Presentation Purpose

- **Objective:** This presentation is to provide an overview of the current status of the Load Shape study to the EWR Collaborative.
- **Audience:** MPSC EWR Collaborative, including MPSC staff, peer utilities, implementer, evaluators, intervenors, and other interested parties.
- **Timing:** April 19, 2022 MPSC Collaborative Meeting
- **Structure:**
  - Load Shape Study Overview
  - Residential Methodology and Status Update
  - Commercial Methodology and Status Update
  - Integrating Load Shapes into the MEMD

LOAD SHAPE RESEARCH OVERVIEW AND UPDATE

EWR COLLABORATIVE

April 19, 2022

Presented by Cadmus and TRC

Consumers Energy
Count on Us

DTE

CADMUS

TRC

Agenda

1. Project Overview - TRC
2. Residential Methodology and Status Update - CADMUS
3. Commercial Methodology and Status Update - TRC
4. Integrating Load Shapes into the MEMD - CADMUS

Why Load Shape Research?

In a study supported by the MPSC and contributed to by DTE, Consumers Energy & Morgan Marketing Partners, Lawrence Berkeley National Labs (LBNL) found there is **no Michigan-specific load shape data.**

This limits the characterization of the time-varying value of efficiency savings, especially as **some load shapes have low transferability across regions.**

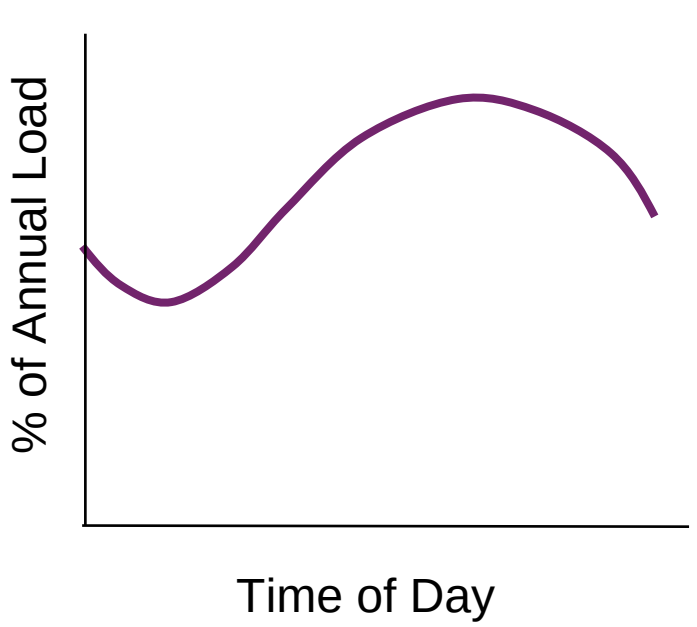
- Current modeling processes used in Integrated Resource Plans (IRP) and DSMore rely on load shape and coincidence factor data from other regions, which may not be completely suitable for Michigan.
- Using non-Michigan load shapes or those that are scaled from whole house demand may not always align with the Michigan system peak and appropriately value a program or measure impact.

See our June 2021 presentation to the EWR Collaborative for more details on the value and potential uses of Michigan-specific load shapes.

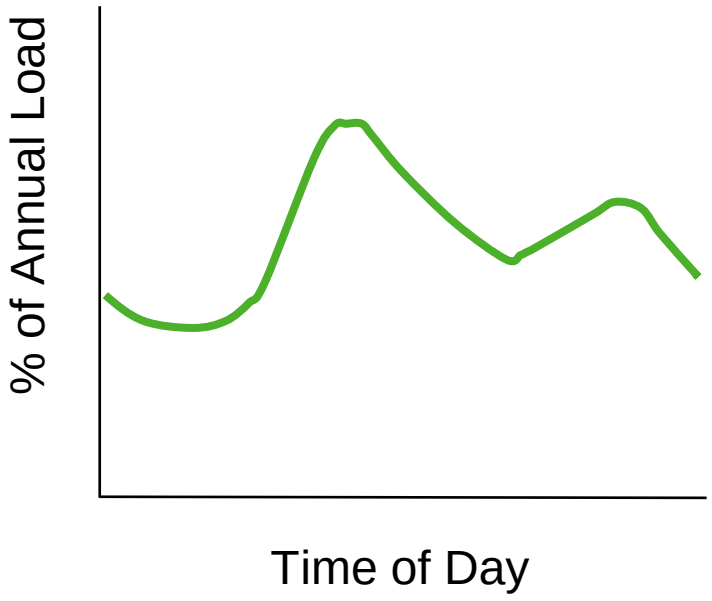
LBNL study: https://escholarship.org/content/qt7576110g/qt7576110g_noSplash_7bfdc8cc3c5362231ec0de48b774154f.pdf

Load Shape Terms

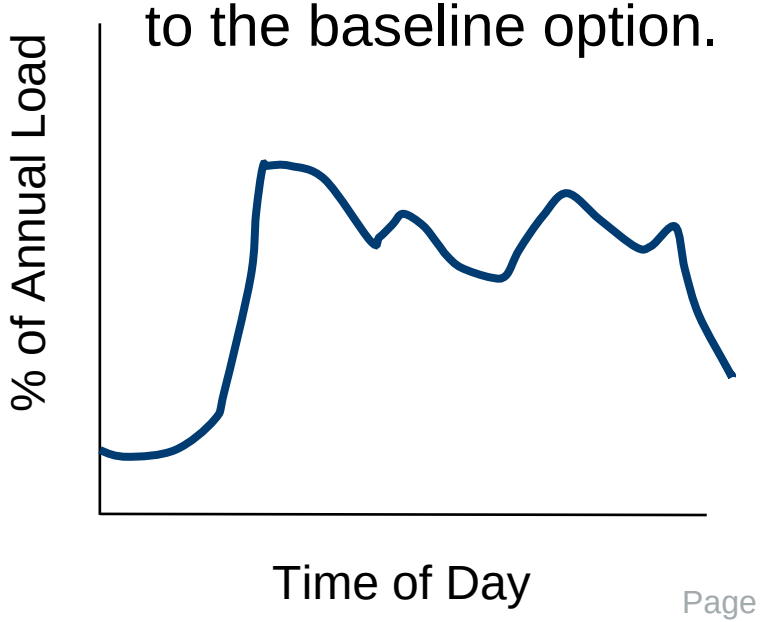
A **utility load shape** shows the time-of-day variation in energy demand for a utility. Loads shapes may vary by month and season.



An **end use load shape** shows the time-of day variation in consumption from a particular end use – like lighting or water heating.

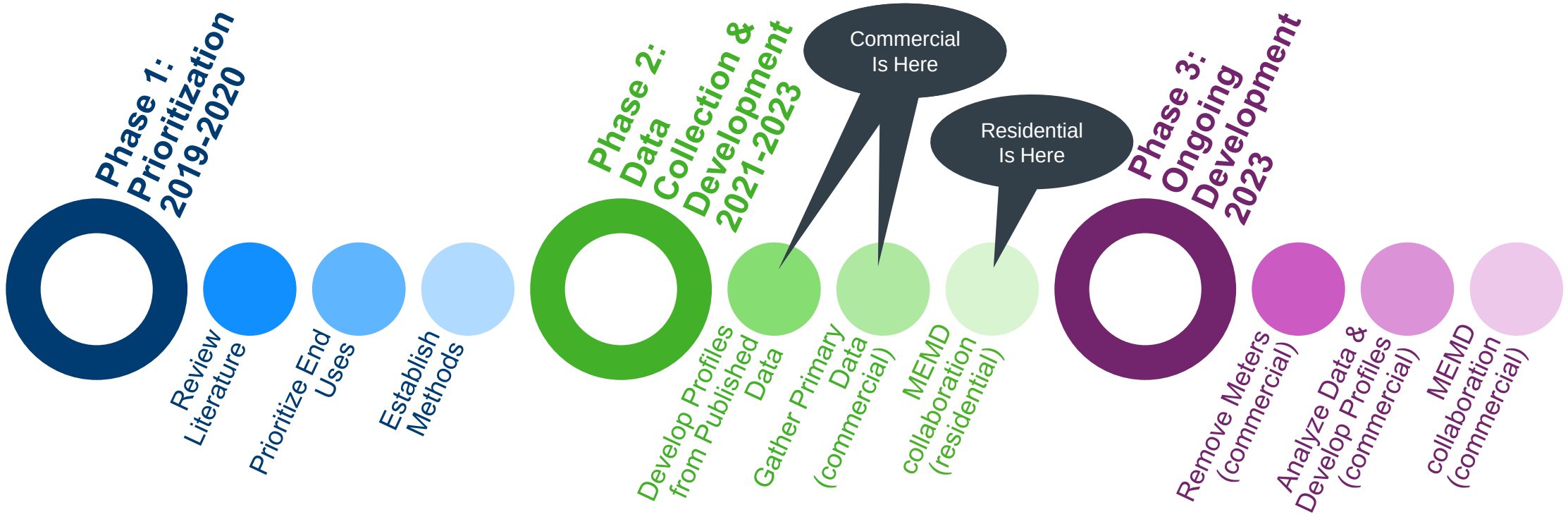


A **savings load shape** shows the time-of day variation in consumption from an efficient piece of equipment compared to the baseline option.



Load Shapes Research Overview

This research establishes an extensive library of
hourly end-use load profile data to support utility resource planning
such as EWR program planning, MEMD savings estimates, rate design, and capacity planning.

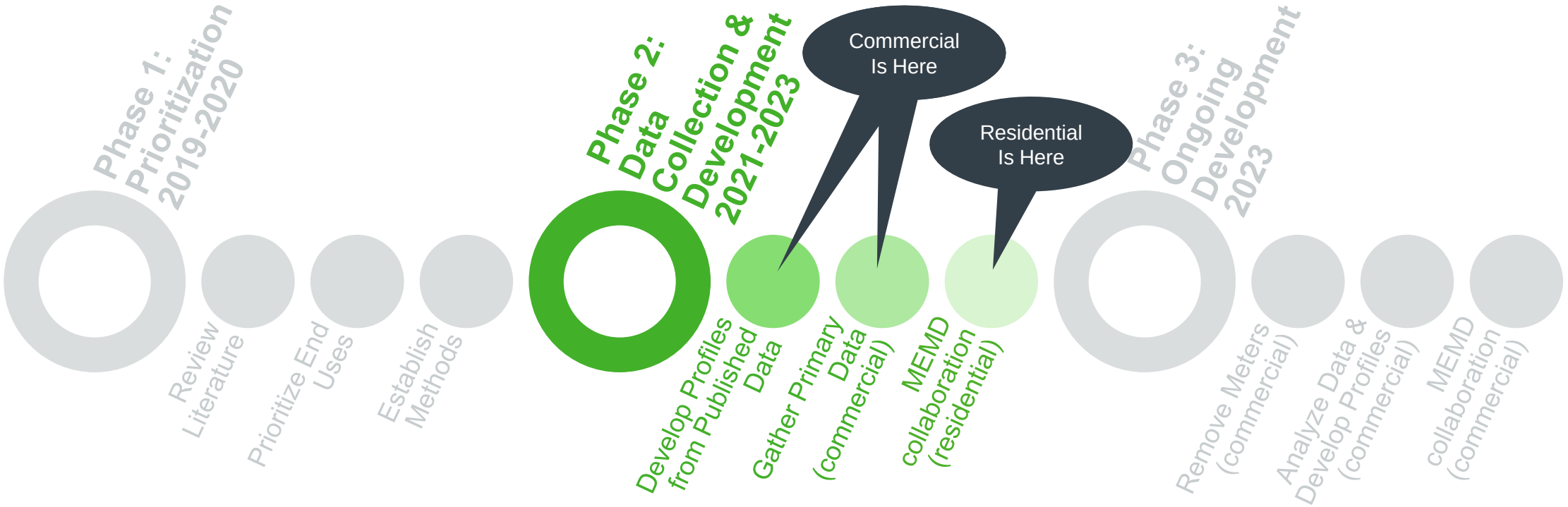


Load Shapes Research Overview

Phase 1 included activities that are foundational to the research, with primary objectives to **explore existing load research data** that may be suitable for use in Michigan, **prioritize end uses,** and **establish methods** for developing load shapes.

Load Shapes Research Overview

During Phase 2, the research team is **gathering data and developing load shapes**.
We are also beginning to explore the process of **integrating residential load shapes into the MEMD**.



Load Shapes Research Overview

Phase 3 will focus on **finalizing commercial load shapes**, including removing meters used for primary data collection, developing the load shapes, and **integrating commercial load shapes into the MEMD.**

Residential Methodology and Status Update

Residential Process Overview

Res

70+ Studies / Resources

- NREL
- NEEA / RTF
- MA EEAC

- **The plan was to use secondary sources where possible**
- **Cadmus identified dozens of studies and resources**

2,000+ Res. Shapes

- Heat Pump
- Furnace
- Baseboard Heat

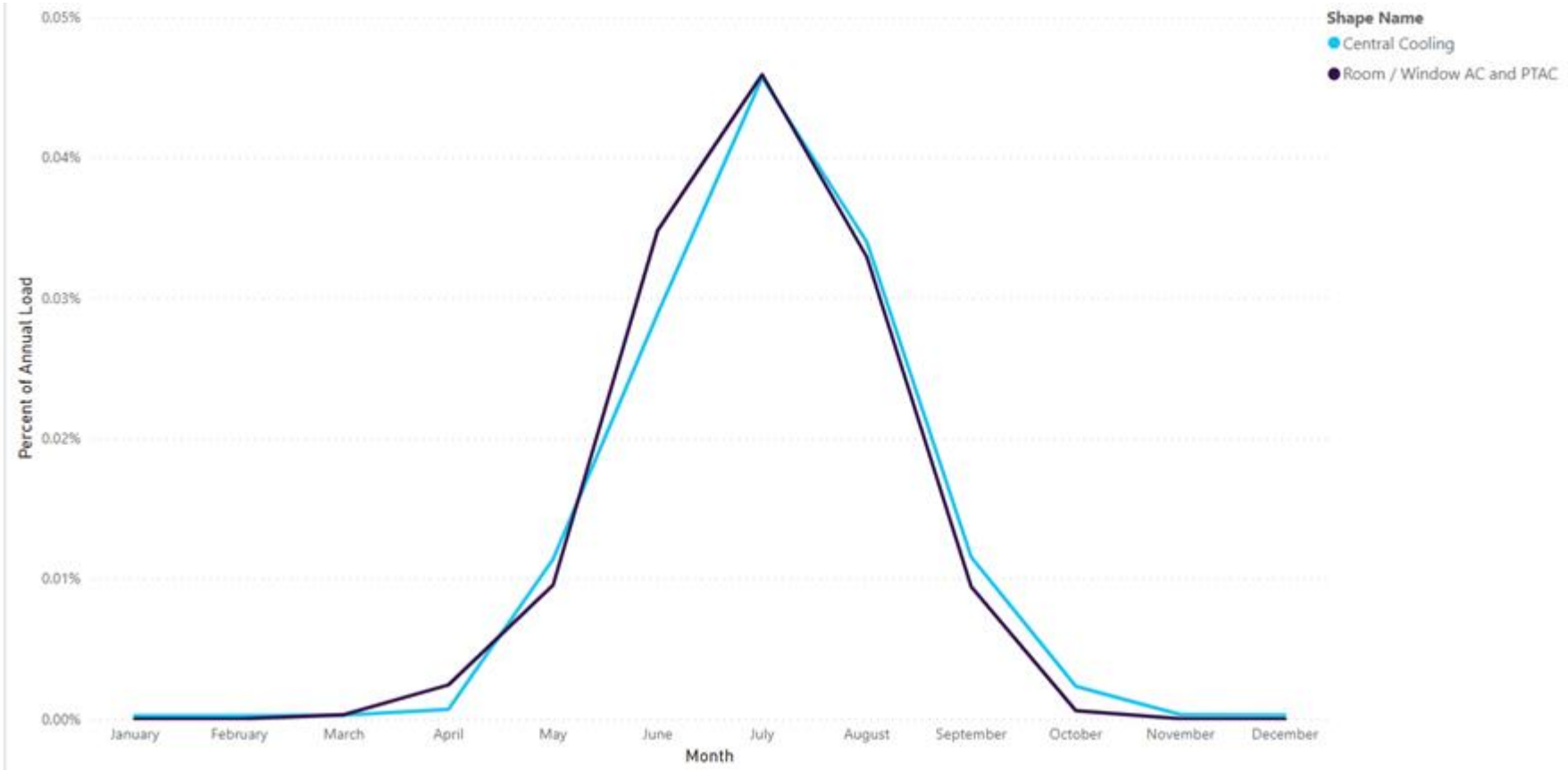
- **Identified thousands of possible shapes**
- **Developed robust review and prioritization process**

13 Equipment Categories

- HVAC - Heating
- HVAC - Cooling
- Appliances

- **Identified best source**
- **Applied statistical analysis to configure to Michigan**

Residential Status



42 shapes developed

Secondary data main source

Shapes developed for Consumers and DTE

Residential Status

42 Shapes Cover 10 End-Uses

Appliances

HVAC

Lighting

Whole Home

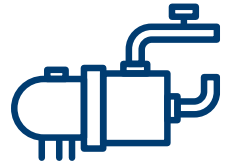
Water Heater

Cooking

Plug Loads

Renewables

Electric Vehicle



Pool Pumps

Note: Some end-uses have multiple shapes (i.e., HVAC Heating and HVAC Cooling)

Residential End Use and Equipment

Appliances

- Clothes washer
- Clothes dryer
- Clothes dryer (HP)
- Dehumidifier
- Dishwasher
- Freezer
- Refrigerator (Primary and secondary)

Cooking

- Microwave
- Oven

EV

- Electric vehicle charger – home charger
- Level 1 charger

Plug Loads

- Cable box
- Computer
- Gaming console
- Primary TV/Accessories
- Secondary TV/Accessories

Lighting

- Interior
- Exterior

Pool Pump Renewables Whole Home

- Pool pump
- Solar PV
- Whole Home

Residential End Use and Equipment

HVAC

- Air source heat pump
- Ground source heat pump
- Electric furnace
- Gas furnace (fan)
- Portable heaters
- Zonal electric resistance heat
- Central AC tune-up
- Central cooling
- Room/window AC/PTAC
- Air handler
- Boiler distribution
- Duct sealing

Water Heat

- Electric storage
- Fossil fuel storage
- Heat pump water heater
- Showerhead

Residential Methods

Identify appropriate secondary data sources

12 unique sources used

- NREL which was developed from AMI and modeling
- Metered data from places such as NEEA EULR and MA baseline study
- Cadmus-derived from conditional demand analysis

Configure to Michigan & Standardize

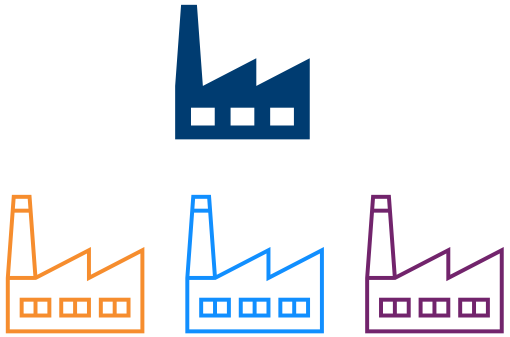
2 methods used

- *Weatherization* – using regression to adapt weather-sensitive load shapes to Michigan
- *Calendarization* –predicting load shapes using 2021 dates, aligning existing weekday/month-based predictions with 2021 calendar year

NEEA EULR: https://neea.org/data/nw-end-use-load-research-project/energy-metering-study-data
MA Baseline: https://ma-eeac.org/studies/residential-program-studies/

Commercial and Industrial Methodology and Status Update

Commercial & Industrial Process Overview



Industrial Load Shapes

- Classified 100% of electric sales into **11 segments** based on NAICS classification using previous Michigan market and potential studies.
- Data Source: **utility AMI data**.
- Produced aggregated premise-level profiles in 2021.

Commercial Load Shapes

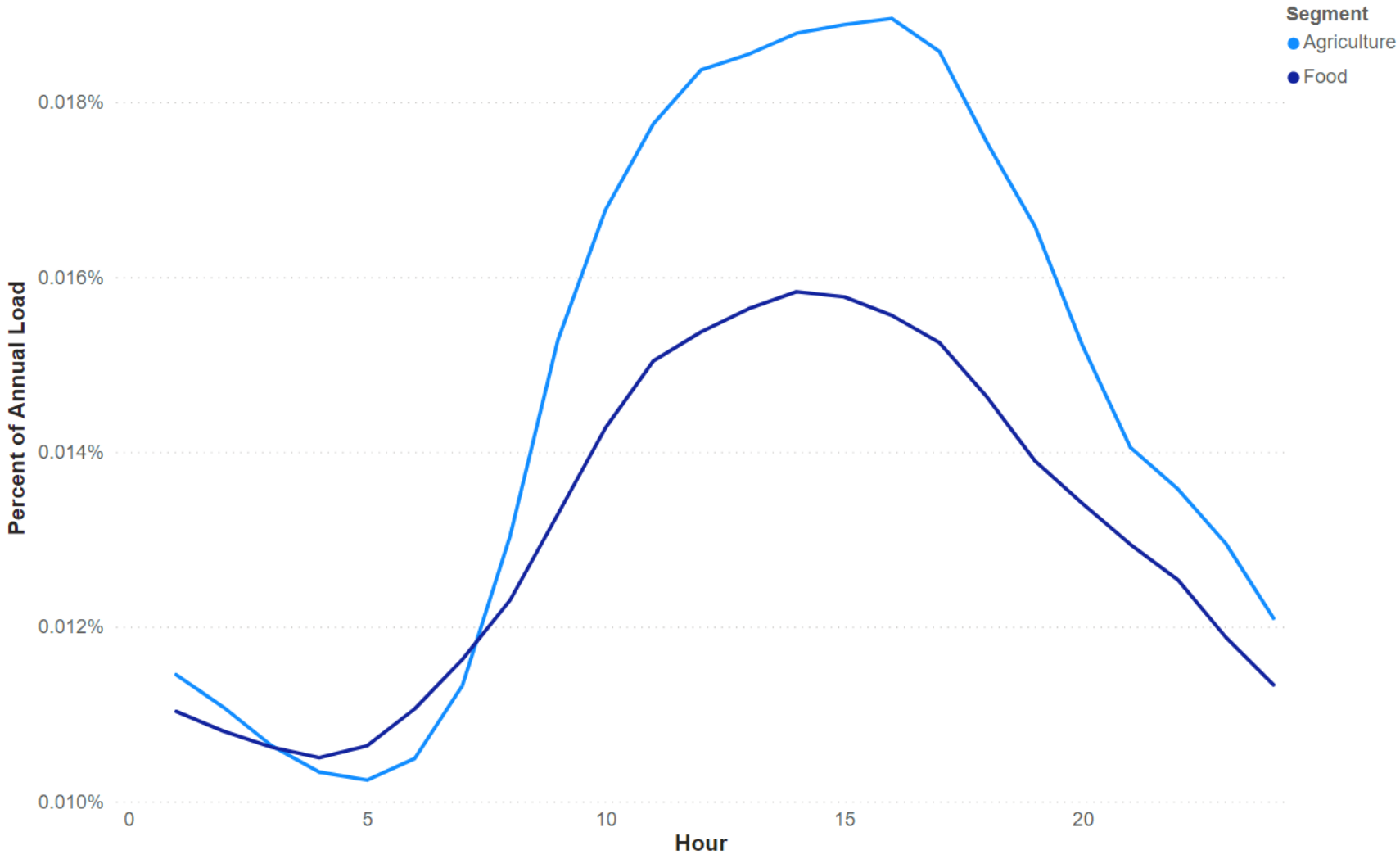
- Prioritized **9 end uses in 8 building types** using previous Michigan market and potential studies.
- Data Source: **primary & secondary data**.
- Profiles from secondary data are coming in 2022, along with primary data collection for profiles to be produced in 2023.

Industrial Methods

- **Segmented utility AMI data** for 4,621 Consumers Energy and 5,532 DTE customers based on NAICS codes.
- **Produced load-weighted profiles** that represents the aggregated loading for each industrial segment in each hour of the year.
- Utilities may use these for various system planning and forecasting activities.

- Agriculture
- Chemical
- Computer & Electronics
- Fabricated Metal Products
- Food
- Industrial Machinery
- Nonmetallic Mineral Products
- Paper
- Plastic & Rubber
- Primary Metal
- Transportation Equipment

Example Industrial Shapes



Agriculture and Food segments

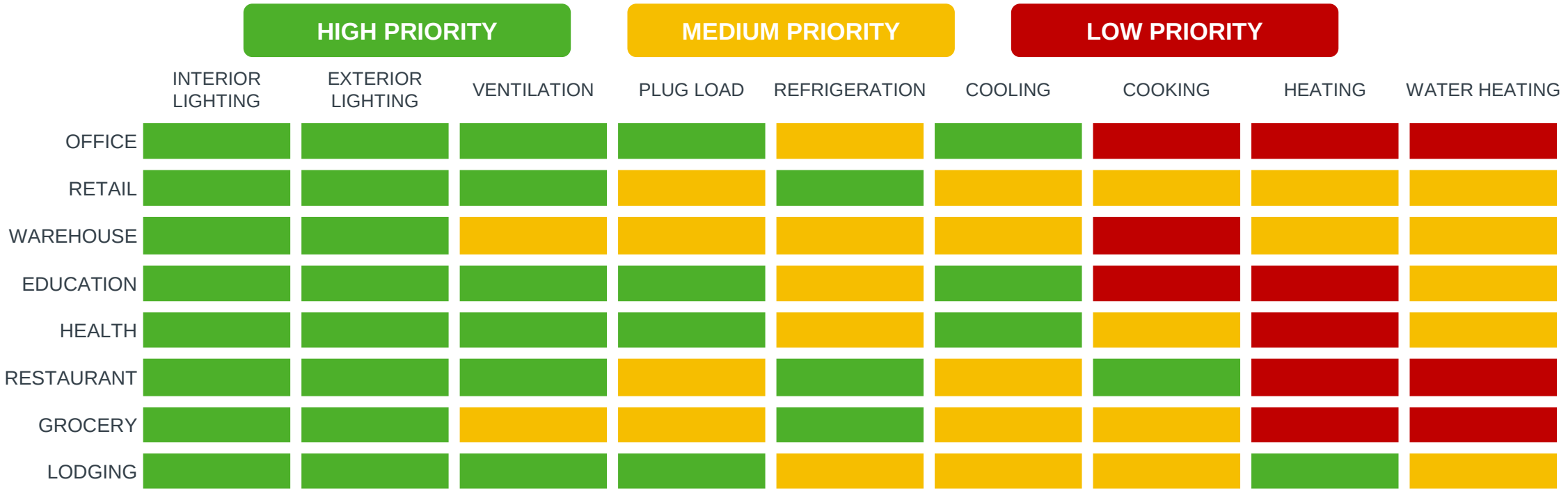
Average July weekday

Sourced from utility AMI data

Commercial Prioritization

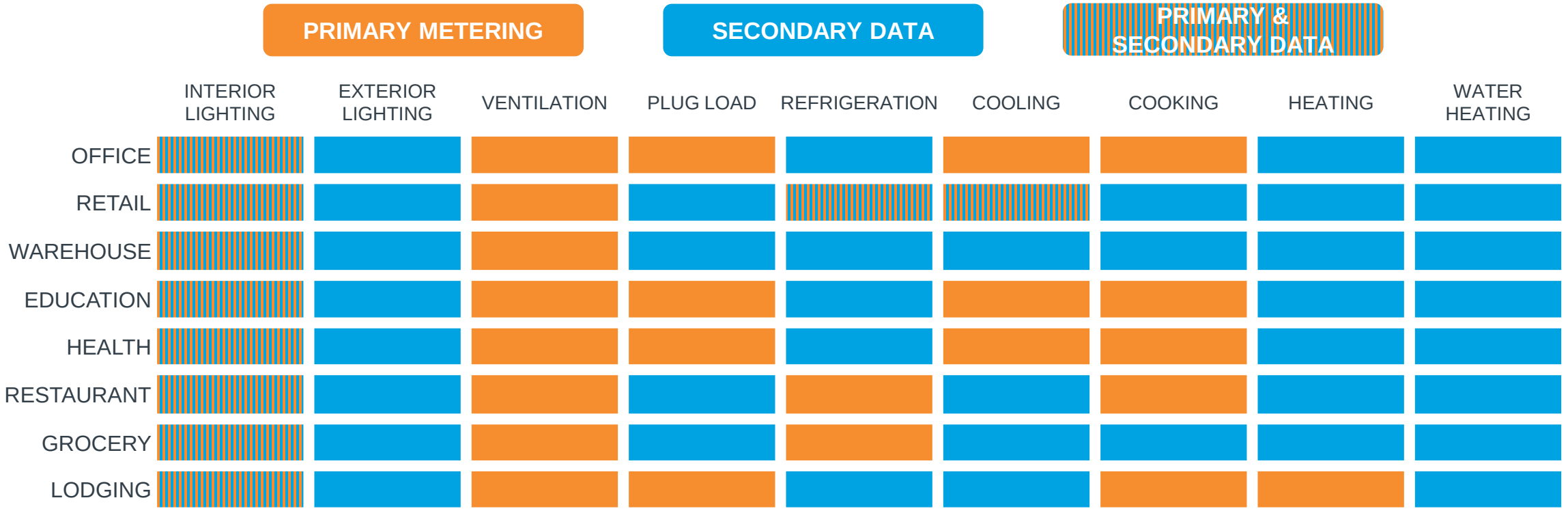
We utilized previous Michigan market and potential studies to inform the following prioritization criteria:

- Contribution of the end use and building type to total electric sales. **higher sales → higher priority**
- Composition of end uses' contribution within each building type. **higher contribution → higher priority**
- Historical and potential EWR program savings, provided by Consumers Energy staff input. **higher savings → higher priority**



Commercial Data Sources

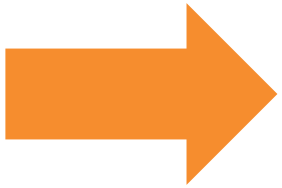
We aligned data sources based on priority and suitability of secondary data.
More specific and precise data are sought for the high priority loads.



Commercial Primary Data Methods

Gather Primary Data from End Use Equipment

- Design **sample plan** that achieves 20% precision with 80% confidence across 95% of hours in the year.
    1. Determine what equipment comprises most of the consumption for each end use.
    2. Analyze study data to determine consumption variation.
- **Recruit** customers to participate.
- **Install meters** and measure consumption for 10-12 months.



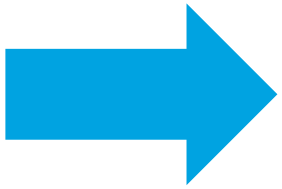
Analyze Data to Develop Load Shapes

- **Extrapolate** data to reach coverage across a full year.
- **Aggregate** data from each equipment and building type to create a load shape for each end use by building type.
- **Calendarize** the data to align with calendar year 2021 for consistency with residential load shape data.

Commercial Secondary Data Methods

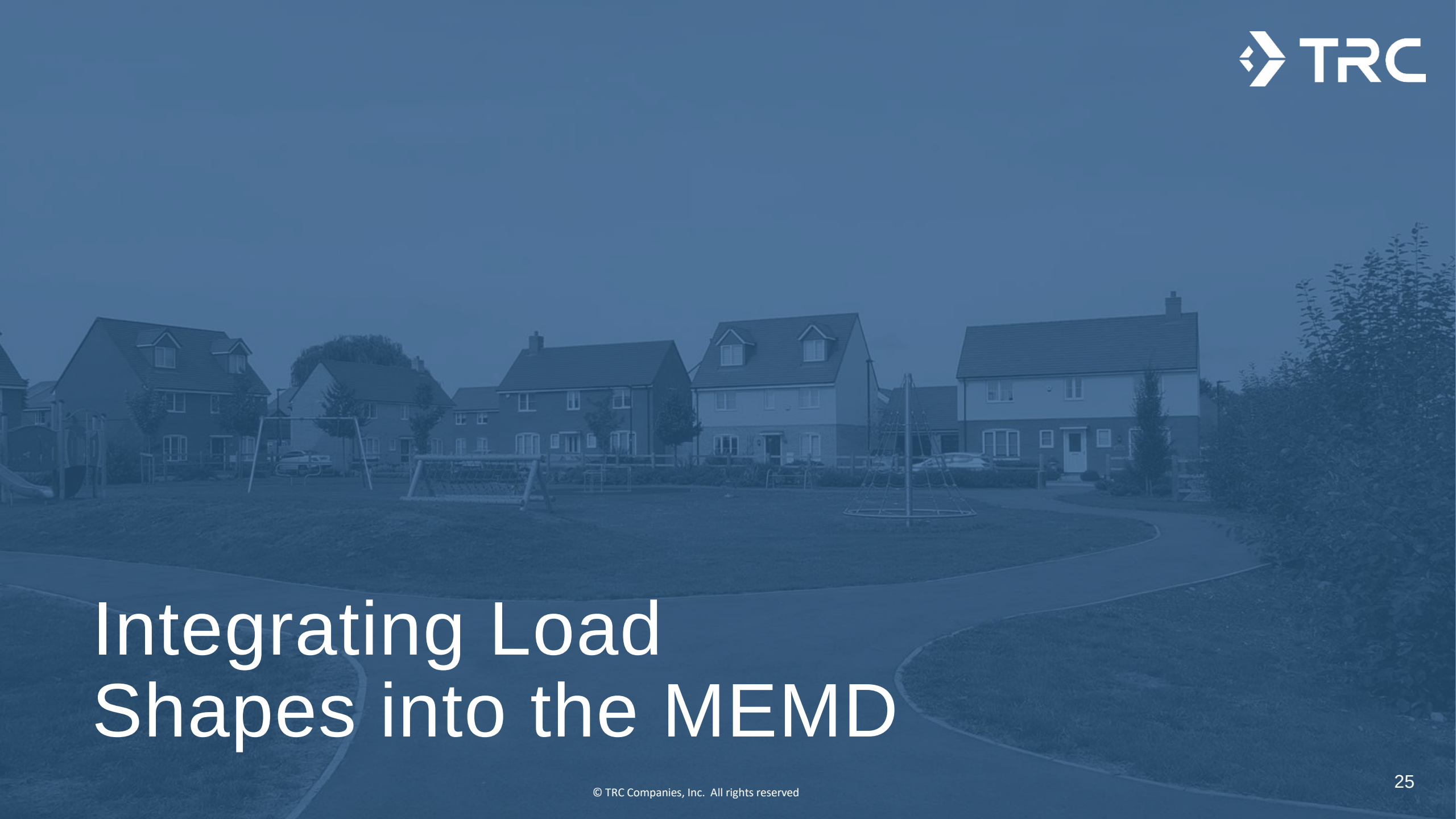
Identify appropriate secondary data sources

- Illinois Technical Reference Manual
- Database for Energy Efficient Resources (DEER)
- Michigan Statewide Commercial and Industrial Lighting Hours-of-Use Study
- Michigan Commercial Lighting Controls Metering Study
- Michigan Commercial and Industrial Market Assessment
- NREL Comstock database



Configure to Michigan & standardize

- **Exterior Lighting**: Adjust Illinois data to Michigan daylight hours.
- **Interior Lighting**: Update DEER with data from Michigan studies to develop combined load shape using a Bayesian statistics approach.
- **All Other End Uses**: Adjust NREL equipment-level load data using Michigan C&I Market Assessment data.



Integrating Load Shapes into the MEMD

Load Shapes and MEMD

- Evaluators and Rick Morgan's team have convened to discuss how to integrate load shapes into the MEMD
- Rick Morgan's team presented a revised approach for calculating peak demand savings for non-weather sensitive measures and the impact it would have for several measures to the EWR Technical Subcommittee on April 13.
  - There was consensus around the approach, however the group has till April 29th to weigh-in with final comments and suggestions
  - This new approach would impact residential non-weather sensitive measures and only commercial lighting measures (most commercial measure load shapes still in development)
  - If approved, this would go into effect in the 2023 MEMD
- Rick Morgan's team also discussed how weather sensitive load shapes would be used to update peak demand saving estimates
  - Timing on this application is pending furnace meter results

Thank You

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