PRESENTATION FOR

The Public Utilities Board

MANITOBA HYDRO NFAT REVIEW

DIRECT TESTIMONY OF PHILIPPE DUNSKY

April 28, 2014

dunsky
ENERGY CONSULTING

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DUNSKY OVERVIEW

CLIENTS (sample from among >100)

EXPERTISE

- Energy Efficiency and Demand-Side Management
- Renewable Energy and Emerging Technologies
- Greenhouse Gas Reductions

SERVICES

- Design and evaluation of programs, plans and policies
- Strategic, regulatory and analytical support
- New opportunities assessments

CLIENTELE

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

DUNSKY **EXPERTISE**

We assist our clients in the following areas:

RESIDENTIAL

- ✓ New Construction
- ✓ Retrofit (able-to-pay & low-income)
- ✓ Advanced HVAC (incl. controls)
- ✓ Lighting & Appliances
- ✓ Behavioural, Plug Load, Others

BUSINESS & GOVERNMENT

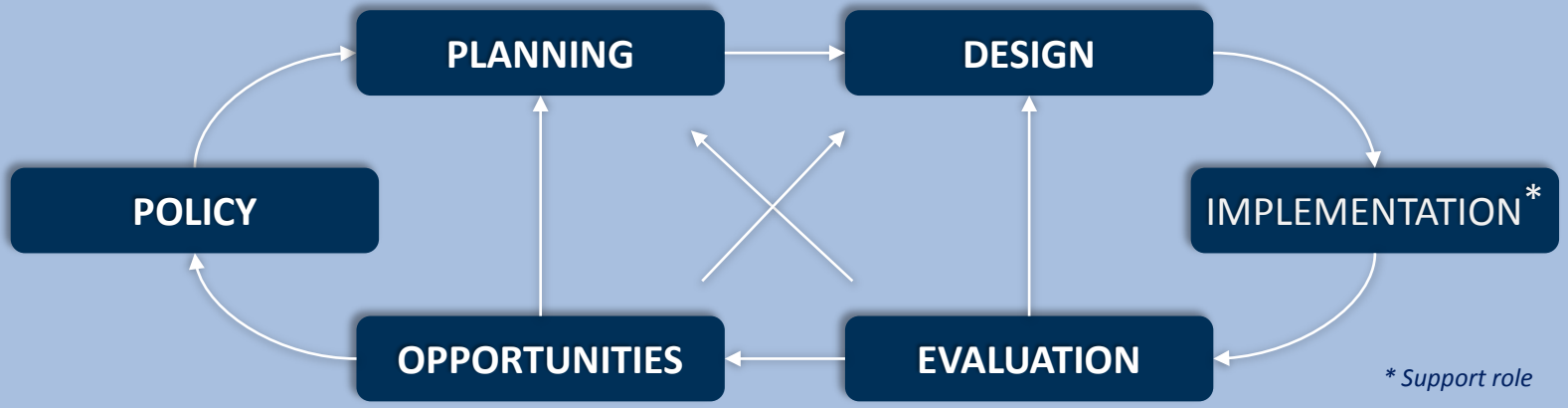
- ✓ Existing Buildings (custom, direct install, continuous optimization)
- ✓ New Construction (small and large)
- ✓ Equipment (Lighting, Controls, HVAC, Motors)
- ✓ Innovative Solutions

CROSS-SECTORAL

- ✓ Policies and Comprehensive Plans
- ✓ Regulatory Frameworks
- ✓ Innovative Financing
- ✓ Building Labelling & Benchmarking
- ✓ Rate Structures & Options
- ✓ Demand Response & Load Control
- ✓ Smart Meters / Grids
- ✓ Customer-sited Renewables
- ✓ Next-Generation Technologies
- ✓ Codes and Standards

DUNSKY **SERVICE AREAS**

PRIMARY AREAS



SUPPORT SERVICES

STRATEGIC & MARKET

- Comprehensive Plans
- Program Design
- Best Practice reviews
- Gap Analyses
- Business Plans
- Strategic Evaluations
- Process Evaluations
- Benchmarking
- Market Research
- Stakeholder Engagement
- Regulatory Frameworks
- Regulatory Support

TECHNICAL & ECONOMIC

- Potential Studies
- Technology Assessments
- Measure Characterization
- Savings Algorithms
- Modelling
- Impact Evaluations
- Cost-Effectiveness Screening
- Financial Analysis
- Energy System Modelling
- Carbon Markets

BUILDING SERVICES

- Building Assessments & Modelling
- Building Performance Optimization
- Building Certifications (LEED, BOMA, ESPM, etc.)
- Related services

My Qualifications

23 YEARS OF EXPERIENCE

- 10 leading my firm (advising N.A. govts, utilities, others)
- 8 as Executive Director of energy think tank
- 5 working with government and non-profits

PAST APPOINTMENTS

- GOVT: Canadian GMF ($650m); Quebec EE Agency, Quebec Energy Commission, NRTEE
- PRIVATE: Venture cap (FIDD), EIG investment fund, Enbridge DSM Audit Comm., others…
- Non-profit: FAQDD, PlanetAir, BC Green Landlords Project, Daphna Foundation, others…

CURRENT PROJECTS

- **Comprehensive Plans**
  - *MB (CAC/GAC): review NFAT filing*
  - *NB (NBP): design RASD plan (EE+DR)*
  - *VT: long-term energy planning / modelling*
- **Program Design and C&S**
  - *SK: solar finance design*
  - *ON (TAF): innovative finance model (C&I)*
  - *MB (MH): low-income program review*
  - *OEE: home retrofit strategies*
  - *OEE: new LVT standards*
- **Program Evaluation**
  - *CA (CPUC): impact evaluations (lead)*
  - *CA (IOUs): process evaluations*
- **Potentials and Opportunities**
  - *NB (NBP): potential studies*
  - *MA (CLC): potential study*
  - *MA (NU): smart thermostats*
  - *MA (NU): new gas savings opportunities*
- **Economic & Technical Analysis**
  - *AESP: Trainer – DSM Economics (Advanced)*
  - *GM: incorporation of non-energy benefits*
  - *CA: Methodologies for finance programs*
  - *ENSC: Frameworks for planning and IRP*
  - *NBP: Technical Resource Manual (TRM)*
  - *ON (OPA): advanced lighting TRM*

CURRENT OTHER CONTRIBUTIONS

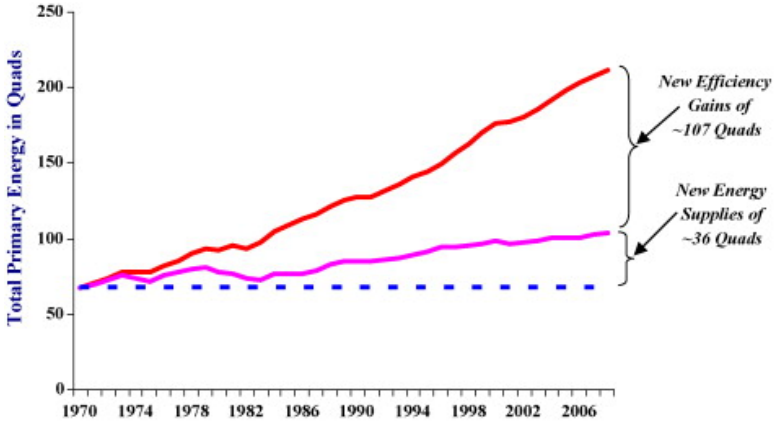
- NESP (cost-effectiveness): Advisor
- NEEP-AHP (Cold Climate): Member
- NEEP-AHP (Policy): Member
- Others (ACEEE, AESP, CEEA, AQME)

CONTENTS

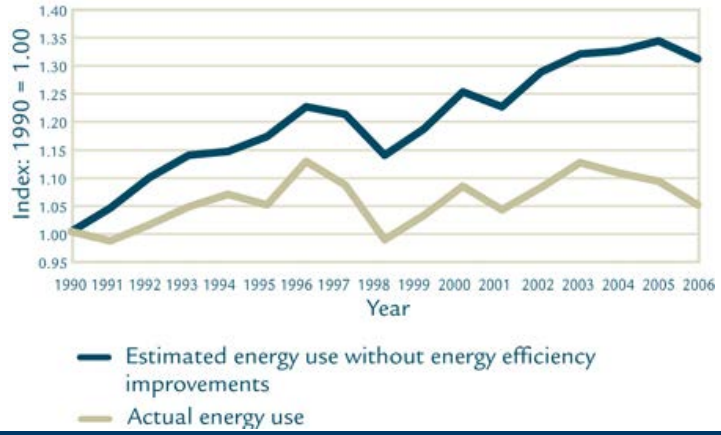
CONTENTS

Demand-Side Management (DSM)

- **Two options to ensure sufficient supply**
  - Increase Supply
  - Increase Efficiency (reduce demand)
- In U.S., since 1970 energy efficiency has supplied 75% of growth in demand
  - Increased supply: 25%
  - **Increased efficiency: 75%**
- In Canada, from 1990 to 2006, energy efficiency (DSM) supplied majority of residential growth in demand for energy services
  - Increased supply: 15%
  - **Increased efficiency: 85%** or $6.6B

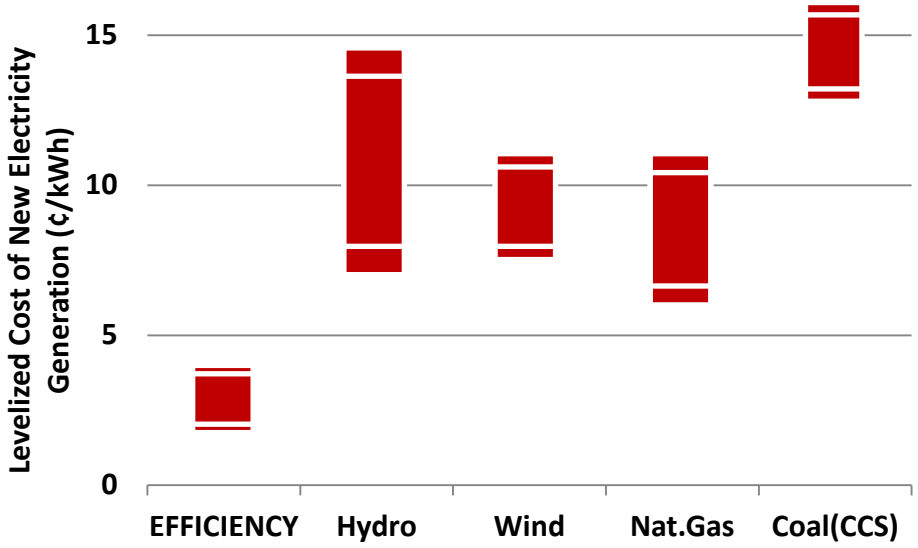


Residential Energy Use, Actual and Without Energy Efficiency Improvements, 1990 to 2006



EFFICIENCY'S BUSINESS CASE

- ✓ **CHEAP**
  - 2-8 times cheaper than new supply (power plants)
  - Also lower risk
- ✓ **JOBS**
  - ~2-10 times more jobs per million dollars invested
- ✓ **CLIMATE**
  - 1st priority in reducing CO2 emissions
- ✓ **ECONOMIC BENEFIT**
  - Increases household disposable income
  - Frees business capital for productive use
- ✓ **CUSTOMER SATISFACTION**
  - Opportunity to reduce bills and secure other benefits



MANITOBA HYDRO

- **Strong history with energy efficiency**
  - A+ ratings
  - Awards

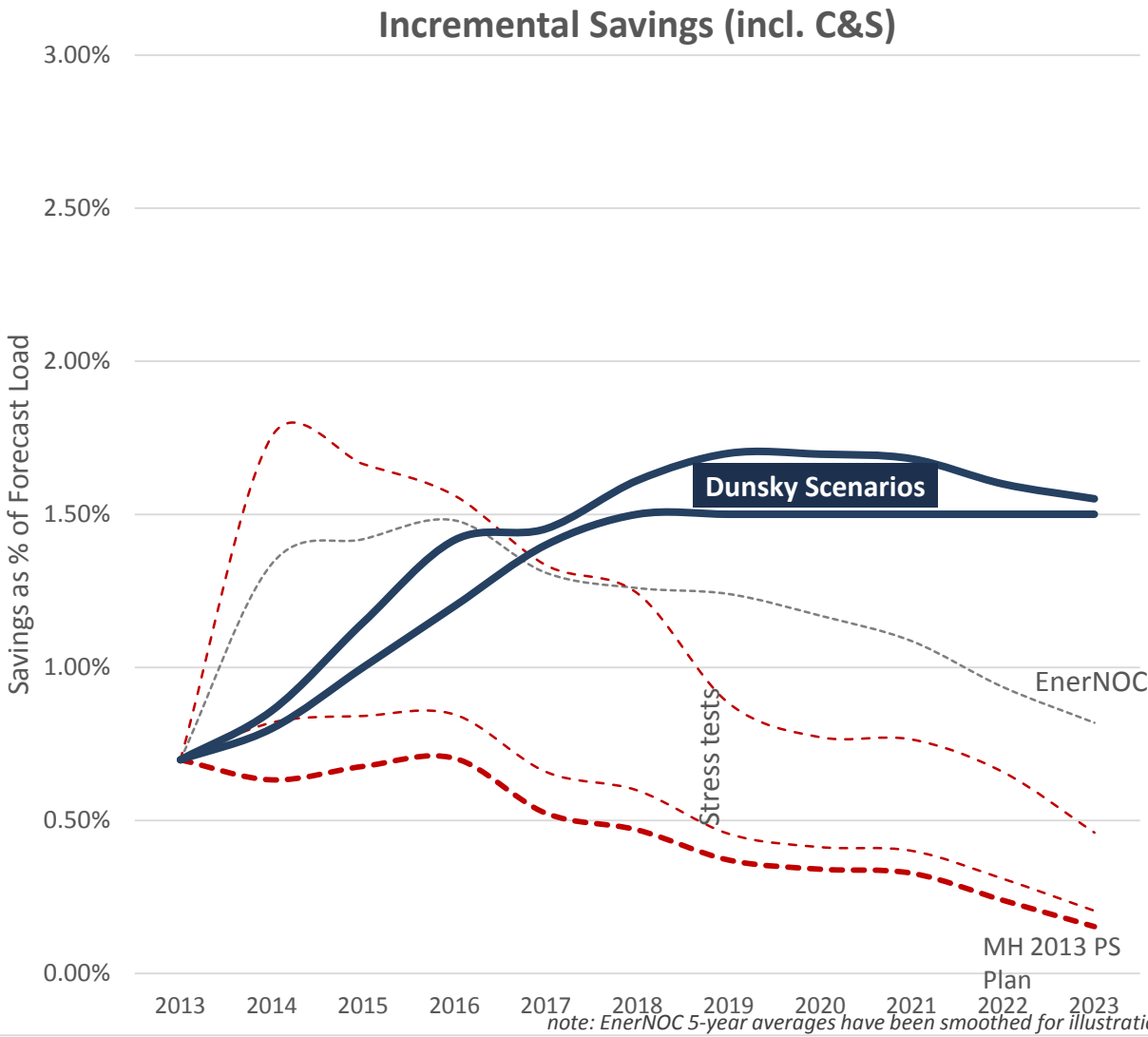
- **Unique strengths to deliver DSM**
  - ✓ Full territorial coverage
  - ✓ Electric-Gas Integration
  - ✓ History of DSM *incl. relationships with market channels, experienced/capable staff*
  - ✓ Billing integration
  - ✓ Data integration
  - ✓ Others

DSM & NFAT

- INTRO
  - DSM critical resource for balancing supply & demand
  - Hydro: great strides in 6 months
  - Remaining steps to ensure long-range planning is as accurate as possible
- MY PRESENTATION
  - Seek to answer Q: **“What role should DSM be assumed to play for proper long-run planning?”**
  - Focus here on energy only; can speak to capacity – and demand response needs – upon request; other issues as well

Original Values (to 2023)

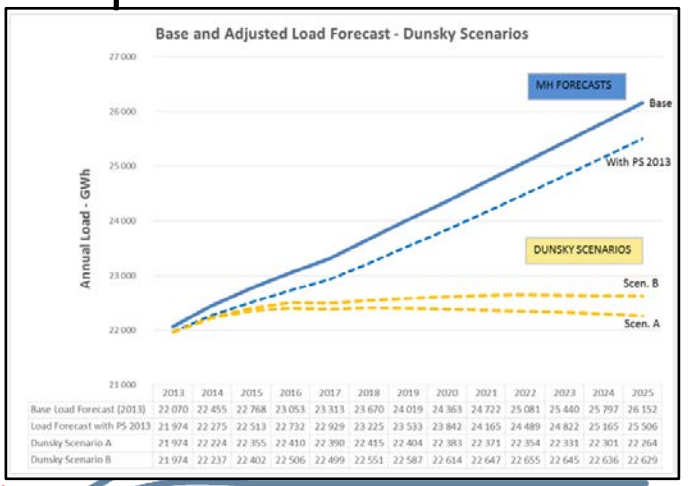
- MH 2013 Plan: ~0.4%/yr (avg)
- EnerNOC Mkt. Pot.: ~1.0%/yr (avg)
- Stress Tests (2013 x1.5 /x4.0)
- Dunsky scenarios: 1.3% and 1.1%



New MH "Levels" (to 2023)

DUNSKY DSM Scenarios → Impact on Load F'cast

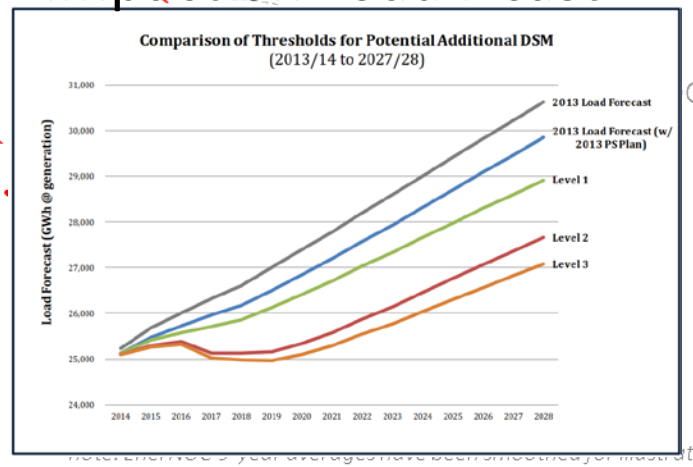
		2014	2015	2016	2017	2018	2019	2020 ++	10 YEAR AVG 2014-2023 (programs only)	10-yr Avg. 2014-2023 (prog's + C&S)
Scen. A (1.3%)	%/yr:	0.6%	0.8%	1.0%	1.2%	1.4%	1.5%	1.5%	1.3%	1.5%
	GWh/yr:	135	182	231	280	331	360	365	3,013 GWh/yr (cumulativ	3,534 GWh/yr (cumulative
Scen. B (1.1%)	%/yr:	0.5%	0.7%	0.8%	1.1%	1.3%	1.3%	1.3%	1.1%	1.3%
	GWh/yr:	122	149	181	267	305	312	317+	2,634 GWh/yr (cumulative)	3,220 GWh/yr (cumulative



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Base Load Forecast (2013)	22 070	22 455	22 768	23 053	23 313	23 670	24 019	24 363	24 722	25 081	25 440	25 797	26 152
Load Forecast with PS 2013	21 974	22 275	22 513	22 732	22 929	23 225	23 533	23 842	24 165	24 489	24 822	25 165	25 506
Dunsky Scenario A	21 974	22 224	22 355	22 410	22 390	22 415	22 404	22 383	22 371	22 354	22 331	22 301	22 264
Dunsky Scenario B	21 974	22 237	22 402	22 506	22 499	22 551	22 587	22 614	22 647	22 655	22 645	22 636	22 629

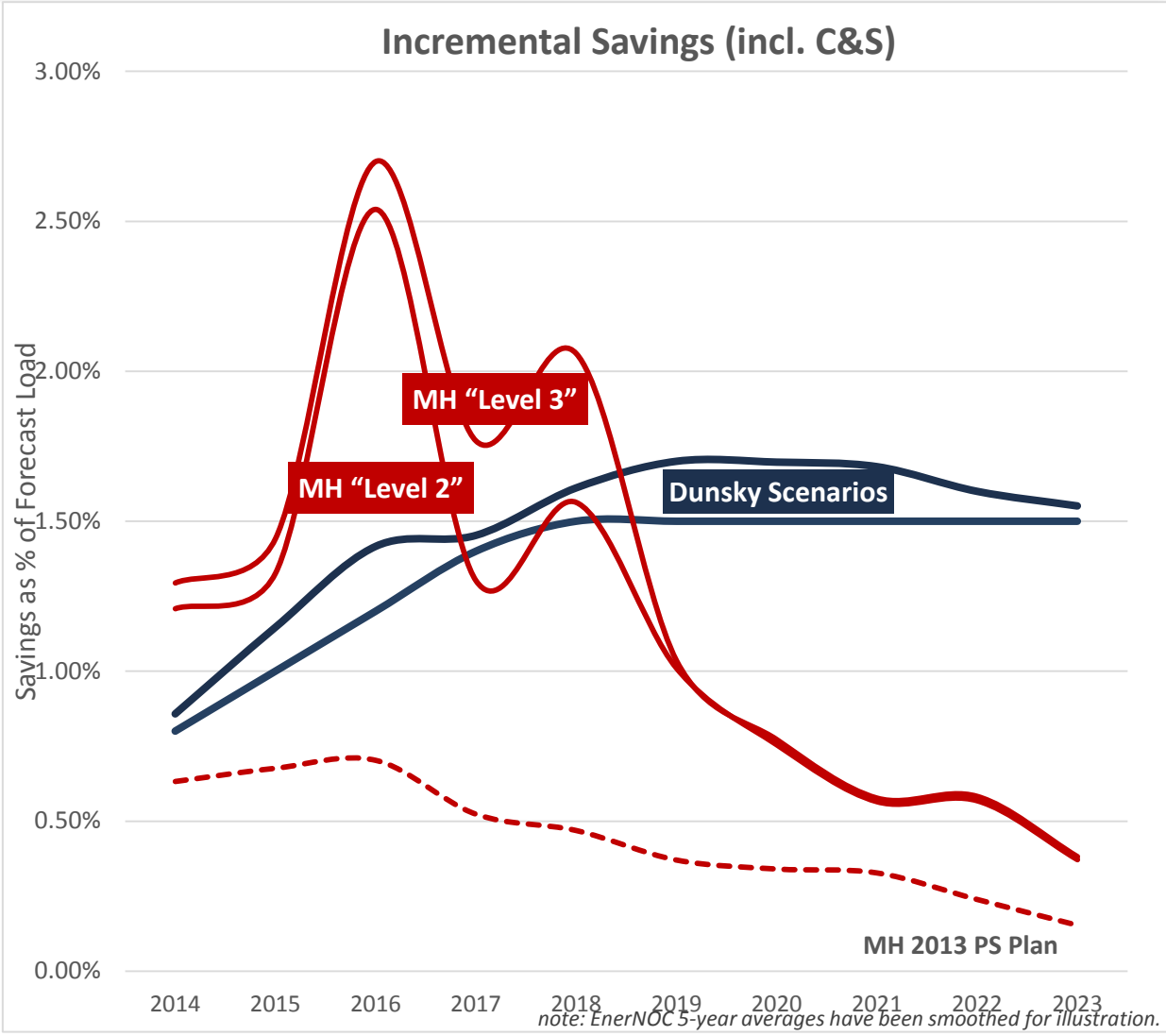
MANITOBA HYDRO DSM Scenarios → Impact on Load F'cast

		2014	2015	2016	2017	2018	2019	10 YEAR AVG 2014-2023 (programs only)	10 -yr Avg. 2014-2023 (prog's + C&S)
Level 1 0.5%	%/yr:	0.4%	0.6%	0.7%	0.6%	0.5%	0.5%	0.5%	0.7%
	GWh/yr:	110	160	170	167	138	137	1,272 GW.h/yr (cumulative)	1,918 GW.h/yr (cumul
Level 2 1.1%	%/yr:	0.5%	1.0%	1.0%	2.1%	1.3%	1.6%	1.1%	1.3%
	GWh/yr:	138	244	255	559	352	445	2,459 GW.h/yr (cumulative)	3,104 GW.h/yr (cumulative)
Level 3 1.2%	%/yr:	0.6%	1.0%	1.1%	2.3%	1.5%	1.8%	1.2%	1.5%
	GWh/yr:	141	266	285	601	403	499	2,833 GW.h/yr (cumulative)	3,478 GW.h/yr (cumulative)



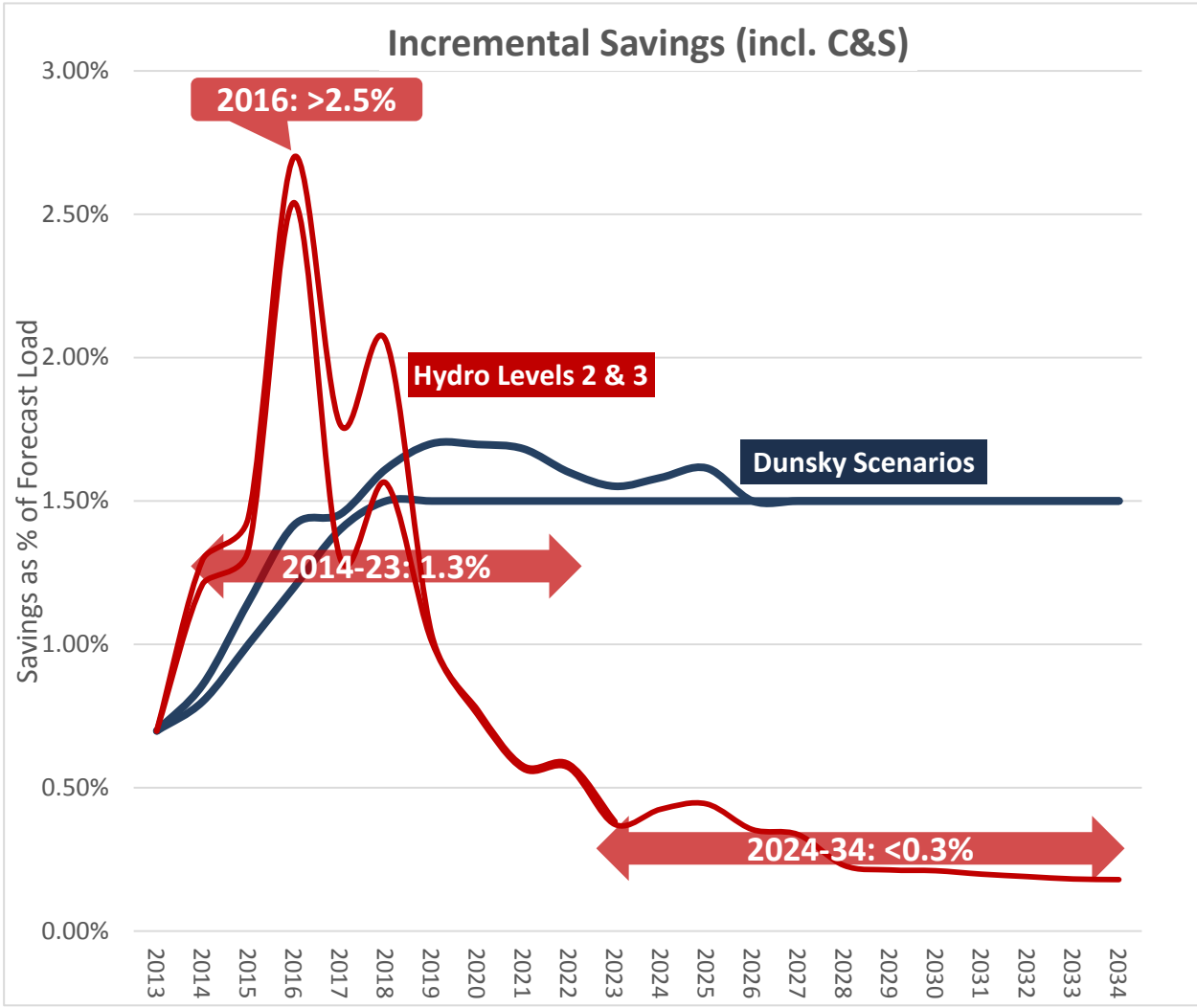
New MH "Levels" (to 2023)

- Dramatic change in MH's DSM plan
- **2013-16:** Extremely aggressive ramp-up
- **> 2018: Rapid decline**



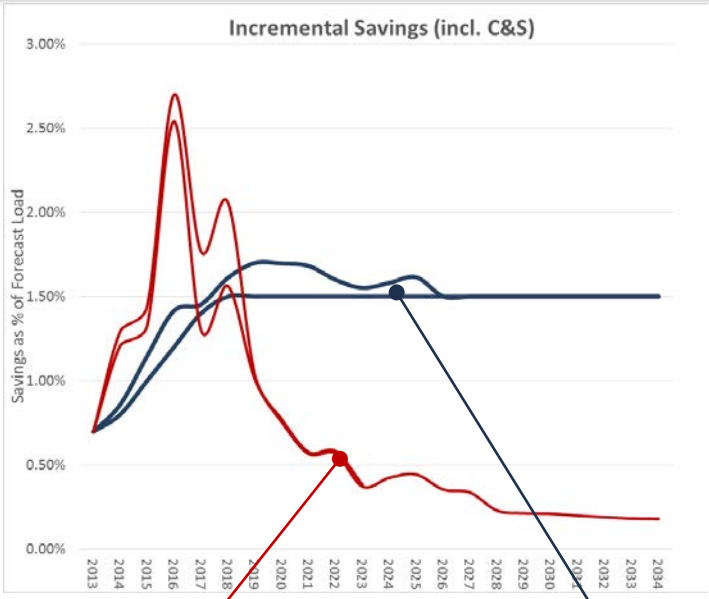
New MH "Levels" (to 2034)

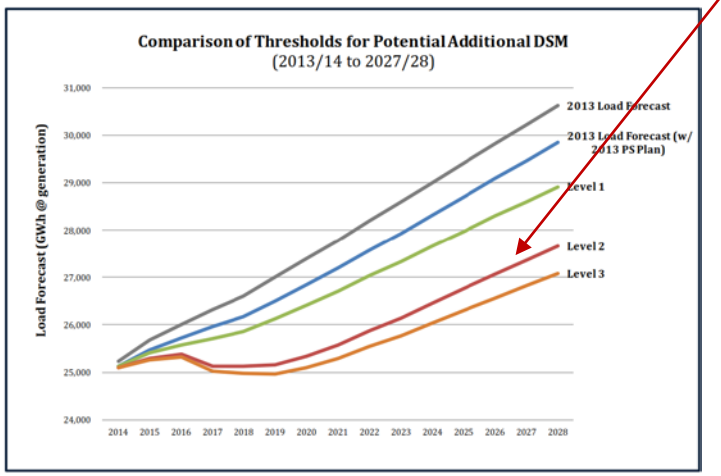
- Dramatic change in MH's DSM plan
- **2013-16:** Extremely aggressive ramp-up
- **> 2018: Rapid decline**
- **≥ 2023: 0.28%/yr (avg) = 90% below Level 2 peak**

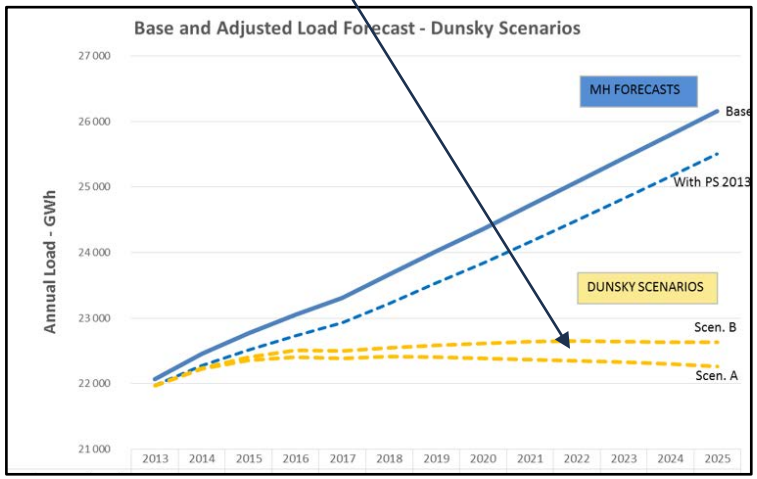


RECAP OF DIFFERENCES

- New MH Levels maintain "static" view of DSM
- = unrealistic assumption of few if any opportunities beyond what we now know







In the near-term, Hydro's Levels 2 and 3 represent a dramatic – and commendable – change in DSM planning and target-setting.

In the long-term, planning-level inputs quickly revert back to previous assumptions. These grossly understate DSM's future contributions – assuming Hydro maintains its "pursuit of all economic DSM" policy – and undermine the credibility of the domestic net load forecast.

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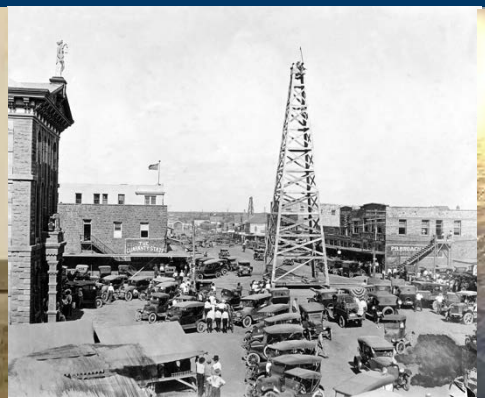
DSM RESOURCE = INNOVATION

- Like mining, or oil & gas “drilling”, the more we want, the more we look, and the more we find
- Innovation does not stop; it strengthens over time
- Unprecedented capital flowing to energy innovations; will transform energy markets over coming 10-20 years

MANITOBA HYDRO'S RECOGNITION

"**Manitoba Hydro recognizes that the targets in this plan are conservative** as some programs and opportunities which could reasonably be expected to be achieved within the planning horizon were excluded (e.g. LED applications for Roadway lighting, residential and commercial applications; load displacement opportunities, fuel switching opportunities and energy conservation rates). **These and other programs are expected to be added in future Power Smart Plans"**

"To reflect DSM targets for resource planning purposes, the Corporation intends to forecast its expectation of DSM savings which will most likely be achieved, and therefore may include energy savings from emerging technologies or other initiatives such as load displacement, energy conservation rates and fuel switching."

(Rebuttal, page 28)

SAMPLE INNOVATIONS

Below are five sample areas where we *already know* that innovation will significantly impact demand for grid power in the coming years

i. **New efficiency standards**
   to secure savings from recent innovations

ii. **New: LED Lighting**

iii. **New: Heat Pumps**

iv. **New: Data-Driven Analytics**

v. **New: Solar PV**

i. Codes & Standards

Building Codes and "Appliance" Standards secure adoption of DSM innovations

- **CODES**
  - Specific to geography
  - Canada recently adopted far more stringent model codes
  - MB historically a leader
- **STANDARDS**
  - Typically Canada-wide; federal govt chose to follow U.S. lead
  - Obama admin.: unprecedented overhaul of EE standards
    - ***approx. 300 TWh/yr of savings expected by 2030***
    - *More to come (150 TWh more?)*
  - **= >10% of total U.S. electricity consumption**

New U.S. Standards Adopted Under Obama

Product	Final Rule Date	Effective Date	Cumulative Electricity Savings Through 2030 (billion kWh)[iii]	Cumulative CO_2 Reductions Through 2030 (MMT)[iii]	Net Present Value of Savings (billion 2012$)[iv]
EISA[v] - General Service Lamps (GSLs)	March 2009	2012-2014	1,510.9	704.4	168.7
EISA (excluding GSLs)	March 2009	2008-2013[vi]	472.5	234.6	50.5
Ranges and Ovens	April 2009	2012	--	3.9	1.3
Commercial Boilers	July 2009	2012	--	6.1	1.5
General Service Fluorescent Lamps	July 2009	2012	414.6	193.2	17.6
Incandescent Reflector Lamps	July 2009	2012	98.3	46.1	6.7
Beverage Vending Machines	August 2009	2012	16.5	7.7	1.2
Commercial Clothes Washers	January 2010	2013	2.7	2.7	0.8
Small Motors	March 2010	2015	175.5	81.4	9.9
Water Heaters	April 2010	2015	118.1	74.8	6.3
Direct Heating Equipment	April 2010	2013	--	0.4	0.05
Pool Heaters	April 2010	2013	--	0.5	0.05
Clothes Dryers	April 2011	2015	21.9	10.6	2.7
Room Air Conditioners	April 2011	2014	40.2	18.7	3.1
Central A/C and Heat Pumps	June 2011	2015	112.6	52.2	8.8
Refrigerators and Freezers	September 2011	2014	248.7	115.4	15.7
Fluorescent Lamp Ballasts	November 2011	2014	318.1	147.6	30.9
Clothes Washers	May 2012	2015	115.5	59.3	29.9
Dishwashers	May 2012	2013	0.0	1.3	0.3
Distribution Transformers	April 2013	2016	58.6	27.2	8.7
Microwaves	June 2013	2016	26.1	12.1	3.0
Metal Halide Light Fixtures	February 2014	2017	13.0	6.8	1.3
External Power Supplies	February 2014	2016	28.3	23.6	1.2
Commercial Refrigeration Equipment	March 2014	2017	112.5	48	9.7
Total	--	--	**3,905**	**1,879**	**380**

Ref: http://www.appliance-standards.org/sites/default/files/Progress_toward_3_billion_CO2_reduction_0.pdf. *Feb. 18, 2014*

i. Codes & Standards

- Canada now playing catch-up
  - Strong push to harmonize with U.S.
  - **32 energy efficiency standards currently proposed for adoption**
  - Vast majority electric
- More to follow?

Canada 2014 Proposed Standards

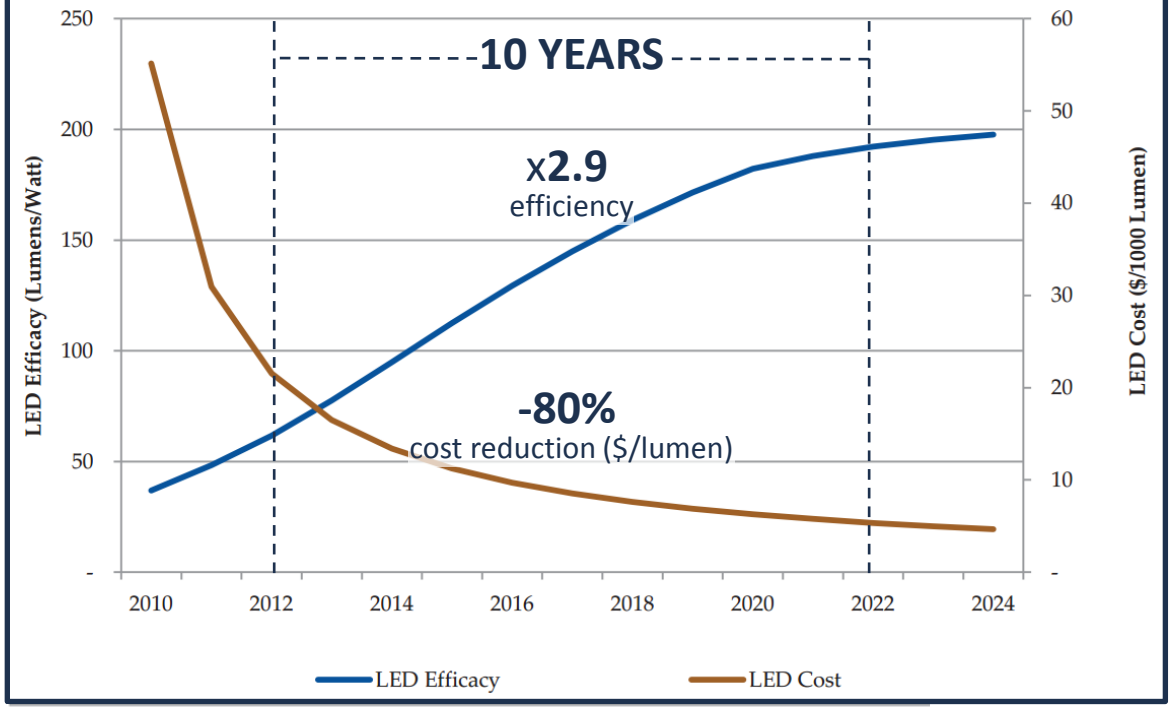
(to harmonize with new U.S. standards)

1. Chillers
2. Commercial self contained refrigeration products
3. Gas water heaters
4. General service incandescent reflector lamps
5. General service fluorescent lamps
6. Oil fired water heaters
7. Packaged terminal air-conditioners and heat pumps
8. Room air-conditioners
9. Residential refrigerators
10. Residential freezers
11. Residential dishwashers
12. Residential clothes washers
13. Residential clothes washer-dryers
14. Commercial clothes washers
15. Residential clothes dryers
16. Central air-conditioners and heat pumps
17. Vending machines
18. Oil furnaces
19. Fluorescent lamp ballasts
20. Dry-type transformers
21. Large air-conditioners and heat pumps
22. Metal halide ballasts
23. Commercial boilers
24. Line Voltage Thermostats
25. Pre-rinse spray valves
26. Tankless gas water heaters
27. Commercial water heaters
28. Commercial refrigeration with remote condensing unit
29. Small electric motors
30. Microwave ovens
31. Walk-in refrigerators
32. Pool heaters

ii. LED Lighting

- Rapid improvements on their way
  - 3x more efficient in 10 years
  - 80% cheaper for same light output
  - Anticipate dramatic savings across all sectors
- Note re. MH:
  - EnerNOC: LEDs not included until 2020 because too costly
  - MH: LEDs already promoted today

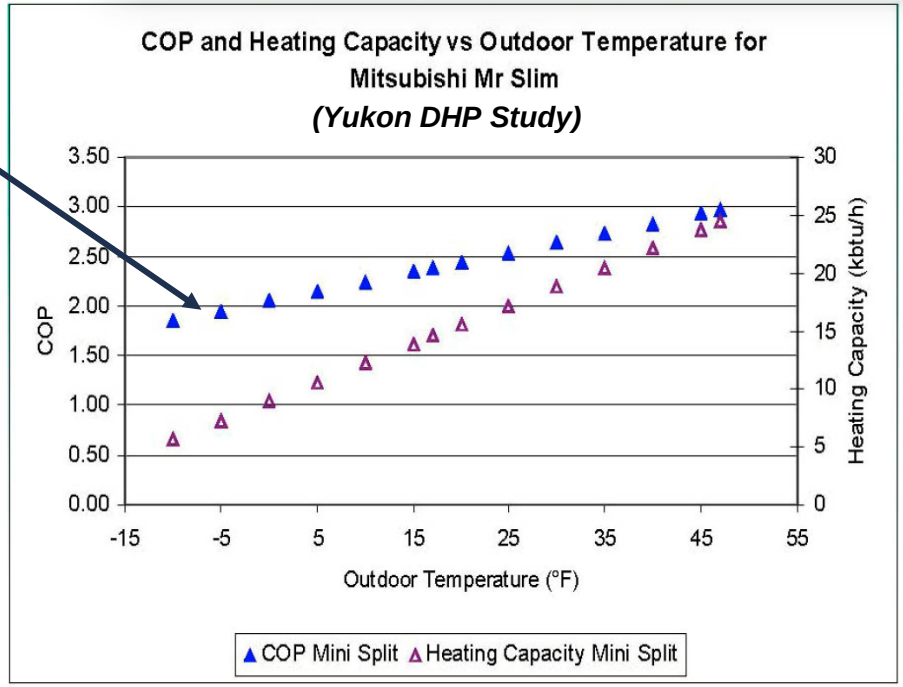
LED Lighting | Efficiency & Costs 2010-2024



Source: Navigant. Energy Savings Potential of Solid-State Lighting in General Illumination Applications. Prepared for the U.S. Department of Energy. January 2012.

iii. DHPs (Ductless Heat Pumps)

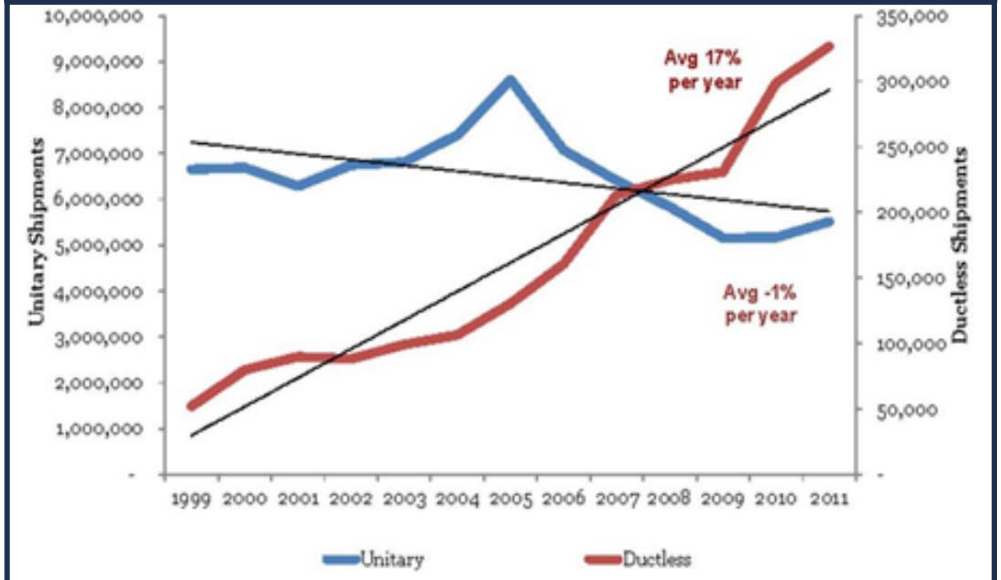
- **DHPs transforming heating options in colder climates**
  - **Excellent opp for baseboard heated homes** (no internal heat distribution system)
  - Inverter-driven models can achieve 200% efficiency at *minus 20^{o} C*
  - Can supply **30-60% of Manitoba home heating needs**
  - Improved customer value: air quality in winter; zonal control; AC in summer



iii. DHPs (Ductless Heat Pumps)

- DHPs posting strong growth across North America
  - U.S.: x2 every 4 yrs
  - Canada: anecdotal evidence suggests very strong growth

DHPs | U.S. Sales 1999-2011

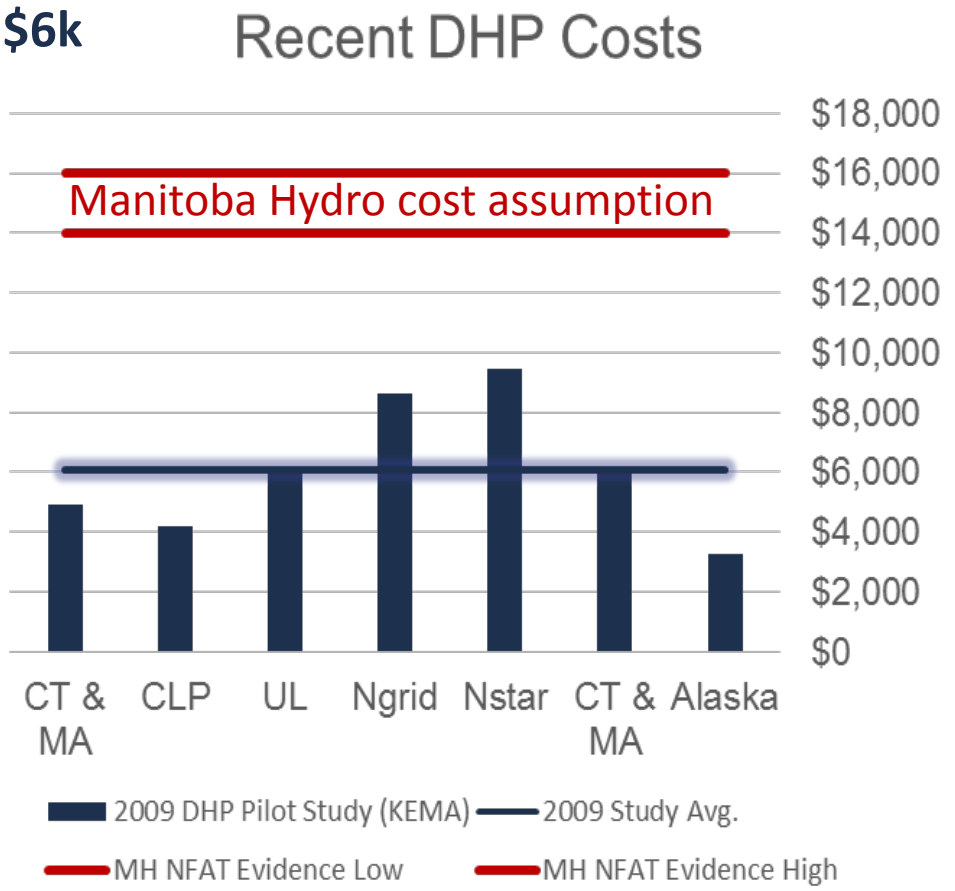


Source: AHRI, cited in NEEP, Mid-Atlantic Air Source Heat Pump Market Strategies Report, Jan. 2014.

DHPs (Ductless Heat Pumps)

- **High-efficiency DHPs now affordable**
  - Typical: $4k +$2k install = **$6k**
  - Less for smaller homes

- **MB notes:**
  - **MH assumes "$14-16k" cost** (rebuttal, p.37)
  - Excluded from EnerNOC study



iv. Data-Driven Analytics

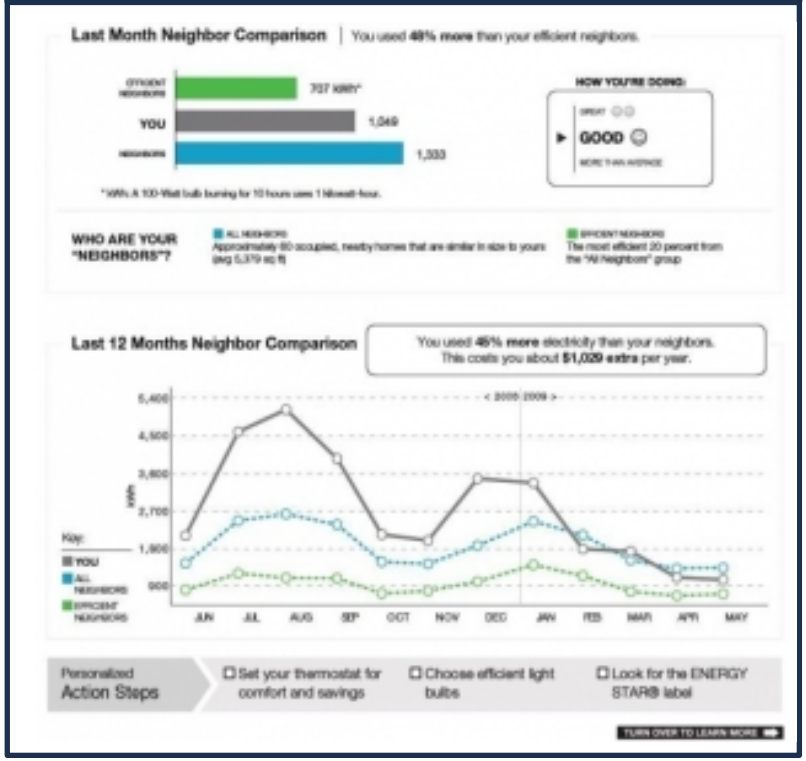
- Combination of computing power and prevalence of wireless communications capabilities is driving unprecedented innovation in three areas:
  - **Residential "behaviour"**
  - **C&I facilities operations**
  - **Utility control of end uses**

iv. Data-Driven Analytics

CASE STUDY: **OPOWER**

- Simple concept: Neighbour comparisons
- Driven by deep analytics and strong social science research
- Educates and motivates change
- 1-3% savings across multiple regions and timespans (independent evaluations)
- Very successful IPO last month

Home Energy Report | Sample



iv. Data-Driven Analytics

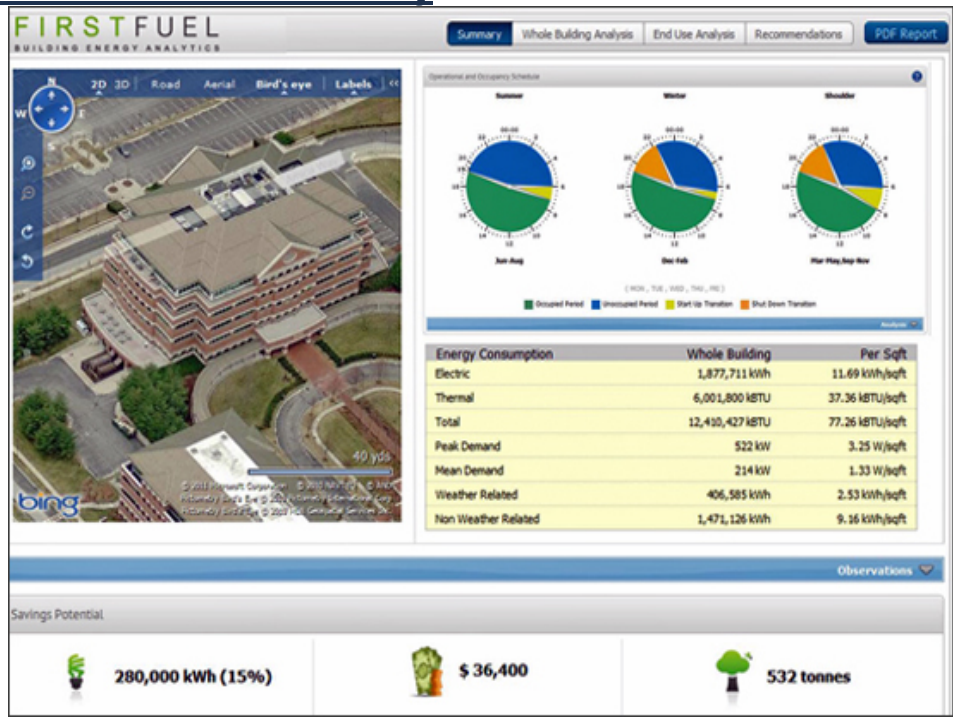
CASE STUDY: **SMART THERMOSTATS**

- Dozens of new entrants incl. Nest (Google), Honeywell, Ecobee…
- Wide array of functionalities including:
  - Assisted programming
  - Nudges and automated setting changes
  - Touchless home energy assessment and automated suggestions
  - Predictive start-to-temp set algorithms
  - Distance-based user controls
  - Distance-based *utility* controls (voluntary)
  - Furnace alerts, weather, photos, music, etc.
- Very large recorded savings to date (5-15%)

iv. Data-Driven Analytics

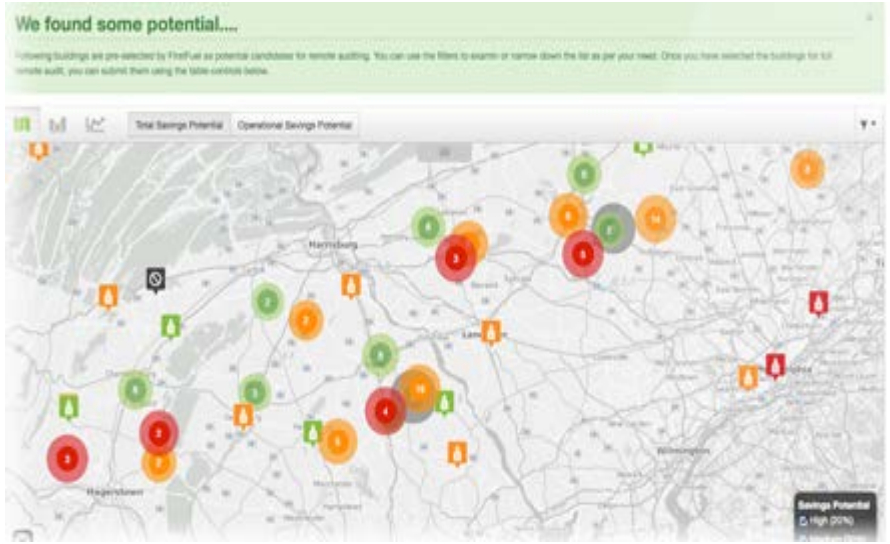
CASE STUDY: **FIRST FUEL (BLDG DIAGNOSTICS)**

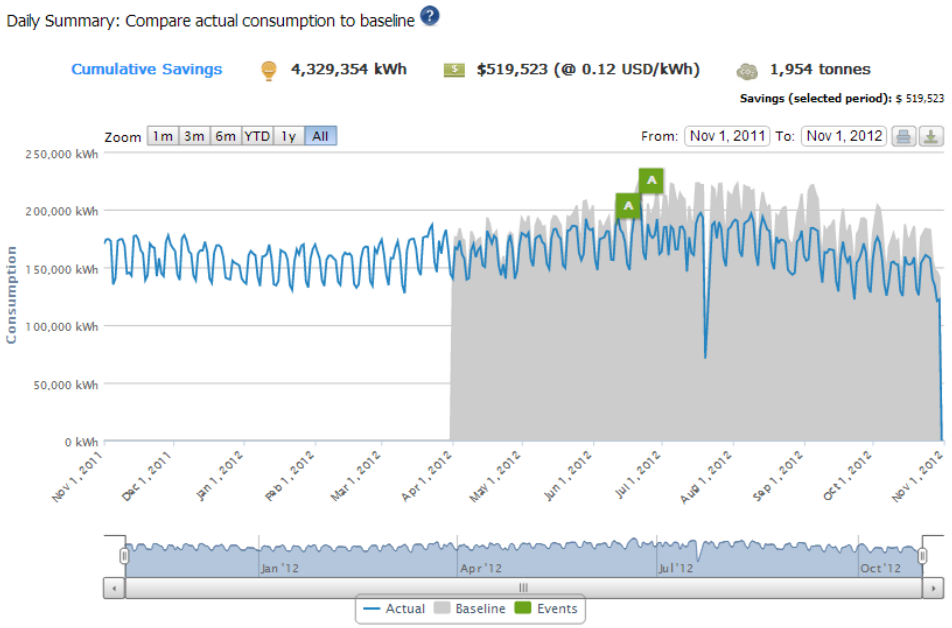
- Powerful use of new data streams to conduct "touchless audits"
  - Real-time meter data
  - Matched localized weather data
  - High-quality satellite imagery
  - Skilled back-office analysts
- Cost: 1/3 of traditional audits

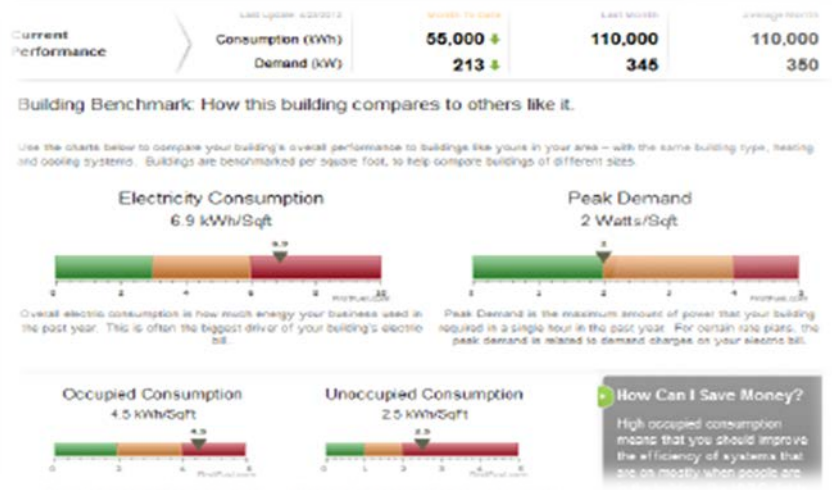


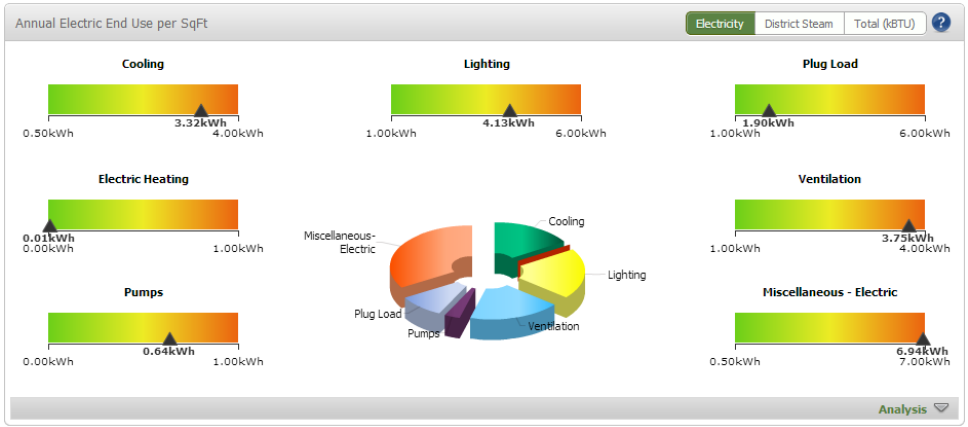
- ASHRAE Level 2 quality + web platform facilitates continuous improvements
- **Scale: 100s and 1000s replace one-offs**

iv. Data-Driven Analytics



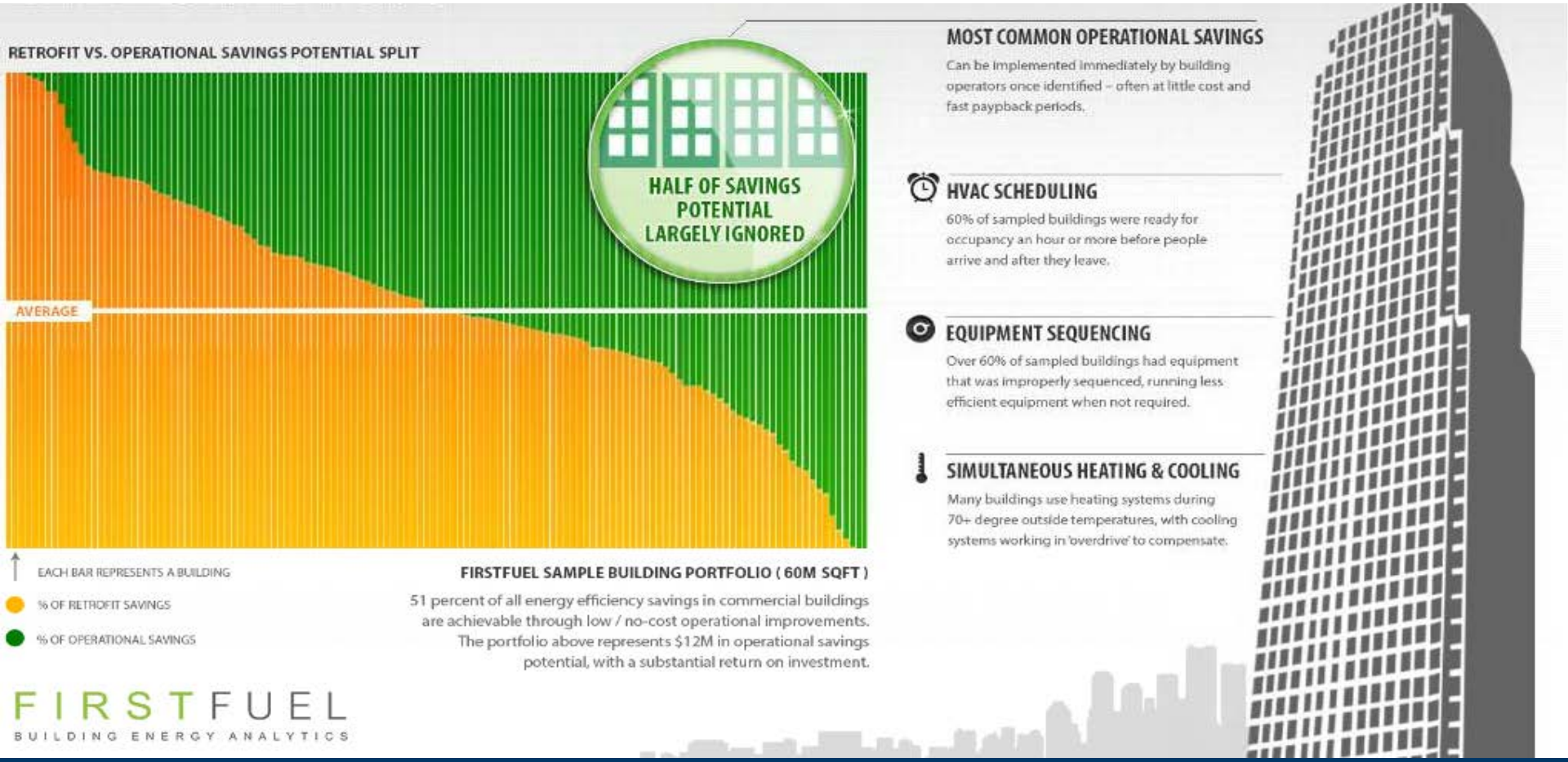






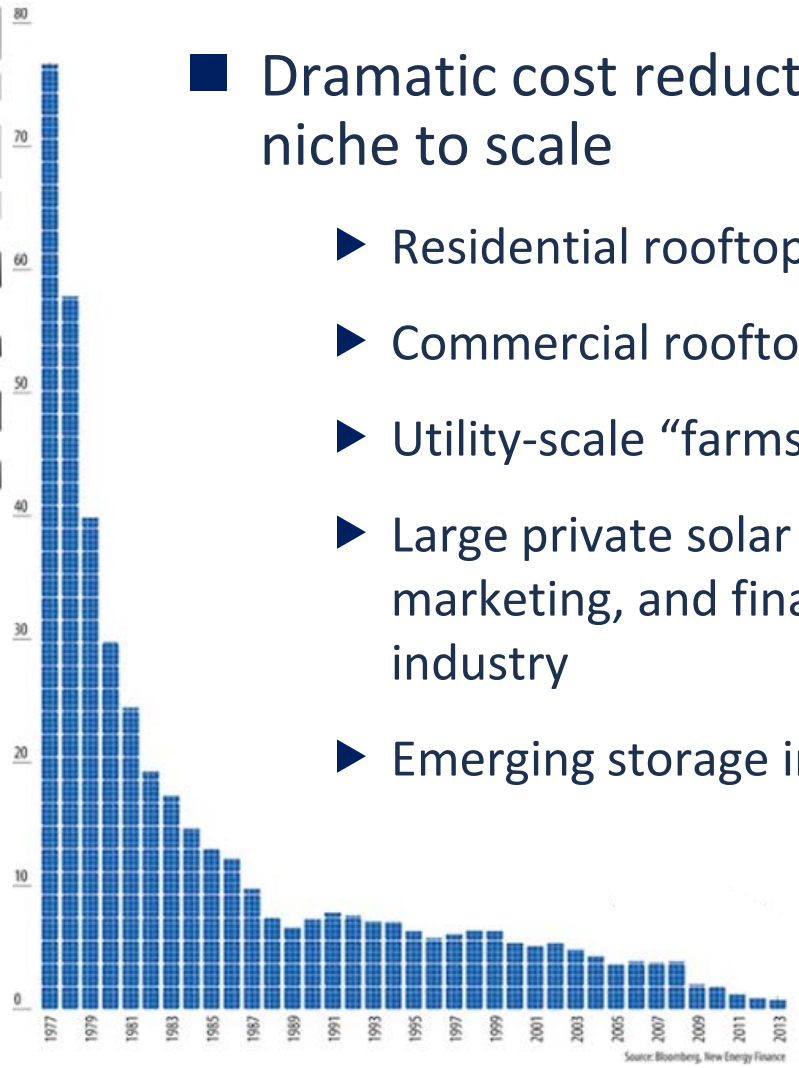
iv. Data-Driven Analytics

- Large savings from previously missed opportunities

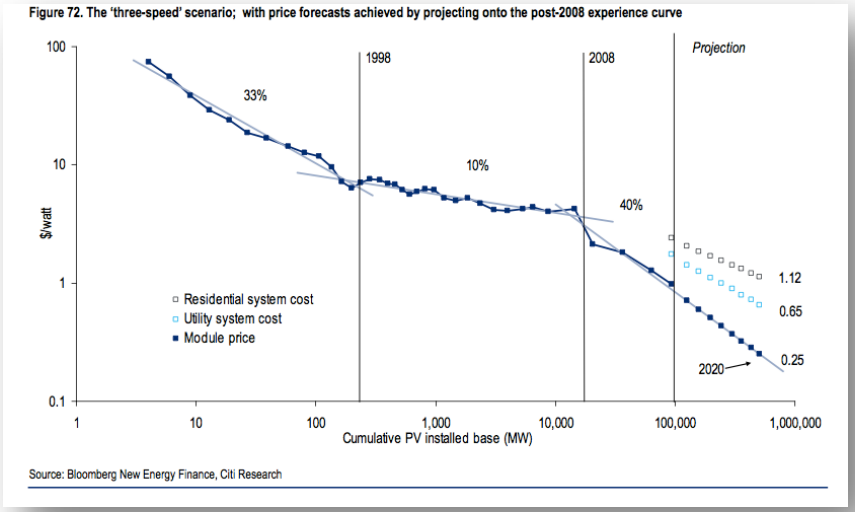


v. Solar Photovoltaics (PV)

- Dramatic cost reductions have led solar to move from niche to scale
  - Residential rooftop
  - Commercial rooftop
  - Utility-scale "farms"
  - Large private solar install, marketing, and financing industry
  - Emerging storage industry (private and utility)



PV COST F'CAST FROM MB HYDRO'S FILING

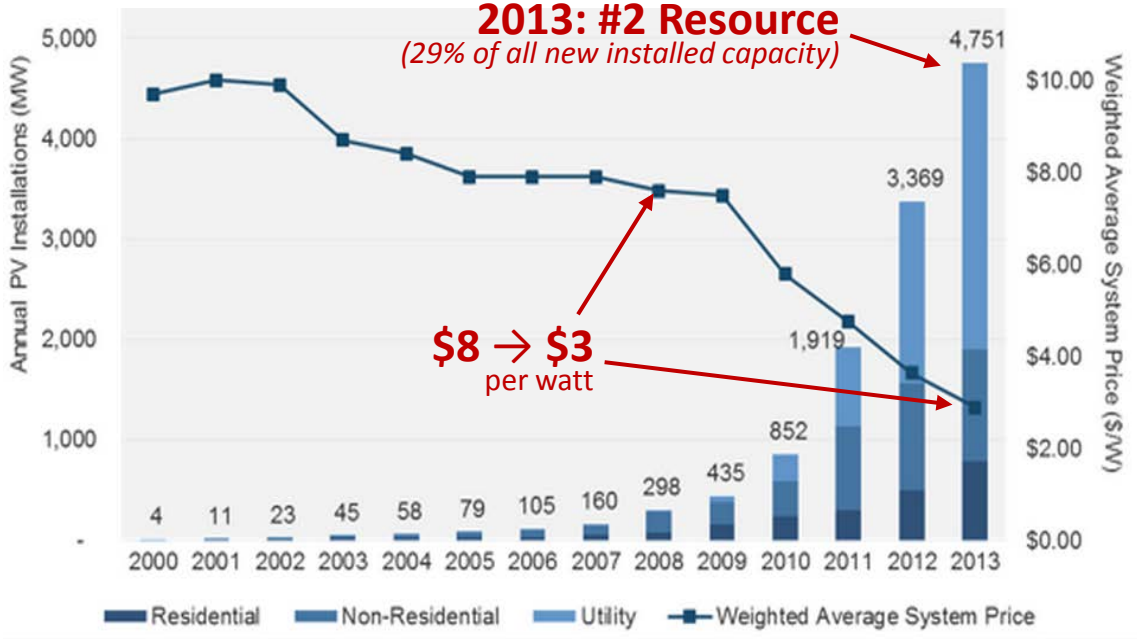


← Module Cost | Installed System Cost`

v. Solar PV

- **Recent history (5yrs)**
  - PV module cost down ~80%
  - PV installed cost down ~60%
  - Annual installs up >15x (U.S.)
  - 30% U.S. market share in 2013 (#2 resource)

SOLAR PV | U.S. Installations & Prices 2000-2013



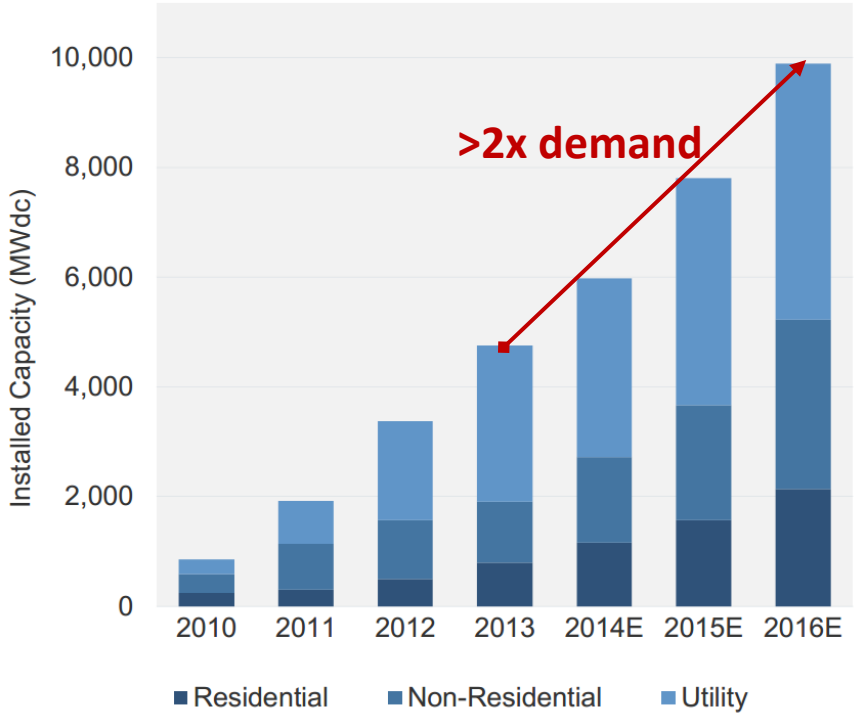
Source: GTM Research/SEIA U.S. Solar Market Insight: 2013 Year-in-Review

v. Solar PV

Near Future

- Continued cost declines
  - *Modules: -25% over 4yrs due to automation*
  - *Installation: savings from new plug-play designs*
  - *Financing: reductions with growth and strong track record (Solar City <1% defaults)*
- 3x manufacturing capacity anticipated over 5 yrs
- Continued demand growth (2x annual U.S. installs over coming 3 yrs)

Figure 2.14 U.S. PV Installation Forecast, 2010-2016

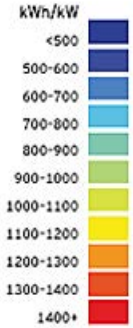


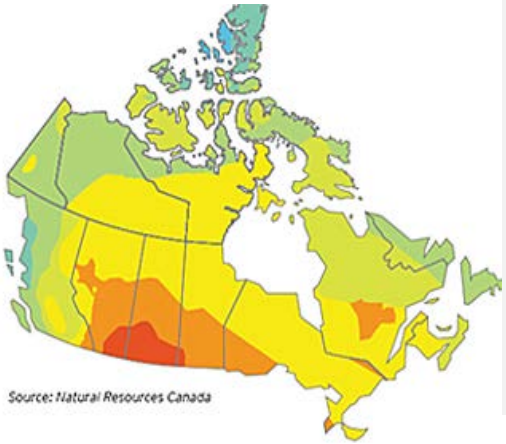
Source: GTM Research, PV Technology and Cost Outlook, 2013-2017

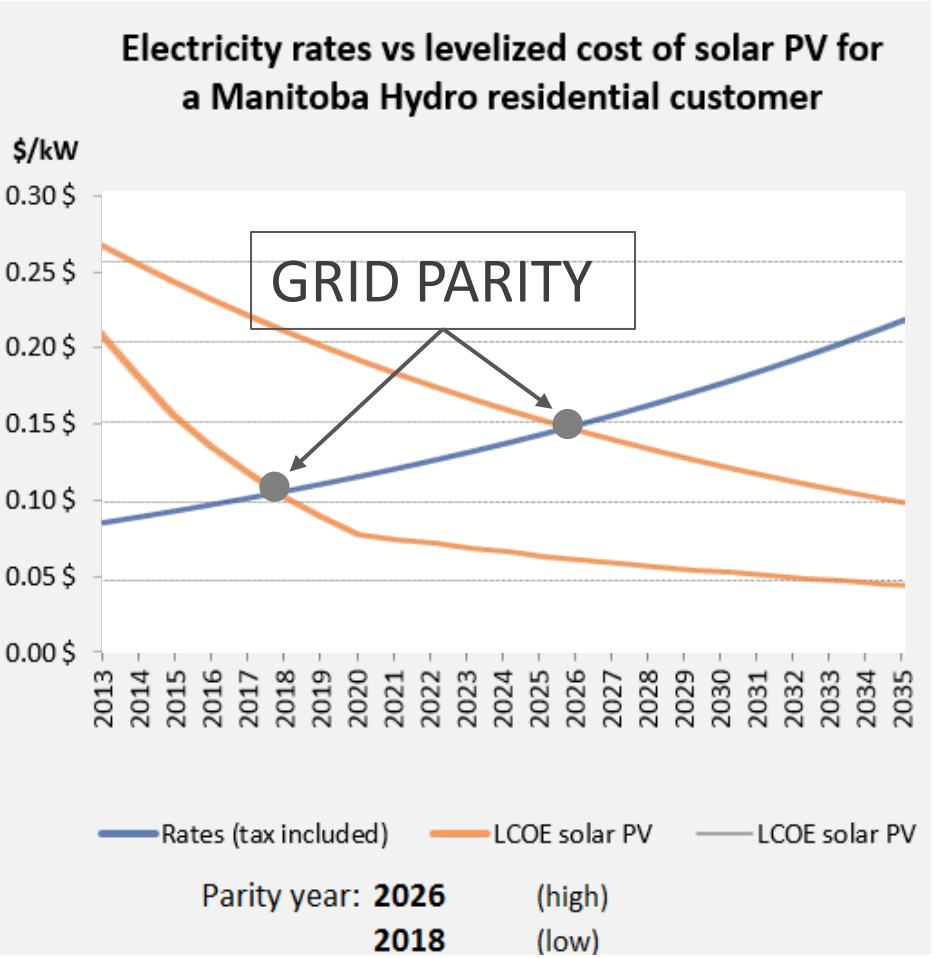
v. Solar PV

- **Implications for MB**
  1. Growing DSM opportunity
  2. Breakout demand suppression “threat” (locally or in export markets)?
  3. Low-cost Utility-scale power supply option/competitor

Germany







v. Solar PV

"Investors beware: Distributed generation could kill utilities as we know them today."

"Distributed Generation: The Death Spiral", February 2014. MORNINGSTAR®

Energy innovations are moving faster than at any time in recent history. New DSM opportunities abound – including several "game changers" that have already landed in market, with many more to come.

Not accounting for them exposes long-run investment plans to significant risk.

CONTENTS

Planner's Dilemma

- Dilemma: How to account for the not-perfectly-known?
- How do Leaders Address This?
  - Past: truth is, many used to ignore future savings
  - Now: Then they took a closer look to improve planning precision and avoid over-committing to new supply
  - Three case studies:
    - ***New England ISO: EE Committee***
    - *California ISO: EE Committee*
    - *Nova Scotia Power*

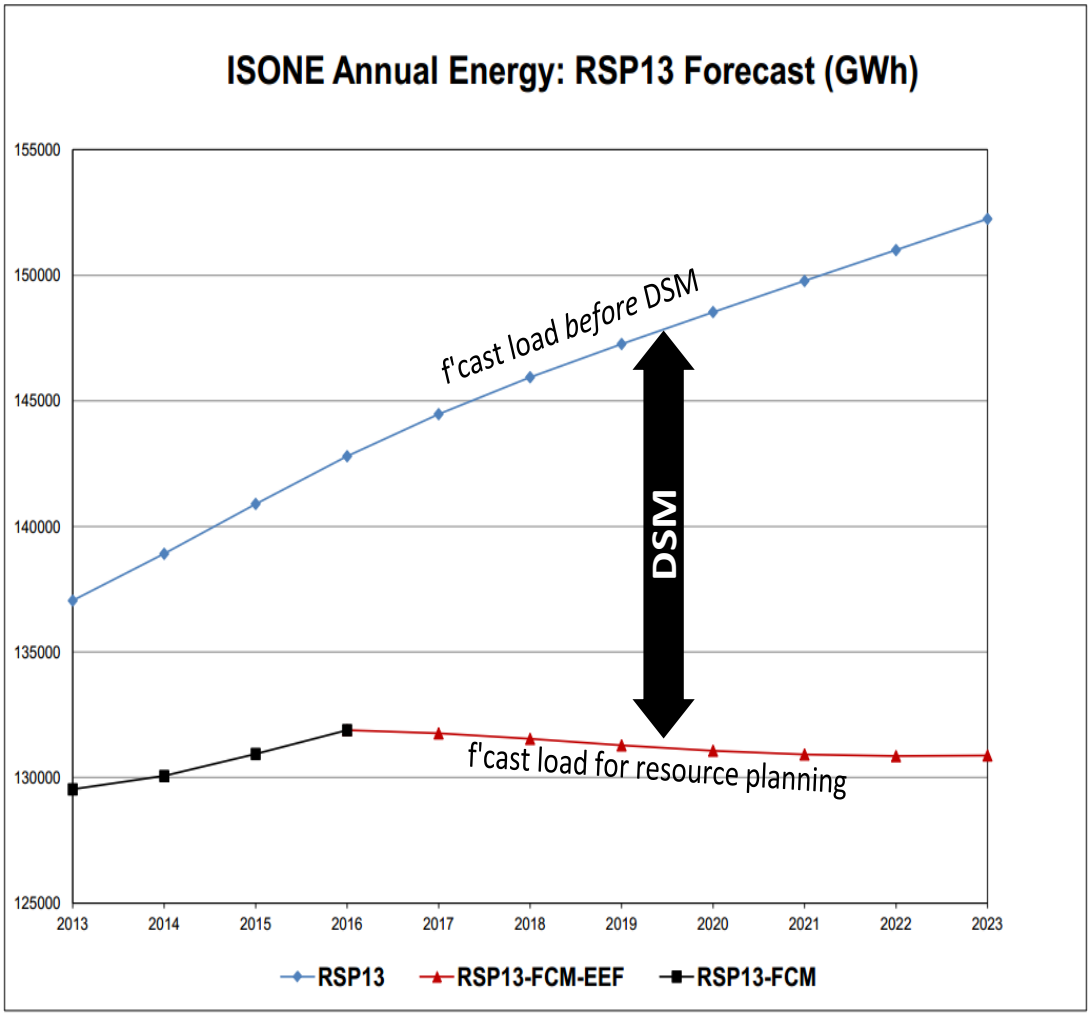
ISO New England

Mandate: ensure reliable supply of electricity across the six-state region

- Three basic tasks:
  - Day-to-day operation of bulk power system
  - Oversight and administration of regional wholesale market
  - **Management of comprehensive power planning process**
- Previous approach accounted only for approved EE plans
  - Committee struck to examine issue
  - Regional consultations of key market stakeholders
- New approach: long-term assumptions critical to planning

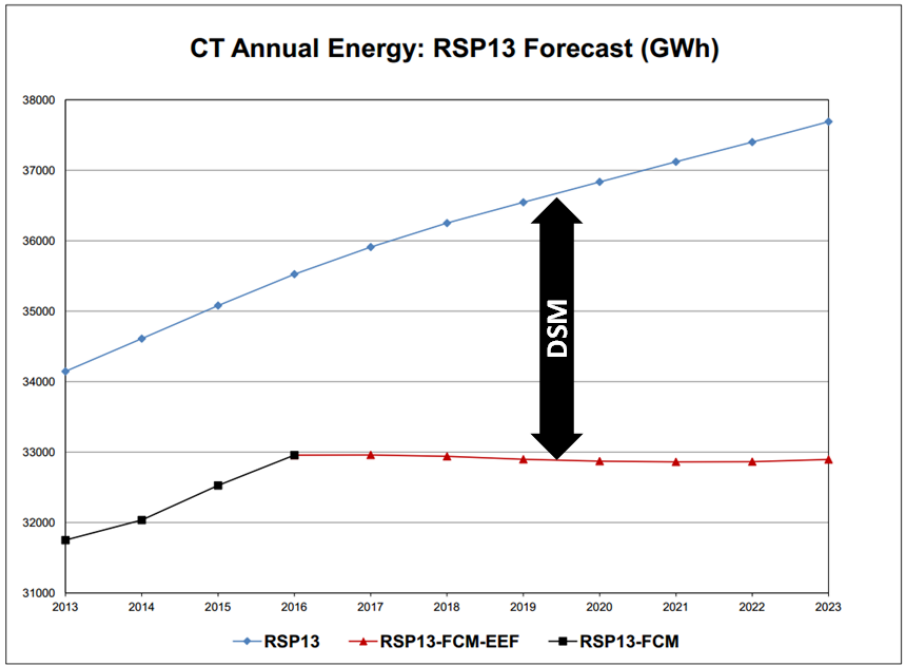
ISO-NE (New England)

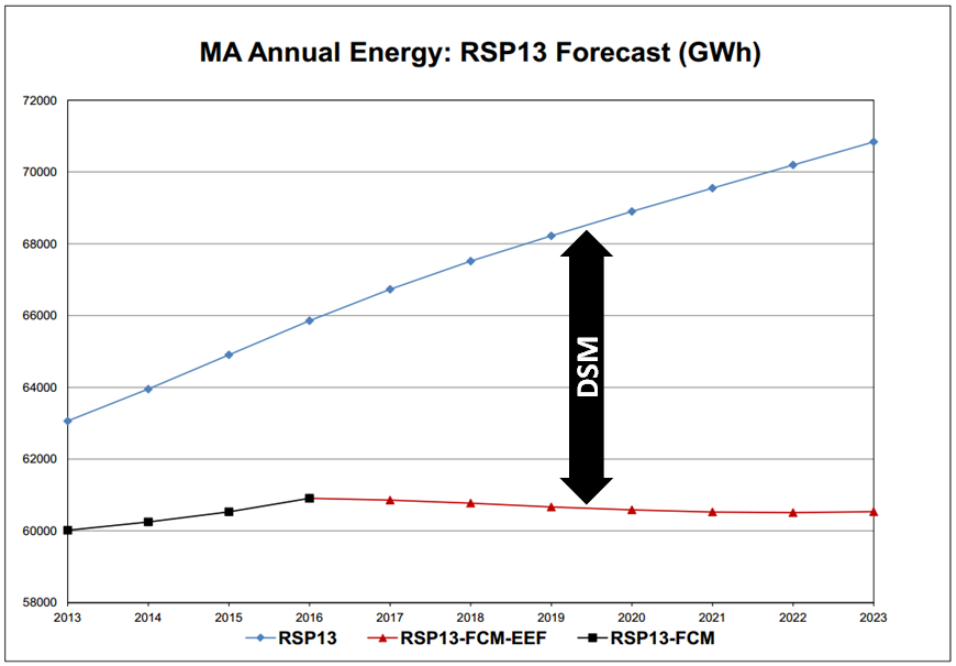
- Key Finding: sufficient evidence that DSM potential *replenishes itself* at roughly the same cost
- 100% of assumed DSM accounted for
- **Result: new plans anticipate zero net load growth** across the region



ISO-NE (New England)

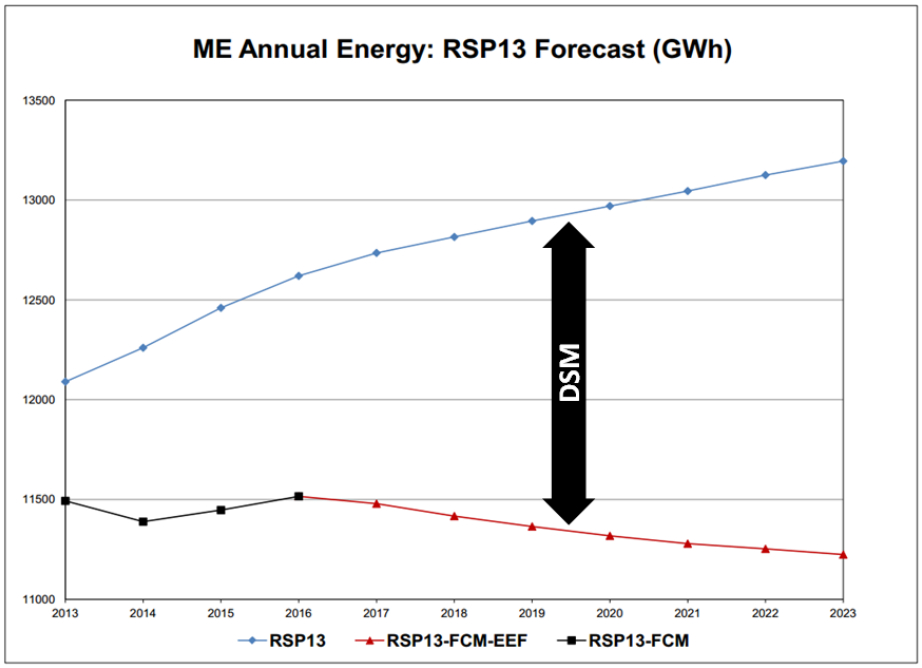
- Connecticut and Massachusetts are among the continent's leaders in DSM

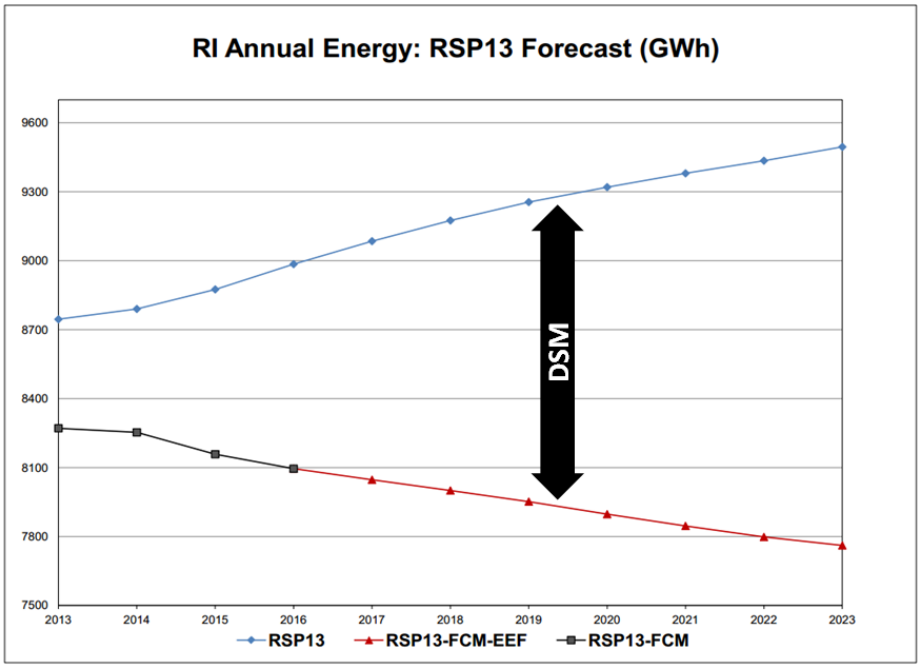




ISO-NE (New England)

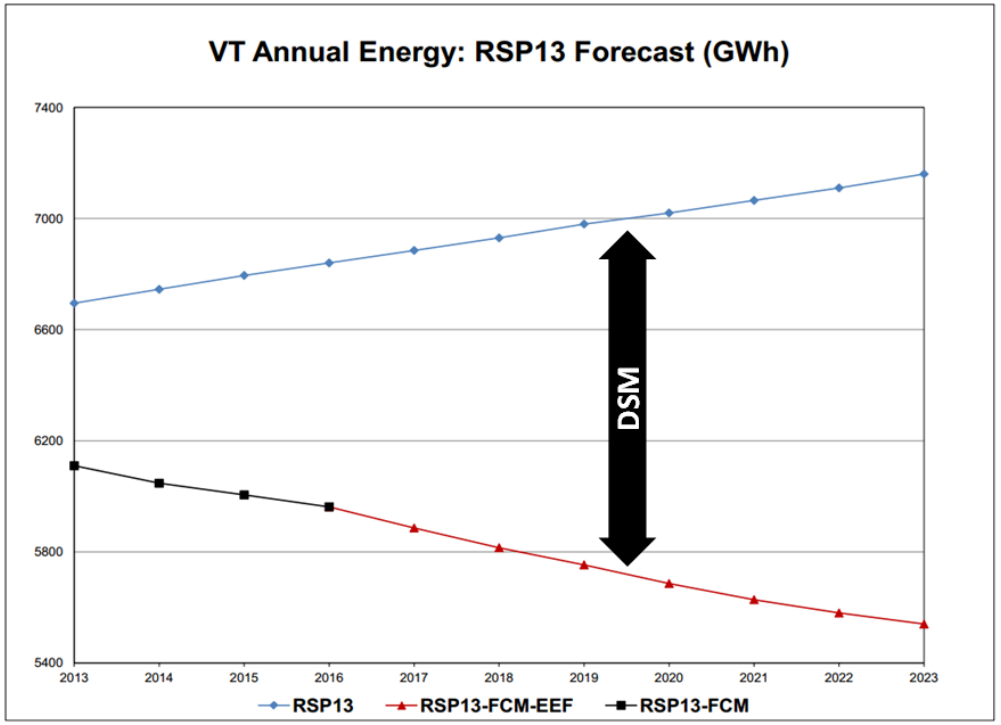
- Maine and Rhode Island have recently emerged as very strong DSM players





ISO-NE (New England)

- Vermont is the historic leader in DSM.
- VT is currently considering increasing from ~2%/yr to an unprecedented 3%/yr (proposal of the independent DSM administrator)
- For the state's longer-term energy planning, 2%/yr is assumed to be the baseline… for the next 35 years



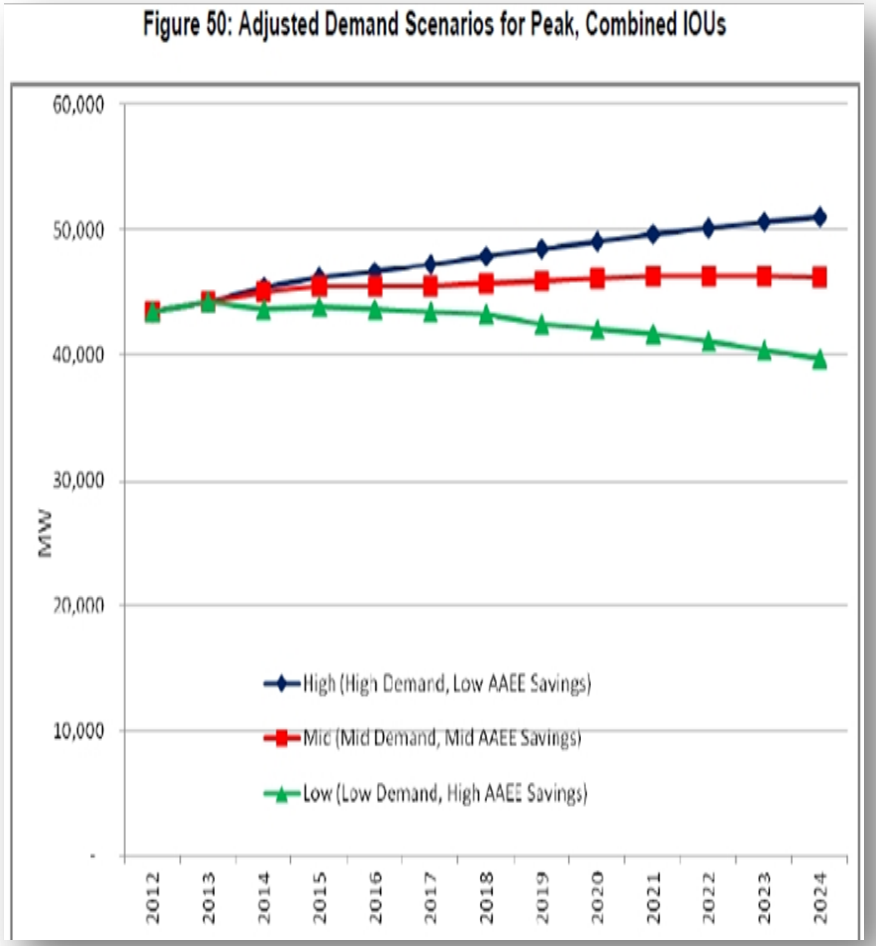
CalISO (California)

Mandate: ensure a reliable, efficient and affordable bulk power system while upholding the State's energy goals

- Includes planning function similar to ISO-New England
- Previous approach accounted only for approved EE plans
  - Multi-agency agreement to jointly examine issue: CEC / CPUC / CalISO
  - Statewide consultations of key market stakeholders
- New approach: long-term assumptions critical to planning

CalISO (California)

- Key Finding: sufficient evidence that DSM potential *replenishes itself* over the long-term
- Approach: adapt long-run DSM potential model to account for future savings opportunities
- Scenario analysis assumes actual savings may be higher or lower than anticipated
- 100% of DSM potential accounted for in mid scenario
- **Result: new plans anticipate near-zero net load growth** across the State



Others: Nova Scotia

- NSPI 2007 IRP examined long-run DSM potential study
- Incorporated 100% of study results
- Outcome: declining demand forecast
- *Note: N.S. went on to ramp up DSM from near-zero in 2009, to 1.5% savings/yr by 2012*

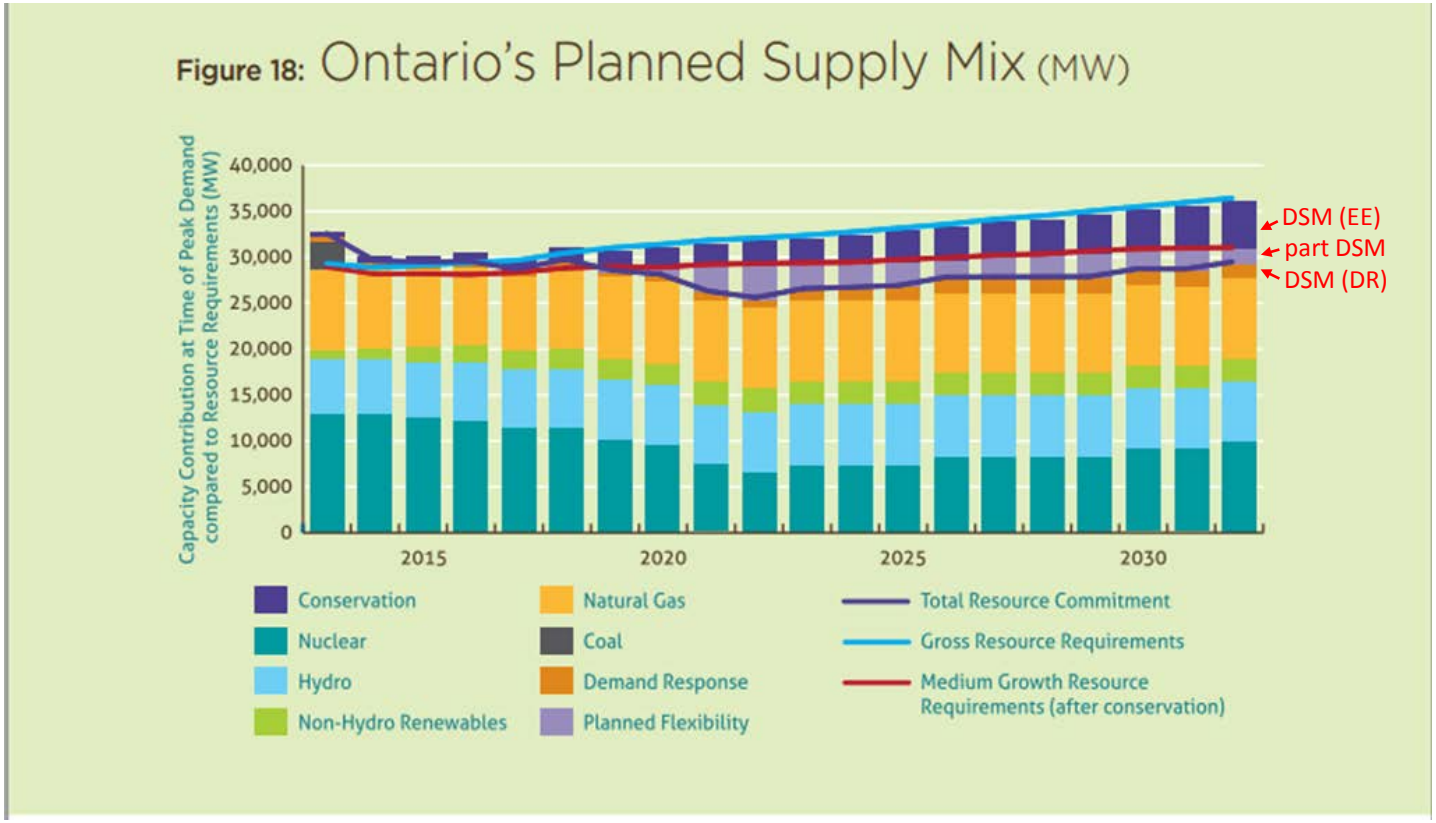
Table 1 – Total Energy Requirement with Future DSM Program Effects[2]

Year	Net System Requirement (GWh)	Annual Change (%)
2003	12,009.1	4.4
2004	12,387.7	3.2
2005	12,338.2	-0.4
2006	10,946.2	-11.3
2007	12,638.9	15.5
2008*	12,538.3	-0.8
2009*	12,073.1	-3.7
2010*	12,157.7	0.7
2011*	11,906.8	-2.1
2012*	10,475.4	-12.0
2013F	11,003.3	5.0
2014F	10,917.2	-0.8
2015F	10,919.9	0.0
2016F	10,853.2	-0.6
2017F	10,776.8	-0.7
2018F	10,707.4	-0.6
2019F	10,733.1	0.2
2020F**	10,710.1 [9,569.1]	-0.2 [-10.8]
2021F**	10,663.1 [9,522.1]	-0.4 [-0.5]
2022F**	10,595.8 [9,454.8]	-0.6 [-0.7]
2023F**	10,563.8 [9,422.8]	-0.3 [-0.3]

* Results for the years 2008 to 2012 contain the effects of past DSM programs

** Bracketed numbers represent the low load scenario without Port Hawkesbury Paper load.

Others: Ontario



Others

- Several regions have examined the issue of risk raised by Elenchus
- As noted by Elenchus, no state or province in North America has concluded the need to discount DSM savings projections
- Some have concluded the opposite
  - **Northwest U.S. applies 10% reduction to DSM costs** to account for net risk benefits when compared with supply resources
  - **Vermont and other states apply 10% risk premium to supply** options when compared with DSM
  - *Note: Vermont, the Northwest U.S., and California represent the three most experienced regions when it comes to DSM*

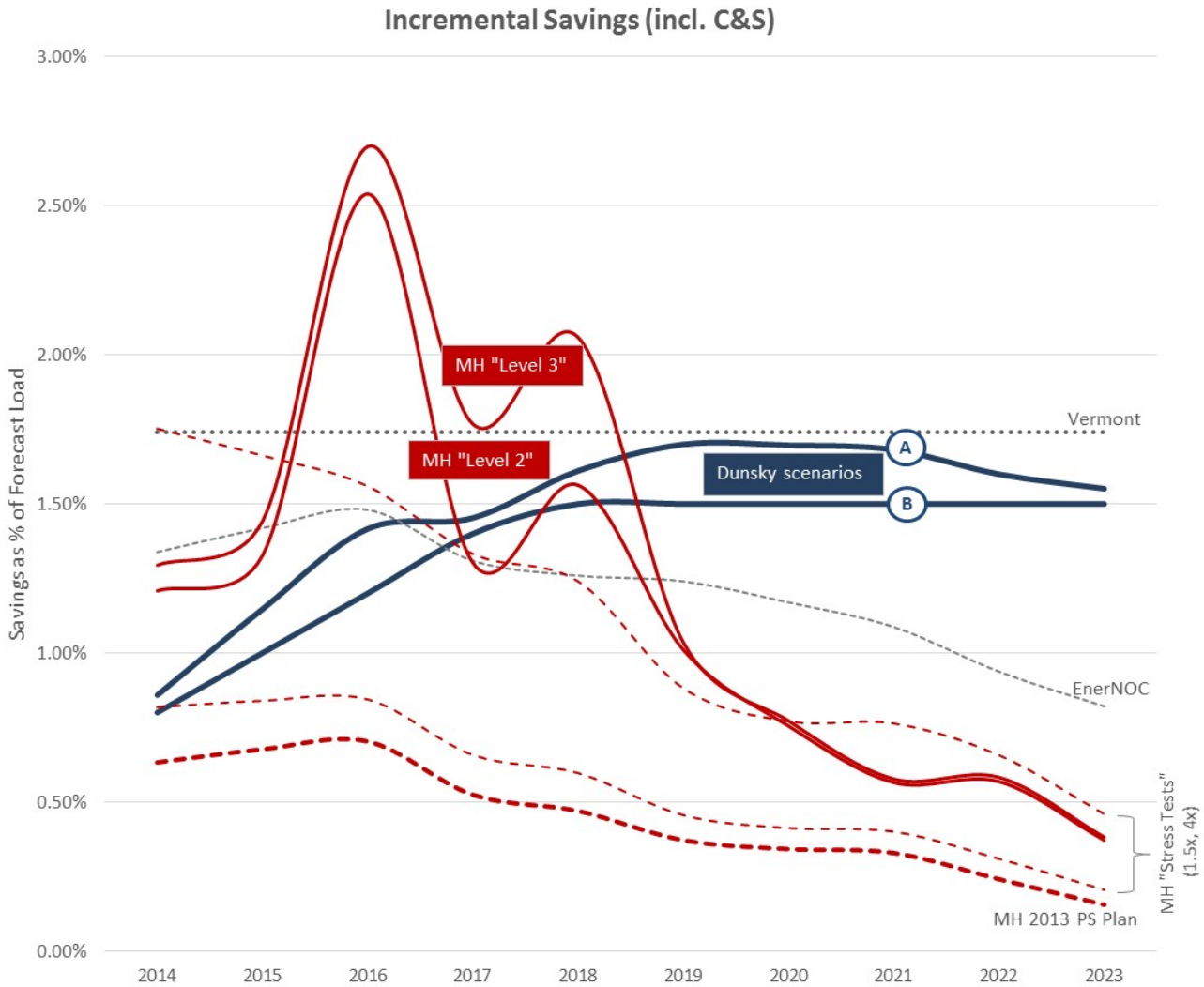
System planners who have been tasked with shining a light on DSM have concluded that, rather than seeing its potential depleted, it renews itself through innovation. They also conclude that it is a dependable, low-risk resource.

As a result, they have concluded that it would be **imprudent to *not* assume continued DSM improvements**, for planning purposes.

CONTENTS

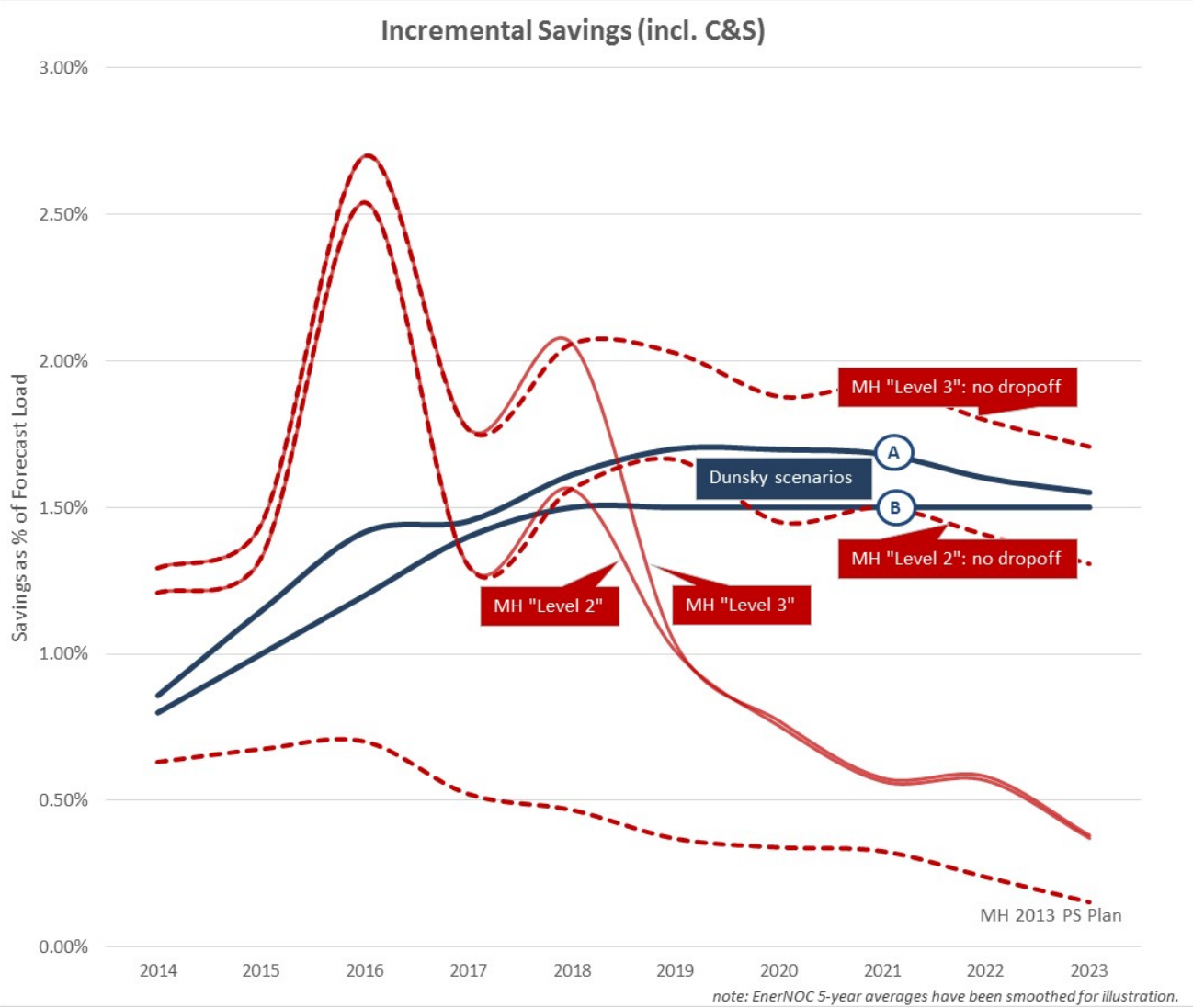
DSM Scenarios (from previous slide)

- Original written evidence included two long-run DSM scenarios
- Below: new effort to build from MH's "Levels 2 & 3"
  - Extend savings >2018
  - Rolling 3-year average



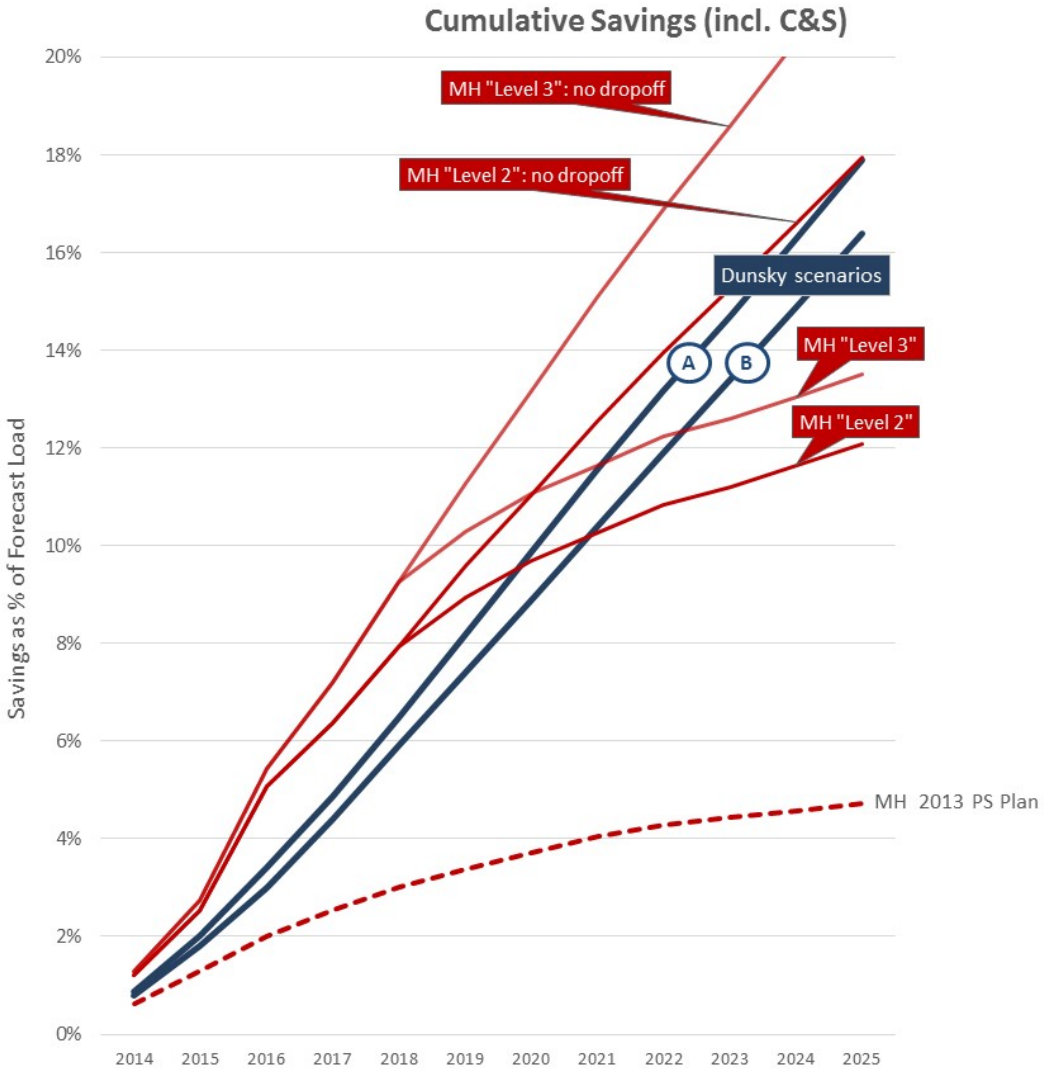
DSM Scenarios *incl. extended version*

- Extended versions of Levels 2 and 3 assume sudden no dropoff after 2018
- Results similar (both higher and lower) to our original Scenarios A and B

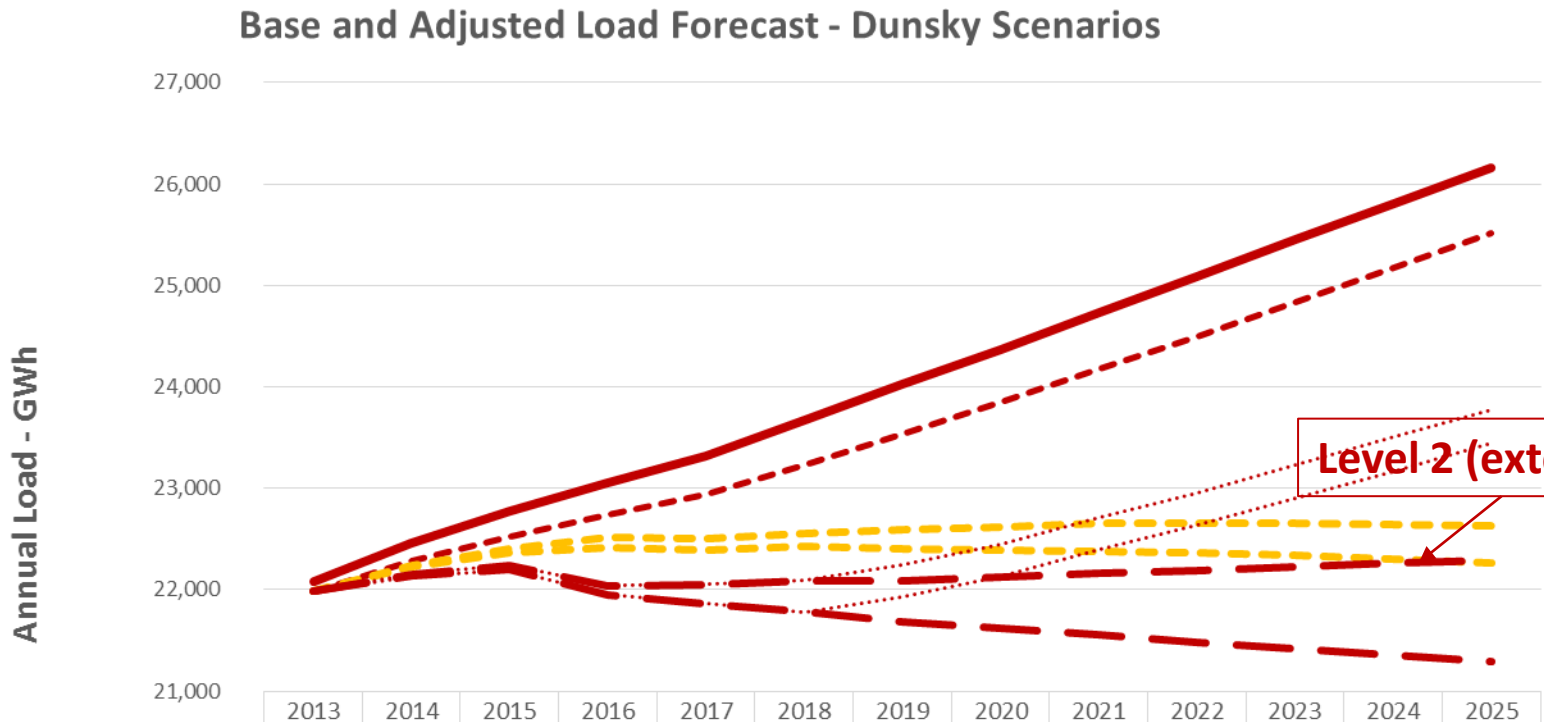


DSM Scenarios *incl. extended version*

- **Same results, but viewed in *cumulative annual* savings** *(as opposed to incremental annual)*

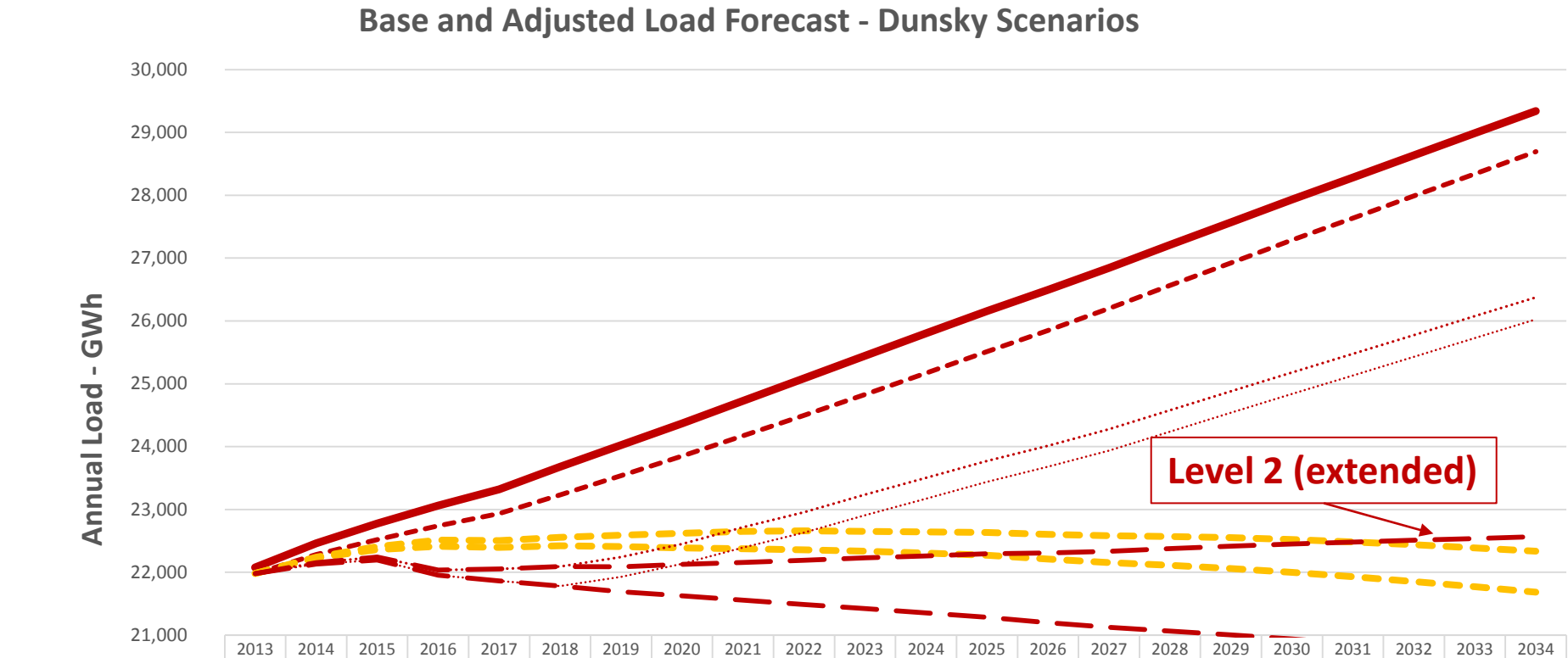


Impact on Load Forecast (to 2025)



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Base Load Forecast (2013)	22,076	22,460	22,774	23,059	23,319	23,677	24,024	24,369	24,728	25,087	25,446	25,802	26,158
Load Forecast with PS 2013	21,980	22,280	22,519	22,738	22,935	23,232	23,538	23,848	24,171	24,495	24,828	25,170	25,512
Dunsky Scenario A	21,980	22,229	22,361	22,415	22,396	22,422	22,409	22,388	22,376	22,359	22,336	22,305	22,269
Dunsky Scenario B	21,980	22,242	22,408	22,512	22,504	22,557	22,592	22,619	22,652	22,660	22,650	22,640	22,634
MH Level 2	21,980	22,151	22,241	22,037	22,052	22,090	22,242	22,451	22,716	22,957	23,235	23,502	23,772
MH Level 3	21,980	22,131	22,196	21,954	21,861	21,782	21,928	22,133	22,394	22,632	22,907	23,172	23,439
MH Level 2: no dropoff	21,980	22,151	22,241	22,037	22,052	22,090	22,085	22,125	22,158	22,190	22,229	22,261	22,293
MH Level 3: no dropoff	21,980	22,131	22,196	21,954	21,861	21,782	21,689	21,624	21,554	21,487	21,424	21,354	21,286

Impact on Load Forecast (to 2034)



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Base Load Forecast (2013)	22,076	22,460	22,774	23,059	23,319	23,677	24,024	24,369	24,728	25,087	25,446	25,802	26,158	26,495	26,846	27,210	27,571	27,931	28,283	28,636	28,988	29,340
Load Forecast with PS 2013	21,980	22,280	22,519	22,738	22,935	23,232	23,538	23,848	24,171	24,495	24,828	25,170	25,512	25,849	26,200	26,564	26,925	27,285	27,637	27,990	28,342	28,694
Dunsky Scenario A	21,980	22,229	22,361	22,415	22,396	22,422	22,409	22,388	22,376	22,359	22,336	22,305	22,269	22,208	22,156	22,113	22,061	22,001	21,929	21,852	21,770	21,682
Dunsky Scenario B	21,980	22,242	22,408	22,512	22,504	22,557	22,592	22,619	22,652	22,660	22,650	22,640	22,634	22,604	22,583	22,570	22,550	22,522	22,483	22,438	22,389	22,335
MH Level 2	21,980	22,151	22,241	22,037	22,052	22,090	22,242	22,451	22,716	22,957	23,235	23,502	23,772	24,015	24,276	24,578	24,880	25,181	25,477	25,775	26,075	26,375
MH Level 3	21,980	22,131	22,196	21,954	21,861	21,782	21,928	22,133	22,394	22,632	22,907	23,172	23,439	23,679	23,937	24,237	24,538	24,837	25,132	25,428	25,726	26,024
MH Level 2: no dropoff	21,980	22,151	22,241	22,037	22,052	22,090	22,085	22,125	22,158	22,190	22,229	22,261	22,293	22,307	22,334	22,376	22,414	22,450	22,479	22,508	22,538	22,567
MH Level 3: no dropoff	21,980	22,131	22,196	21,954	21,861	21,782	21,689	21,624	21,554	21,487	21,424	21,354	21,286	21,199	21,125	21,065	21,002	20,937	20,866	20,794	20,722	20,650

IMPLICATIONS

- **For planning purposes, a near-flat, long-run demand curve is the most prudent assumption for *domestic needs***
  - Note: not a *prediction*; rather a **likeliest scenario assuming MH pursues its stated policy of securing all economically achievable demand side management opportunities**
- Implies that Keeyask and other supply investments will **primarily or exclusively serve export opportunities**

= MERCHANT PLANT PERSPECTIVE

DISCUSSION: MERCHANT PLANTS

- **Preferred Plan *may* still be preferential**
  - ✓ Initial export contracts to secure part of investment
  - ✓ Additional export opportunities down the road
  - ✓ Added reliability benefits
- **But value is heavily dependent on key risk factors**
  - How will natural gas prices evolve?
  - How quickly will solar PV costs continue to drop?
  - Will U.S. adopt more aggressive CO_2 reduction requirements?
- **PUB decision would benefit from assessment rooted in this perspective**

For planning purposes, it may be more prudent to assume MH Level 2 *extended after 2018.*

This suggests a *nearly* flat domestic demand curve to 2034, which in turn suggests that Keeyask and other supply investments should be assessed primarily as merchant plants.

QUESTIONS?

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