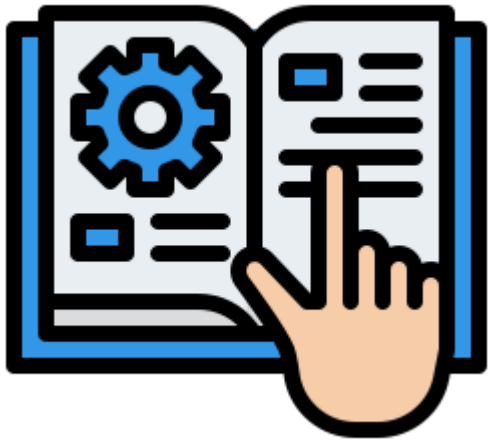
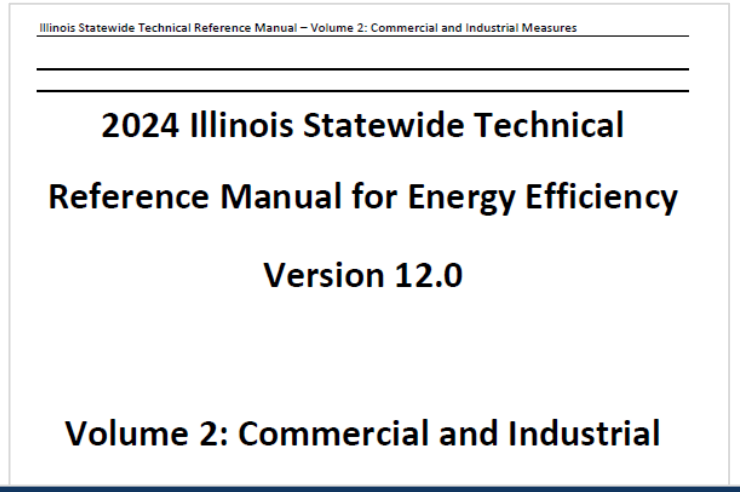
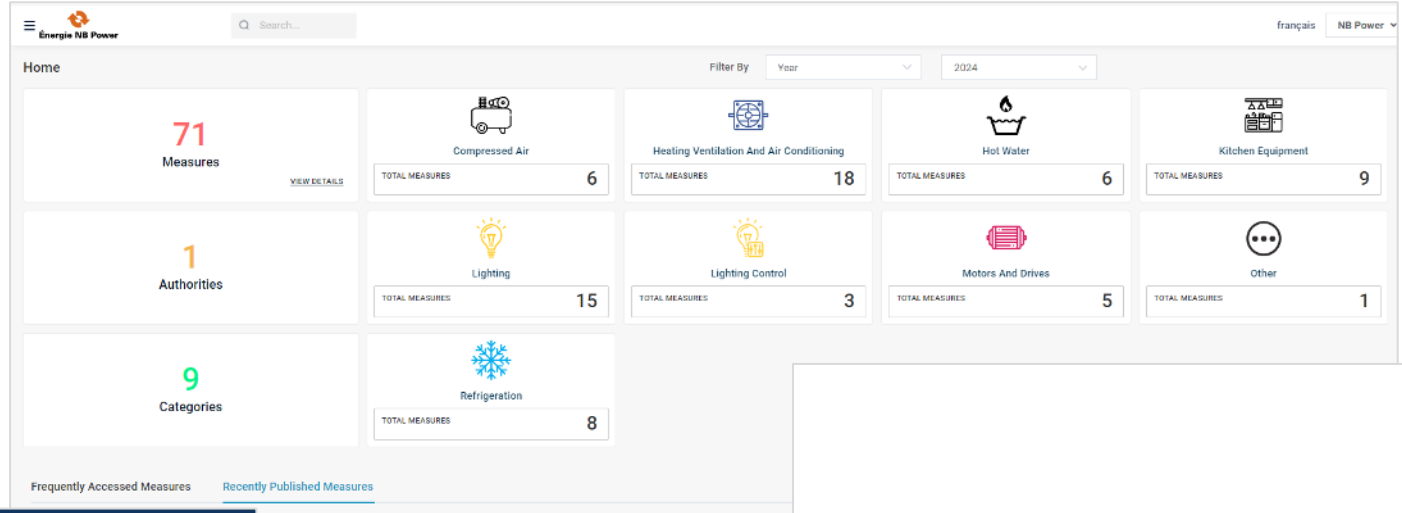
Technical Reference Manual (TRM) Research

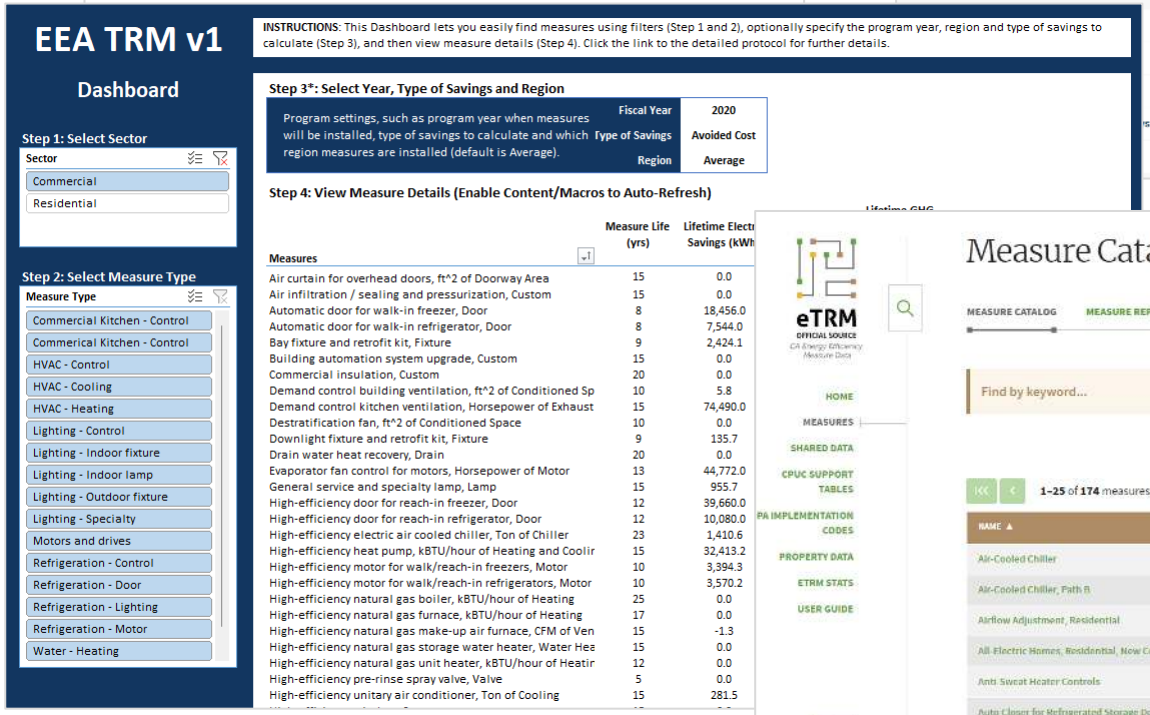
Technical Reference Manuals (TRMs)

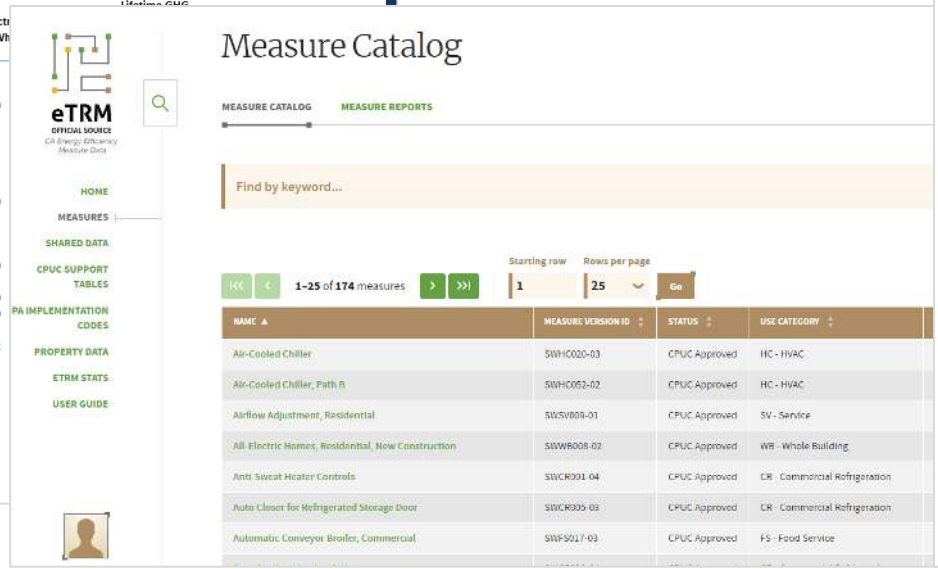


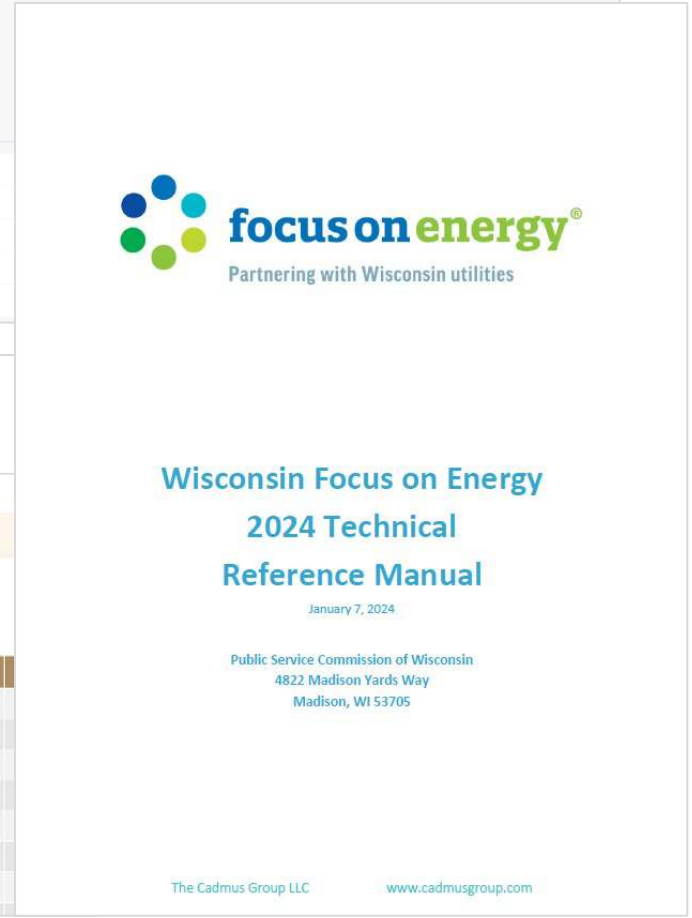
- TRMs provide information used for planning and evaluating the energy and demand savings associated with ratepayer funded energy-efficiency measures.
- Not always called TRMs. For example:
  - Regional Technical Forum (RTF) in Northwest
  - Program Savings Document (PSD) in CT
  - Michigan Energy Measures Database (MEMD) in MI











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Technical Reference Manuals (TRMs)

- TRM information may include:

Eligibility	Default Conditions	Energy Savings	Cost-effectiveness Inputs	Supporting Documentation
• Customer type (e.g., residential, low-income, small business) • Project conditions (e.g., new construction, time of failure, retrofit) • Product criteria	• Definition of baseline and efficient conditions • Assumptions such as hours, horsepower, and peak coincidence	• Deemed energy and demand savings values • Engineering algorithms • Load shapes	• Incremental measure cost • Measure life • Non-energy impacts (e.g., water savings)	• References to studies and other TRMs • Citations • Rationale

4.5.10 Lighting Controls

Description

This measure relates to the installation of new occupancy or daylighting sensors and con
lighting system. Lighting control types covered by this measure include wall, ceiling, fixtu
controls in addition to Luminaire Level Lighting Controls (LLLCs) or Networked Lighting C
additional high-end trim and networking capabilities. Passive infrared, ultrasonic detect
sensors or sensors with a combination thereof are eligible. Lighting controls required by s
eligible. This must be a new installation with additional control features and may not sole
existing lighting control with the same control features.

This measure was developed to be applicable to the following program types: RF.

If applied to other program types, the measure savings should be verified.

Definition of Efficient Equipment

Lighting that is controlled by any of the control strategies characterized in this measure;
dual (occupancy and daylighting) controls with or without high-end trim, and Luminaire-lev
/ Networked Lighting Controls (NLC).

LLLCs or NLCs are defined according to DesignLights Consortium (DLC) Networked Lighting Controls definition, which
requires systems to have fixture networking capabilities, individual addressability, occupancy sensing, daylight
harvesting, hig rk ability

Lighting Control Type	Incremental Cost[1295]
Interior Wall Switch Occupancy Sensor	$55.00
Interior Fixture-Mounted Occupancy Sensor	$67.00
Interior Remote or Wall-Mounted Occupancy Sensor	$125.00
Interior Fixture-Mounted Daylight Sensor	$50.00
Interior Remote or Wall-Mounted Daylight Sensor	$65.00
Interior Integrated Occupancy for LED Interior Fixtures < 10,000 Lumens	$40.00
Interior Integrated Occupancy for LED Interior Fixtures >= 10,000 Lumens	$40.00
Interior Integrated Dual Occupancy & Daylight Sensor for LED Interior Fixtures < 10,000 Lumens	$50.00

Algorithm

Calculation of Savings

Electric Energy Savings

$$\Delta kWh = ((Watts_{base} - Watts_{EE})/1000) * Hours * WHF_e * ISR$$

Where:

$Watts_{base}$ = Input wattage of the existing system which depends on the baseline fixture configuration (number and type of lamp) and ballast factor (if applicable) and number of fixtures.

= Actual

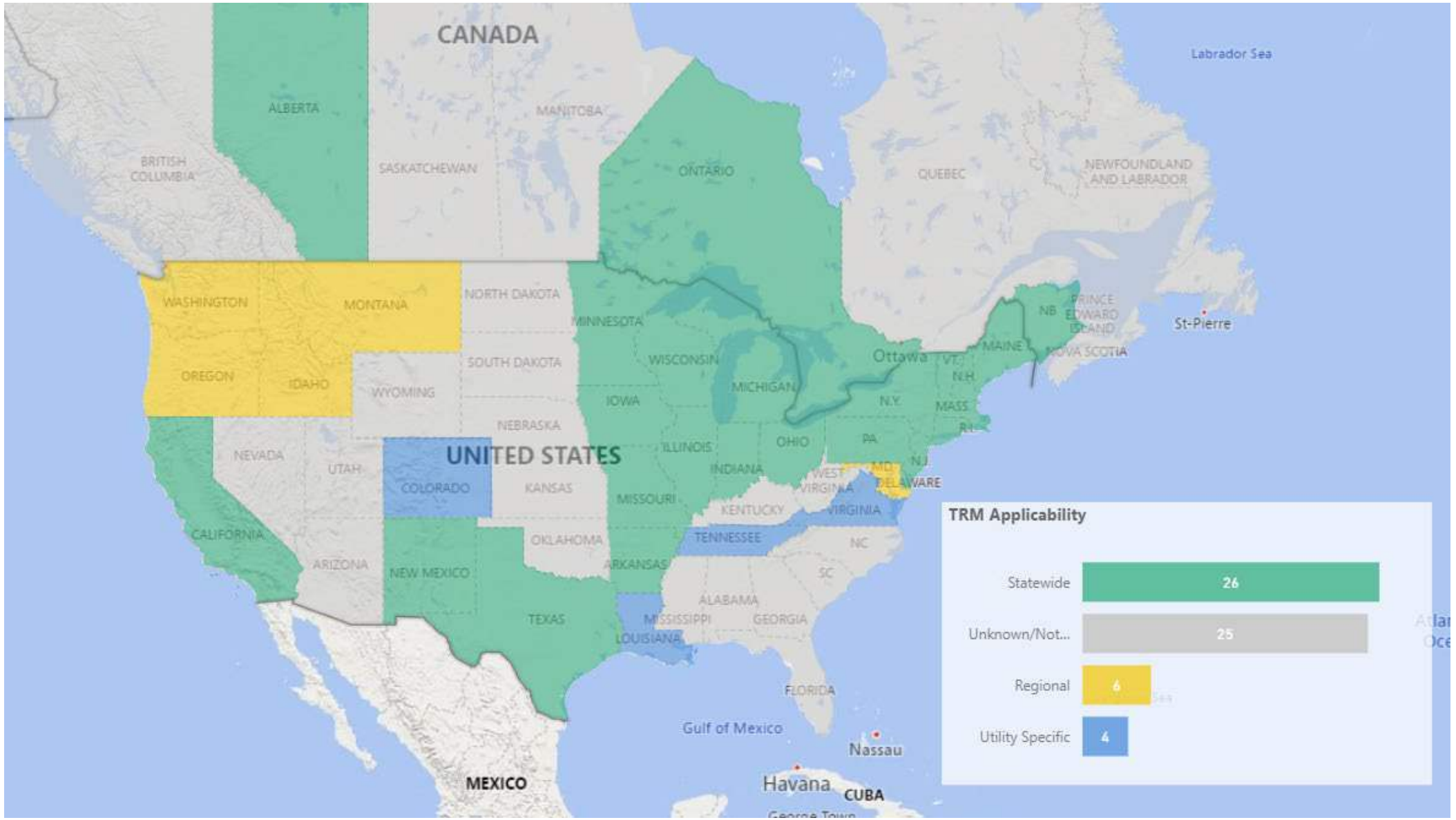
$Watts_{EE}$ = New Input wattage of EE fixture which depends on new fixture configuration (number of lamps) and ballast factor (if applicable) (if applicable) and number of fixtures.

= Actual

Hours = Average hours of use per year as provided by the customer or selected from the Reference Table in Section 4.5, Fixture annual operating hours, by building type. If hours or building type are unknown, use the Miscellaneous value.

WHF_e

Lighting Control Type	Energy Savings Factor[1299]
Fixture Measurement of Control savings through Networked Trending (Interior or Exterior)	Custom
Interior Occupancy Sensor (Switch, Wall, Fixture or Remote Mounted or Integrated in Fixture)	24% 37% with High End Trim
Interior Occupancy Sensor configured as "Vacancy Sensor" (Switch, Wall, Fixture or Remote Mounted or Integrated in Fixture)	31% 44% with High End Trim
Interior Daylight Sensor (Wall, Fixture or Remote Mounted)	28% 41% with High End Trim
Interior Dual Occupancy & Daylight Sensor (Integrated of Fixture Mounted)	38% 51% with High End Trim[1300]
Interior Networked Luminaire-Level Lighting Controls	61%[1301]
Interior Networked Lighting Controls Only with No LLLCs	35%
Interior Networked Lighting Controls (unknown or mixed LLLCs)	49%


CANADA
Labrador Sea
ALBERTA
MANITOBA
BRITISH COLUMBIA
SASKATCHEWAN
ONTARIO
QUEBEC
NEWFOUNDLAND AND LABRADOR
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
PRINCE EDWARD ISLAND
NB
St-Pierre
OREGON
IDAHO
WYOMING
SOUTH DAKOTA
WISCONSIN
Ottawa
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NOVA SCOTIA
VT.
N.H.
MICHIGAN
IOWA
N.Y.
MASS
R.I.
NEBRASKA
UNITED STATES
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UTAH
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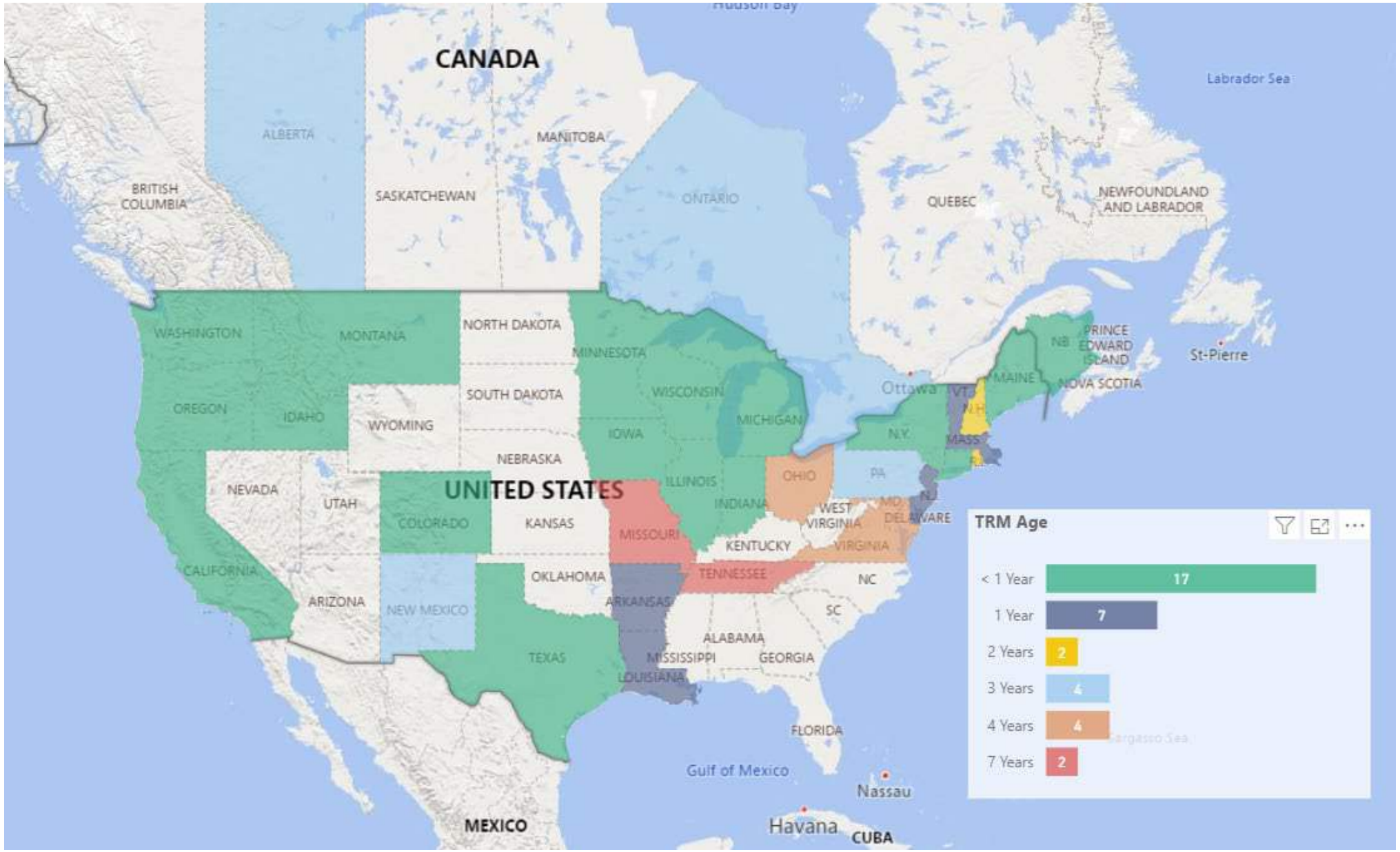
KANSAS
ILLINOIS
OHIO
PA
INDIANA
MD
N.J.
DELAWARE
WEST VIRGINIA
MISSOURI
KENTUCKY
VIRGINIA
CALIFORNIA
OKLAHOMA
TENNESSEE
NC
ARIZONA
NEW MEXICO
ARKANSAS
SC
ALABAMA
TEXAS
MISSISSIPPI
GEORGIA
LOUISIANA
FLORIDA
Gulf of Mexico
Nassau
MEXICO
Havana
CUBA
TRM Applicability
Statewide
26
Unknown/Not...
25
Regional
6
Utility Specific
4



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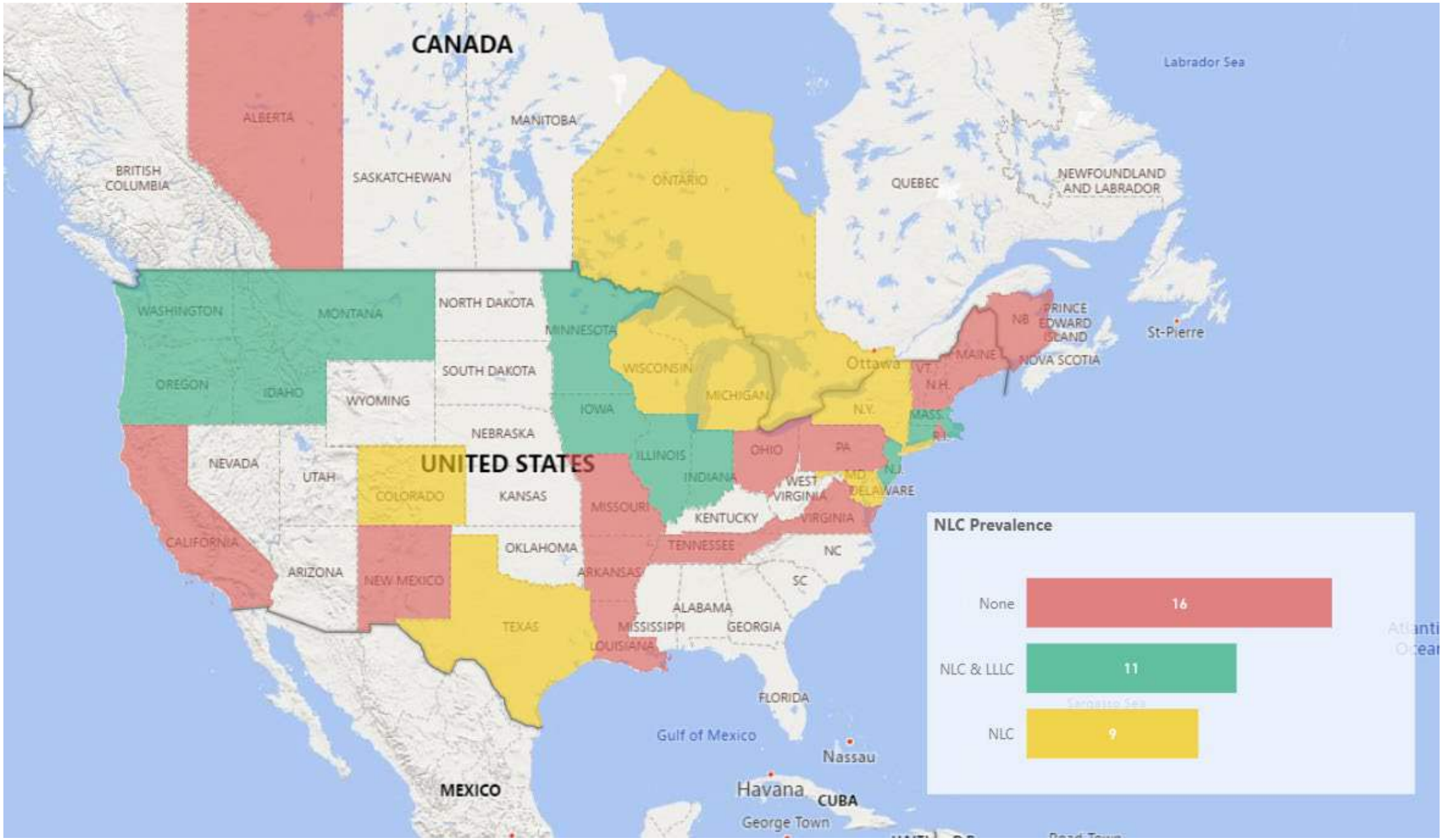
TRM Jurisdictional Scan

- Availability and use of TRMs
- Presence of NLC/LLLC measures within TRMs
- Lighting control measure assumptions within TRMs
  - Control savings factor/fraction (CSF)
  - Operating hours
  - Measure life



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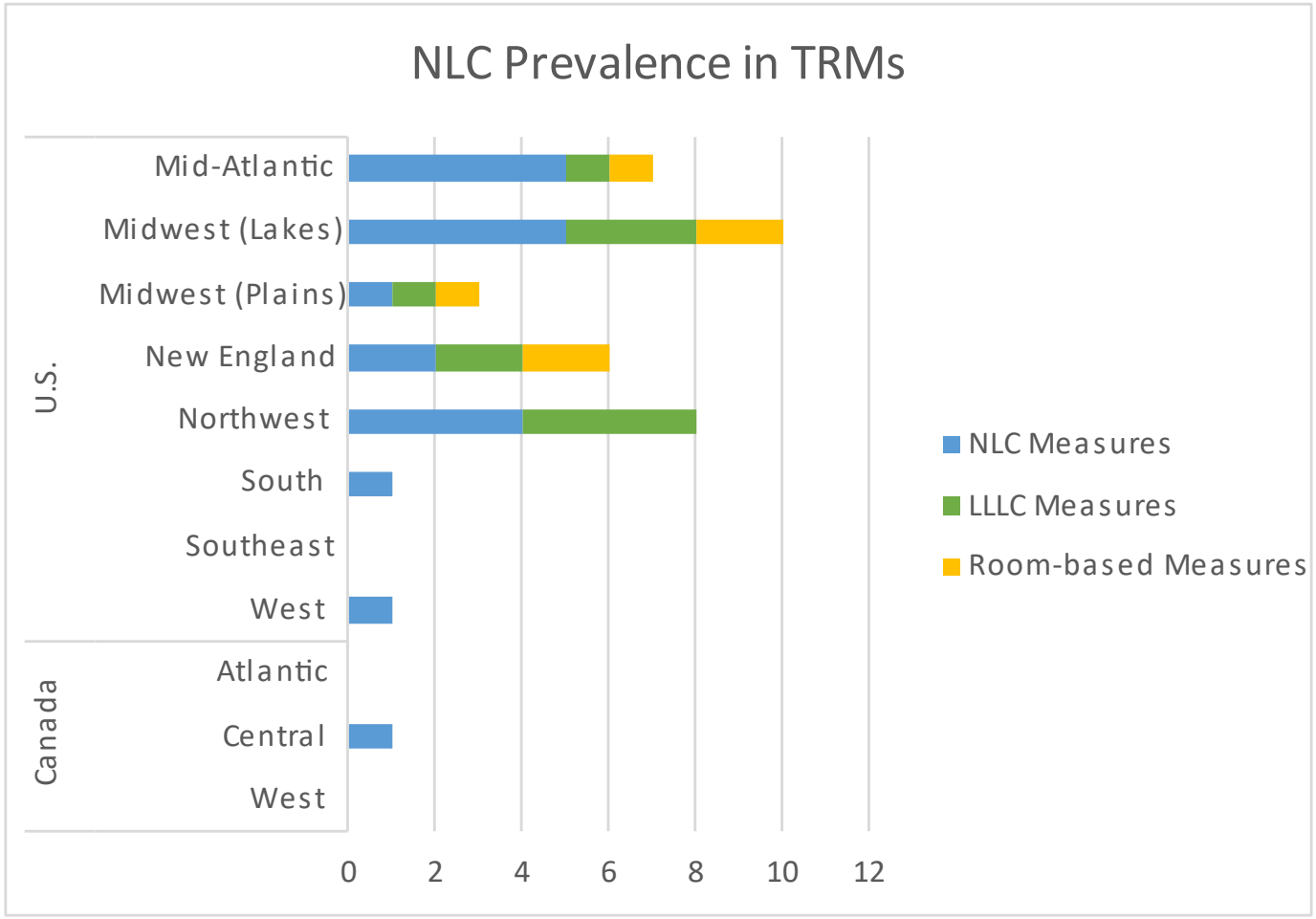
Jurisdictional Scan Results

Country	Region	States/ Provinces	TRMs Found	TRMs Not Found	NLC Measures	% with NLC	LLLC Measures	% with LLLC	Room-based Measures	% with Room-based
U.S.	Mid-Atlantic	6	6	0	5	83%	1	17%	1	17%
U.S.	Midwest (Lakes)	6	6	0	5	83%	3	50%	2	33%
U.S.	Midwest (Plains)	6	2	4	1	50%	1	50%	1	50%
U.S.	New England	6	6	0	2	33%	2	33%	2	33%
U.S.	Northwest	6	4	2	4	100%	4	100%	0	0%
U.S.	South	7	4	3	1	25%	0	0%	0	0%
U.S.	Southeast	7	1	6	0	0%	0	0%	0	0%
U.S.	West	7	4	3	1	25%	0	0%	0	0%
U.S.	**Subtotal**	**51**	**33**	**18**	**19**	**58%**	**11**	**33%**	**6**	**18%**
Canada	Atlantic	4	1	3	0	0%	0	0%	0	0%
Canada	Central	3	1	2	1	100%	0	0%	0	0%
Canada	West	3	1	2	0	0%	0	0%	0	0%
Canada	**Subtotal**	**10**	**3**	**7**	**1**	**33%**	**0**	**0%**	**0**	**0%**
Grand Total		**61**	**36**	**25**	**20**	**56%**	**11**	**31%**	**6**	**17%**

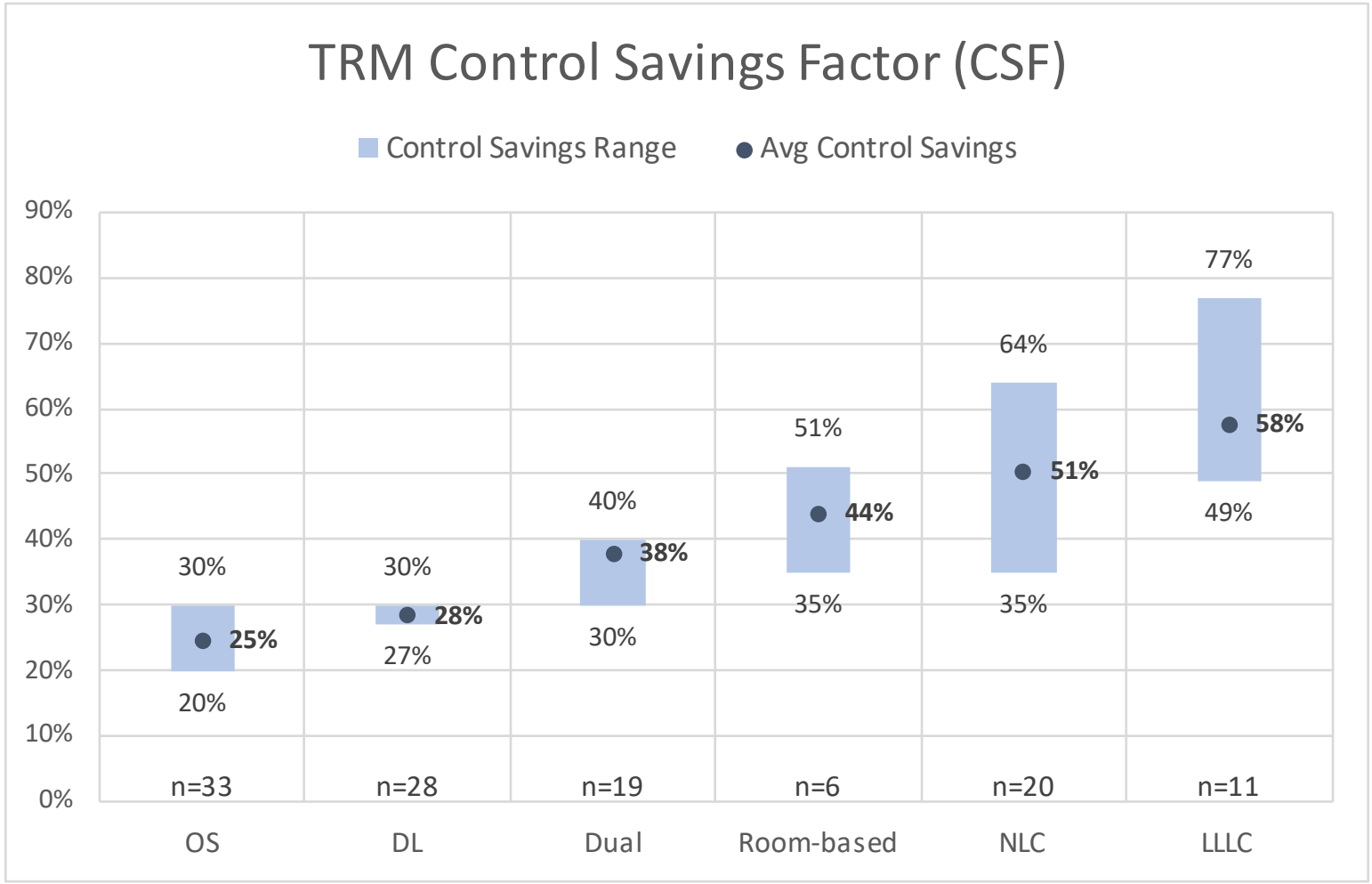
NLC Prevalence by Region

- Strong prevalence in Mid-Atlantic, Midwest, and Northwest
- Gaps exist in New England (only 33% have NLC), South, Southeast, West, and Canada



Control Savings Factor (CSF)

- CSF defines the % savings off the controlled load, due to the use of controls
- Some TRMs also define a baseline CSF, such as the pre-existing use of occupancy sensors



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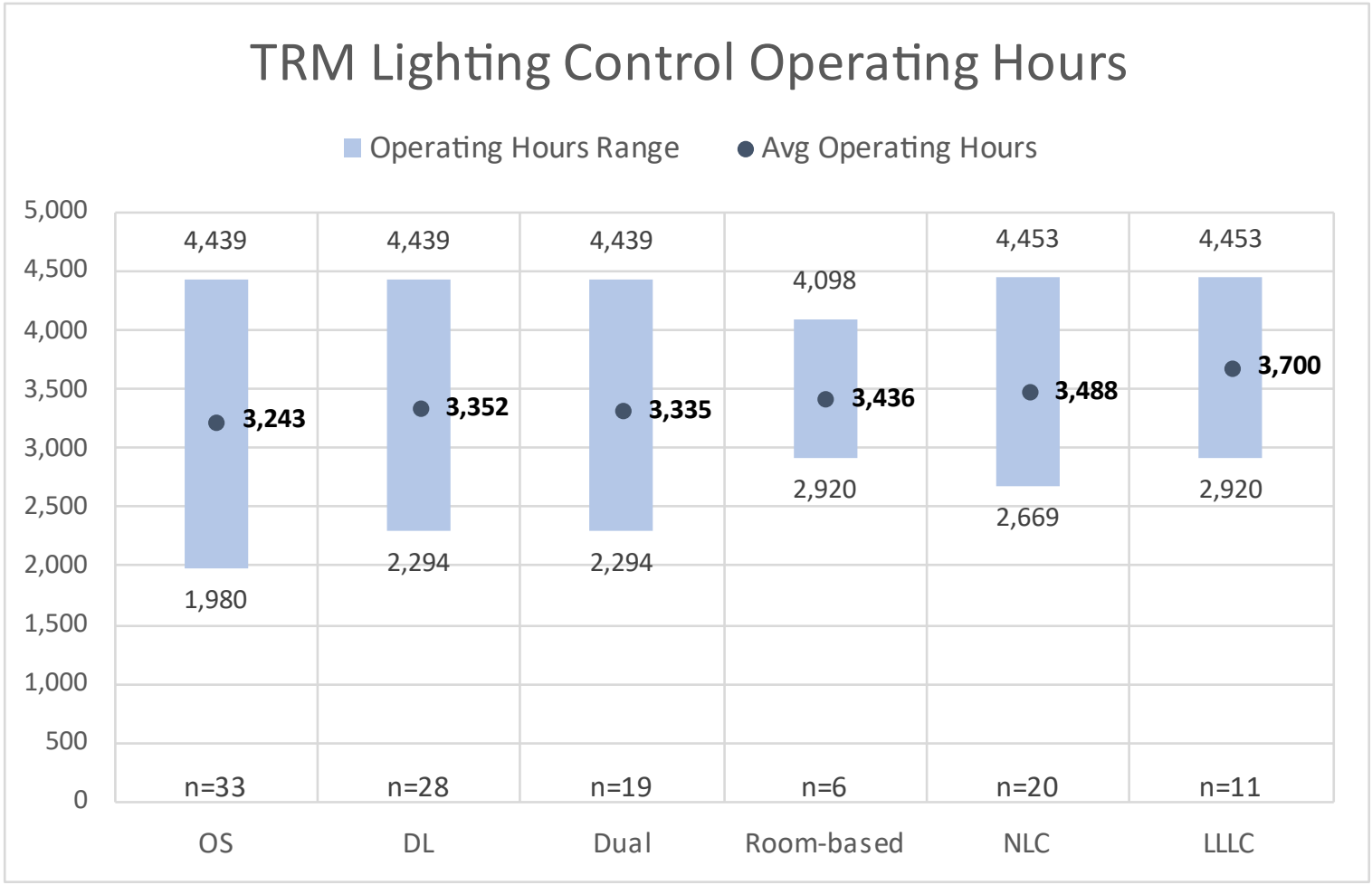
Operating Hours (for “Office” space type)

- Operating hours are defined by space type for use across all lighting measures
- One TRM (Illinois) defines longer operating hours for NLC measures, based on the DLC/NEEA study



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Measure Life

- Measure life is used in cost-effectiveness screening, calculation of lifetime savings, and IRP modeling.
- TRM measure life ≠ functional life
- LLLC measures are more often tied the (longer) measure life to the fixture