U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Introduction to Miscellaneous Energy Loads (MELs) and BTO's MELs Characterization Efforts

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What are miscellaneous energy loads (MELs)?

- **Miscellaneous energy loads (MELs) are loads outside of a building's core functions of heating, cooling, lighting, water heating, refrigeration, etc.**

- **MELs are modeled with less detail than other major building end uses in the U.S. Energy Information Administrations (EIA's) National Energy Modeling System (NEMS)**
  - Their cost and service lifetime are not estimated, so uptake and shipments aren't modeled
  - Only average unit energy consumption, and not equipment efficiency is modeled

MELs comprise a number of minor loads that together consume a lot of energy

Residential MELs

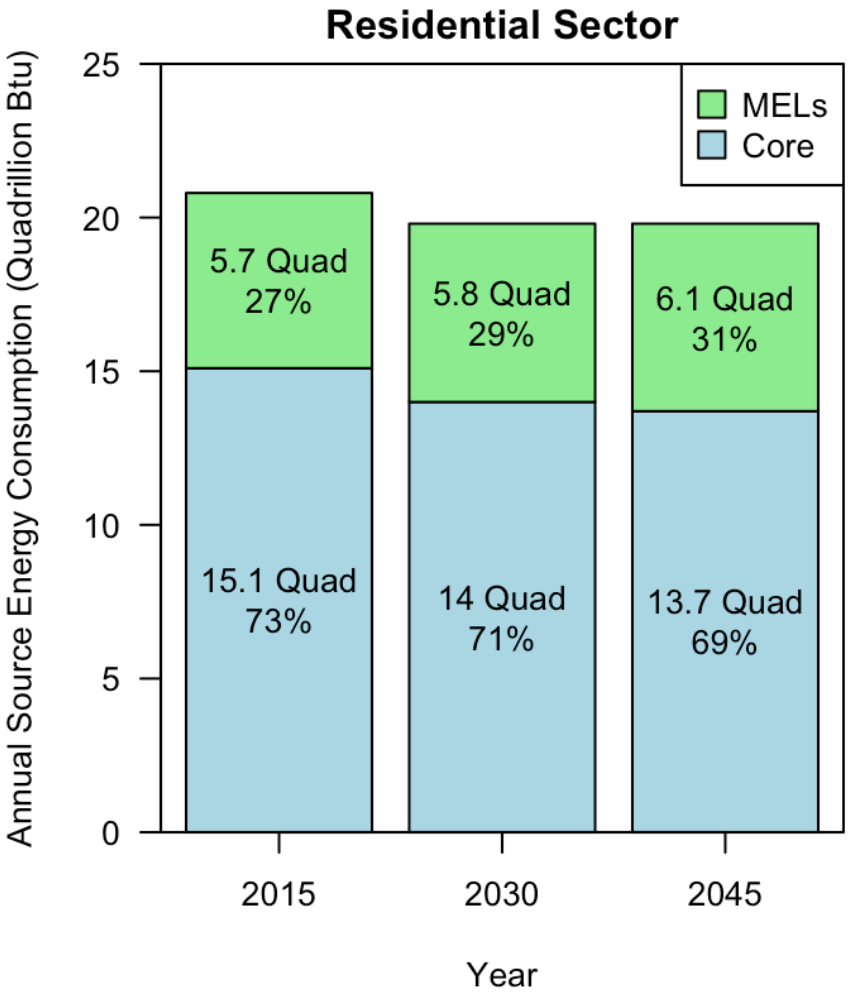
End Use	% of Total Residential Source Energy Consumption
Other Electric/Undefined	16%
Set Top Boxes	1.9%
Furnace Fans/Boiler Pumps	1.7%
Television	1.7%
Ceiling Fan	1.4%
Pool Heater/Pumps	1.1%
Microwaves	0.77%
Desktop PC	0.55%
Spas	0.53%
Laptops	0.47%
Wine Coolers	0.36%
Dehumidifiers	0.35%
Network Equipment	0.25%
Coffee Makers	0.25%
Monitors	0.24%
Rechargeable Batteries	0.22%
DVD Players	0.17%
Home Theater	0.16%
Video Game Consoles	0.11%
Security Systems	0.10%
Total	**28%**

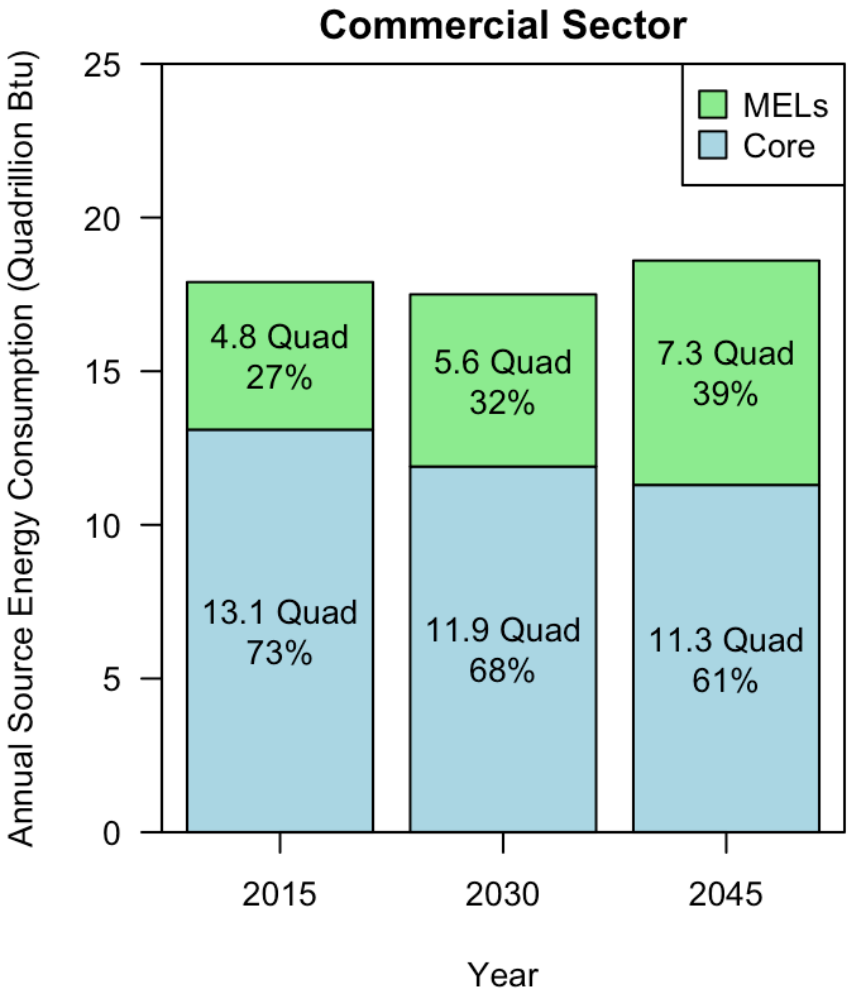
Commercial MELs

End Use	% of Total Commercial Source Energy Consumption
Other/Undefined	11%
Office Equipment - PCs	5.7%
Office Equipment - Non-PCs	3.9%
Dry Transformers	2.2%
Kitchen Ventilation	2.0%
Non-Road Electric Vehicles	0.72%
Security Systems	0.54%
Lab Fridges and Freezers	0.22%
Coffee Brewers	0.15%
Elevators	0.15%
Video Displays	0.15%
Laundry	0.07%
Fume Hoods	0.05%
Escalators	0.03%
Large Video Boards	0.01%
Medical Imaging	Data Missing
Total	**27%**

All data based on Annual Energy Outlook 2017 estimates for consumption in year 2017.

Both MELs consumption and MELs' share of building consumption are projected to increase





All data based on Annual Energy Outlook 2017

Our goal is to both reduce MELs consumption and improve MELs characterization

- With MELs responsible for about 30% of residential and commercial energy consumption, there is a need to develop technologies to reduce their consumption

- At the same time, about half of MELs consumption is from undefined/unknown loads, and defined MELs are modeled with less precision than core end uses

- Thus, there is a need to improve characterization of MELs end uses in NEMS and BTO tools that use AEO data to estimate energy savings potentials (Scout)

We are inventorying and aggregating MELs baseline technology data from various sources

- While EIA does not catalogue baseline installed cost, efficiency, and product lifetime data for MELs end uses, some of these data are available

- DOE, state energy offices, and ENERGY STAR catalogue these data to estimate the costs and benefits of energy efficiency standards

- Industry associations such as the Consumer Technologies Association track historical product costs and shipments, and estimate product energy consumption

Appliance and equipment standards contain detailed data for a number of MELs end uses

- Final appliance and equipment standards include analysis of product cost, efficiency, and lifetime data to estimate the lifecycle cost and national energy impact

- MELs that have established standards:

Residential	Commercial
Ceiling Fans	Dry transformers
Coffee Makers	Clothes washers
Dehumidifiers	
Furnace Fans	
Microwaves	
Pool Pumps	
Pool Heaters	
Rechargeables	
Set Top Boxes*	
Wine Coolers	

https://www.energy.gov/eere/buildings/standards-and-test-procedures

Case Studies

Distribution transformers, hot water circulation pumps, washlets

Case studies

- **Well-documented MELs have:**
  - Stock, UEC, sales, lifetime
  - Technology cost curves
- **Poorly documented MELs have:**
  - Uncertain stock
  - Anecdotal UEC data
  - No technology-cost data
- **The Next Big MEL has:**
  - Small stock (today)
  - Anecdotal UEC data
  - Expectation of rapid growth







Low-voltage dry distribution transformers

- LVDT steps down utility voltages to in-building voltages
- Owned by building owner and located inside building
- It is a MELs because there is no NEMS baseline data
- Alternative source of information: Analysis for appliance efficiency standards, "*Final Rule Technical Support Document*"

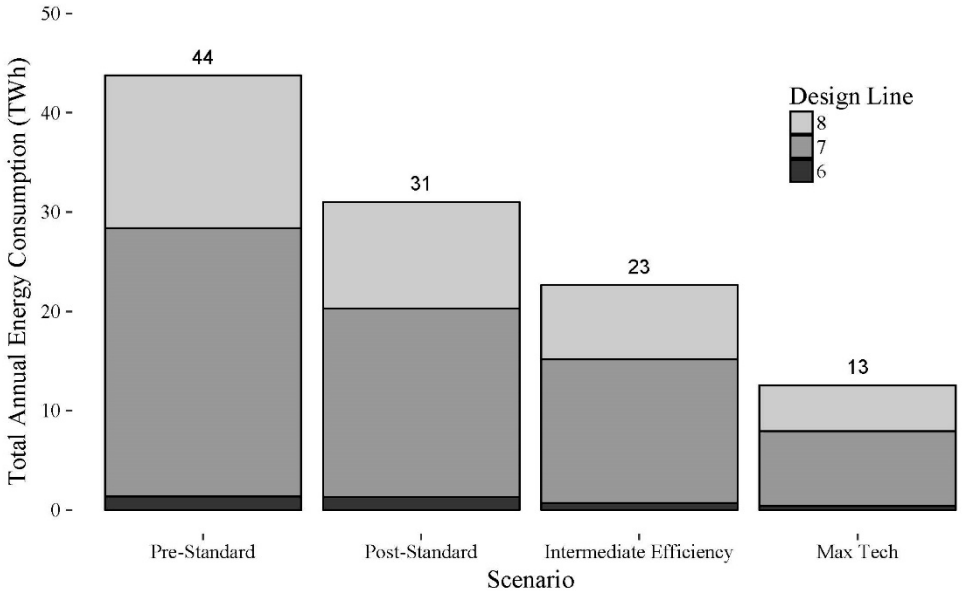






Transformers (cont.)

- Stock known for 3 design lines
- Baseline energy use: 44 TWh pre-standard
- Technology-cost tradeoffs enable scenarios
- Max-tech designs would decrease national LVDT energy from 44 → 13 TWh/year

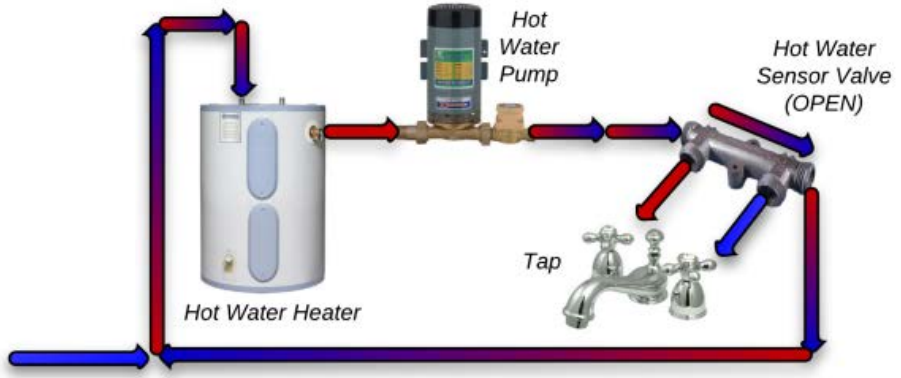


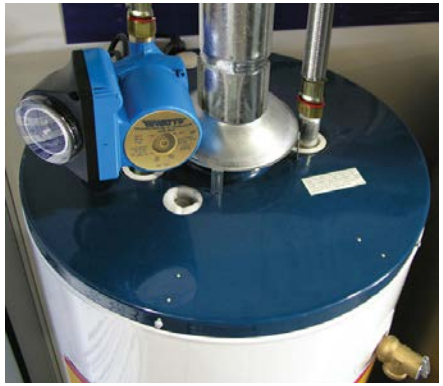
National annual energy consumption of 3 LDVT design types across four scenarios of technological energy efficiency improvements after stock turnover.

This is easy to include in Scout and, eventually, in NEMS

Hot Water Recirculation Pumps

- **Common in large homes and light commercial**
  - Becoming more popular
- **Stock not known (but sales are)**
- **Energy consumption arises from circulation pump and hot water make-up (electricity and gas)**
- **UEC not known**
  - 4 – 150 kWh/year + makeup heat (600 kWh/year?)
  - Some pumps have timers, which greatly affects energy use
- **In 2028: 12 TWh/year?**





This is challenging to include in Scout

Washlets (Japanese– style toilets)

- Just entering US market (>75% penetration of Japanese market)
- Functions include heating, pumping, illumination, logic …
- UEC ~ 200 kWh/year
  - Some options to reduce energy use
- 2028 Energy use: 8 TWh/year?

This is challenging to include in Scout





Heaters, pumps, fans, electronics

Conclusions

- MELs represent a significant and growing portion of total building energy consumption

- There is a need to improve representation of MELs in energy demand models (e.g. NEMS) to improve understanding of their consumption and technology development opportunities for improving efficiency

- There are varying levels of data available for each MEL. MELs with DOE standards have sufficient data and are the starting point for this work.