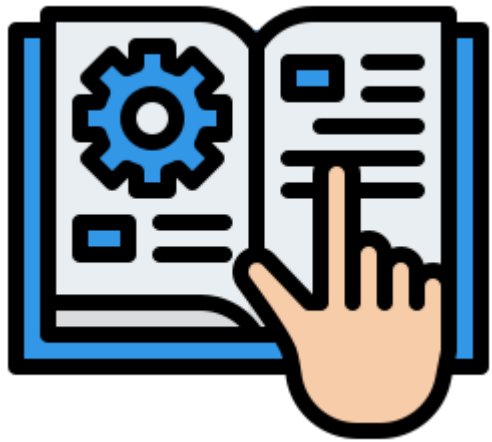




# **Technical Reference Manual (TRM) Research**

# 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

# 2024 Illinois Statewide Technical Reference Manual for Energy Efficiency

Version 12.0

## Volume 2: Commercial and Industrial

### EEA TRM v1

#### Dashboard

##### Step 1: Select Sector

Sector

Commercial

Residential

##### Step 2: Select Measure Type

Measure Type

Commercial Kitchen - Control

Commercial Kitchen - Control

HVAC - Control

HVAC - Cooling

HVAC - Heating

Lighting - Control

Lighting - Indoor fixture

Lighting - Indoor lamp

Lighting - Outdoor fixture

Lighting - Specialty

Motors and drives

Refrigeration - Control

Refrigeration - Door

Refrigeration - Lighting

Refrigeration - Motor

Water - Heating

INSTRUCTIONS: This Dashboard lets you easily find measures using filters (Step 1 and 2), optionally specify the program year, region and type of savings to calculate (Step 3), and then view measure details (Step 4). Click the link to the detailed protocol for further details.

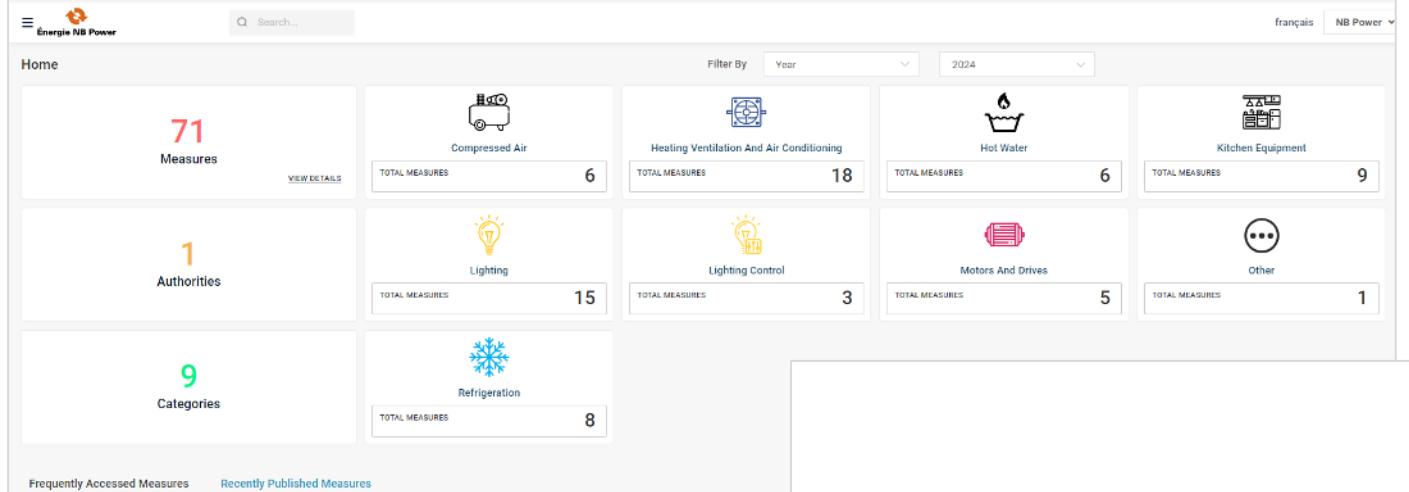
##### Step 3\*: Select Year, Type of Savings and Region

Program settings, such as program year when measures will be installed, type of savings to calculate and which region measures are installed (default is Average).

Fiscal Year	2020
Type of Savings	Avoided Cost
Region	Average

##### Step 4: View Measure Details (Enable Content/Macros to Auto-Refresh)

Measures	Measure Life (yrs)	Lifetime Electrical Savings (kWh)
Air curtain for overhead doors, ft² of Doorway Area	15	0.0
Air infiltration / sealing and pressurization, Custom	15	0.0
Automatic door for walk-in freezer, Door	8	18,456.0
Automatic door for walk-in refrigerator, Door	8	7,544.0
Bay fixture and retrofit kit, Fixture	9	2,424.1
Building automation system upgrade, Custom	15	0.0
Commercial insulation, Custom	20	0.0
Demand control building ventilation, ft² of Conditioned Sp	10	5.8
Demand control kitchen ventilation, Horsepower of Exhaust	15	74,490.0
Destratification fan, ft² of Conditioned Space	10	0.0
Downlight fixture and retrofit kit, Fixture	9	135.7
Drain water heat recovery, Drain	20	0.0
Evaporator fan control for motors, Horsepower of Motor	13	44,772.0
General service and specialty lamp, Lamp	15	955.7
High-efficiency door for reach-in freezer, Door	12	39,660.0
High-efficiency door for reach-in refrigerator, Door	12	10,080.0
High-efficiency electric air cooled chiller, Ton of Chiller	23	1,410.6
High-efficiency heat pump, kBtu/hour of Heating and Coolin	15	32,413.2
High-efficiency motor for walk/reach-in freezers, Motor	10	3,394.3
High-efficiency motor for walk/reach-in refrigerators, Motor	10	3,570.2
High-efficiency natural gas boiler, kBtu/hour of Heating	25	0.0
High-efficiency natural gas furnace, kBtu/hour of Heating	17	0.0
High-efficiency natural gas make-up air furnace, CFM of Ven	15	-1.3
High-efficiency natural gas storage water heater, Water Hea	15	0.0
High-efficiency natural gas unit heater, kBtu/hour of Heati	12	0.0
High-efficiency pre-rinse spray valve, Valve	5	0.0
High-efficiency unitary air conditioner, Ton of Cooling	15	281.5



RESIDENTIAL	NB Power
COMMERCIAL	NB Power
COMMERCIAL, INDUSTRIAL	NB Power
COMMERCIAL, INDUSTRIAL	NB Power
COMMERCIAL	NB Power

### Measure Catalog

#### MEASURE CATALOG

Find by keyword...

Starting row Rows per page

1-25 of 174 measures

1 25 Go

NAME	MEASURE VERSION ID	STATUS	USE CATEGORY
Air-Cooled Chiller	SWHC020-03	CPUC Approved	HC - HVAC
Air-Cooled Chiller, Path B	SWHC052-02	CPUC Approved	HC - HVAC
Airflow Adjustment, Residential	SWSV003-01	CPUC Approved	SV - Service
All-Electric Homes, Residential, New Construction	SWWR008-02	CPUC Approved	WB - Whole Building
Anti-Sweat Heater Controls	SWCR001-04	CPUC Approved	CR - Commercial Refrigeration
Auto-Closer for Refrigerated Storage Door	SWCR005-03	CPUC Approved	CR - Commercial Refrigeration
Automatic Conveyor Broiler, Commercial	SWFP017-03	CPUC Approved	FS - Food Service



## Wisconsin Focus on Energy 2024 Technical Reference Manual

January 7, 2024

Public Service Commission of Wisconsin  
4822 Madison Yards Way  
Madison, WI 53705



Energy · Quality · Controllability™

The Cadmus Group LLC

www.cadmusgroup.com

# Technical Reference Manuals (TRMs)

- TRM information may include:

Eligibility	Default Conditions	Energy Savings	Cost-effectiveness Inputs	Supporting Documentation
<ul style="list-style-type: none"><li>• Customer type (e.g., residential, low-income, small business)</li><li>• Project conditions (e.g., new construction, time of failure, retrofit)</li><li>• Product criteria</li></ul>	<ul style="list-style-type: none"><li>• Definition of baseline and efficient conditions</li><li>• Assumptions such as hours, horsepower, and peak coincidence</li></ul>	<ul style="list-style-type: none"><li>• Deemed energy and demand savings values</li><li>• Engineering algorithms</li><li>• Load shapes</li></ul>	<ul style="list-style-type: none"><li>• Incremental measure cost</li><li>• Measure life</li><li>• Non-energy impacts (e.g., water savings)</li></ul>	<ul style="list-style-type: none"><li>• References to studies and other TRMs</li><li>• Citations</li><li>• Rationale</li></ul>

## 4.5.10 Lighting Controls

### DESCRIPTION

This measure relates to the installation of new occupancy or daylighting sensors and control lighting system. Lighting control types covered by this measure include wall, ceiling, fixture controls in addition to Luminaire Level Lighting Controls (LLCs) or Networked Lighting Controls (NLCs) with additional high-end trim and networking capabilities. Passive infrared, ultrasonic detection sensors or sensors with a combination thereof are eligible. Lighting controls required by state code are eligible. This must be a new installation with additional control features and may not solely replace an 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-level / Networked Lighting Controls (NLC).

LLCs 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, high

Lighting Control Type	Incremental Cost <sup>1295</sup>
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

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

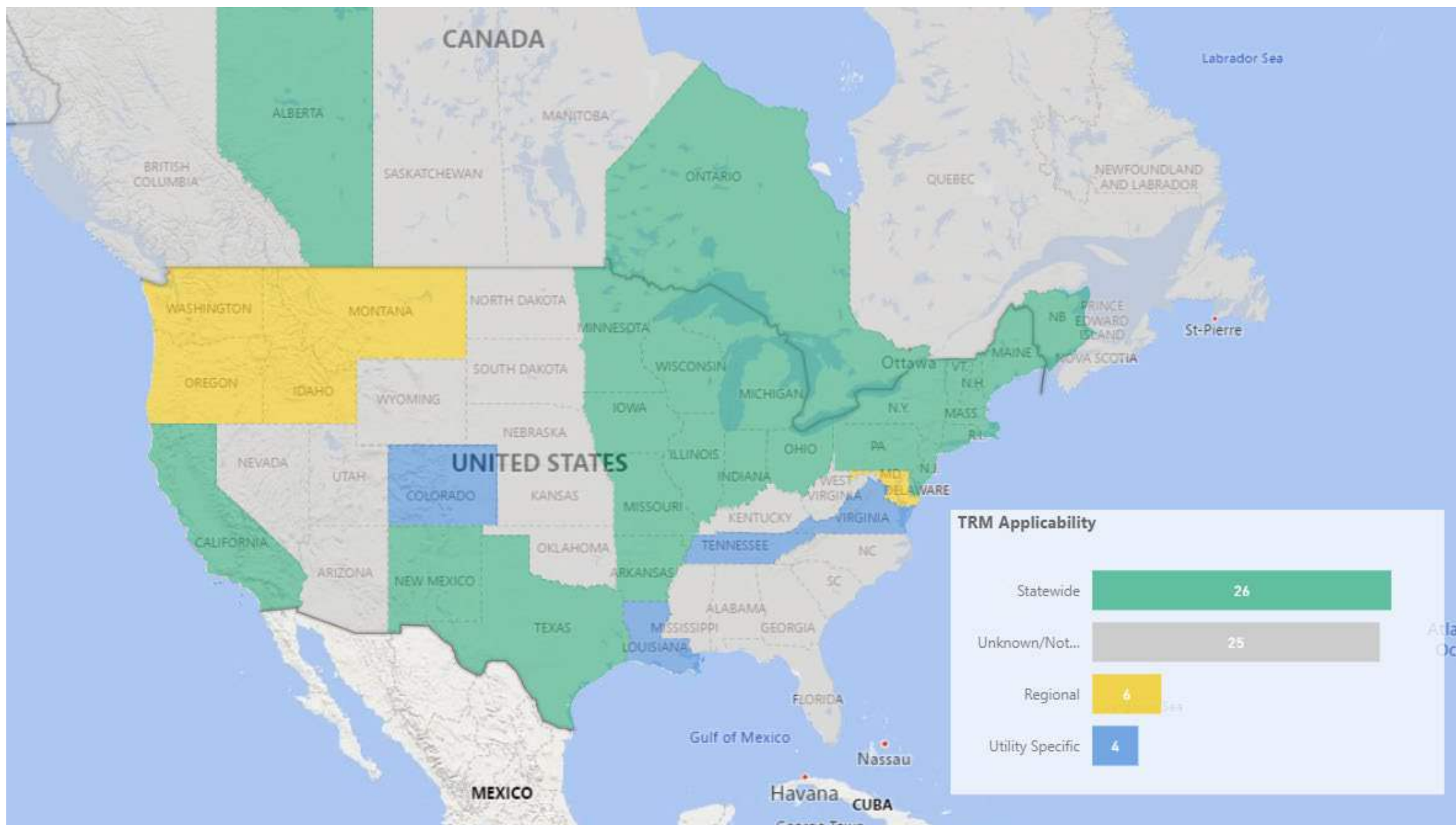
Where:

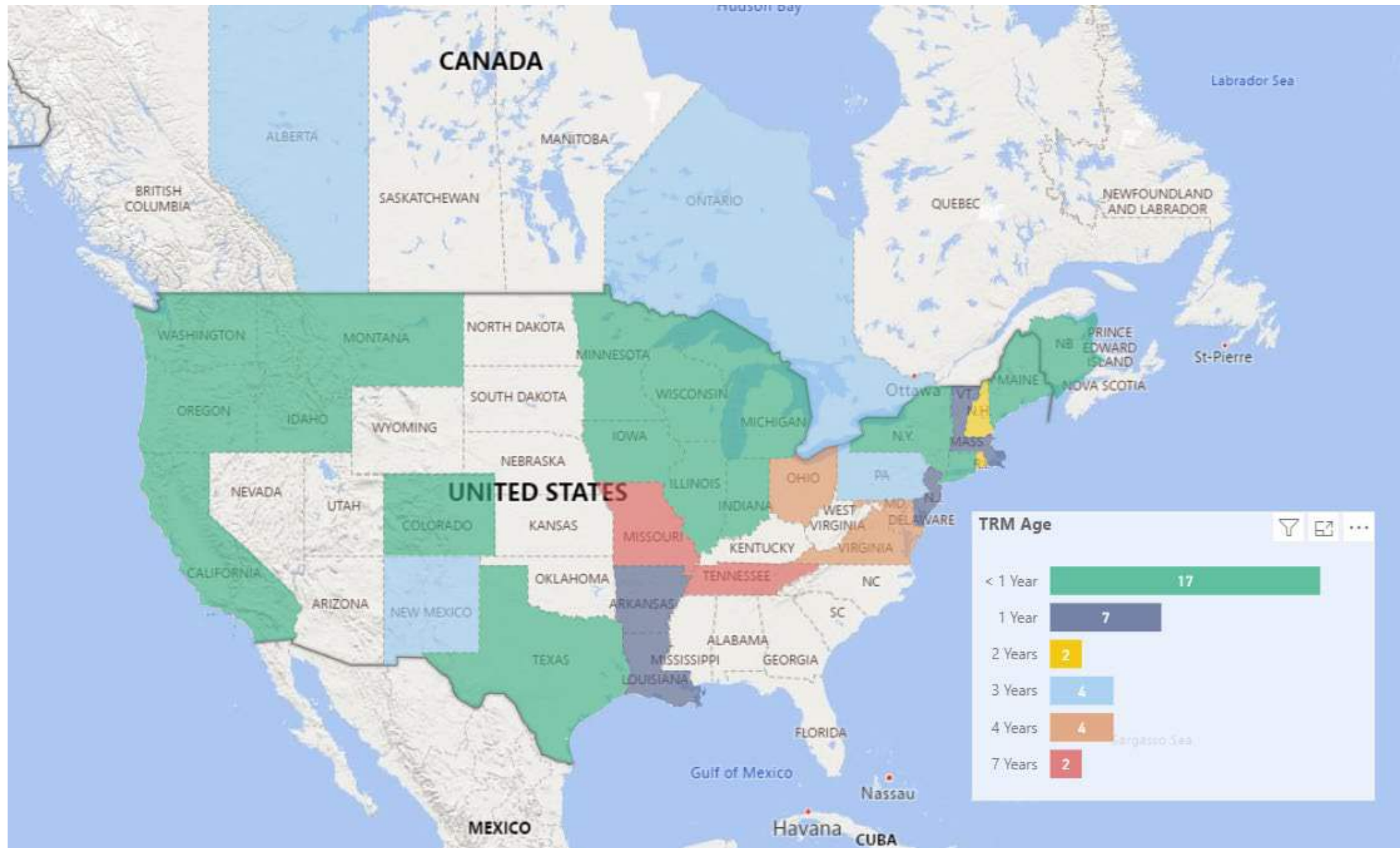
$Watts_{base}$	= Input wattage of the existing system which depends on the baseline fixture configuration (number and type of lamp) and ballast factor (if applicable) and number of fixtures.
$Watts_{EE}$	= Actual = New Input wattage of EE fixture which depends on new fixture configuration (number of lamps) and ballast factor (if applicable) (if applicable) and number of fixtures.
Hours	= Actual = 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 <sup>1299</sup>
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 or Fixture Mounted)	38% 51% with High End Trim <sup>1300</sup>
Interior Networked Luminaire-Level Lighting Controls	61% <sup>1301</sup>
Interior Networked Lighting Controls Only with No LLCs	35%
Interior Networked Lighting Controls (unknown or mixed LLCs)	49%





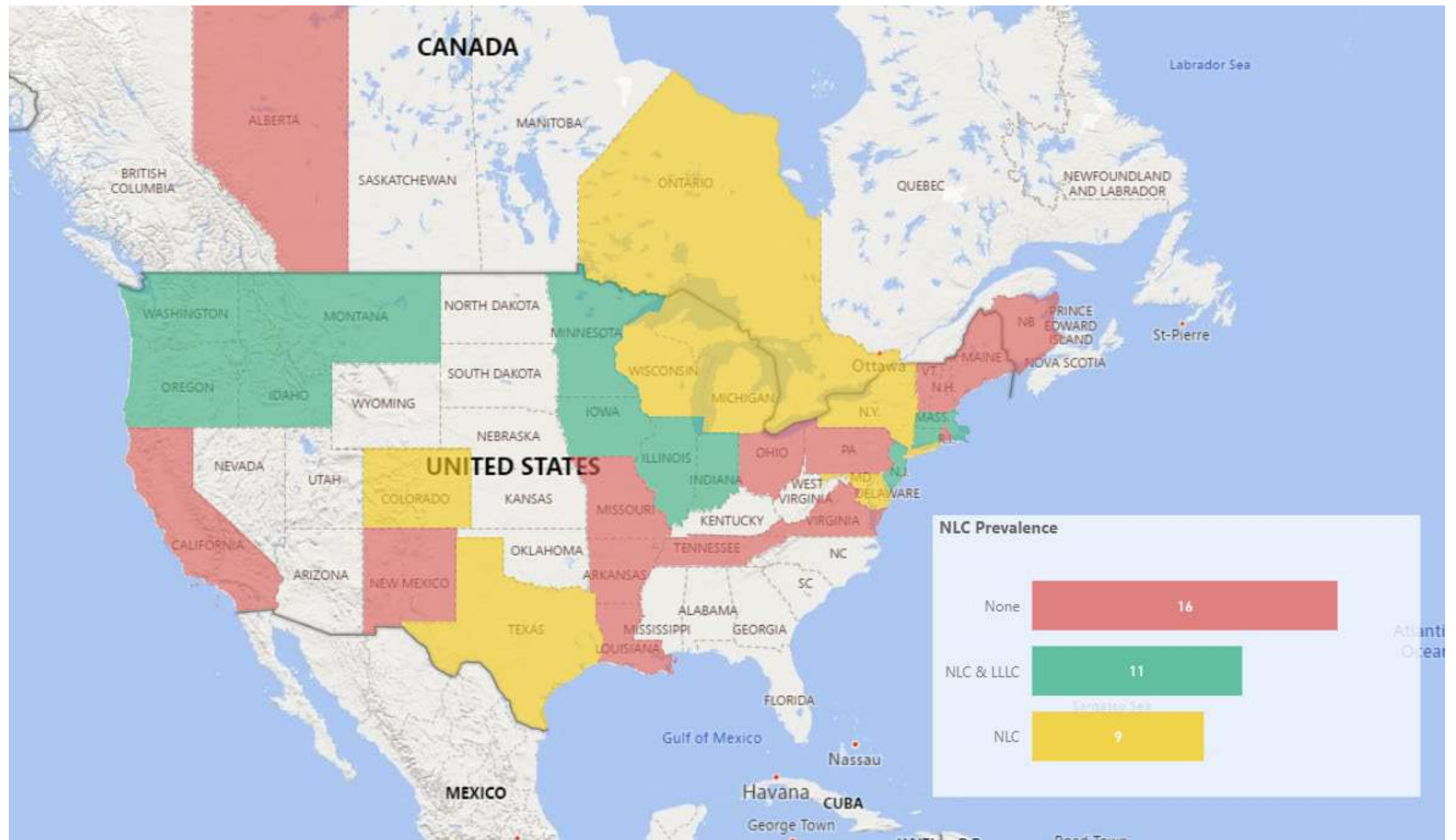




# TRM Jurisdictional Scan

- 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



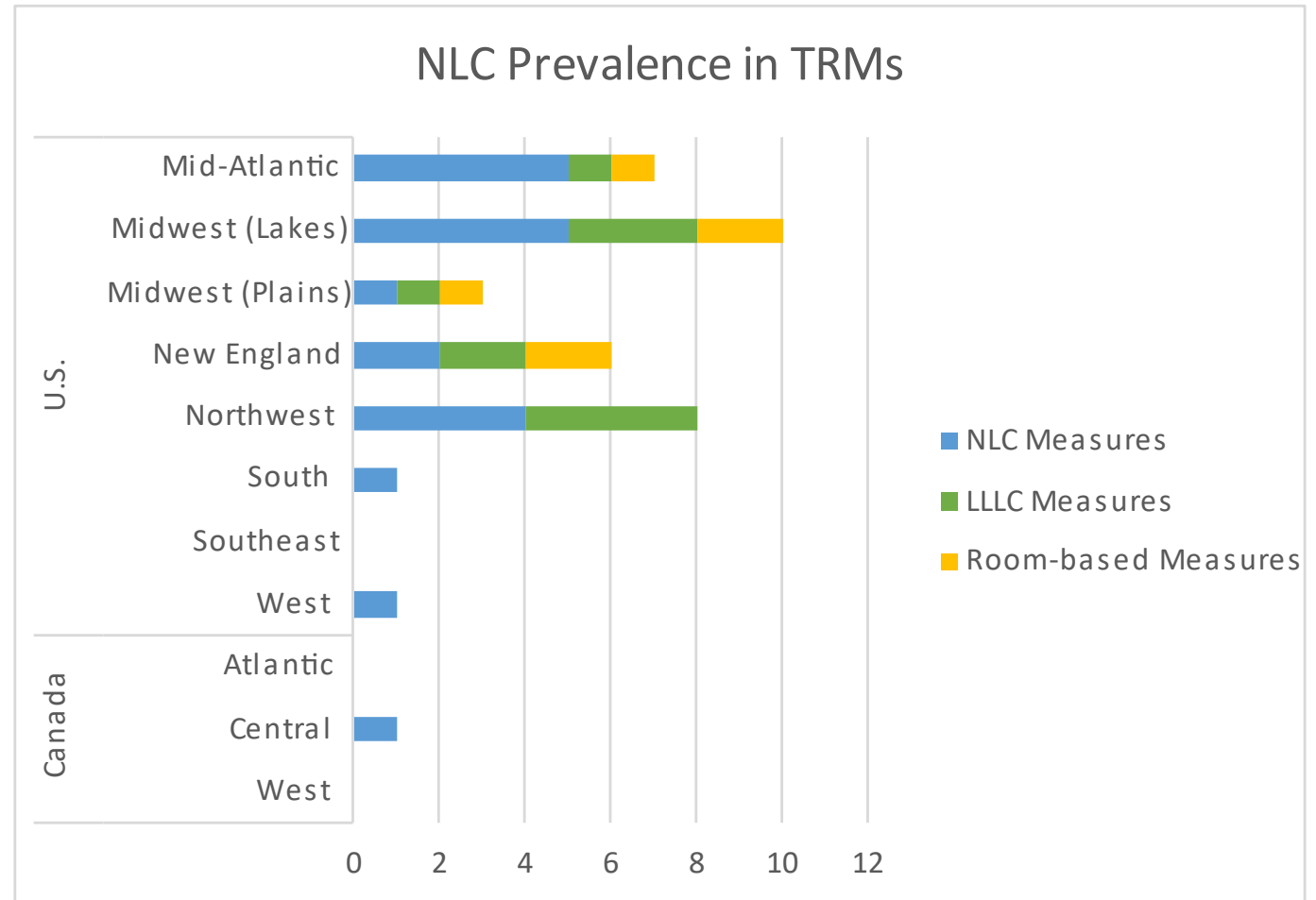


# Jurisdictional Scan Results

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%
<b>U.S.</b>	<b>Subtotal</b>	<b>51</b>	<b>33</b>	<b>18</b>	<b>19</b>	<b>58%</b>	<b>11</b>	<b>33%</b>	<b>6</b>	<b>18%</b>
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%
<b>Canada</b>	<b>Subtotal</b>	<b>10</b>	<b>3</b>	<b>7</b>	<b>1</b>	<b>33%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
<b>Grand Total</b>		<b>61</b>	<b>36</b>	<b>25</b>	<b>20</b>	<b>56%</b>	<b>11</b>	<b>31%</b>	<b>6</b>	<b>17%</b>

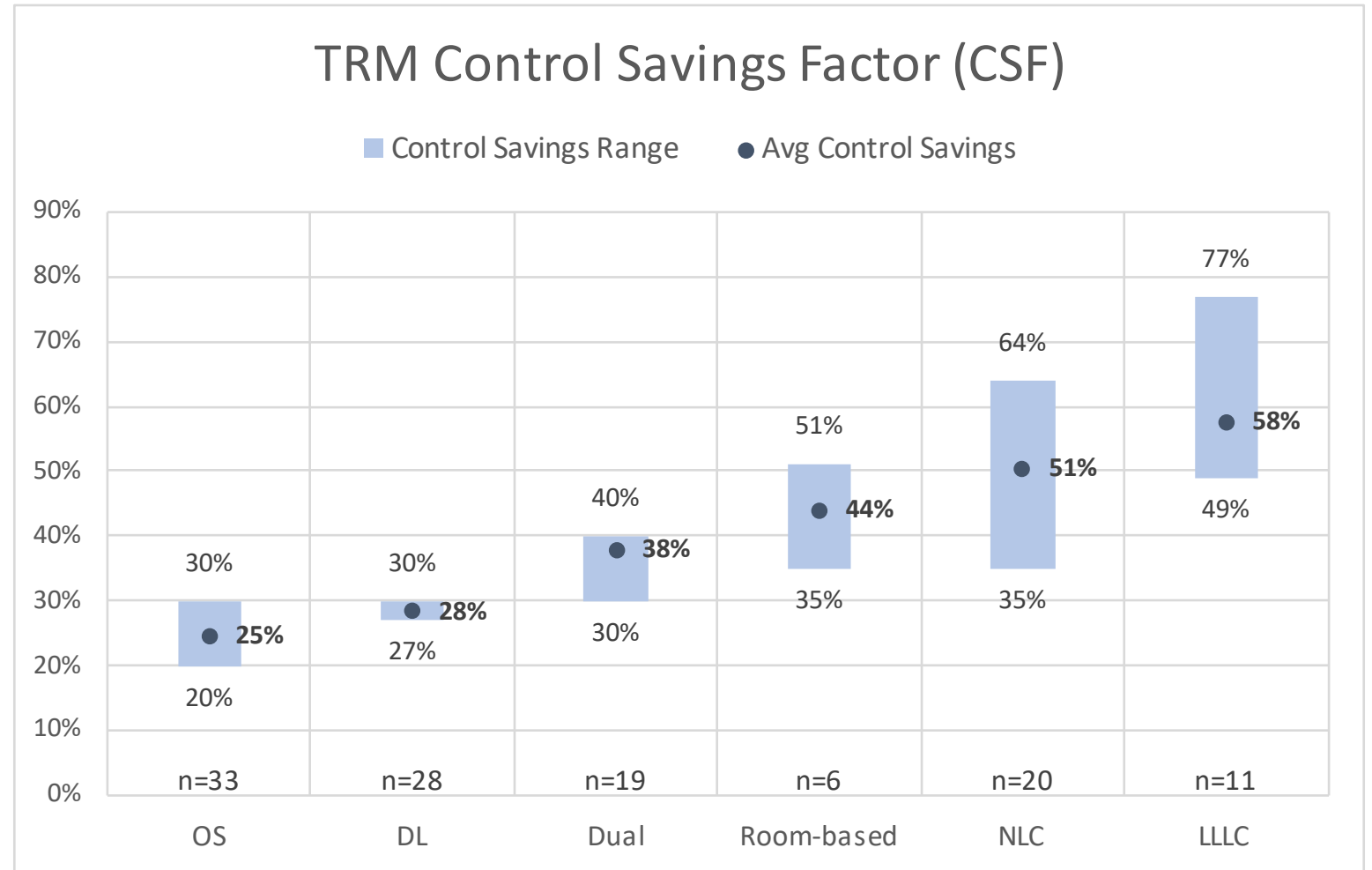
# NLC Prevalence by Region

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



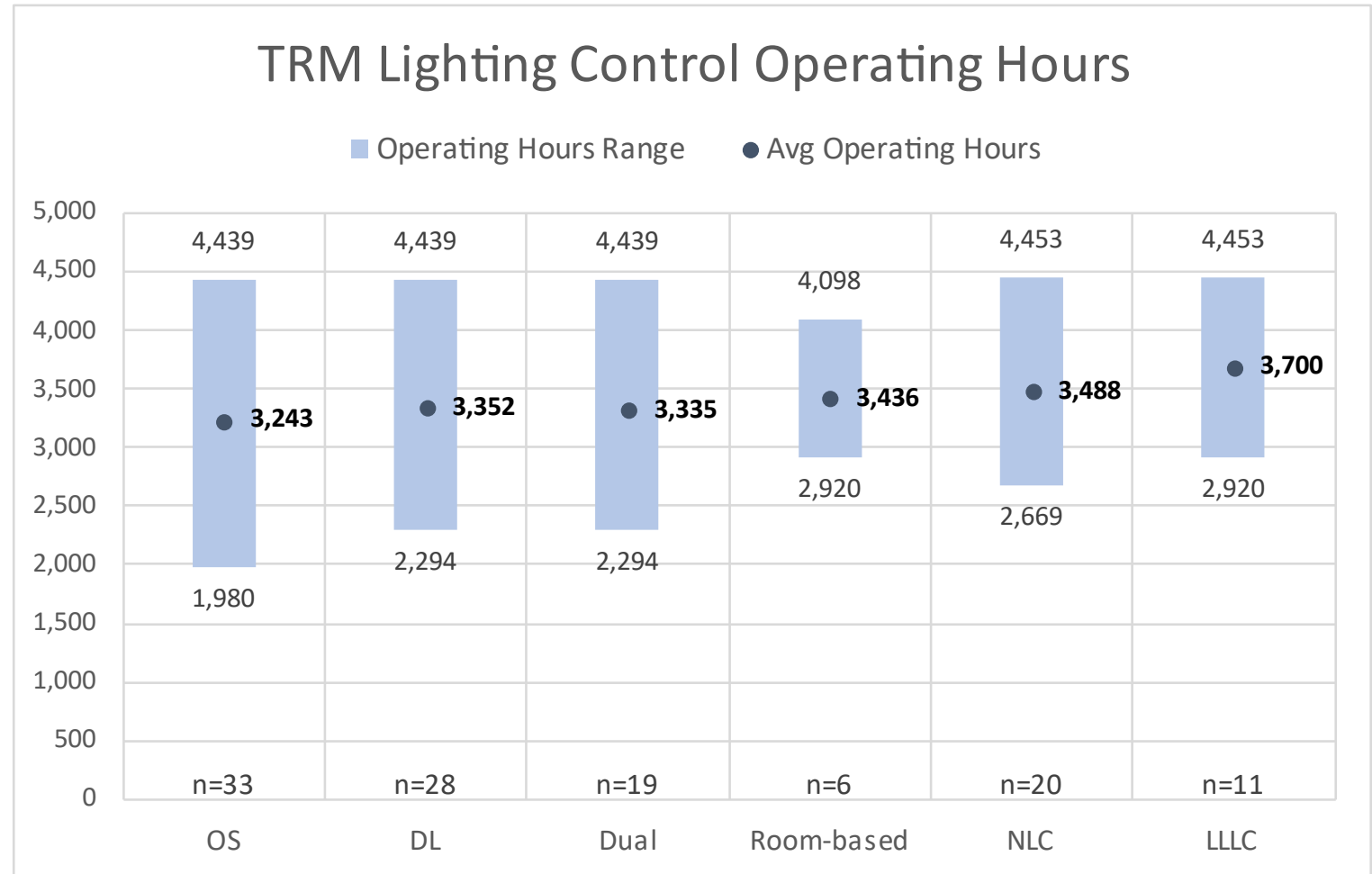
# Control Savings Factor (CSF)

- 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



# 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





# Measure Life

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

