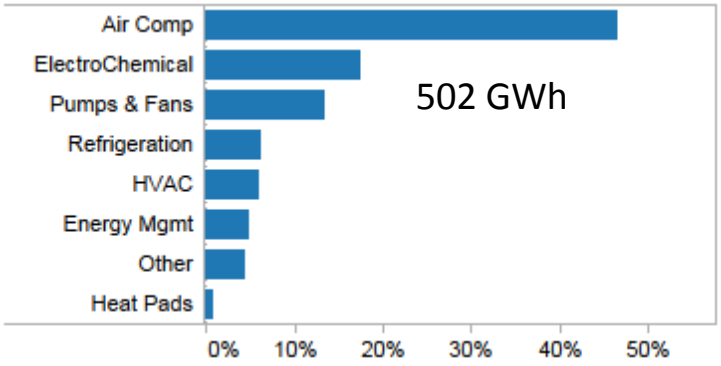
Myles Boonstra, P. Eng, CEM
Sr. Industrial Systems Engineer
Industrial & Commercial Solutions

Manitoba Hydro
POWER SMART

Performance Optimization Program

The 'Systems Approach'

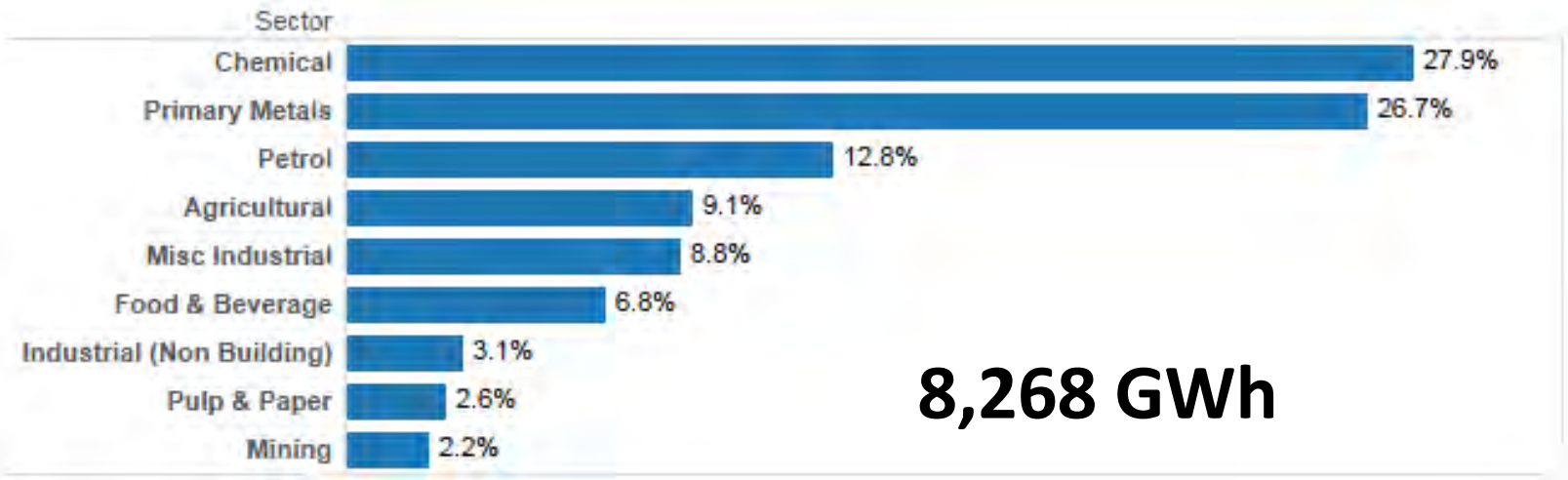
Identify, investigate, and implement system efficiency improvements:



Improved system performance

Greater efficiency
Lower operating costs
Increased productivity

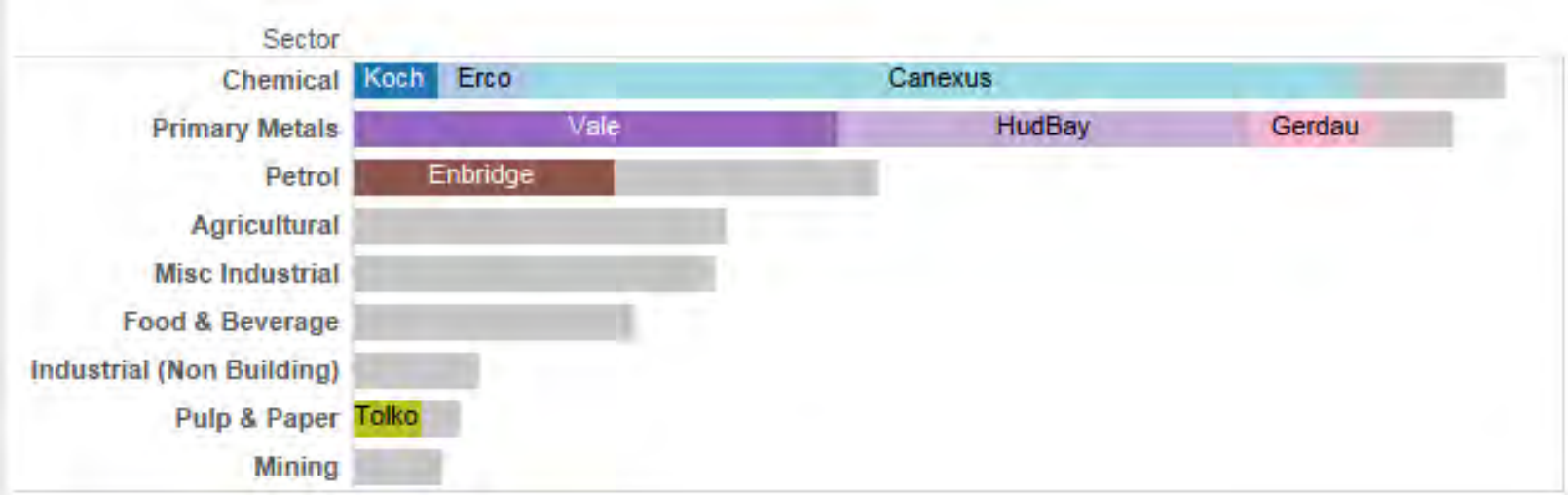
Industrial Sector – The Market



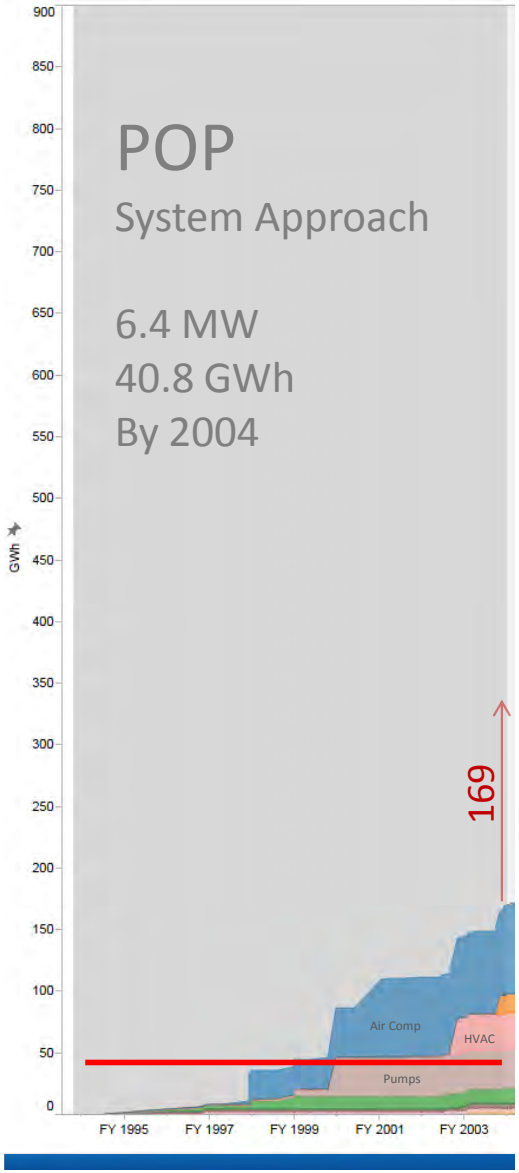
8,268 GWh

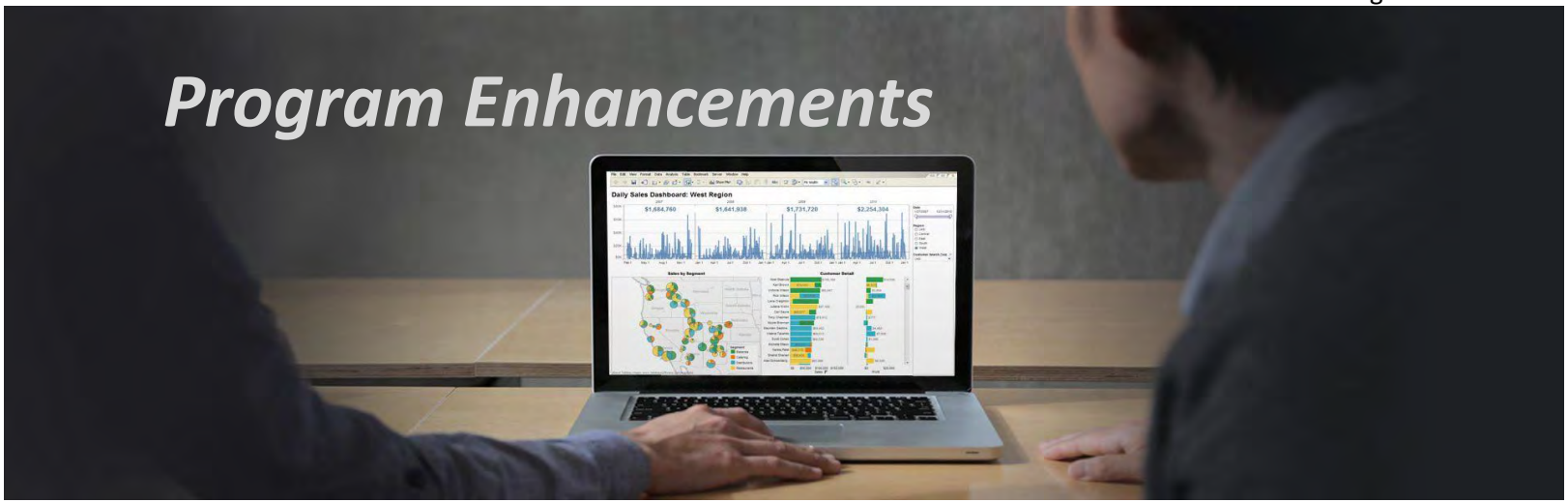
(based on FY2015)

Industrial Sector... *market insight*



Top 3 Customers	**Top 8 Customers**	Top 100 Customers
40%	**60%**	80%


POP
System Approach
6.4 MW
40.8 GWh
By 2004
GWh
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
169
Air Comp
HVAC
Pumps
FY 1995
FY 1997
FY 1999
FY 2001
FY 2003



Energy Manager Initiative

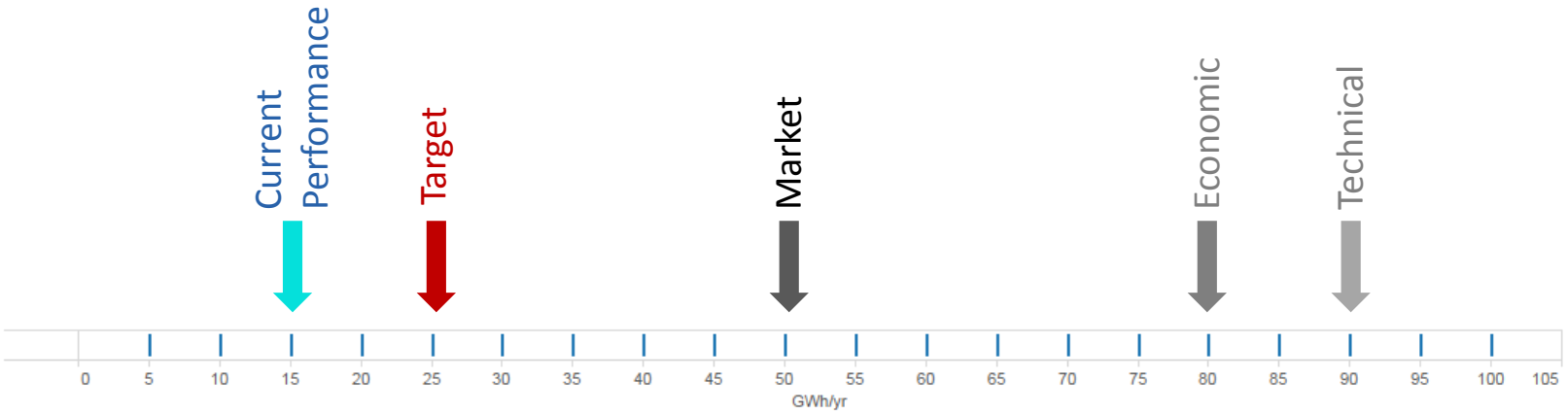
Energy Efficiency Screening Study Expansion

Pump/Fan Vendor Engagement: Scoping Studies

Prescriptive Compressed Air Initiative

Advanced EnerTrend & Control System Integration

EPOP2 Targets

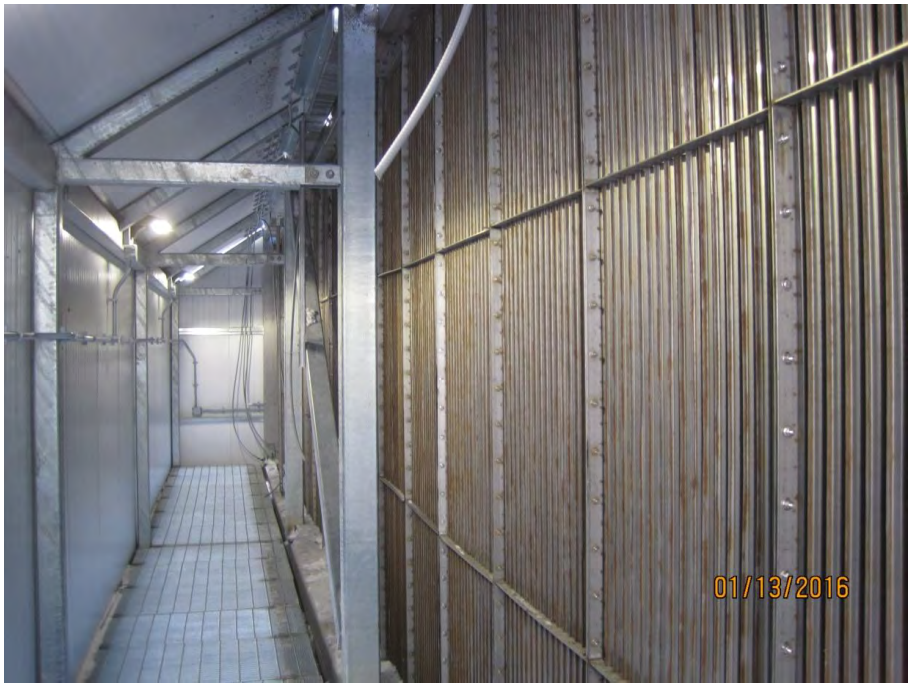


225 364 750 1200 1350

15 Yr GWh Savings Target
(Annual Target x 15)

Manitoba Hydro

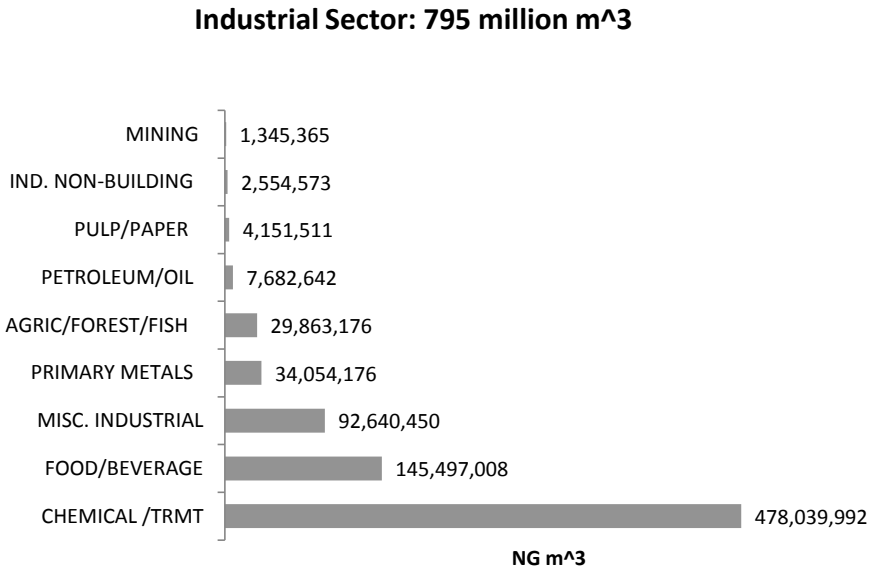
Industrial Natural Gas Optimization



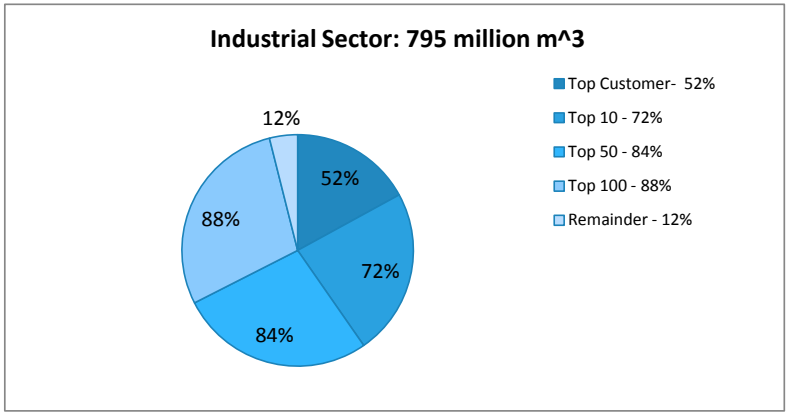
Sean Quigley, P.Eng.
Sr. Technology Development Engineer
Industrial & Commercial Solutions

Manitoba Hydro

Industrial NG – The Market

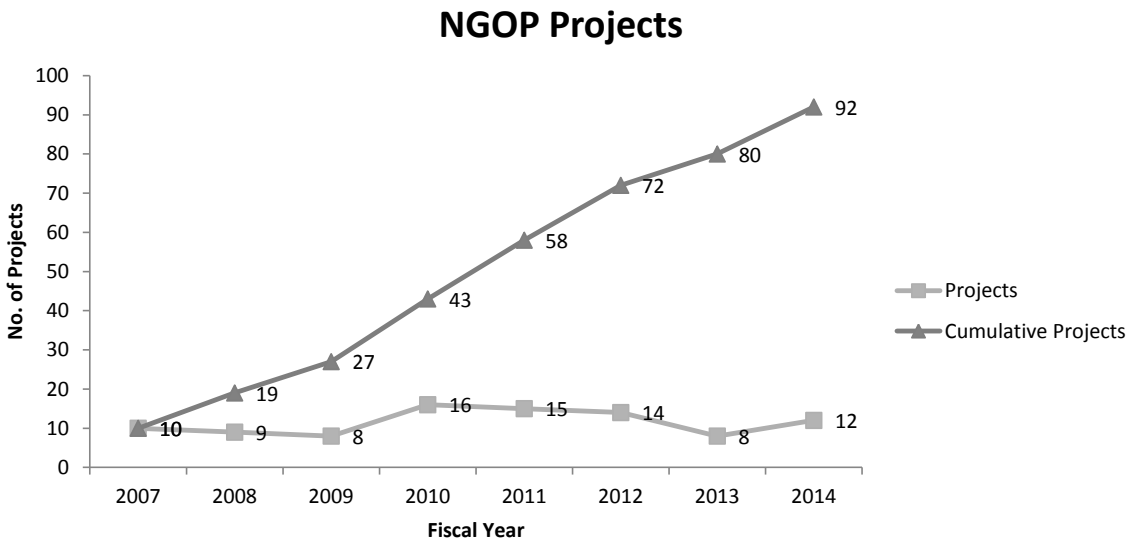


Industrial NG... *market insight*



Top Customer	Top 10 Customers	Top 100 Customers
52%	72%	88%

NGOP Results



CONTROL | OVERVIEW | **Line 1 Blanching Summary** 01/ 31/2011 11:06:14 AM | ALARMS | RETURN

Auger	Blancher 1 Actual	Blancher 1 Setpoint	Blancher 2 Actual	Blancher 2 Setpoint	Blancher 3 Actual	Blancher 3 Setpoint
Blanching Level	78.18	75.00 cm	57.14	56.00 cm	46.36	45.00 cm
Retention Time	5 : 0	5 : 00	5 : 0	5 : 00	3 : 45	3 : 45
Manual Auger Speed Control	63		79		65	
Auger Speed Control	Auto	Manual	Auto	Manual	Auto	Manual
Temperature						
Zone 1 Temperature	73.10	76 °C	78.10	78 °C	75.90	78 °C
Zone 1 Valve Position	100		11		100	
Zone 2 Temperature	78.20	78 °C	78.10	78 °C	78.30	78 °C
Zone 2 Valve Position	75		25		34	
Water						
Fresh Water Flow (lpm)	150.02		Recommended Refresh Flow (lpm)		134.00	
Fresh Water Valve Position	34					
Optek (cu)	0.220	2.000	Optek Purge	Disabled	Enable	

ERS Savings	Today's Total	Yesterday's Total	This Month's Total	This Year's Total	Last Year's Total
L1 Blancher ERS	4.4	0.5	348	1568	414

Manitoba Hydro

NGOP Targets and Enhancements

- Energy recovery
- Boiler replacement and control upgrades
- Potential prescriptive measures
- Steam Trap Replacement
- Behind the NG utility inter-connection–end use meters
- Target marketing to customers outside of the Top 100 NG accounts.

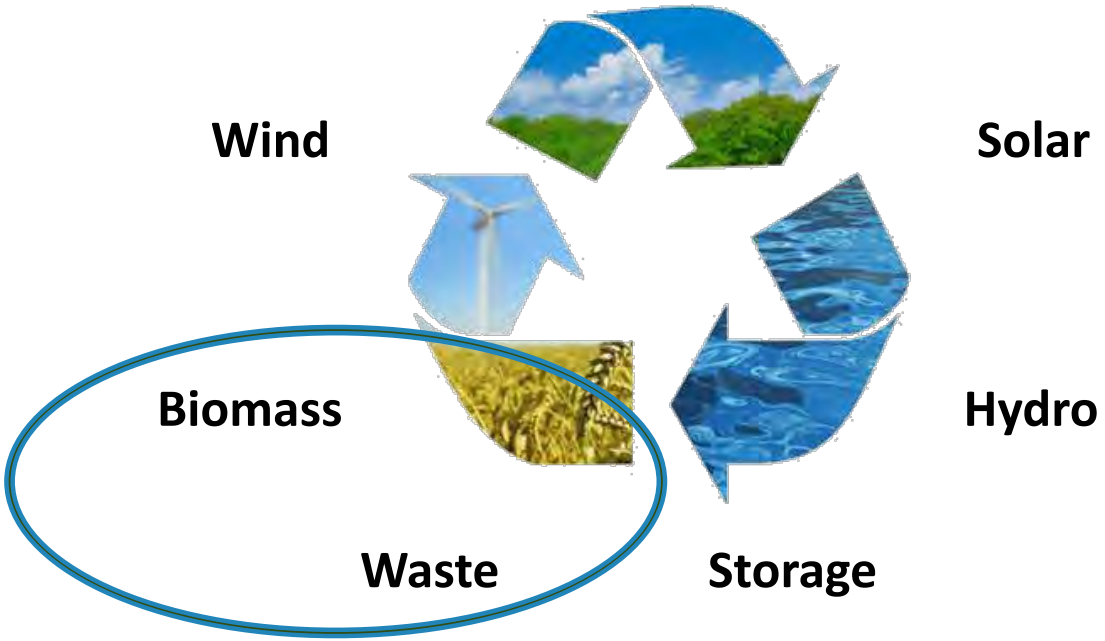
On-Site Generation & Recovery Load Displacement Initiatives

D.R. St. George, M.Sc., P.Eng.
Sr. Biosystems Engineer

Manitoba Hydro

Sustainable Energy Concepts

Reduce, Recycle, Reuse, Recover



Manitoba Hydro Bioenergy Related Power Smart Initiatives

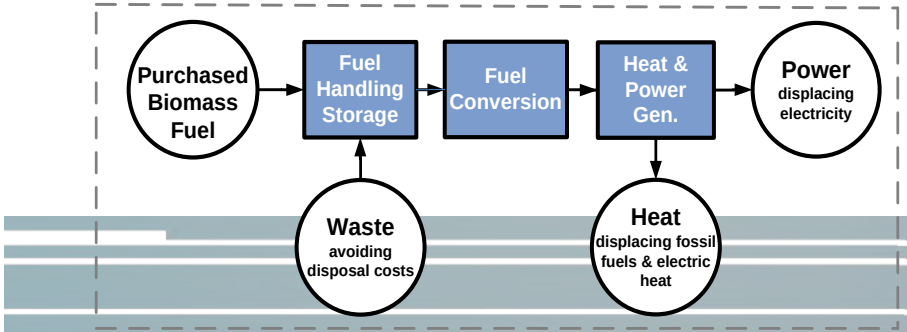
2008

2016

1) **Bioenergy Optimization Program (Active)**

2) **Load Displacement Program (Active)**

3) **Purchased Biomass Fuels Option II (Pending)**



Manitoba Hydro

1) Bioenergy Optimization Program

- 121.8 GWh/yr & 56.5 MW Winter Peak by 2025
- Heat only or combined heat and power (CHP) using waste streams, byproducts and renewable fuels.
- Size range 10 kW to 1 MW.
- Project LUCs 0.02 to 3.5 ¢/kWh.

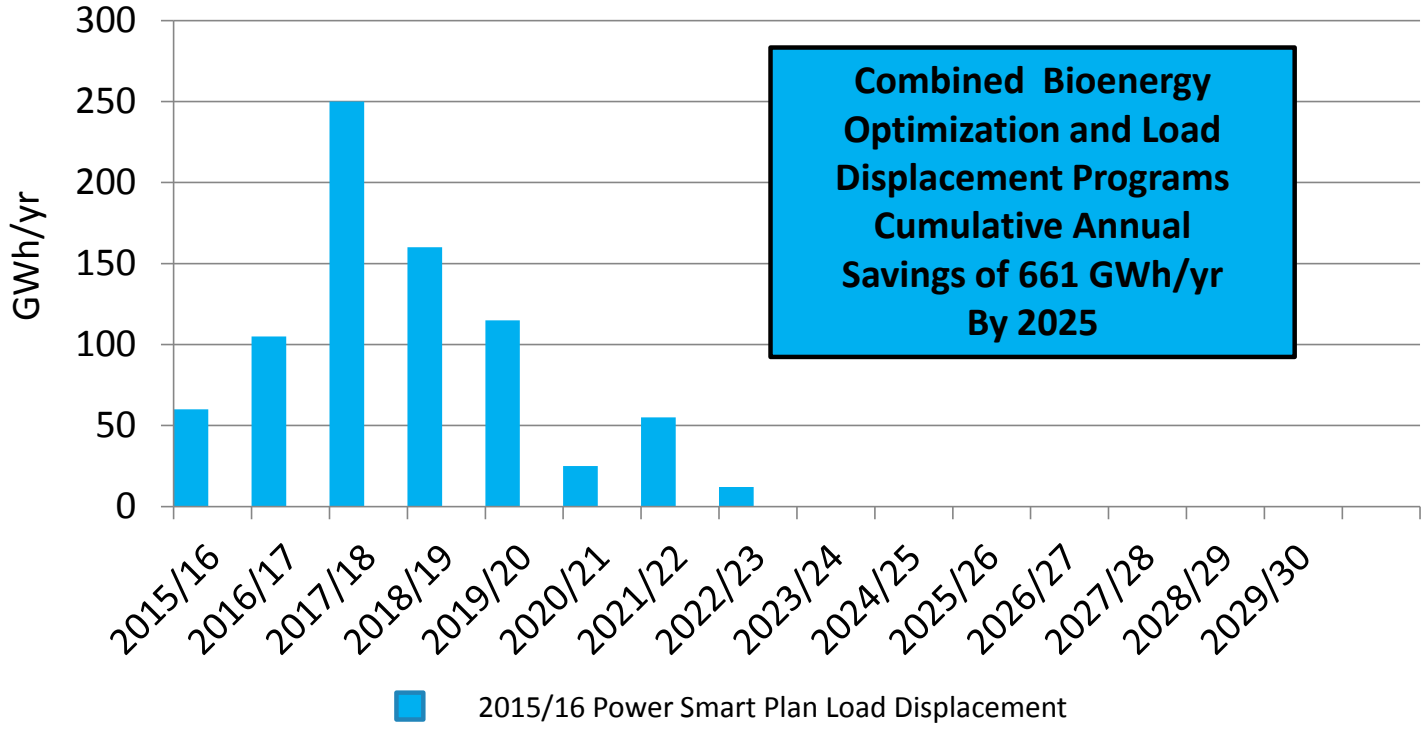
Manitoba Hydro

2) Load Displacement Program

- 539.3 GWh/yr & 68.5 MW Winter Peak by 2025
- Combined heat & power (CHP) using waste streams, byproducts and low cost, readily available biomass.
- Size range > 1 MW.
- Project LUCs 1.1 to 1.4 ¢/kWh.

Targeted Annual Electric Savings

Active Load Displacement Initiatives



3) Purchased Biomass Fuels Option II

- Biomass Heating Initiative.
- Option to meet targets imposed by Manitoba's Climate Change and Green Economy Action Plan.
- 550,000 t/yr wood pellet fuel supply.

La Coop fédérée

Manitoba Hydro

Overarching Support Strategies

Overarching Support Strategies - Financing

Program	Total Amount Loaned	Total Principal Outstanding	Total Loans
Power Smart Residential Loan (4.8%)	$362 M	$63 M	85,378
PAYS – Residential (3.9%)	$4.8 M	$4.4 M	699
PAYS – Commercial (5.5%)	$1.5 M	$1.4 M	36
Residential Earth Power Loan (4.9%)	$20.3 M	$5.2 M	1,209
Furnace Replacement Program (0%)	$4.0 M	$1.1 M	4,358
TOTAL	$392.6 M	$75.1 M	91,644

Overarching Support Strategies – Financing (Customer Service)

Program	Total Amount Loaned	Total Principal Outstanding	Total Loans
Energy Finance Plan (6.75%)	$53.7 M	$9.6 M	21,086
Customer Contribution Time Payment Plan (5.5%)	$1.2 M	$0.5 M	83
TOTAL	$54.9 M	$10.1 M	21,169

Overarching Support Strategies – Leveraging Industry

Manitoba Hydro

Overarching Support Strategies – Leveraging Industry

Manitoba Hydro

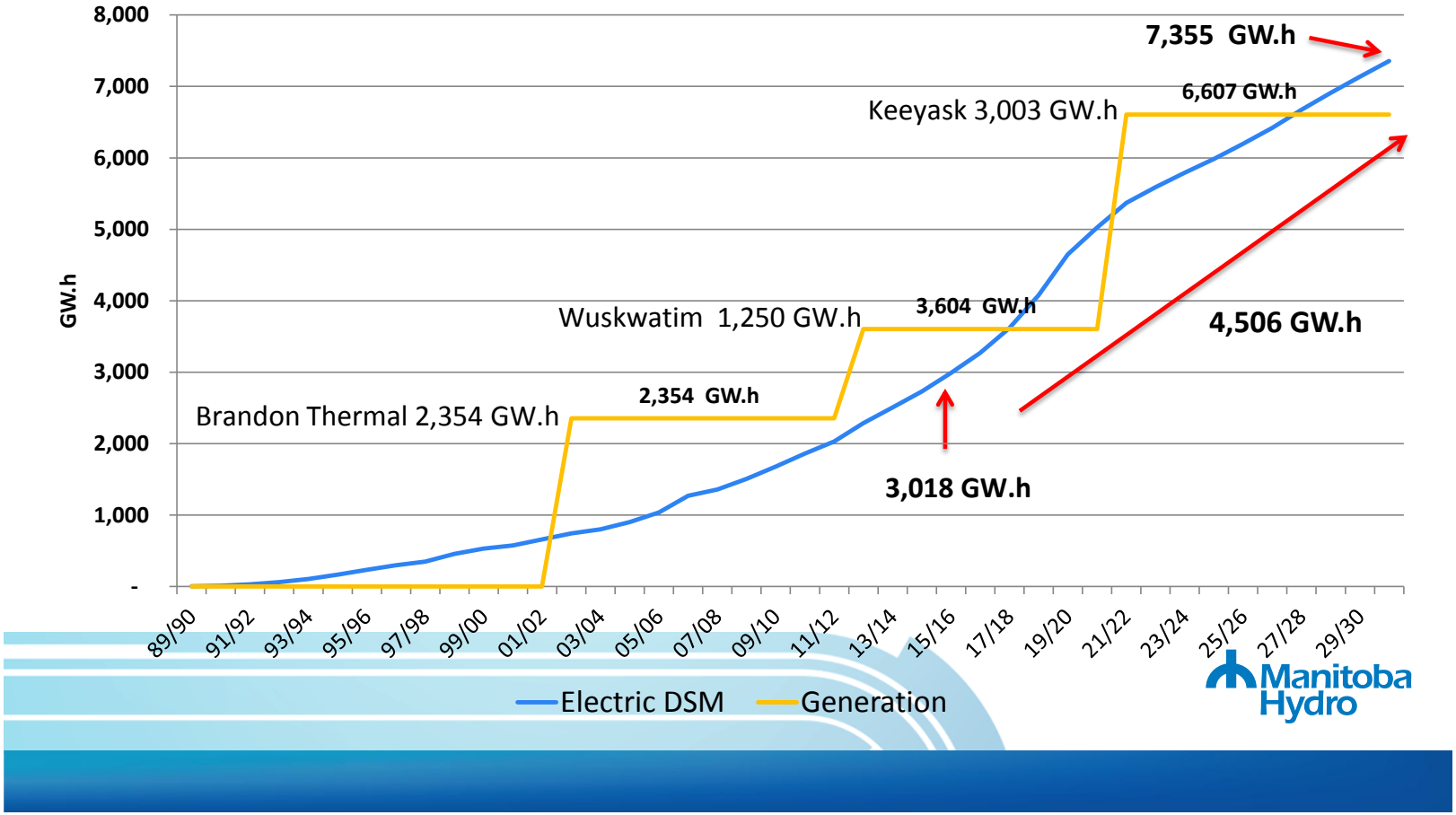
Next Steps

DSM Status Update

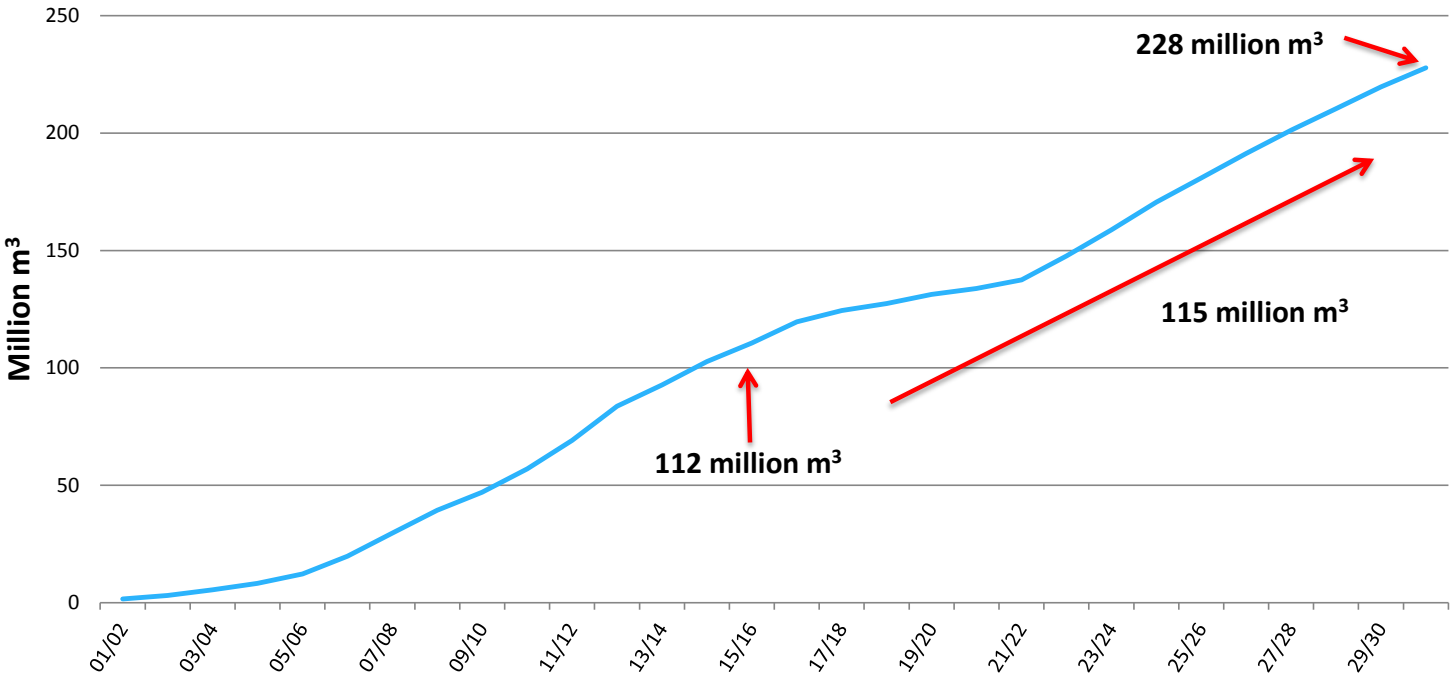
October 6, 2016

Manitoba Hydro

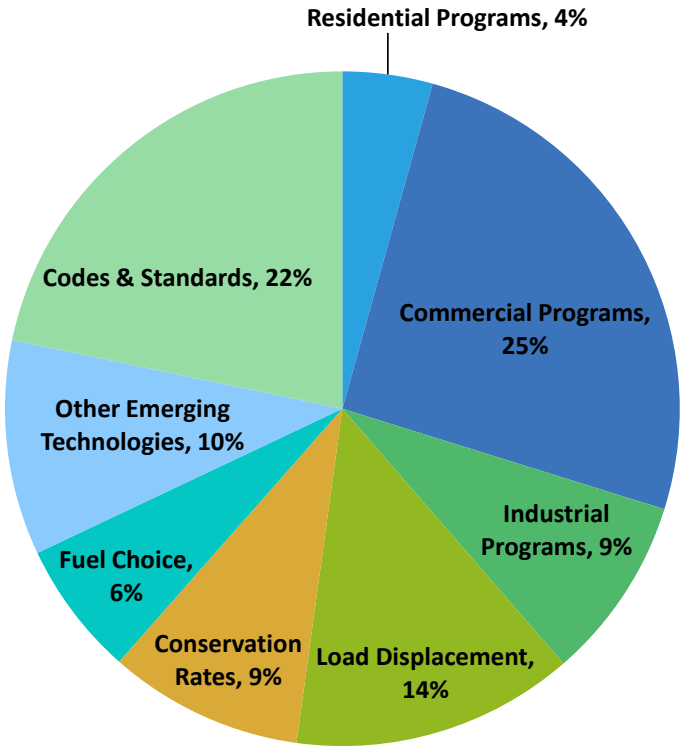
Electric DSM



Natural Gas DSM

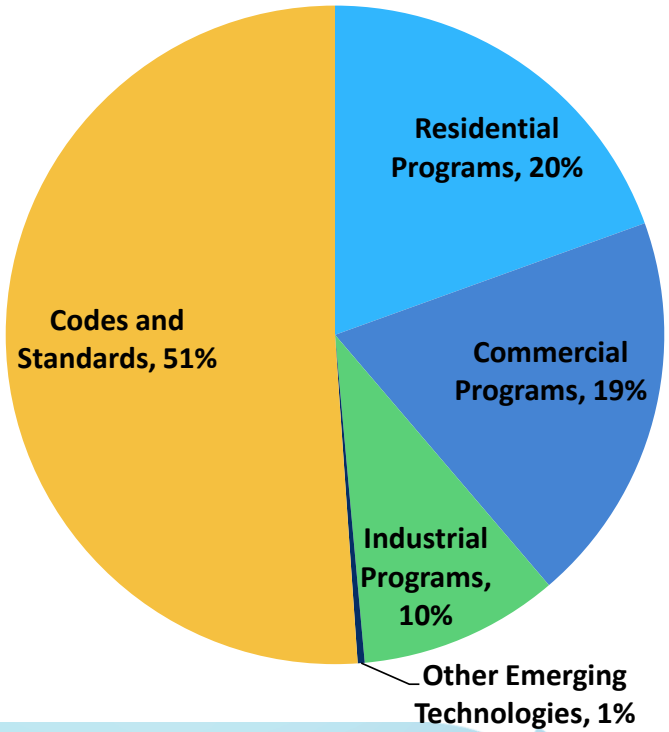


Electric Energy Savings Breakdown



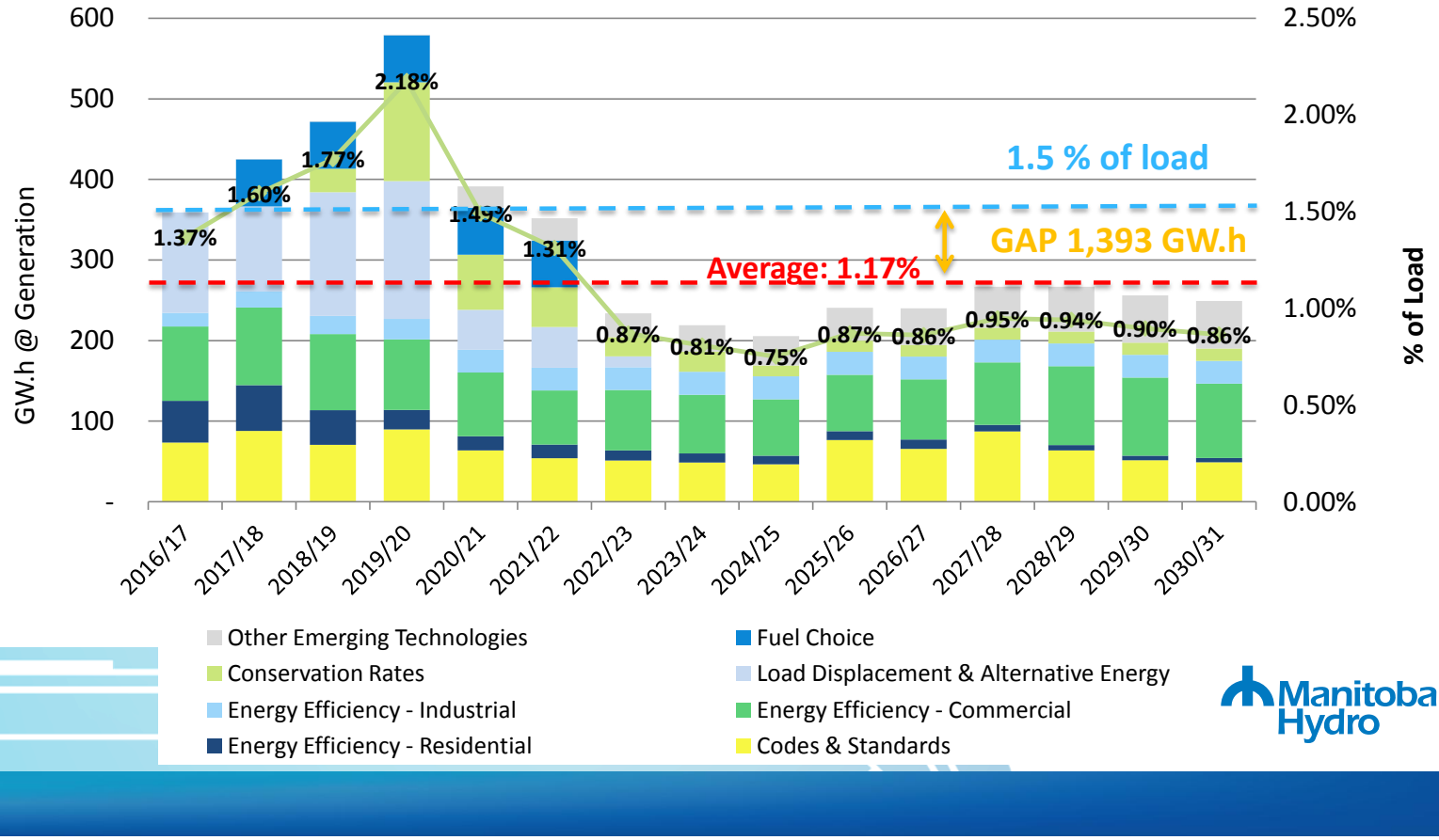
Manitoba Hydro

Natural Gas Savings Breakdown



Annual Electric Savings

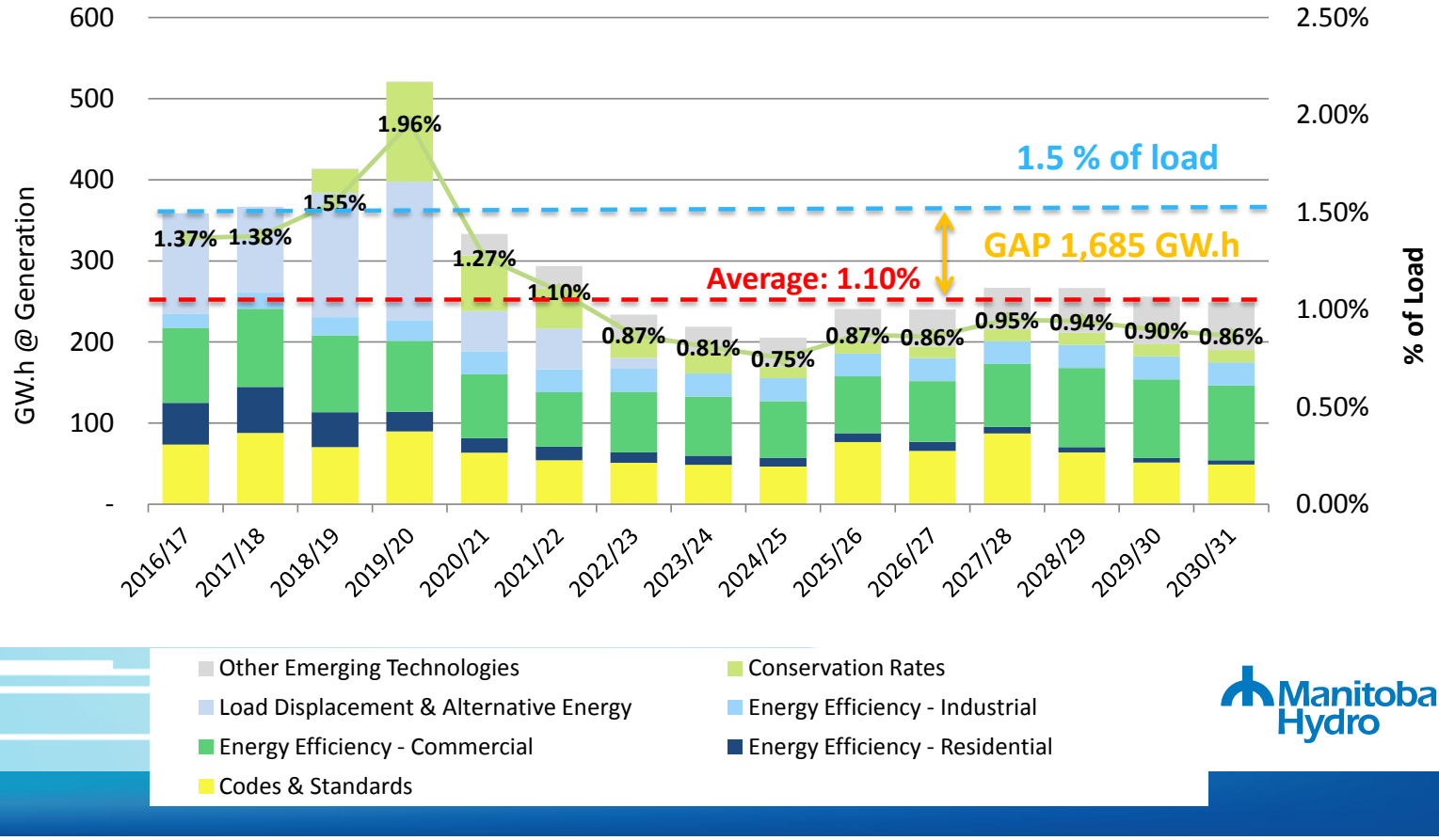
Percent of Annual Load



Annual Electric Savings

Percent of Annual Load

(Excluding Fuel Choice)

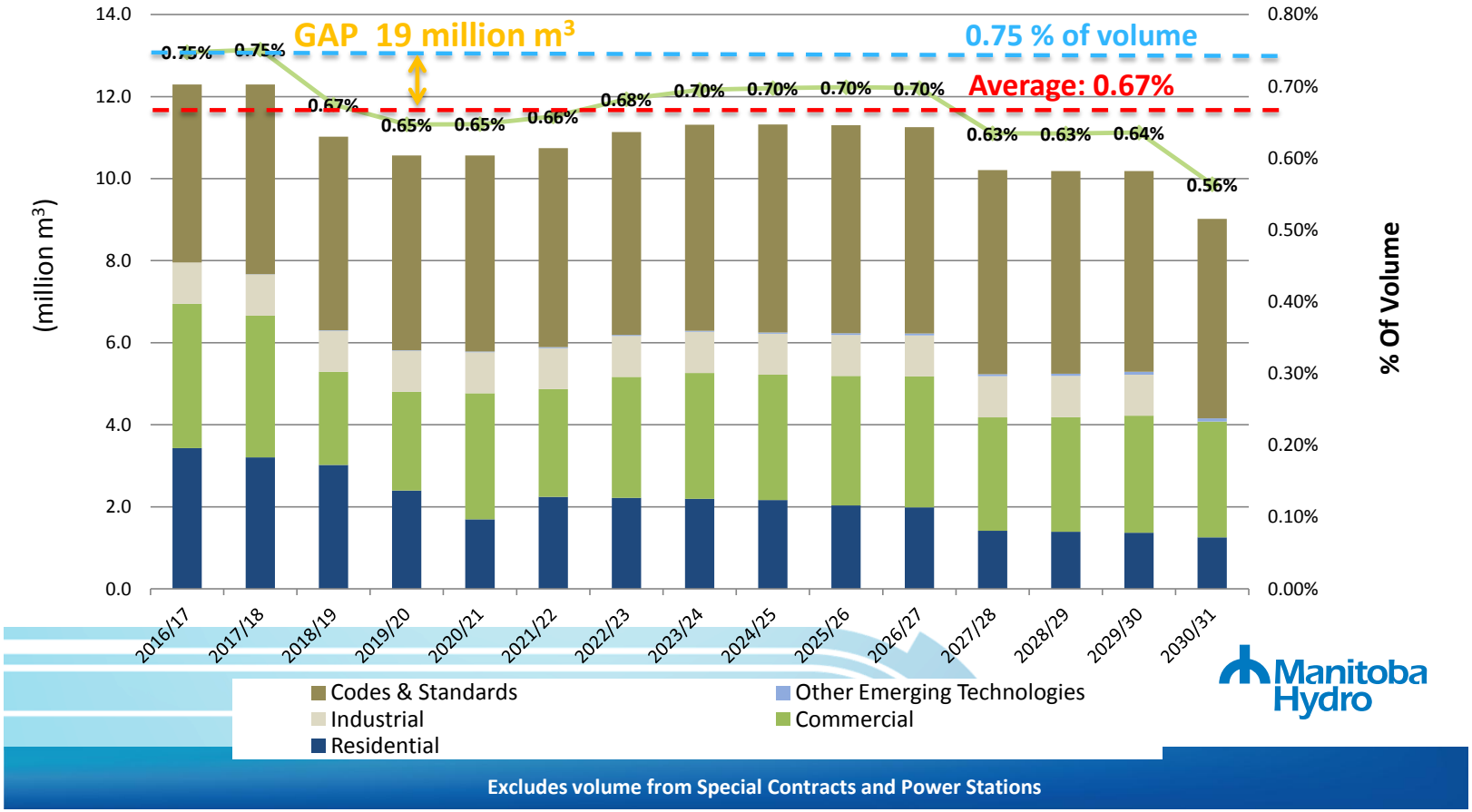


Manitoba Hydro

Annual Natural Gas Savings

Percent of Annual Volume

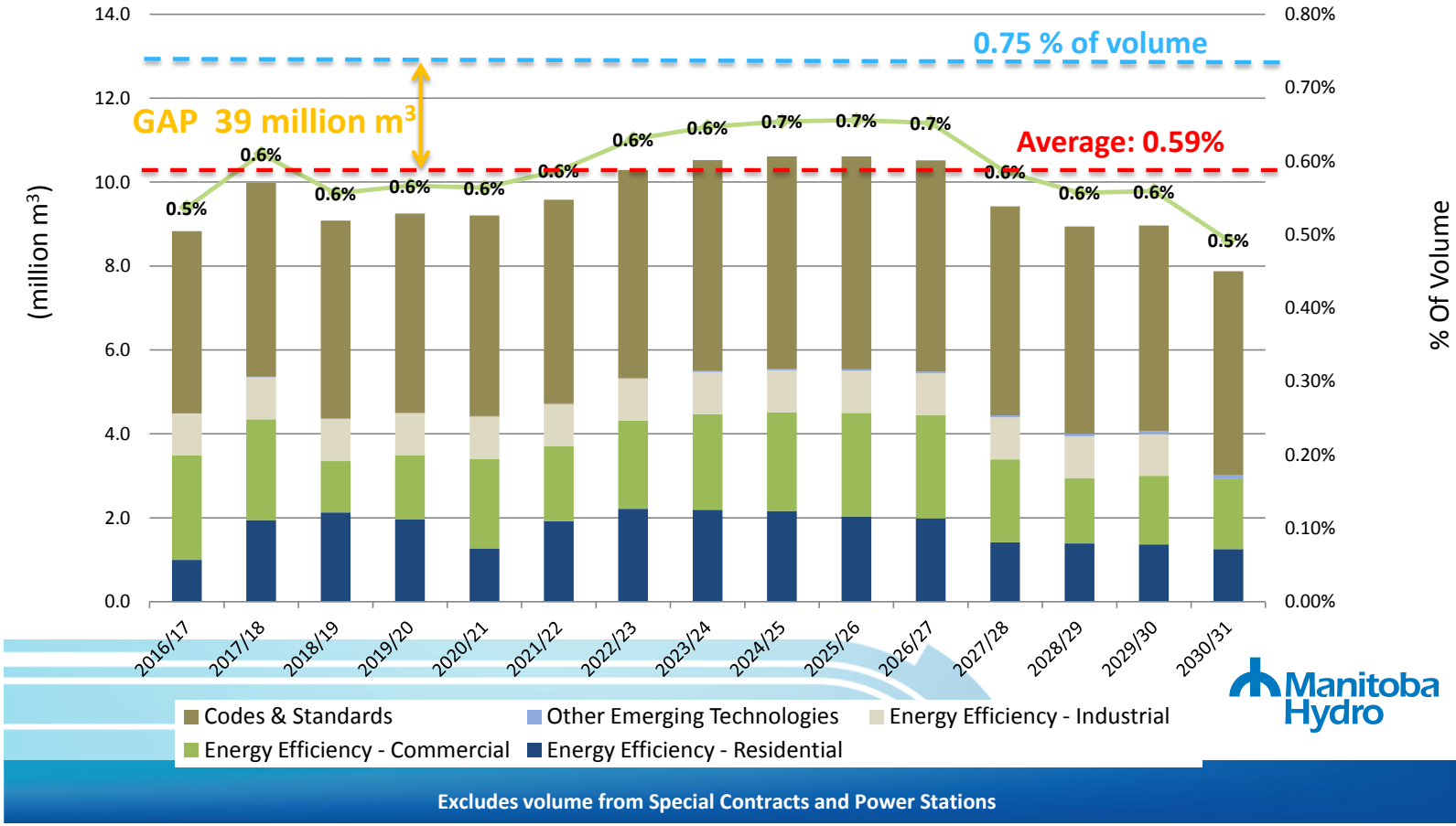
(excluding impacts from Fuel Choice and Interactive Effects)



Annual Natural Gas Savings

Percent of Annual Volume

(excluding impacts from Fuel Choice, including Interactive Effects)



PRESENTATION FOR

Manitoba Hydro

October 6, 2016

DSM Plan Optimization:

Regional Analysis

dunsky ENERGY CONSULTING

www.dunsky.com
(514) 504-9030 | info@dunsky.com

DUNSKY **OVERVIEW**

EXPERTISE

- Energy Efficiency
- Demand Management
- Distributed Energy Resources
- Sustainable Transportation
- Greenhouse Gas Reductions

SERVICES

- Design and evaluation of programs, plans and policies
- Strategic & regulatory support
- Technical & analytical support
- Facilitation & consultation

CLIENTELE

- Utilities
- Governments
- Solution Providers
- Large consumers
- Non-profits

CONTENT

CONTEXT

REGIONAL ANALYSIS RESULTS

INITIAL FINDINGS

NEXT STEPS

CONTEXT

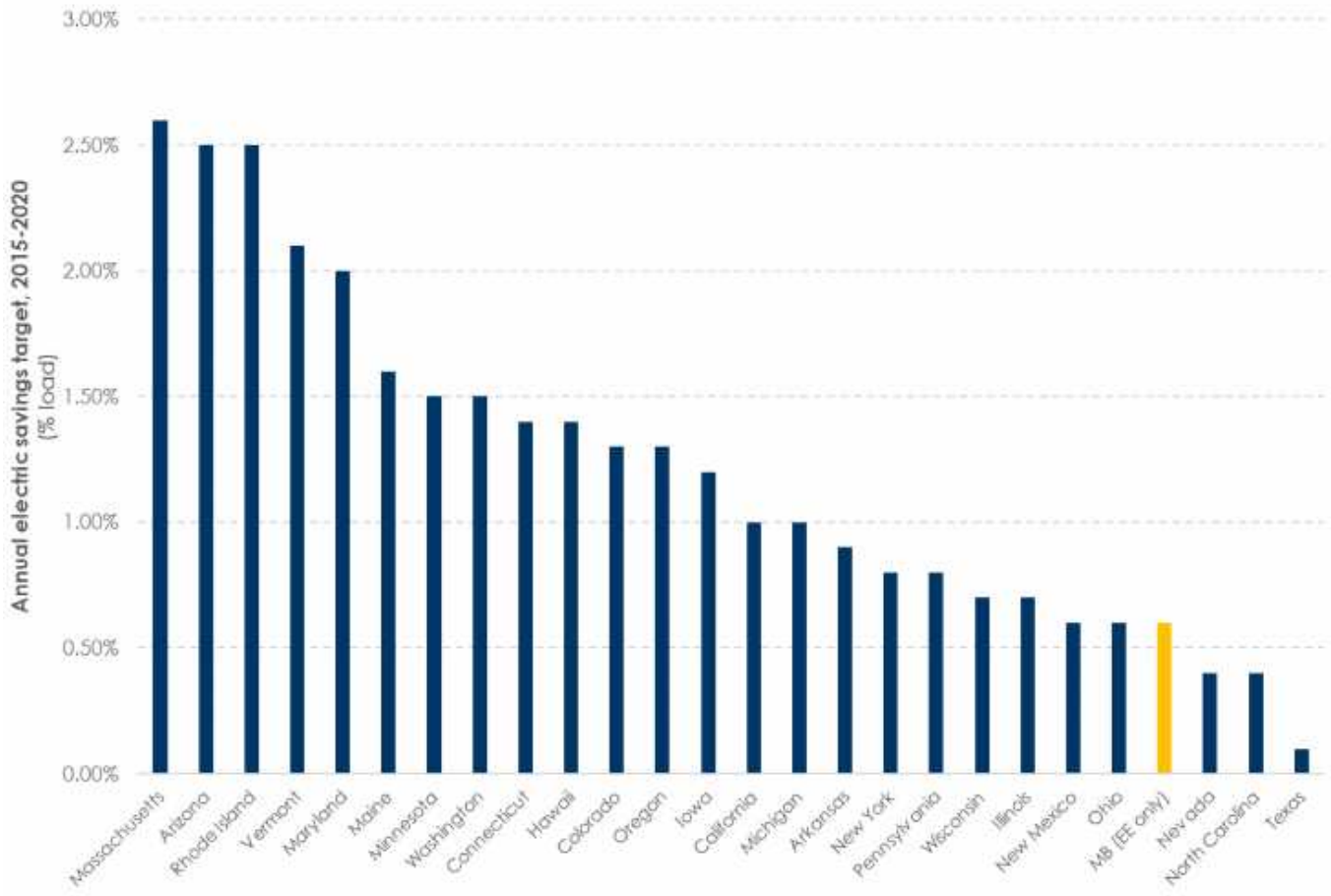
CONTEXT

Dunsky was approached by Manitoba Hydro to assist in determining how to achieve a greater level of energy savings.

Phase 1	• Primary and secondary research • High-level analysis
Phase 2	• Deeper analysis
Phase 3	• Discussions with specific jurisdictions
Phase 4	• Multi-layered review and optimization

REGIONAL ANALYSIS RESULTS

SAVINGS TARGETS: ELECTRICITY

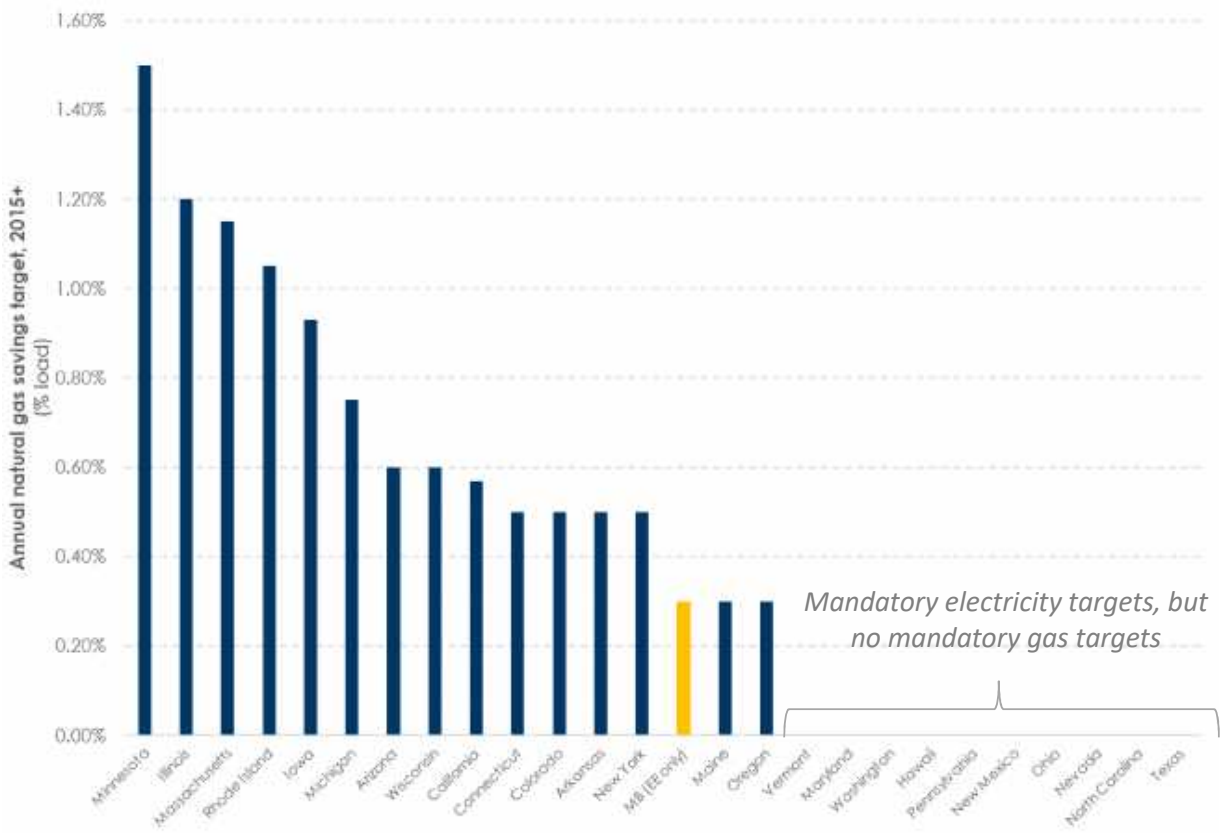


Looking to the 2015/16 period, Manitoba Hydro exhibits an average annual electric savings target of 1.1% (EE + all DSM activities)

Over 2015-2030, all DSM savings average 1.2% for Manitoba Hydro

**Net savings targets. Source: analysis based on ACEEE State Scorecard + primary research*

SAVINGS TARGETS: GAS



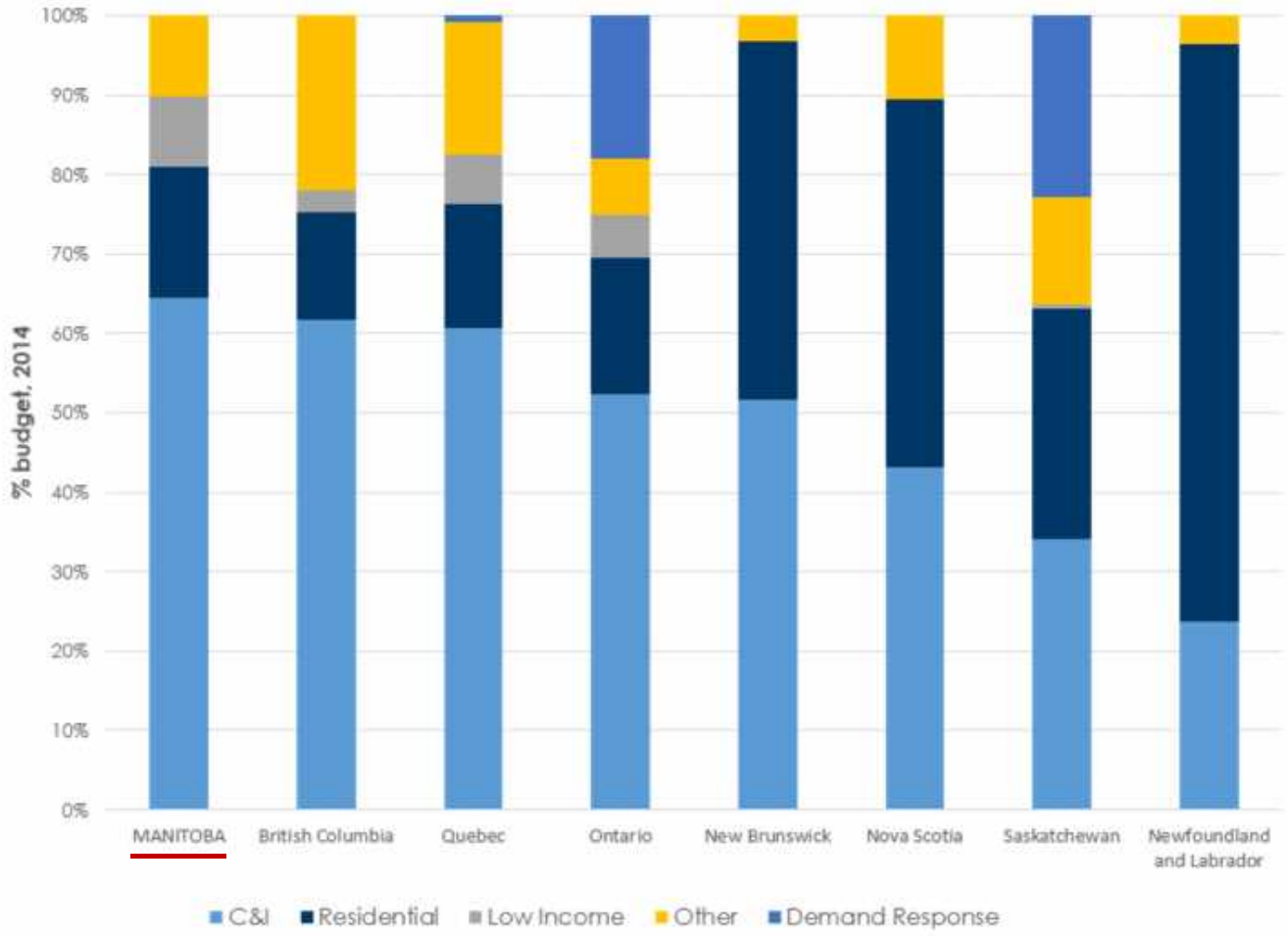
Looking at targets for 2015/16 and later (not all jurisdictions have far-reaching targets for gas), ***Manitoba Hydro*** *exhibits an average annual gas savings target of 0.5% (all DSM).*

**Net savings targets. Source: analysis based on ACEEE State Scorecard + primary research.*

CONSIDERATIONS

- Time in market
  - Nova Scotia (less)
  - Vermont/Massachusetts (similar)
- Jurisdictional similarities/differences
  - Climate:
    - *California (cooling climate)*
    - *Oregon/Minnesota (heating climate)*
  - Rates:
    - *California/Nova Scotia (higher rates)*
- Other
  - Surplus capacity
  - Net benefits
  - Rate impacts
  - Marginal value
  - Etc.

INVESTMENT BY SECTOR (Canada)



In Canada, this picture also varies significantly by jurisdiction.

Note that Manitoba's DSM budget profile reflects its load profile and is roughly in line with British Columbia and Quebec. Newfoundland and Labrador commits most of its budget to residential activities.

PORTFOLIO: RESIDENTIAL

PROGRAM TYPE	MB	BC	MN	VT	NS
Residential					
Appliance recycling	●	●	●	●	●
Behaviour, online audit, feedback		●	●	●	o
Consumer product rebate for appliances	●	●			●
Consumer product rebate for electronics	▪	●			▪
Consumer product rebate for lighting	●	●	●		●
Financing	●	●	●	●	●
Multifamily	●		●	●	●
New construction	●	●	●	●	●
Prescriptive HVAC	●	●	●	●	●
Prescriptive insulation	●	●	●	●	●
Prescriptive water heater	*		●	●	●
Prescriptive windows	●			●	●
Whole home audits	†	●	●	●	●
Whole home direct install	♦				●
Low income	●	●	●	●	●

Manitoba Hydro offers (or plans to) most of the options available in other jurisdictions.

***Note**: These programs are not necessarily offered by each jurisdiction as stated in this list. We have taken measures/ offerings from each jurisdiction and placed them into the Consortium for Energy Efficiency (CEE)'s program categories for comparison.*

º Now considered an 'enabling activity'. † An energy assessment **report** is available by filling out a questionnaire.
▪ ▪ Energy Saving Devices (e.g., power strips w/ timers). * Residential solar thermal water heating program available.
♦ Offered to select groups.

PORTFOLIO: COMMERCIAL

PROGRAM TYPE	MB	BC	MN	VT	NS
Commercial					
Custom audit	●	●	●	●	●
Custom retro-commissioning	●		●	●	●
Building envelope	●	†	●	●	
Financing	●		●	●	●
New construction	●	●	●	●	●
Prescriptive HVAC	●	●	●	●	●
Prescriptive IT and office equipment	●		●	●	●
Prescriptive lighting	●	●	●	●	●
Small commercial custom	●			●	●
Small commercial prescriptive	●	●	●	●	●
Street lighting	●			●	o

Manitoba Hydro's emphasis on the commercial segment is also reflected in other key jurisdictions, with the exception of BC.

***Note**: These programs are not necessarily offered by each jurisdiction as stated in this list. We have taken measures / offerings from each jurisdiction and placed them into the Consortium for Energy Efficiency (CEE)'s program categories for comparison.*

† Focused on new construction
º Mandated by the province, not Efficiency NS.

INITIAL FINDINGS

INITIAL FINDINGS

Our initial work offers a broader understanding of targets and DSM efforts across North America. It reveals a few partial insights:

Manitoba Hydro offers a relatively comprehensive suite of options for customers, comparable to or surpassing other jurisdictions.

Calculations differ from jurisdiction to jurisdiction.

- Savings:
  - Interactive effects
  - Net-to-gross ratios
- Cost-Effectiveness Testing:
  - Type of test
  - Non-energy benefits
  - Value of saved kWh

Most jurisdictions do not include codes and standards,* alternative generation and other initiatives in their targets.

Manitoba Hydro's DSM Plan development process differs from other jurisdictions (annual 15 year Plans compared to 3-5 year Plans filed every 3-5 years).

*Those that do include savings from new codes and standards only.

Interactive Effects

Heat

=

Less Heat Required

Less Heat

=

More Heat Required

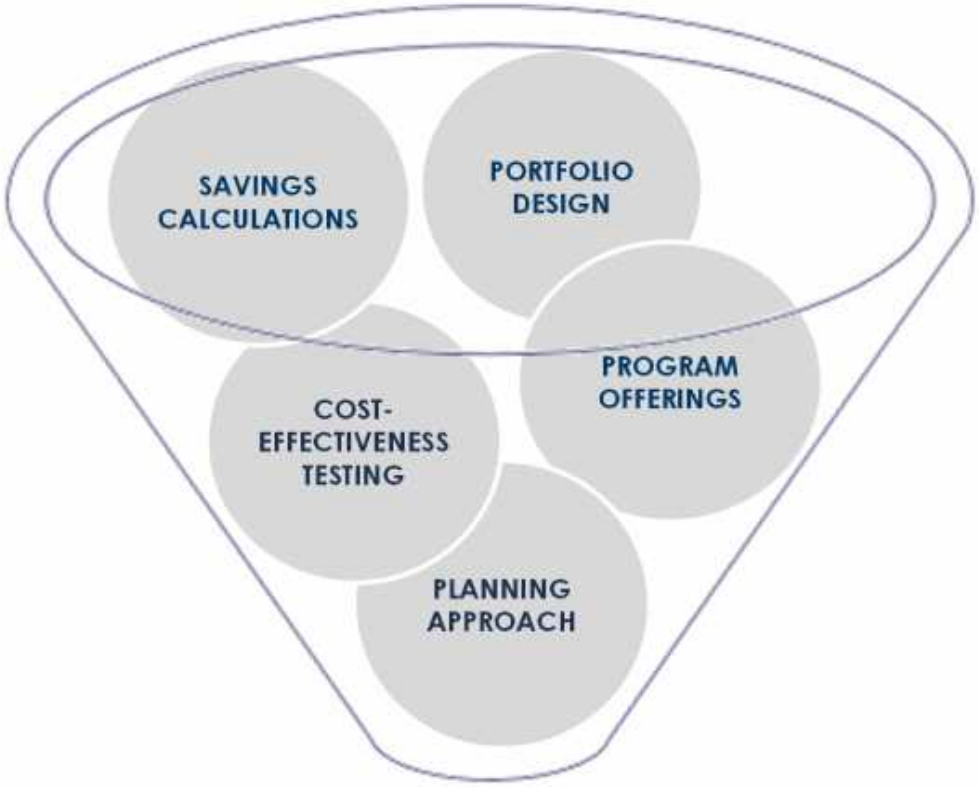
INITIAL FINDINGS

- There is not one “silver bullet.”
- Optimizing the DSM Plan will require a comprehensive approach that considers numerous smaller, incremental changes to achieve higher savings.

NEXT STEPS

NEXT STEPS

A SUITE OF PARAMETERS



OPTIMIZED PLAN

Achieved savings depend on the **combined effect of a suite of parameters**.

PHASE 4 ANALYSIS

- **Savings calculations:** Are there alternative, robust, savings calculations applicable to Manitoba Hydro that would demonstrate added value of DSM?
- **Cost-effectiveness testing:** Does Manitoba Hydro's cost-effectiveness testing fully assess DSM opportunities?
- **Portfolio design:** Can the structure of Manitoba Hydro's portfolio of programs be enhanced to encourage deeper energy savings?
- **Investment efforts:** Do additional opportunities (e.g. business development, enabling strategies, outreach, marketing, etc.) exist to enable higher savings?
- **Planning approaches:** How do Manitoba Hydro's differences in planning affect its energy savings?
- **Program offerings:** Can additional options be provided cost-effectively?
- **Overall investment requirements:** What will it take to achieve a higher level of savings?

QUESTIONS ?

Residential Programs

Tracy Sterdan
Residential Programs Supervisor

Manitoba Hydro

Residential Programs

Existing Programs

- Home insulation
- Lighting
- Water & Energy Saver
- New Homes
- Fridge/Freezer Retirement
- Smart thermostat pilot
- Financing
- Appliance rebate
- Instant rebates
- Thermostat rebate

Upcoming for 2016

- HRV Controls
- Drain Water Heat Recovery

Manitoba Hydro

Residential Programs

Appliances & Devices

Instant Rebates

Manitoba Hydro

Residential Programs

Drain Water Heat Recovery

HRV Controls

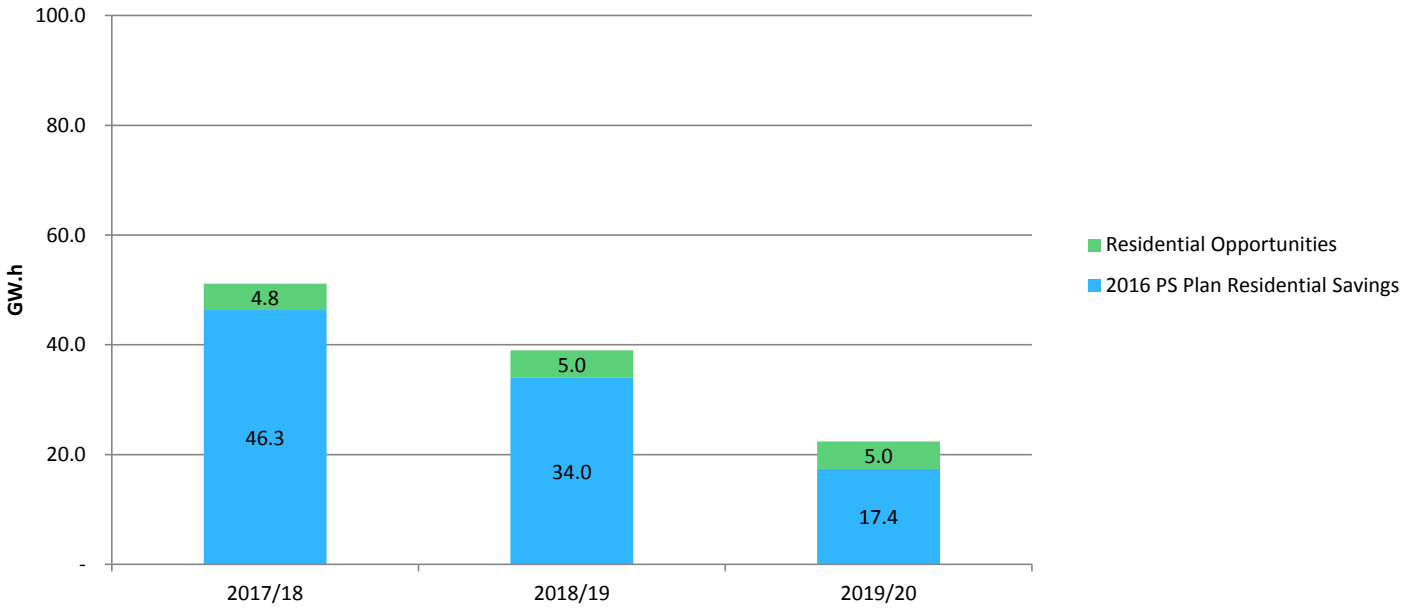
Residential Programs

Additional Opportunities

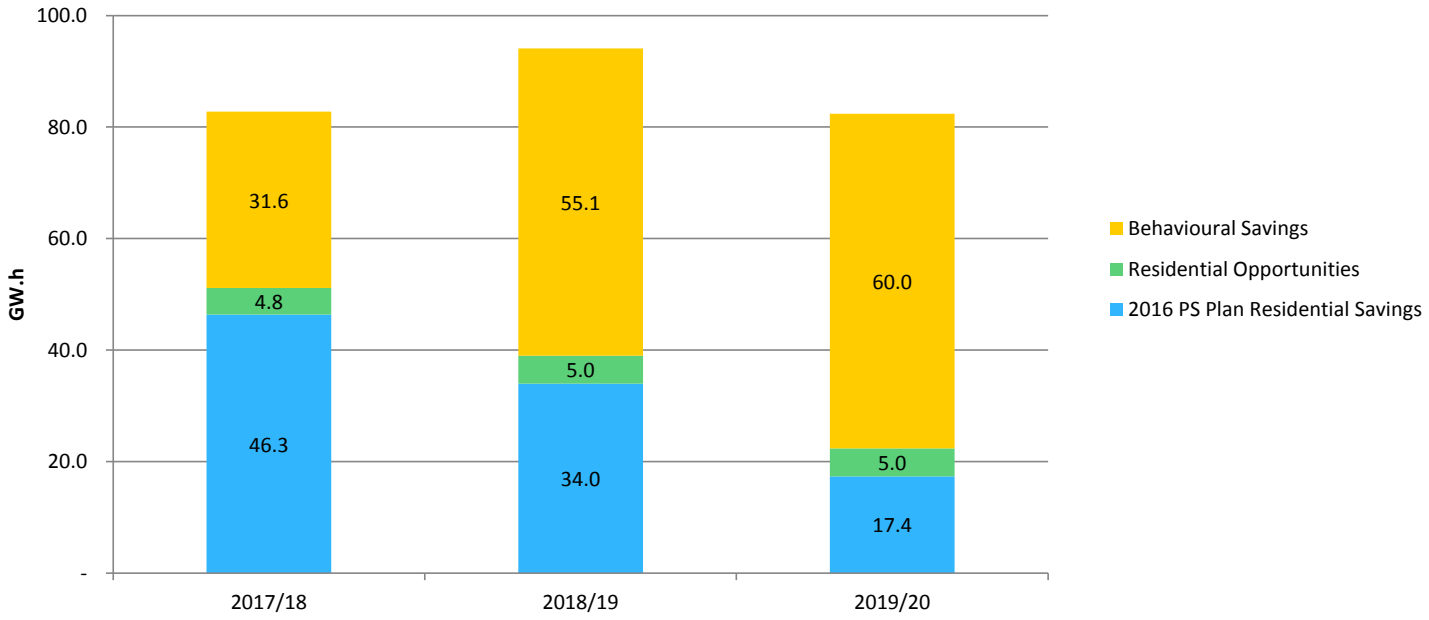
	Savings (GW.h)			TRC	Levelized Utility Cost	Levelized Resource Cost
	2017/18	2018/19	2019/20			
Wood Heating	1.1	1.1	1.1	0.4	15¢	19¢
Appliance Rebates	1.0	1.0	1.0	0.7	4.5¢	25¢
Instant Rebates	1.3	1.3	1.2	2.7	1.0¢	2.9¢
Windows Rebates	1.2	1.2	1.2	1.9	13¢	11¢
Home Audits & Air Sealing	0.3	0.5	0.5	1.4	11¢	9¢
Behavioural – Home Energy Reports	31.6	55.1	60.0	1.2	5.3¢	5.3¢
Total	**36.5**	**60.2**	**65.0**			

Manitoba Hydro

Residential Programs



Residential Programs



Commercial Programs

Roberto Montanino

Commercial Programs Supervisor

Manitoba Hydro

Commercial Programs

Existing Programs

- New Construction
- Small Business Direct Install
- Information Technology (IT)
- Commercial and Roadway Lighting
- Insulation, Windows
- Boilers
- Water Cooled Chillers
- Water Heating
- Retrocommissioning
- Custom Measures
- Water & Energy Saver for MURBs and Recreational Facilities
- Commercial Refrigeration
- Kitchen Appliances (Steamers, Fryers, Spray Valves)
- HRVs (May 2016)
- Parking Lot Controller (June 2016)
- Curtain Wall (July 2016)
- Single Entry Doors (August 2016)

Future Programs

- Race to Reduce *(January 2017)*
- Energy Manager *(April 2017)*
- Air Tightness *(May 2017)*
- Air Cooled Chillers *(June 2017)*
- Variable Speed Drives *(July 2017)*

Manitoba Hydro

Commercial Programs

Heat Recovery Ventilator (HRV) Program – *May 2016*

– Redevelopment of five-storey Scott Block at 272 Main Street to micro-apartments and commercial tenant space

– Fire hall at 228 Mystery Lake Road in Thompson

Manitoba Hydro

Commercial Programs

Parking Lot Controller Program – *June 2016*

– Over 20 active projects representing 1,100 stalls across the commercial office and manufacturing sectors as well as multiunit residential buildings

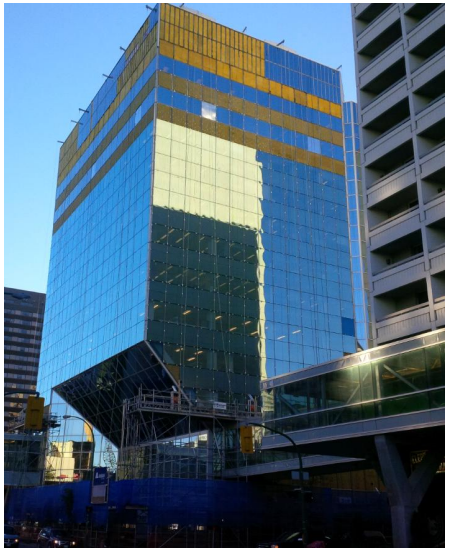
Manitoba Hydro

Commercial Programs

Curtain Wall Program – *July 2016*

– *Artis REIT project at 360 Main Street and*

– *Colliers International project at 330 St Mary Avenue*



Manitoba Hydro

Commercial Programs

Manitoba Race to Reduce – *January 2017*

– Leadership Advisory Council formed, co-chaired by Kelvin Shepherd, Manitoba Hydro and Frank Sherlock, Artis REIT

– Working Groups identified and established

– Over 5 million square feet committed thus far representing 165% of target

MANITOBA RACE TO REDUCE
THE SMART ENERGY BUILDING CHALLENGE

Manitoba Hydro

Commercial Programs

Energy Manager Program – *April 2017*

– Draft memorandum of understanding between Manitoba Hydro and The North West Company

– Manitoba operations include 24 Northern and NorthMart retail stores, 6 Giant Tiger retail stores, head office and distribution centre

THE NORTH WEST COMPANY

Northern NorthMART GIANT TIGER

Manitoba Hydro

Commercial Programs

Air Tightness Testing and Sealing Program – *May 2017*

– Pilot projects with Manitoba Housing

– Bluebird Lodge Senior Home: 11 storey building at 97 Keewatin Street, Winnipeg

- Townview Manor Senior Home: 6 storey building in 169 Main Street, Minnedosa

manitobahousing

Manitoba Hydro

Commercial Programs

Opportunities Identified from Efficiency Nova Scotia

- *Economizers*
- *Hotel / Motel Suite Automation*
- *Dishwashers*
- *Ice Makers*
- *Griddles*
- *Holding Cabinets*
- *Convection Ovens*

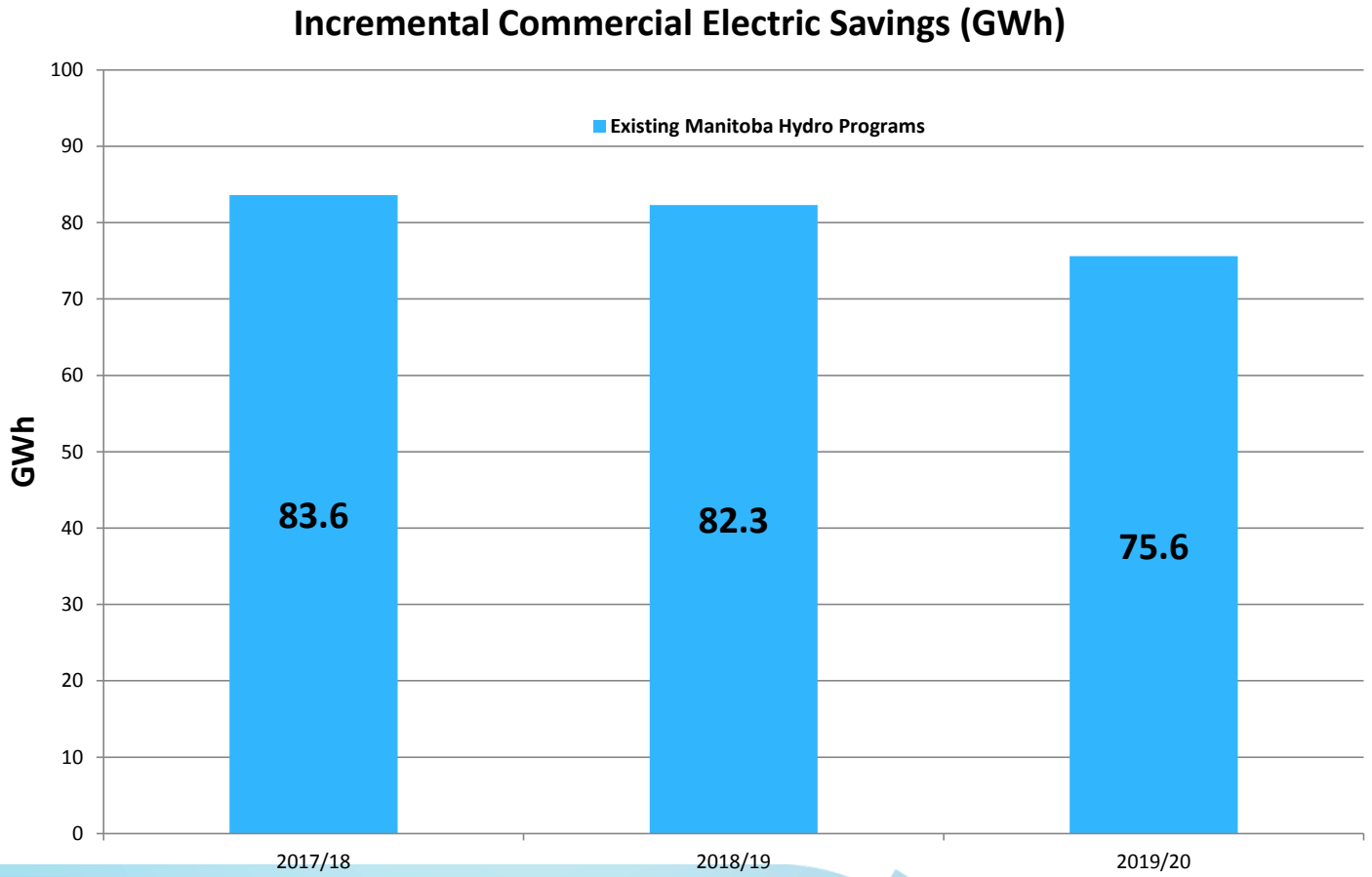
Commercial Programs

Opportunities Identified from Efficiency Nova Scotia

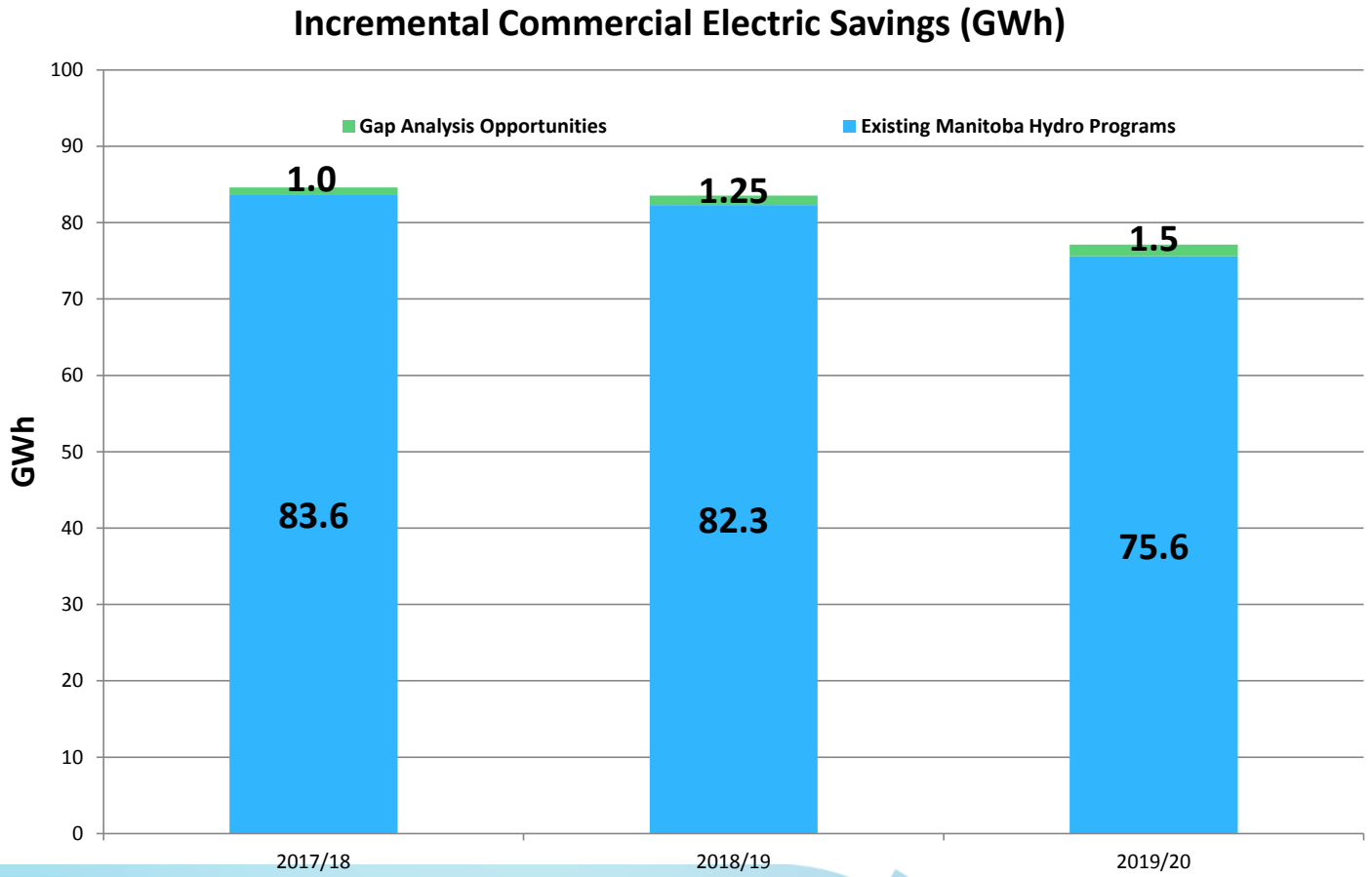
	Savings (GW.h)			TRC	Levelized Utility Cost	Levelized Resource Cost
	2017/18	2018/19	2019/20			
Economizers	0.02	0.03	0.03	0.5	11.9¢	10.8¢
Hotel / Motel Suite Automation	0.02	0.02	0.03	0.6	23.1¢	25.7¢
Dishwashers	0.64	0.82	0.97	5.7	0.8¢	1.2¢
Ice Makers	0.06	0.08	0.09	0.5	11.9¢	13¢
Griddles	0.06	0.07	0.08	0.7	9.1¢	9.6¢
Holding Cabinets	0.14	0.19	0.23	1.2	3.7¢	5.3¢
Convection Ovens	0.03	0.04	0.05	0.4	15.1¢	15.5¢
TOTAL	**0.97**	**1.25**	**1.47**			

Manitoba Hydro

Commercial Programs



Commercial Programs



Earth Energy & Emerging Technologies

Jana-Rae Brunel

Supervisor

Manitoba Hydro

Emerging Technology Programs

Existing Programs

- Community Energy Plans *(May 2016)*
- Commercial & Residential Solar PV *(April 2016)*
- Community Geothermal
- Commercial Geothermal
- Commercial PAYS
- Residential Earth Power Loan
  - Air Source Heat Pumps
  - Solar PV
  - Solar Thermal
  - Geothermal

Community Energy Plans

Dauphin

- Advocate focusing on municipal building energy efficiency opportunities

The Pas

- Power Smart water & energy saving kits being delivered
- Walkthroughs by Power Smart Shops delivery team

Solar Energy Program

The Solar Energy Program was designed for residential, commercial and industrial customers who would like to displace their own energy needs with solar energy.

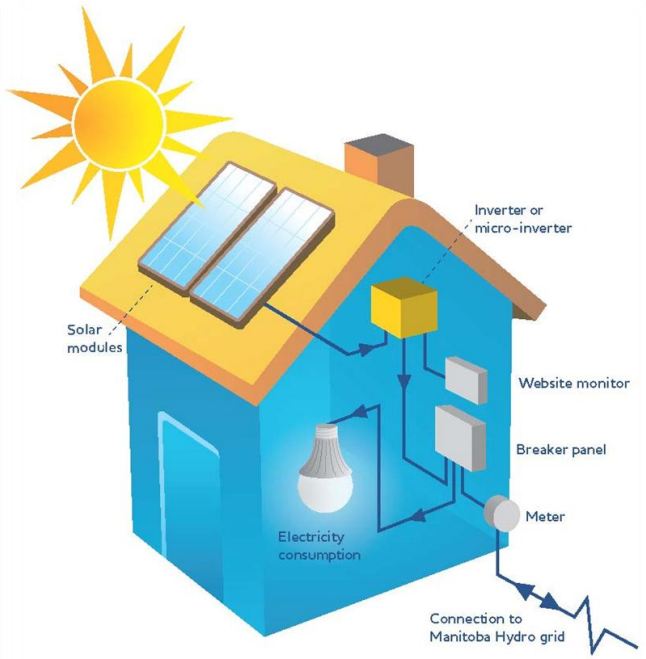
Manitoba Hydro

Solar Energy Program

- Financial incentive of $1/watt (DC)
- Residential, commercial and industrial
- Limited by the annual load displacement requirement at site to a max of 200kW

Participation to Date

- 70 application received
  - total of 1.1 GW.h displaced energy
- 9 completed projects
- 5 loans
- 7 kW average DC size of system
- 83,827 total kW.h displaced



Opportunities Identified from Efficiency Nova Scotia

– *Cold Climate Air Source Heat Pump (ASHP) incentive*

- Current financial support available through REPL
- Monitoring study in progress to determine actual performance of the technology in Manitoba climate
  - Coefficient of Performance (COP) decreases with temperature
  - Monitoring shows SCOP of 1.5 (manufacturer claims over 3)
  - Back up electric heat required at -15 degrees Celsius

Manitoba Hydro

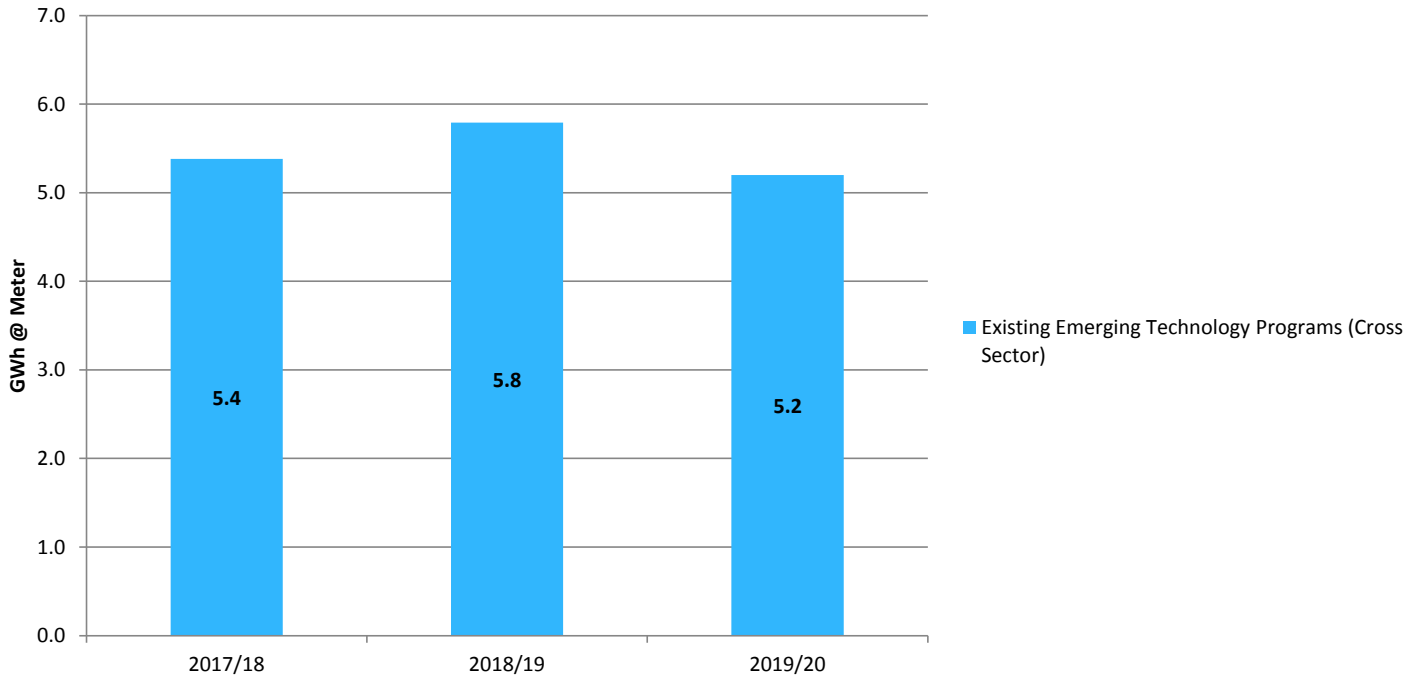
Emerging Technology Programs

Opportunities Identified from Efficiency Nova Scotia

	Savings (GW.h)			TRC	Levelized Utility Cost	Levelized Resource Cost
	2017/18	2018/19	2019/20			
Commercial ASHP	.08	.21	.38	0.37	9.9¢	13.4¢
Residential ASHP	.11	.27	.52	0.27	8¢	18.9¢
Total	**.19**	**.48**	**.9**			

Emerging Technology Programs

Incremental Electric Savings Opportunities



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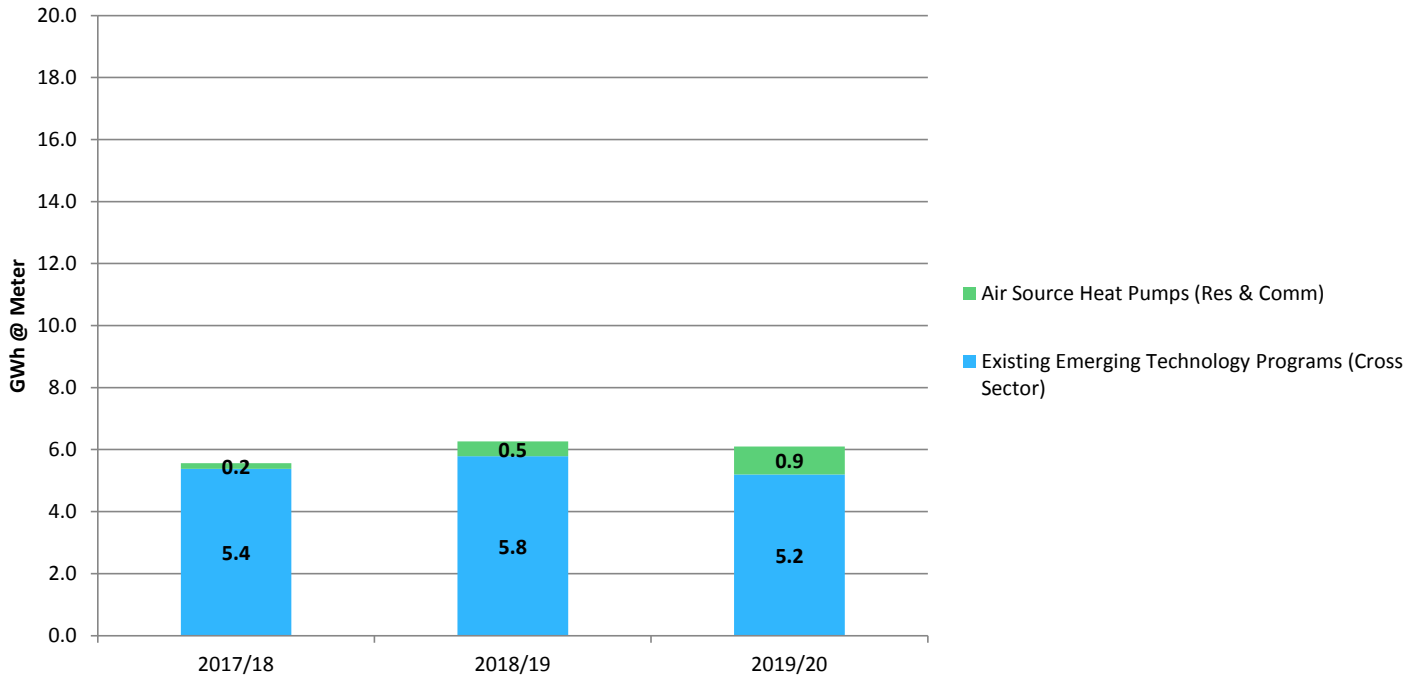
Emerging Technology Programs

Incremental Electric Savings Opportunities

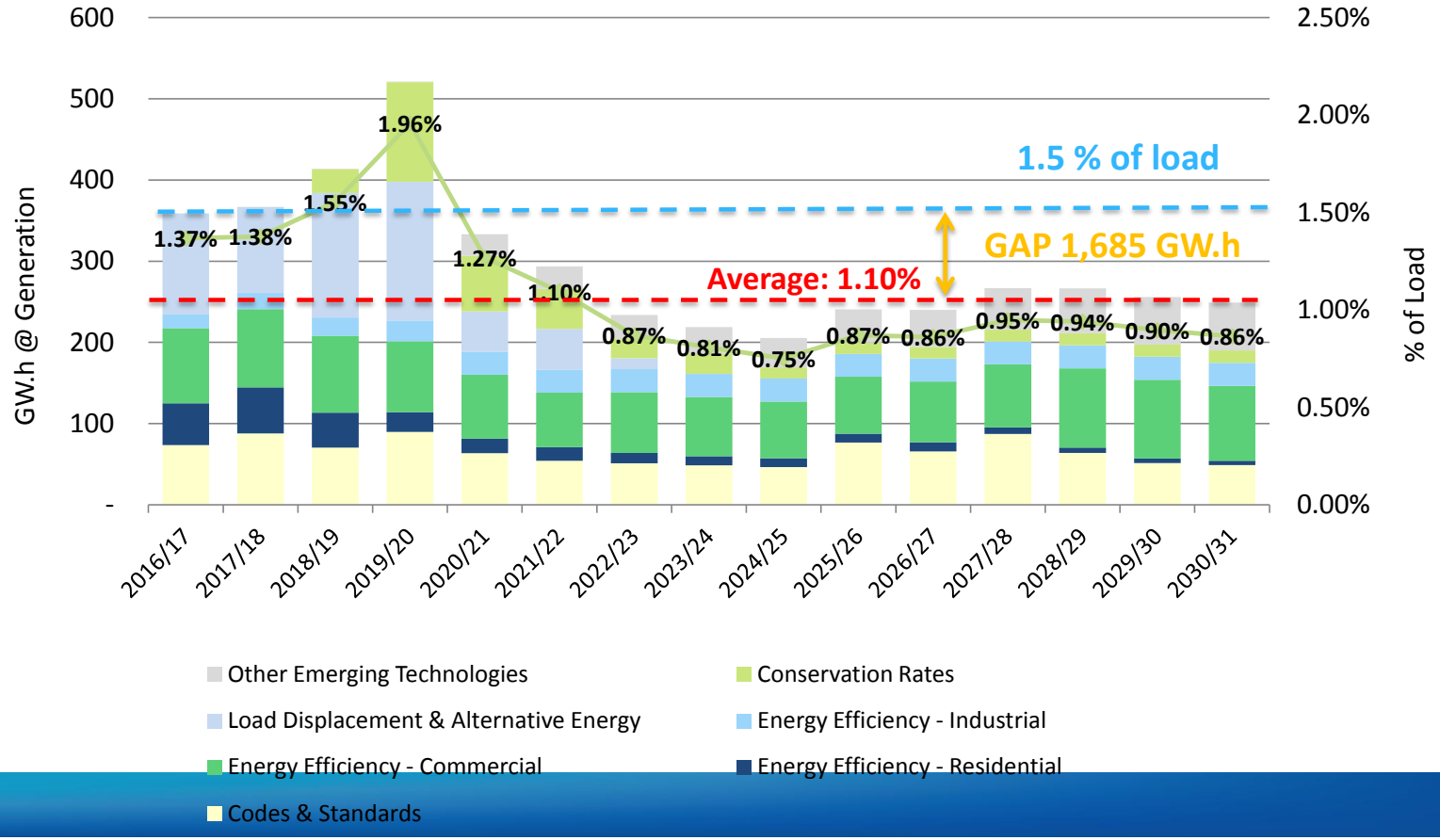


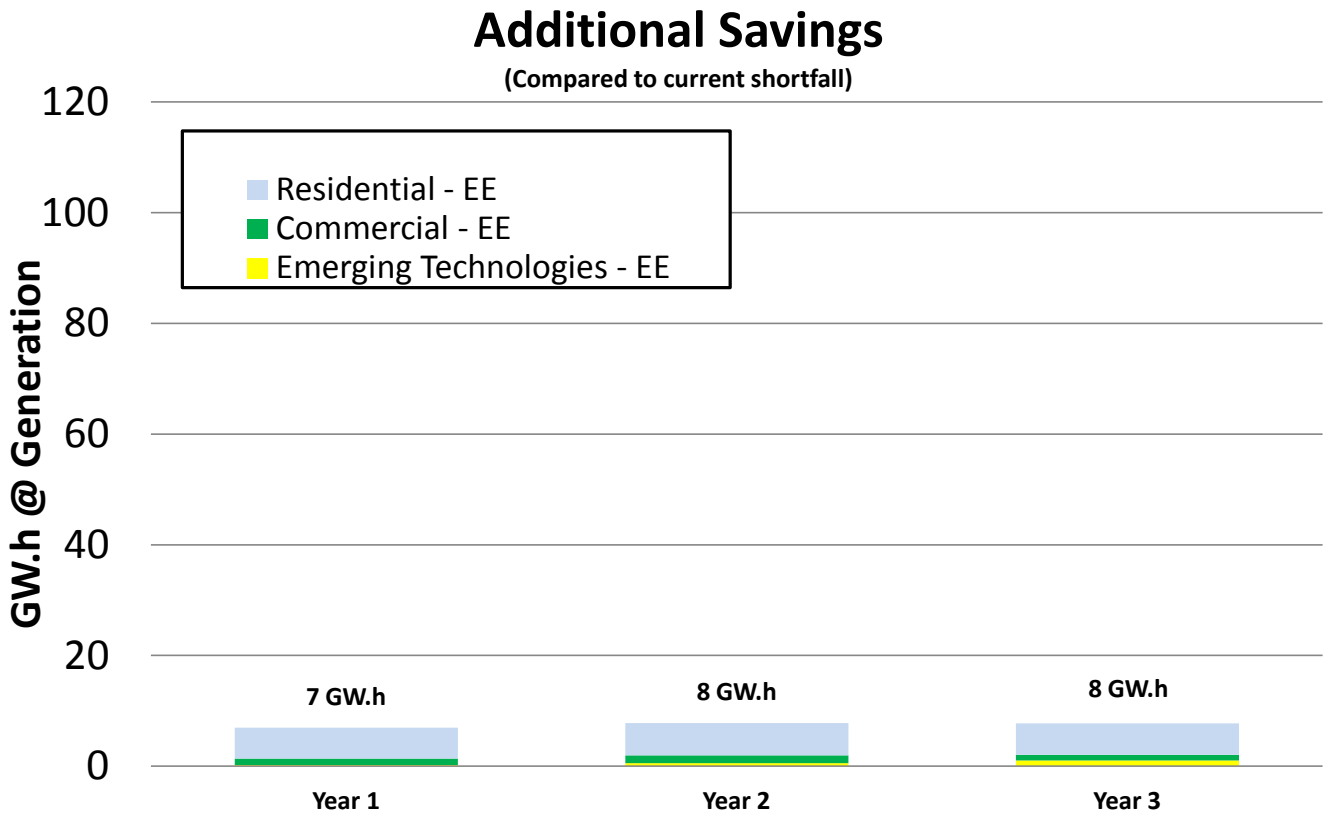
Summary

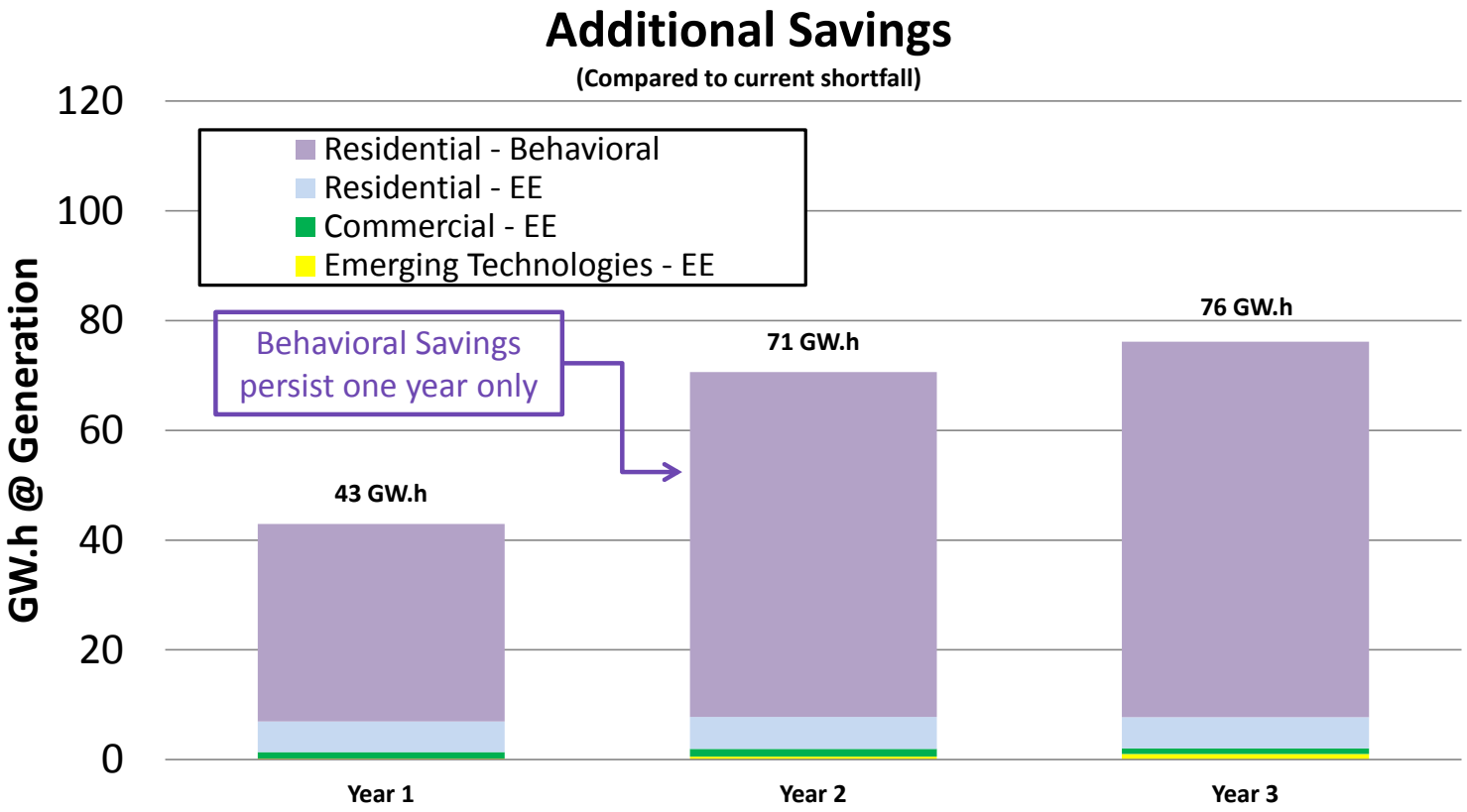
Annual Electric Savings

Percent of Annual Load

(Excluding Fuel Choice)



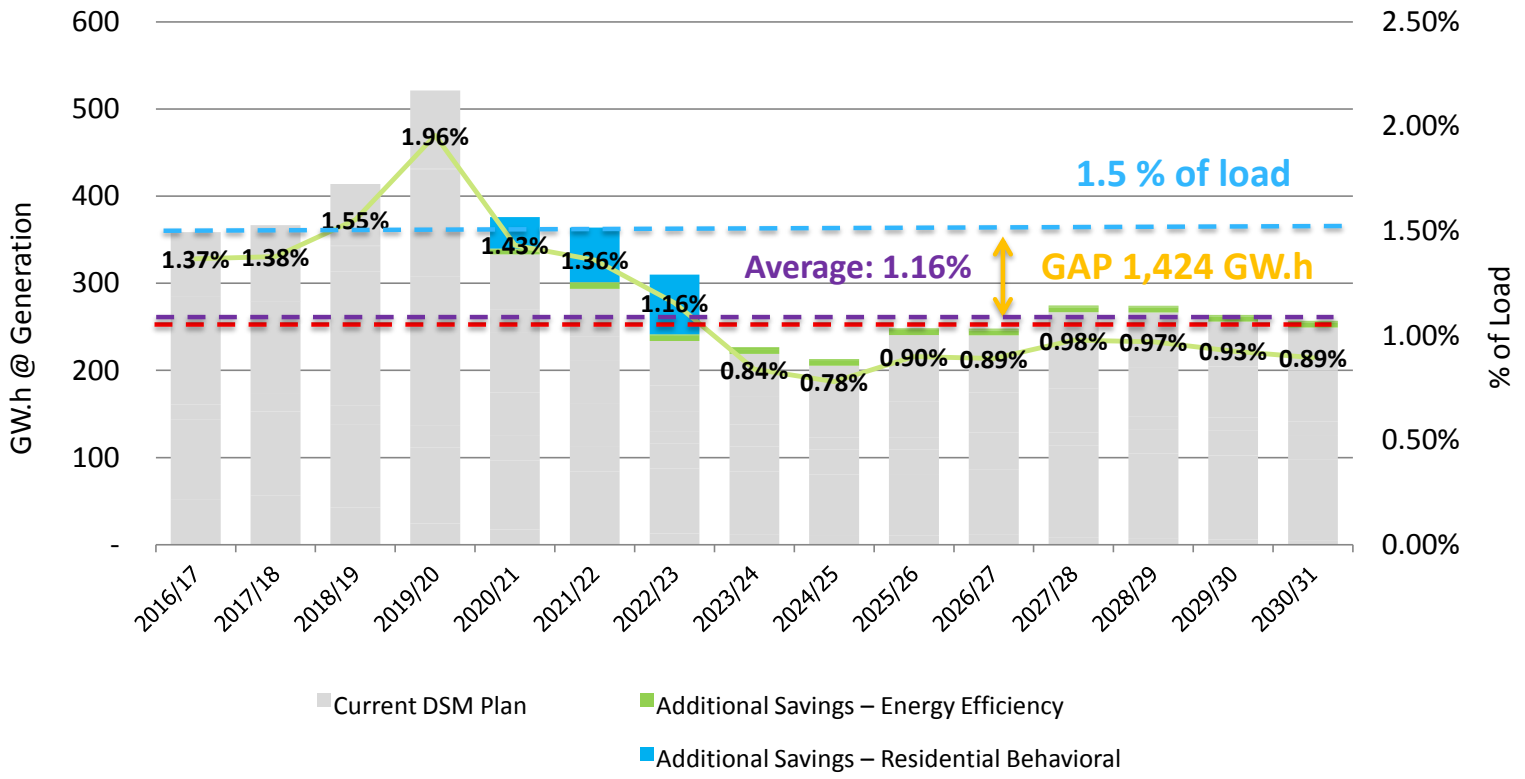

Additional Savings
(Compared to current shortfall)
GW.h @ Generation
120
100
80
60
40
20
0
Residential - EE
Commercial - EE
Emerging Technologies - EE
7 GW.h
8 GW.h
8 GW.h
Year 1
Year 2
Year 3


Additional Savings
(Compared to current shortfall)
GW.h @ Generation
120
100
80
60
40
20
0
Residential - Behavioral
Residential - EE
Commercial - EE
Emerging Technologies - EE
Behavioral Savings persist one year only
43 GW.h
71 GW.h
76 GW.h
Year 1
Year 2
Year 3

Annual Electric Savings

Percent of Annual Load

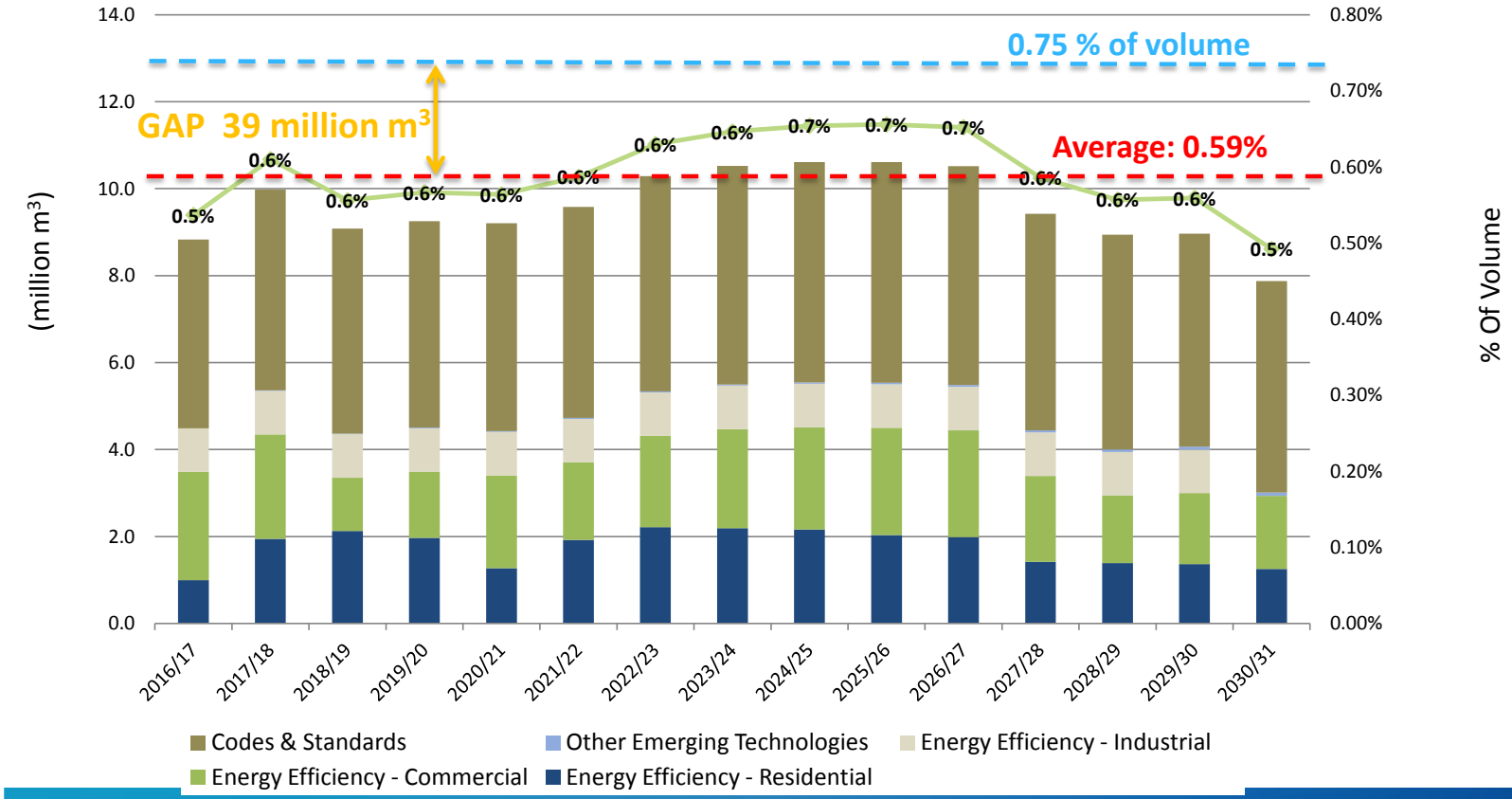
(Excluding Fuel Choice)



Annual Natural Gas Savings

Percent of Annual Volume

(excluding impacts from Fuel Choice, including Interactive Effects)



Excludes volume from Special Contracts and Power Stations

Natural Gas DSM Challenges

- Past Opportunities
  - Standard Furnaces (60%) to High Efficient Furnaces (>92%)
  - Basement and attic insulation
- Future Opportunities
  - Limited inefficient furnaces
  - More Costly Insulation Upgrades
  - Fuel Switching

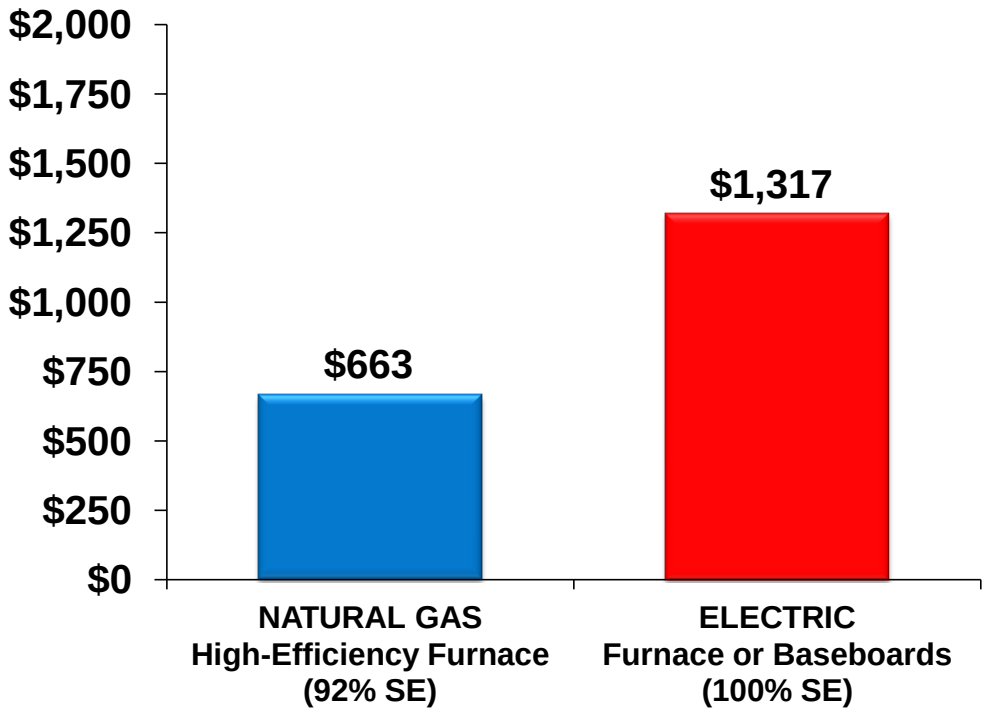
Changing Business Environment

- Carbon Pricing
  - $50 carbon price increases Natural Gas Costs by approximately 25 - 30%
- Manitoba Hydro's Board Business Review
  - Fiscal Situation Unacceptable
  - Debt going from $13 Billion to $25 Billion (doesn't include cost of meeting higher DSM targets)
  - Surplus electricity generation until late 2030's
  - Impact on electricity rates?

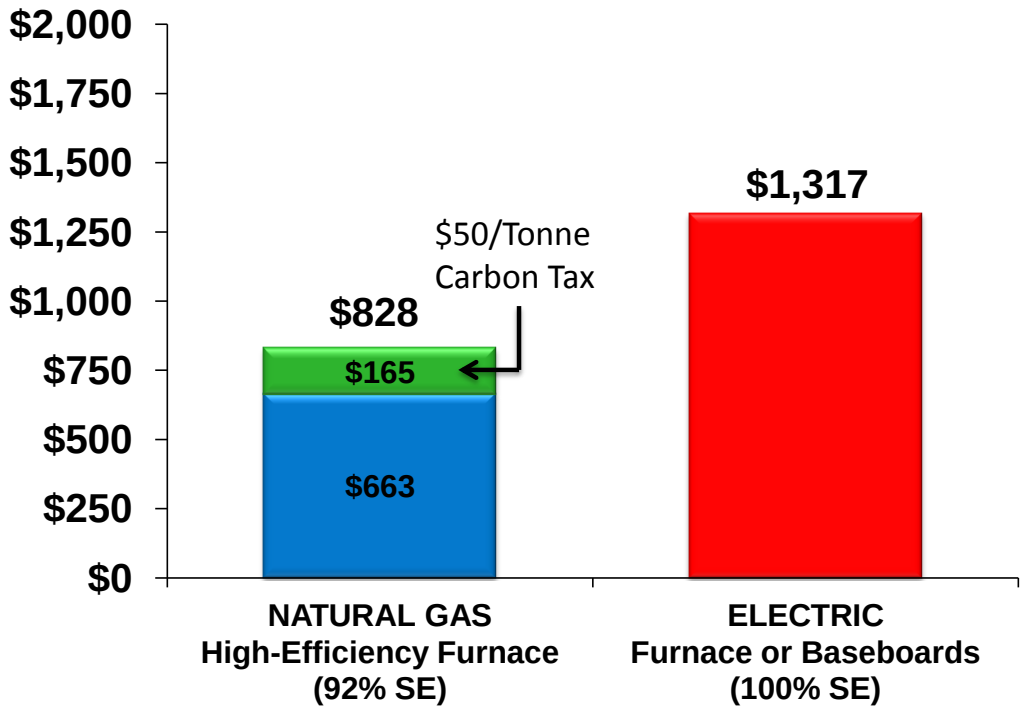
Fuel Switching - Conflicting Drivers

- Affordability
  - Electricity to Natural Gas for Heating
- Emission Reductions (Local vs Global)
  - Natural Gas to Electricity for Heating

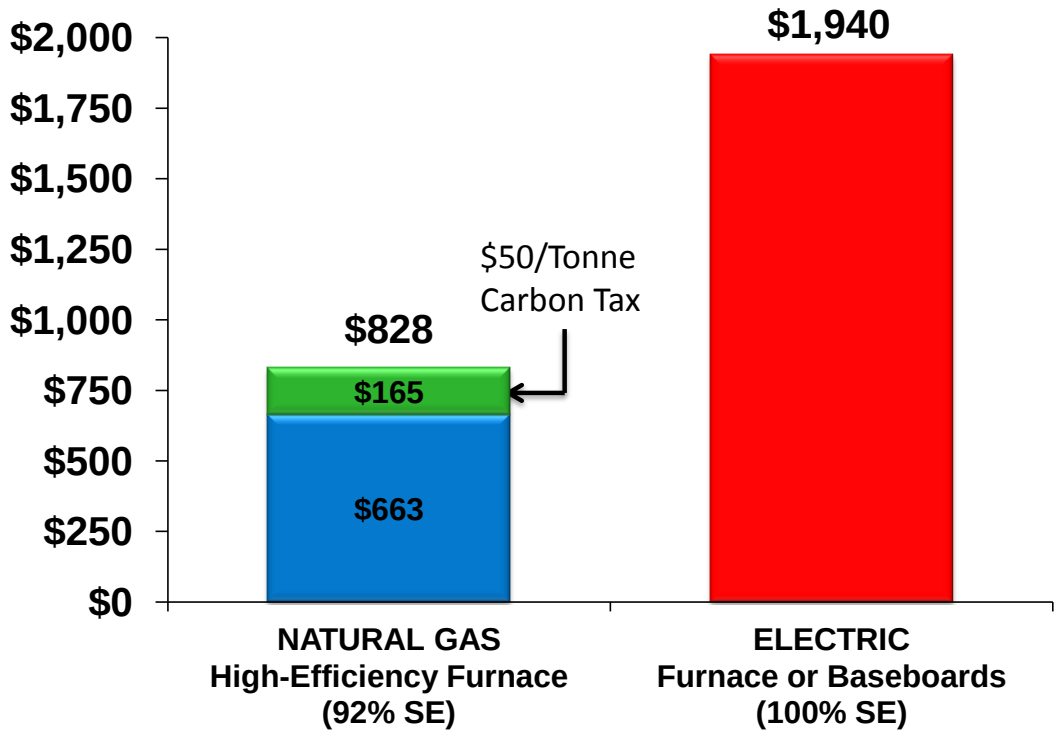
Comparison of Current Annual Space Heating Costs



Comparison of Current Annual Space Heating Costs including $50 per Tonne Carbon Tax



Comparison of Projected Annual Space Heating Costs including $50 per Tonne Carbon Tax



- Assumes current natural gas rate of $0.2839 per $m.^3$
- Electric 10 year projected rate of $0.1168 per kWh

2016 Fuel Switching Analysis - Summary

Impact of Converting from Natural Gas Space Heating to Electric Space Heating

Average Residential Home from Natural Gas to:	Electric Furnace	Geothermal (SCOP 2.5)
Annual Energy Load Impact		
Electric Load Impact (kWh)	16,605	6,642
Natural Gas Load Impact ($m.^3$)	(1,744)	(1,744)
Economic Impact		
Utility Perspective (Electric)	($4,858)	($1,944)
Utility Perspective (Natural Gas)	($5,599)	($5,599)
Customer Perspective	($12,815)	($11,253)
Integrated Utility / Customer Perspective	($23,272)	($18,796)
Net Provincial Inflow (Leakage)	($10,612)	($647)
Annual Environmental Impact		
Manitoba (kg $C0_2e$/year)	(3,313)	(3,313)
US - MISO Region** (kg $C0_2e$/year)	0 to 12,454	0 to 4,982
Net Global**(kg $C0_2e$/year)	(3,313) to 9,140	(3,313) to 1,688

***The US-MISO Region and Net Global impacts are shown as a range, which includes the impact under today's emission policies in export regions and recognizes what the potential impacts could be under more aggressive emission policies in export regions.*

DSM Leadership Mtg – Oct 5, 2016

- Members
  - B.C. Hydro
  - Ontario (IESO)
  - Manitoba Hydro
  - Efficiency Nova Scotia

- DSM investment on per capita basic is comparable

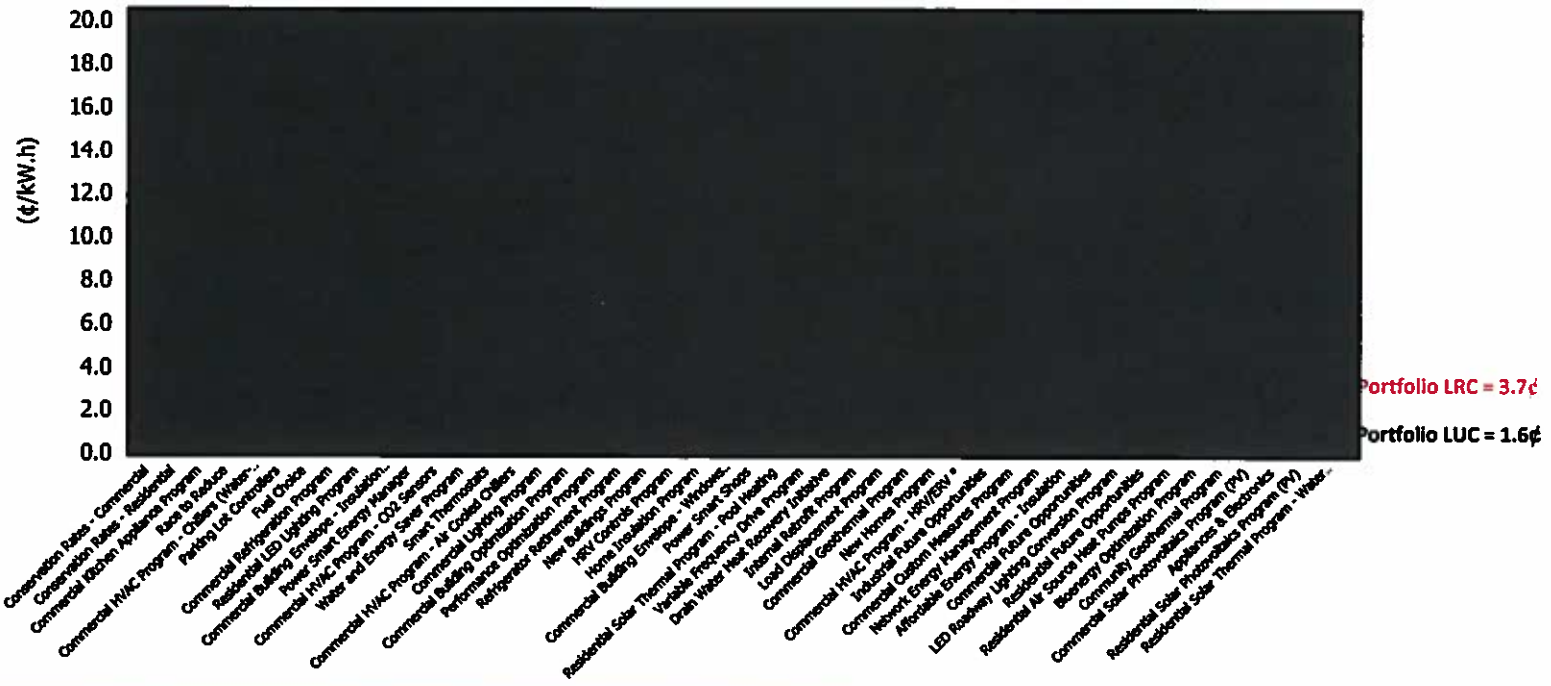
- Issues vary but all considering impact of Carbon Tax
  - Potential future impact: greater electrification of global economy

Next Steps

- Assessing impacts of new DSM Targets & Risks
  - Cost is significant
  - Incremental Savings will be at a higher cost
- Fuel Switching Strategy
- Conservation Rate Strategy

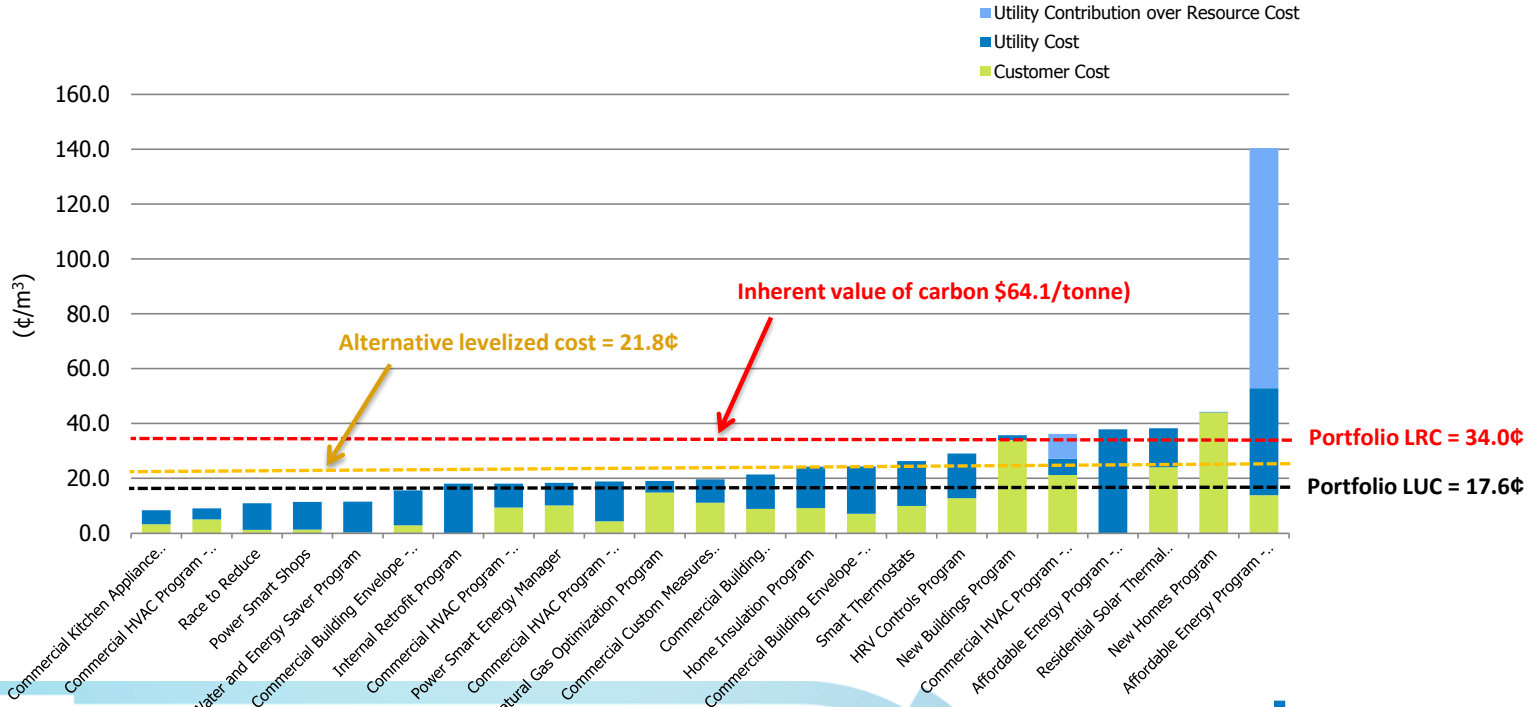
2016 Power Smart Plan

Electric Levelized Cost



2016 Power Smart Plan – 15 Year

Natural Gas Levelized Costs



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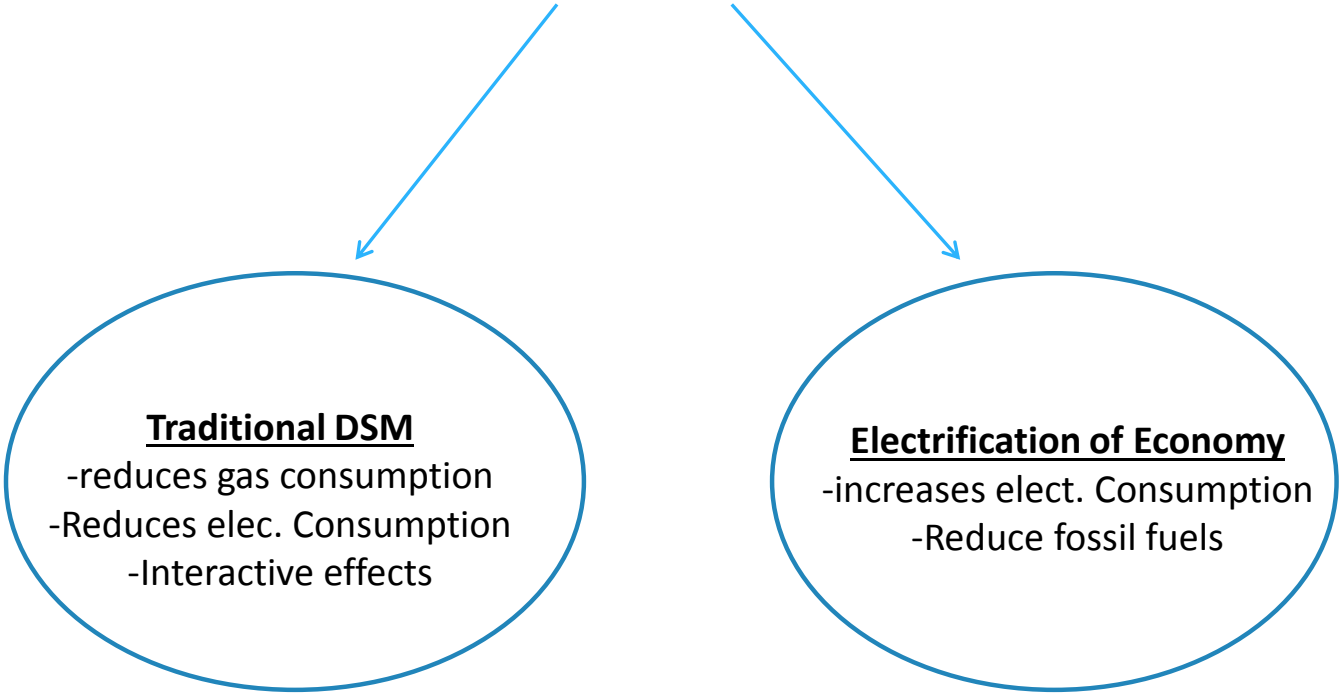
Future DSM Direction



Questions