

**Critical Review of Mobile Source Inventory Data
in EPA 2014 NEI-based Modeling Platforms:
Part Four
(Extended Idling)**

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**MDE Photochemical Modeling Call
February 21, 2019**

MOVES/SMOKE-MOVES Data Inputs

Parameter	Notes	References
Hoteling Hours	Diesel 62 on road 2&4	
Speed Profiles		Nov 29 2018 presentation
Age Distributions		Jan 17 2019 presentation (part one)
Representative County		Jan 17 2019 presentation (part one)
Temporal Profiles	VMT temporalization	Jan 31 2019 presentation (part two)
VPOP	Total and splits	Feb 14 2019 presentation (part three)
VMT	Total and splits	Feb 14 2019 presentation (part three)
Emission Rates		Feb 14 2019 presentation (part three)
CDB/FF10 Conversion	Program splitting VPOP/VMT	Never been examined

This presentation focuses on **hoteling hours**

Datasets available:

- 2011 NEIv2
- 2014 NEIv2
- 2015 (non-NEI year, 2014-based)
- 2016 Alpha (non-NEI year, 2014-based)
- 2016 Beta (non-NEI year, 2014-based, some local data supplied by states)
- 2017 NEI (in preparation by states/EPA, due 01/15/2019)
- 2023 (future year projected from 2016)
- 2028 (future year projected from 2016)

Past presentations are available for download in MDE Photochemical Modeling Dropbox:
<https://www.dropbox.com/sh/f92bs5a6mhy4cqf/AAB8K07OpBuwI4CSlbe5a4nAa?dl=0>

MOVES Decoder

MOVES2014 VMT Types

HPMStypeID	Classifications
10	Motorcycles
25	Light Duty Vehicles
40	Buses
50	Single Unit Trucks
60	Combination Trucks

HPMS 25, adopted in MOVES2014, is an aggregation of the HPMS 20 and HPMS 30 classifications in MOVES2010b

MOVES2014 Road Types

roadTypeID	roadDesc
1	Off-Network
2	Rural Restricted Access
3	Rural Unrestricted Access
4	Urban Restricted Access
5	Urban Unrestricted Access

Ramps are not included

SCC code: AA: Mobile Source (22)
AAFFVRRPP **FF:** MOVES Fuel Types
VV: MOVES VPOP Source Types
RR: MOVES Road Types (excluding ramps)
PP: MOVES Emission Processes

MOVES2014 VPOP Types

ID	SourcetypeName
11	Motorcycle
21	Passenger Car
31	Passenger Truck
32	Light Commercial Truck
41	Intercity Bus
42	Transit Bus
43	School Bus
51	Refuse Truck
52	Single Unit Short-haul Truck
53	Single Unit Long-haul Truck
54	Motor Home
61	Combination Short-haul Truck
62	Combination Long-haul Truck

MOVES2014 Fuel Types

fuelTypeID	Fuel Type Description
1	Gasoline
2	Diesel Fuel
3	Compressed Natural Gas (CNG)
4	Liquefied Petroleum Gas (LPG)
5	Ethanol (E85)
9	Electricity

Why Consistency Matters

- **Inconsistencies are the result of ambiguous or insufficient guidelines for data gathering and not because of better local data collected by states**
 - **Vehicle splits: 31/32, 52/53, 61/62 (MOVES design issue)**
 - **Extended idling (changing methodologies over past 5 years)**
 - **Speed profiles and VMT temporal profiles (few sources for suitable data prior to 2014NEI)**
- **Inconsistent emission inventory results propagate into air quality modeling, often amplifying questionable data**
- **Contribution-to-monitor type of air quality modeling that includes inconsistencies unfairly favors some states while targeting other states**
- **Inconsistency must be corrected by either implementing the same methodologies across the board or revising MOVES internal design**

Clear unambiguous guidelines will help alleviate the problems

Mobile Emissions

□ Four emission sectors:

RPD (rate-per-distance): vehicle in motion
RPV (rate-per-vehicle): vehicle motionless, engine starts
RPP (rate-per-profile): parked vehicles (for VOCs only)
RPH (rate-per-hour): extended idling, hotelling

□ Total Hourly Emissions =

RPD (hourly speed) * VMT * temporalization +
RPV (hr) * VPOP +
RPP (hr) * VPOP +
RPH * Idle Hours * temporalization

▪ In addition to dependence on meteorology (temperature and relative humidity), emission rates are a function of speed for RPD, a function of hour for RPV and RPP (denoted by parenthesis above)

Jan 31 2019 presentation

RPD Emis (tons/hr) = RPD rate (g/mile) * VMT * temporalization * conversion factor

RPV/RPP (tons/hr) = RPV/RPP rate (g/car/hr) * VPOP * conversion factor

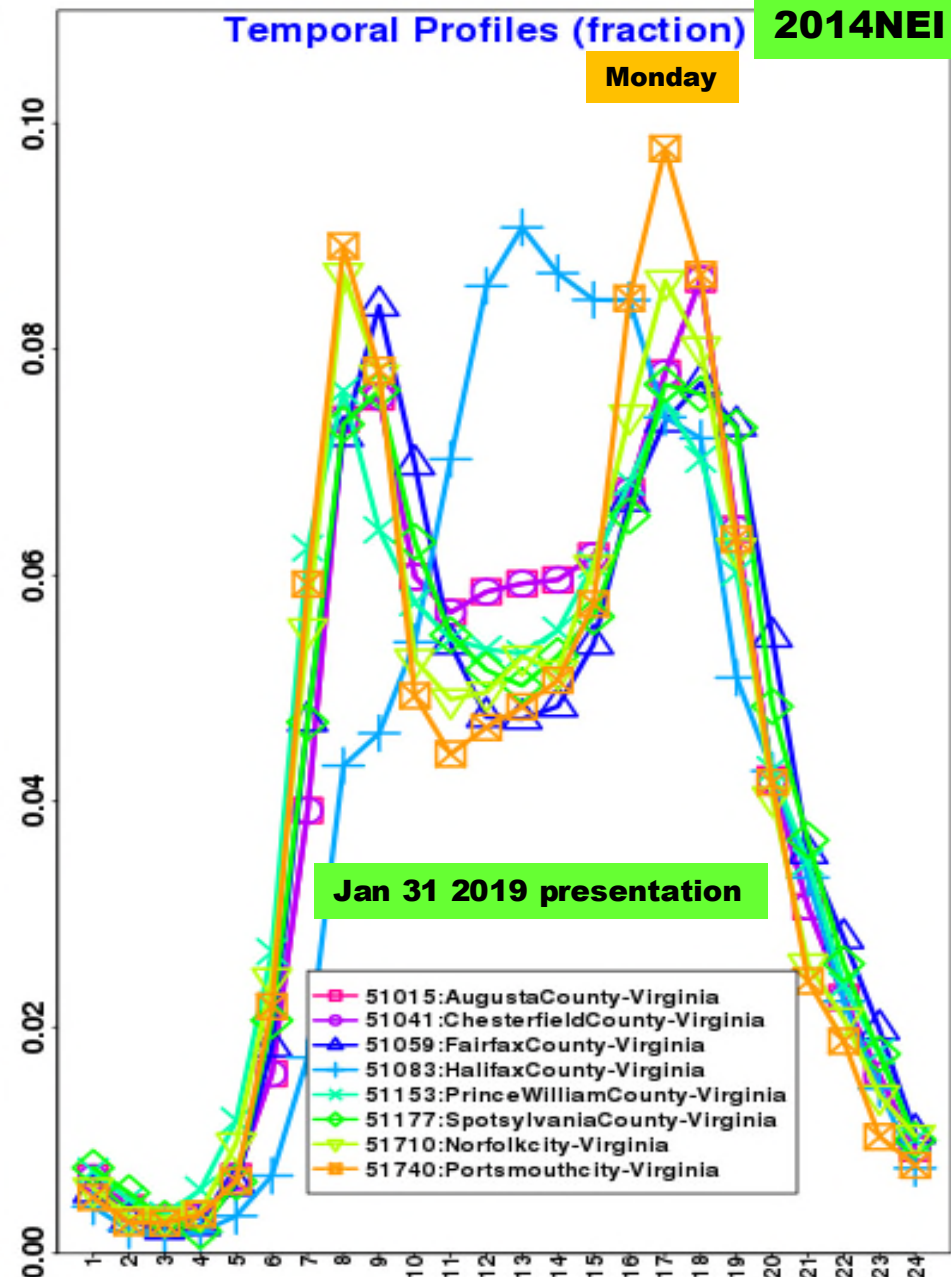
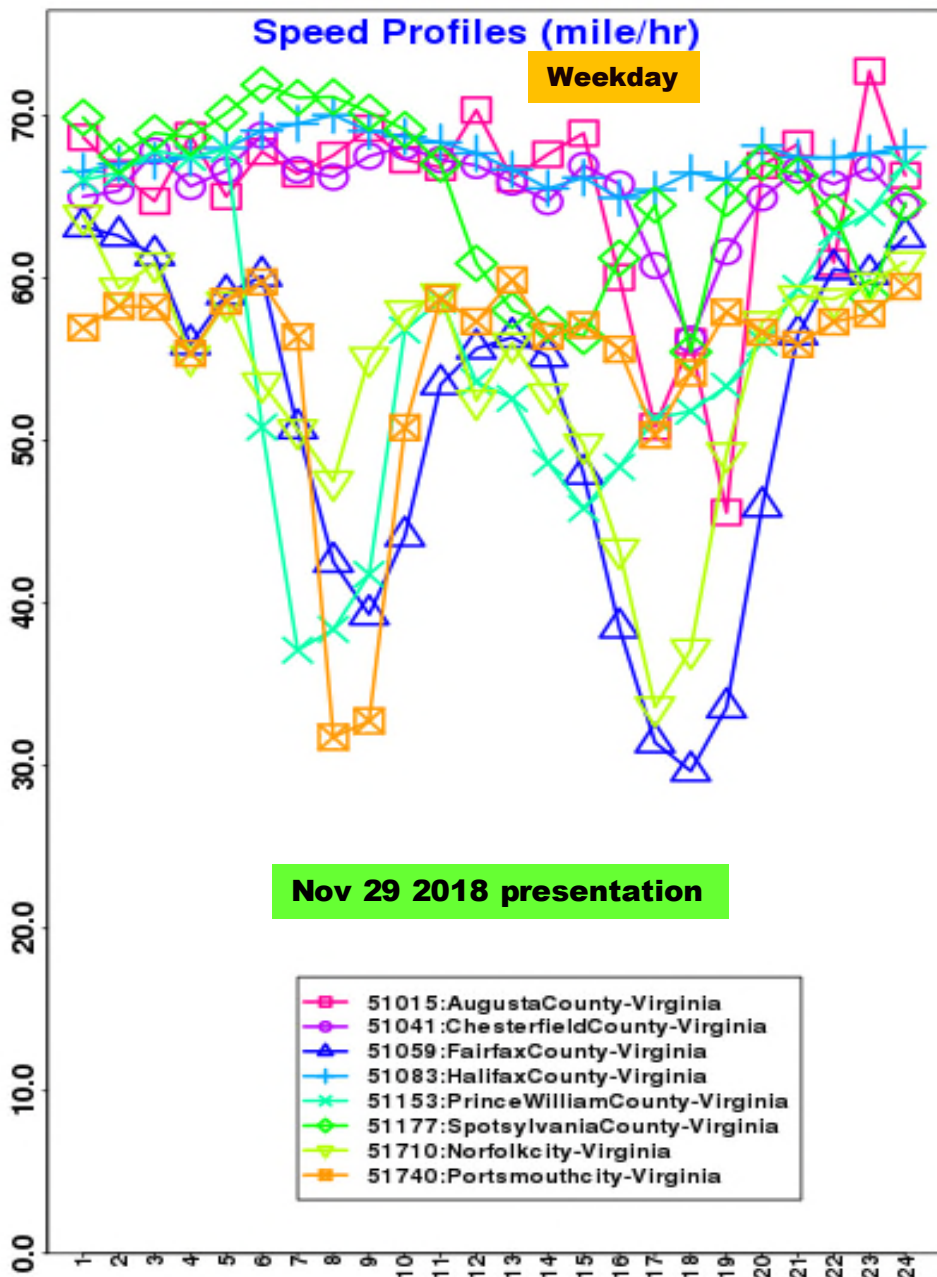
RPH (tons/hr) = RPH rate (g/hr) * idle hours * temporalization * conversion factor

Emission rate (in g/mile, g/car/hr, g/hr): small numbers

Activity: very large numbers

this presentation

Hourly Profiles in SMOKE: Speed Profiles versus VMT Temporal Profiles – Virginia



– Speed profiles show dual (AM and PM) lows, whereas temporal profiles show dual (AM and PM) highs;
 – Both sets of profiles determine hourly emissions and affect modeled air quality

Hoteling (Extended Idling) Hours

- Diesel (02) combination long-haul truck (62) travel on rural restricted roads (02) and urban restricted roads (04)
- Total Hoteling Hours = EXT (process ID 53) + APU (process ID 91)

EXT: Extended Idling

APU: Axillary Power Unit

- Percent Allocation (%) = [EXT or APU / (EXT + APU)] * 100.0

Hotelling Hours by State

2011NEI

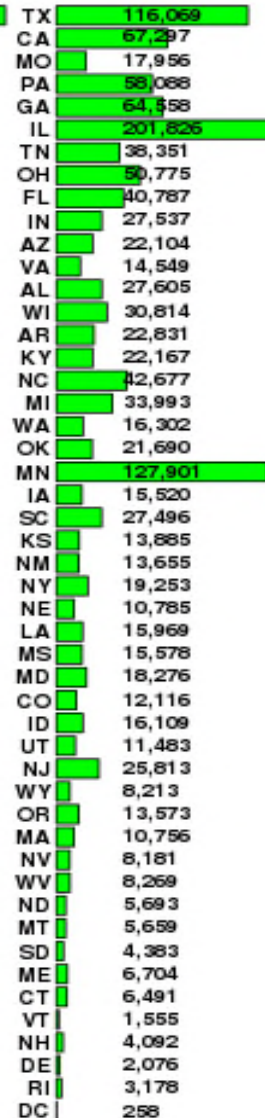
Total Hotelling Hours = EXT (53) + APU (91)

(a) 2011v2 220262 VMT (all road)
(1) 220262 VMT all roads

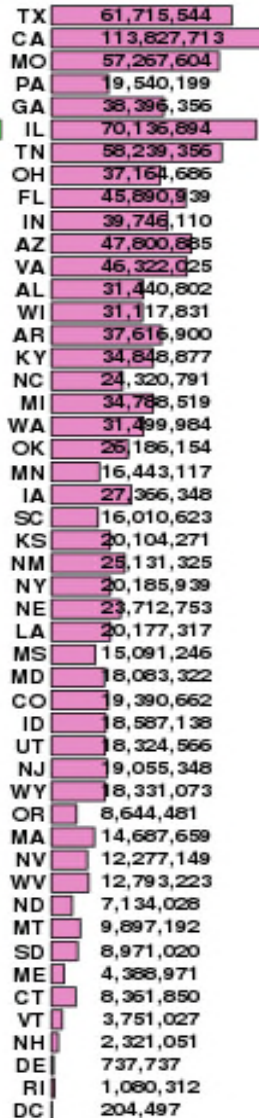


sorted by combination long-haul truck (62) VMT on all roads

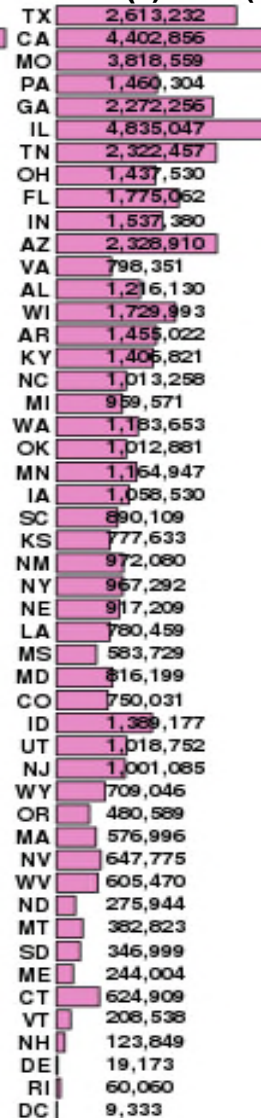
(b) 2011v2 220262 VPOP
(2) 220262 VPOP



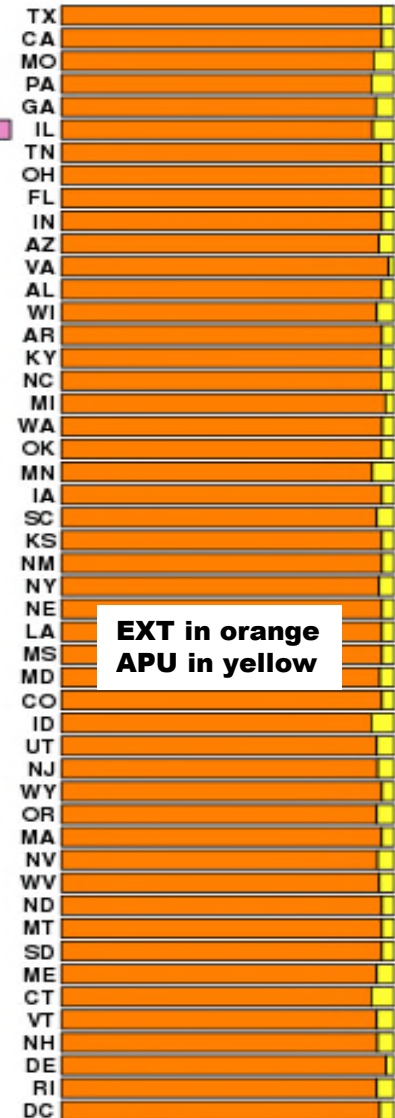
(c) 2011v2 Hotelling (53)
(3) EXT (hours)



(d) 2011v2 Hotelling (91)
(4) APU (hours)



(e) EXT Percent Makeup
(5) Percentage



EXT in orange
APU in yellow

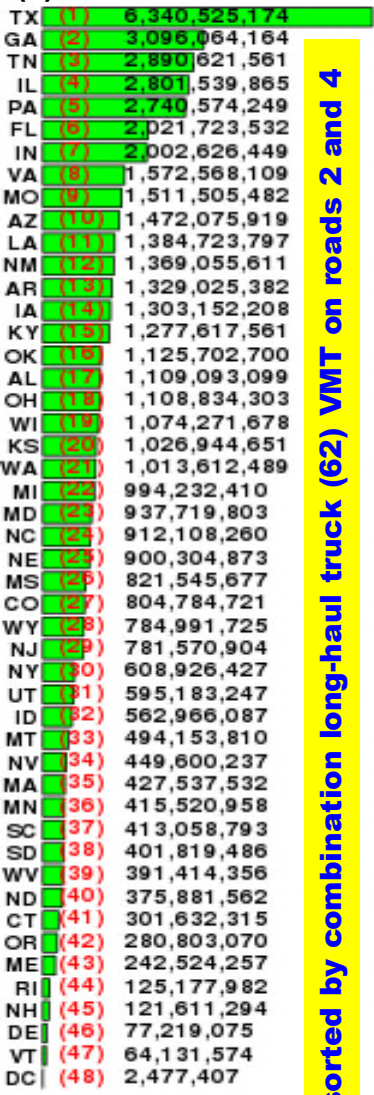
- (a) Combination long-haul truck (62) is the only vehicle type with hotelling activity;
- (b) VPOP and VMT for combination long-haul truck (62) do not align;
- (c) Hotelling hours appear unrelated to total VMT of combination long-haul truck (62);
- (d) Odd 62 VPOP for IL and MN

Hotelling Hours by State

2014NEIv2

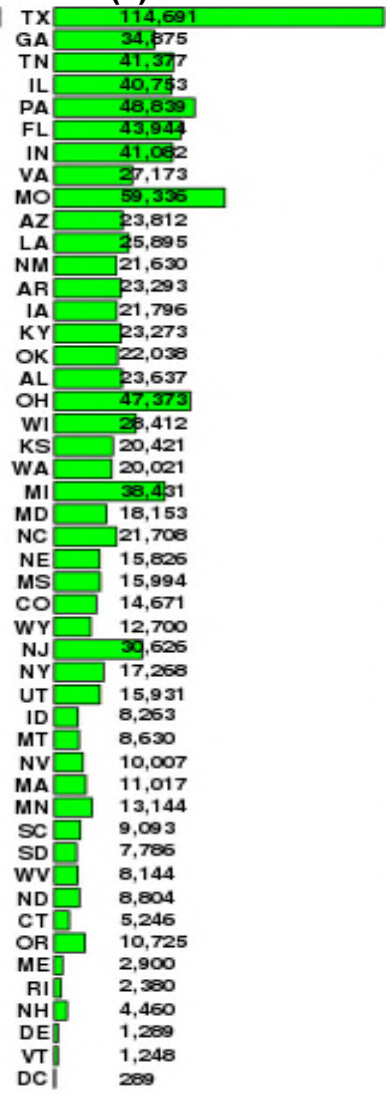
Total Hotelling Hours = EXT (53) + APU (91)

(a) 2014v2 220262 VMT (rd 2&4)
(1) 220262 VMT road 2 & 4

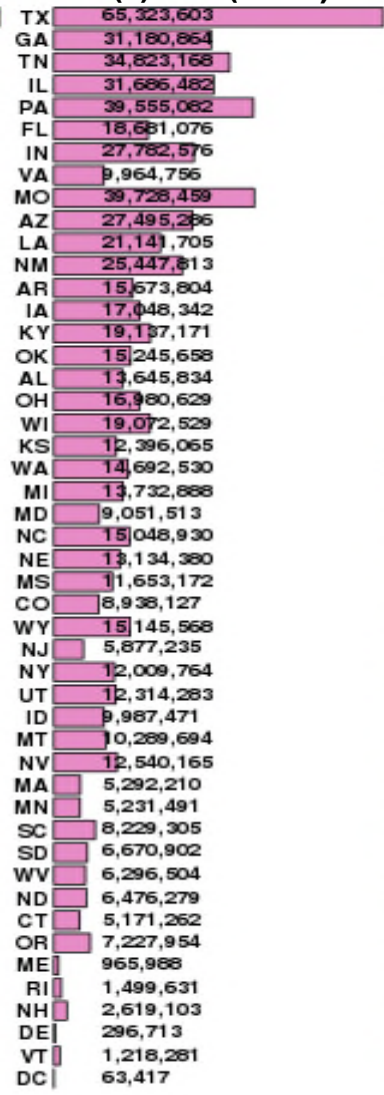


sorted by combination long-haul truck (62) VMT on roads 2 and 4

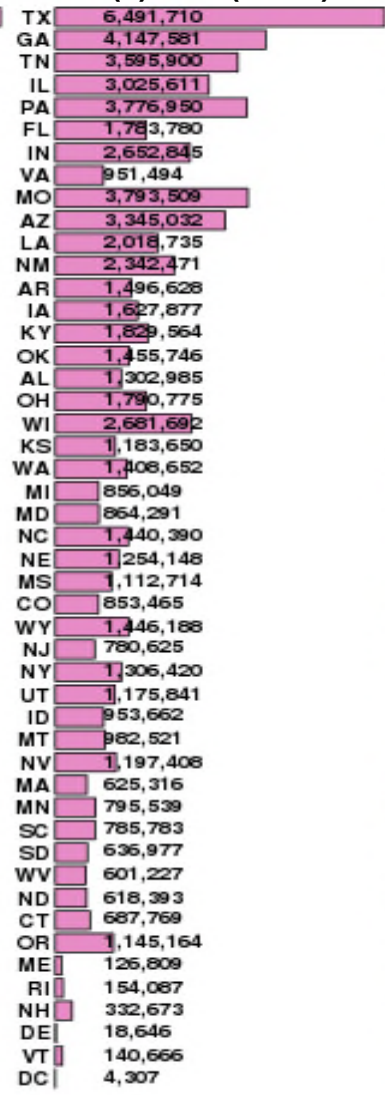
(b) 2014v2 220262 VPOP
(2) 220262 VPOP



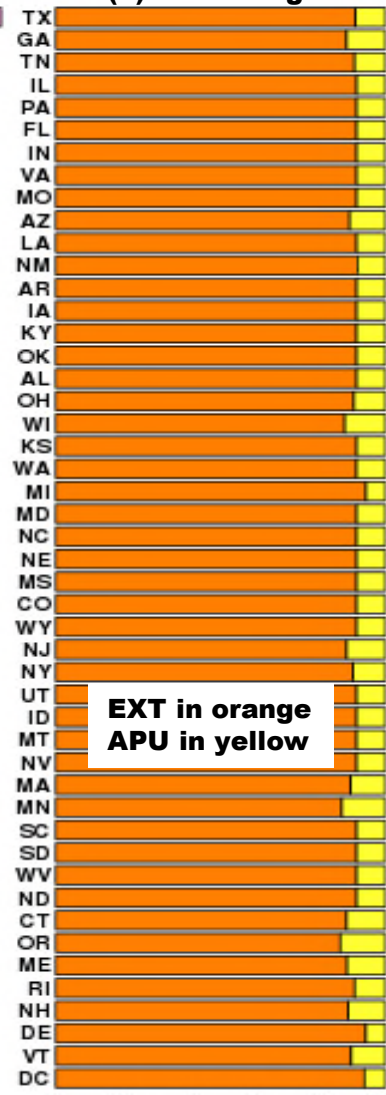
(c) 2014v2 Hotelling (53)
(3) EXT (hours)



(d) 2014v2 Hotelling (91)
(4) APU (hours)



(e) EXT Percent Makeup
(5) Percentage



EXT in orange
APU in yellow

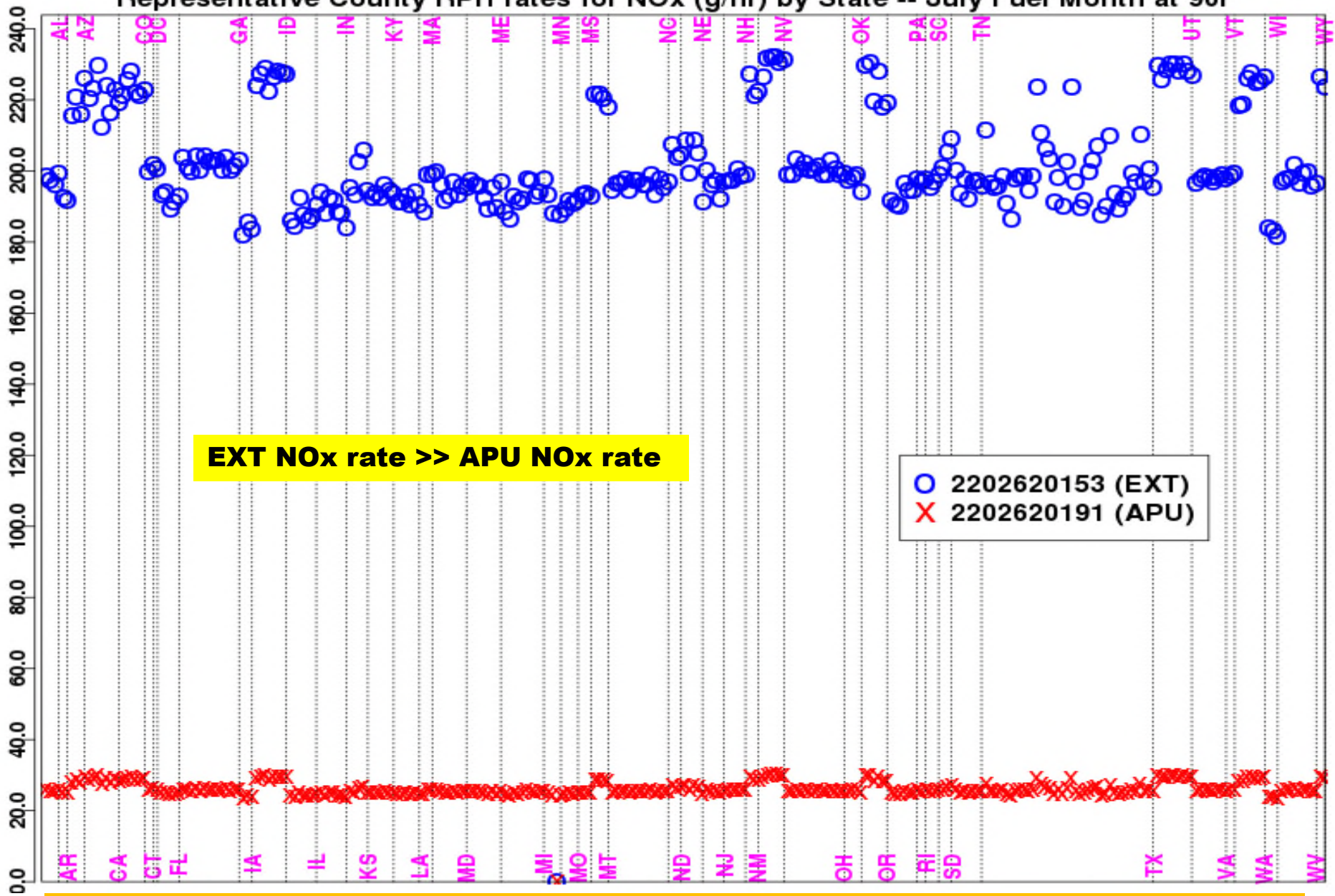
- (a) Only VMT for combination long-haul truck (62) traveling on road 2 (rural restricted) and road 4 (urban restricted) were counted in the first column;
- (b) VPOP and VMT for combination long-haul truck (62) do not align;
- (c) Total hotelling hours appear to be more in line with VPOP than VMT of combination long-haul truck (62)
- (d) APU percentage increases from 2011 to 2014

Further investigation needed

RPH (Rate per Hour) NOx rate (g/hr)

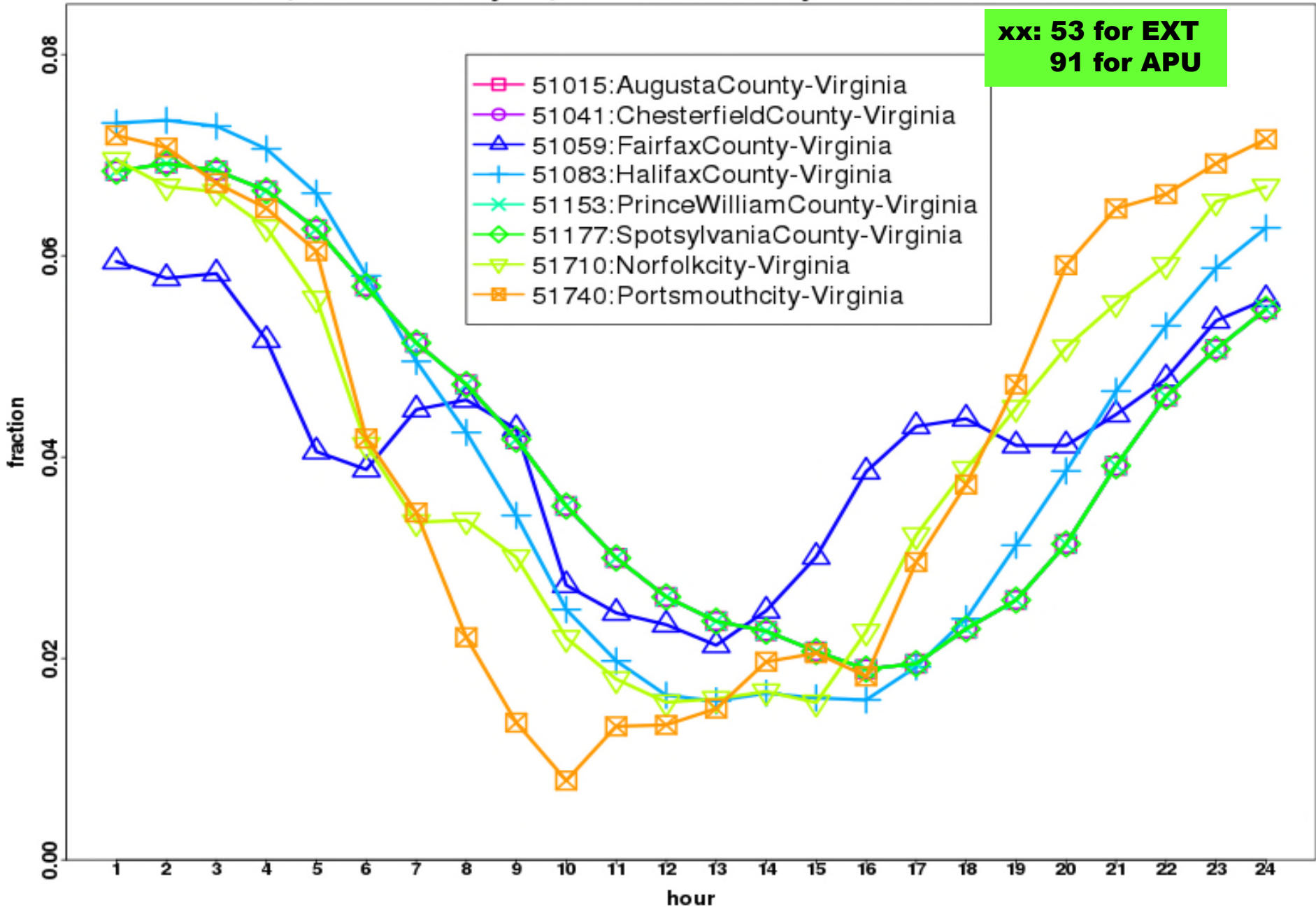
2014NEI

Representative County RPH rates for NOx (g/hr) by State -- July Fuel Month at 90F



-- Hourly NOx rates depend on temperature but not on relative humidity;
-- At the same temperature of 90F, it's not clear why some counties have higher rates than others

Temporal Profiles by Representative County for 22026201xx for VA

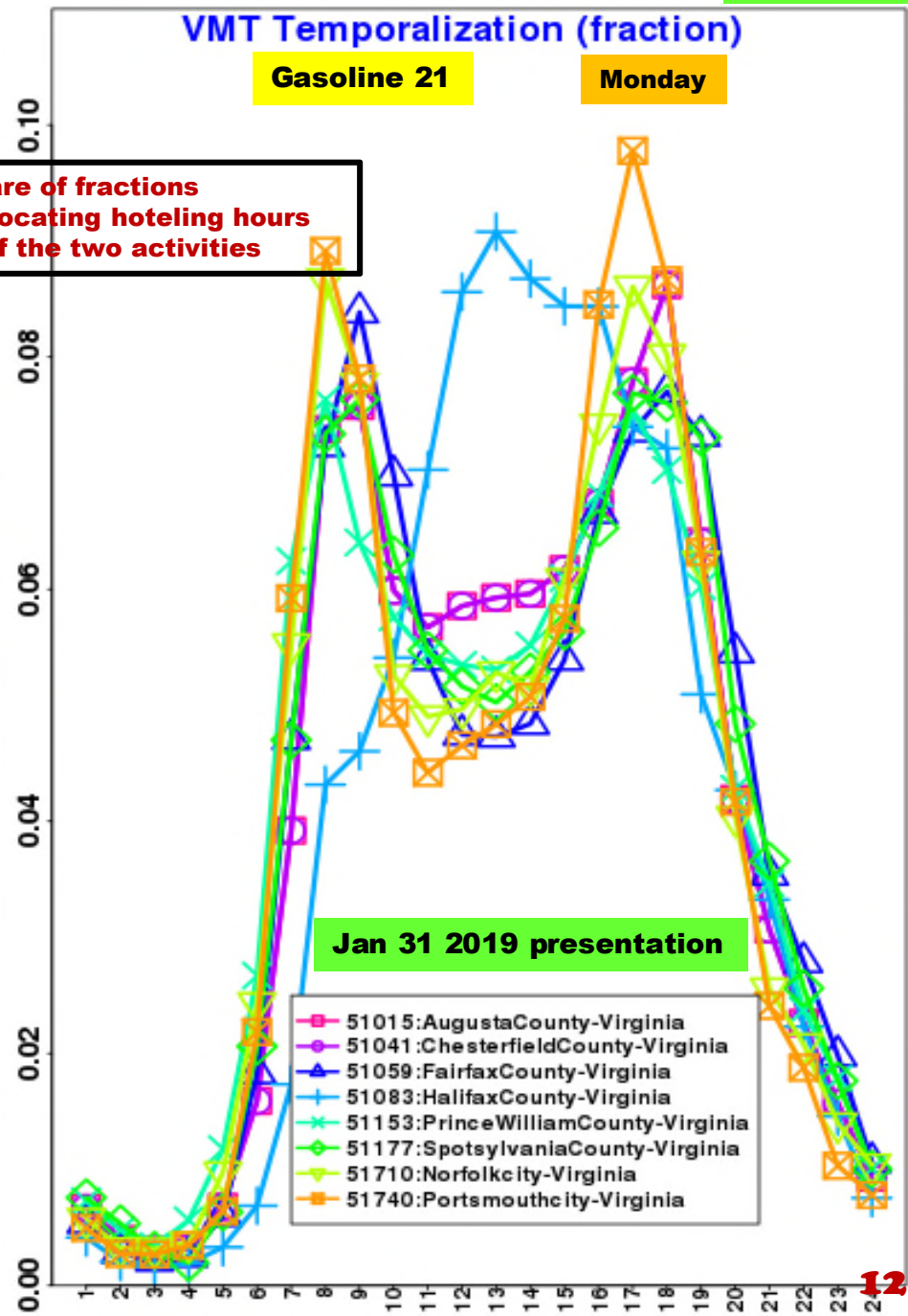
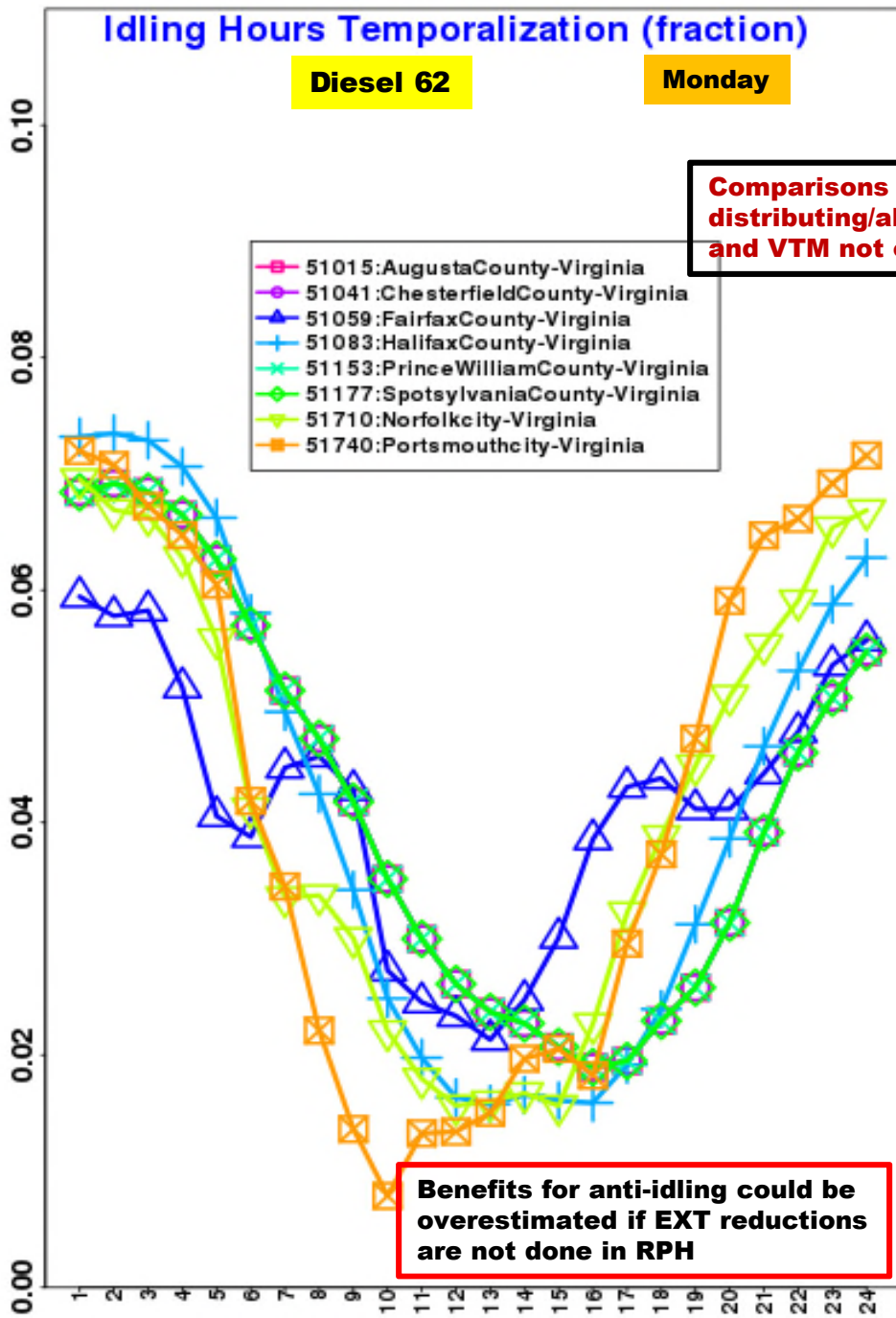


**xx: 53 for EXT
91 for APU**

**- EXT and APU have identical profiles (not shown);
- Hoteling profiles show a bowl shape with lows in mid-day and highs at night and wee hours**

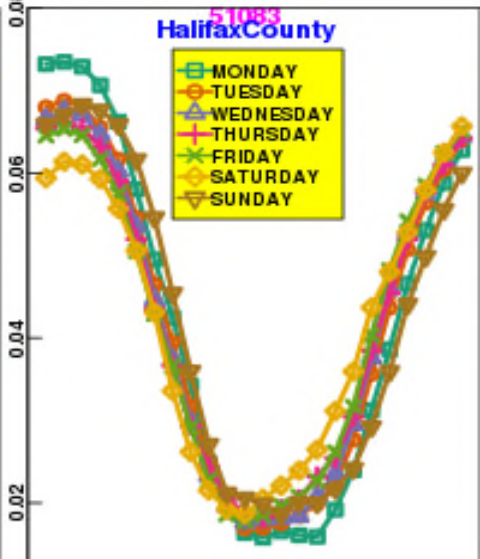
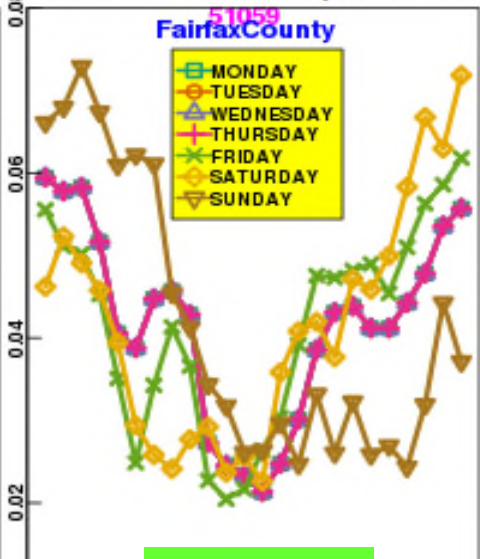
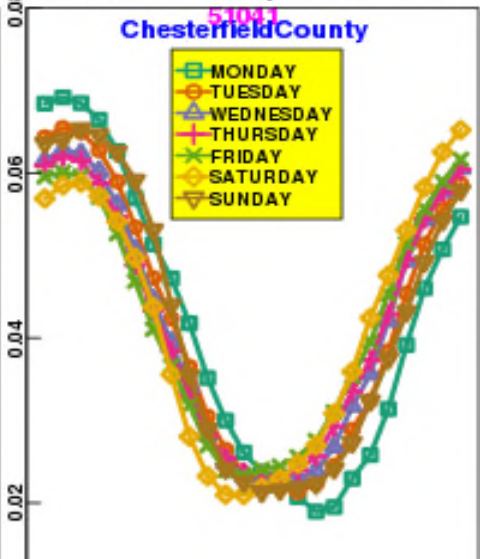
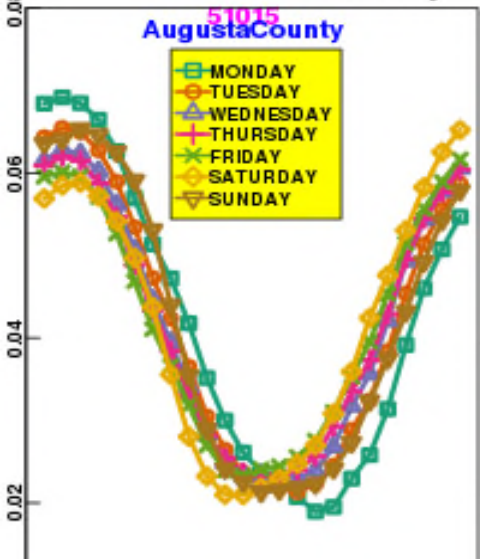
Idling Hours Temporalization versus VMT Temporalization - Virginia

2014NEI



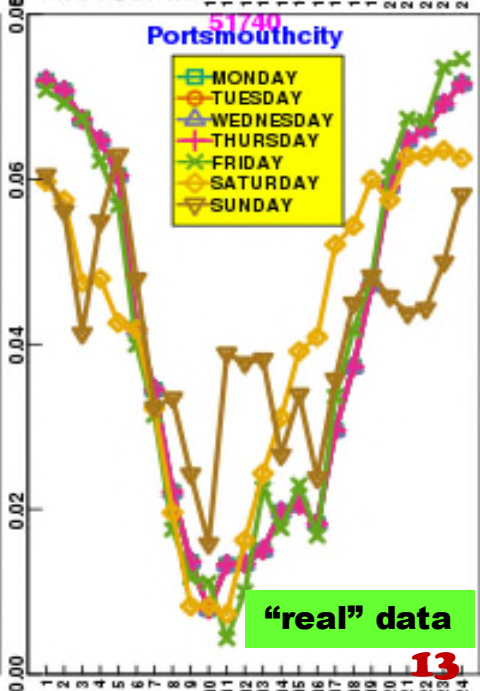
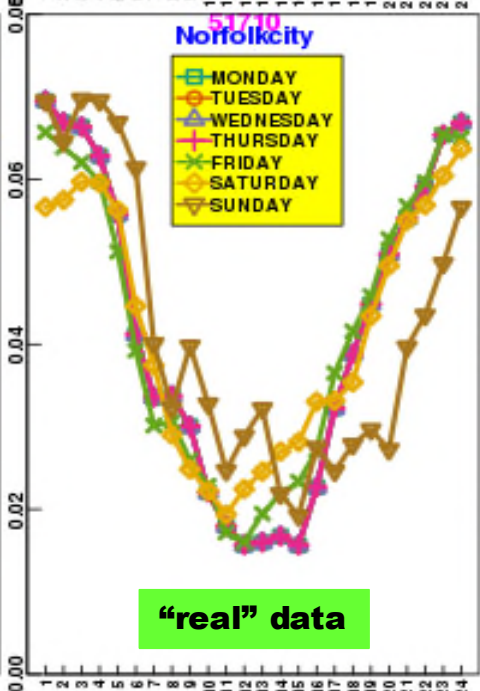
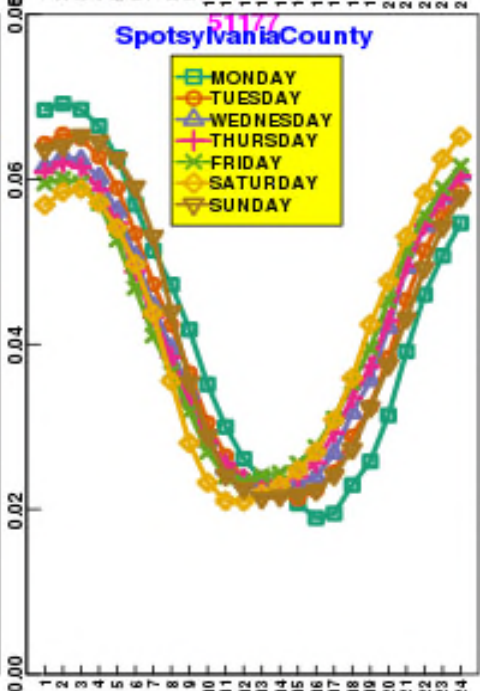
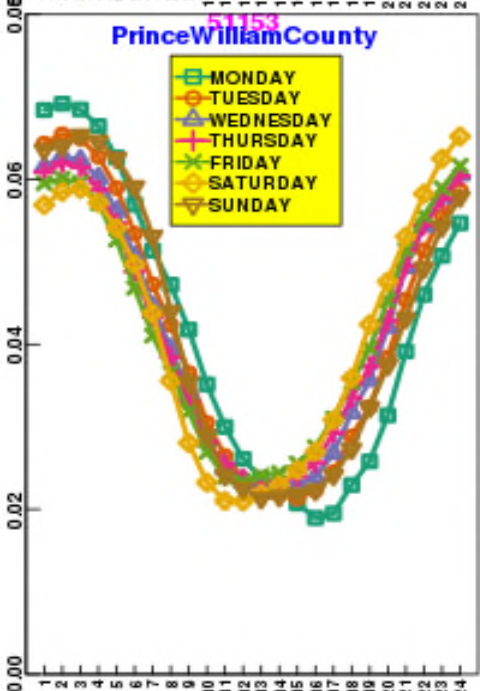
Weekdays and Weekend Temporal Profiles for 22026201xx – 8 Representative Counties

Virginia, 2014



Minor differences among days of week

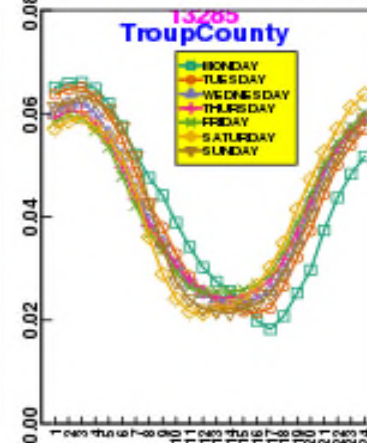
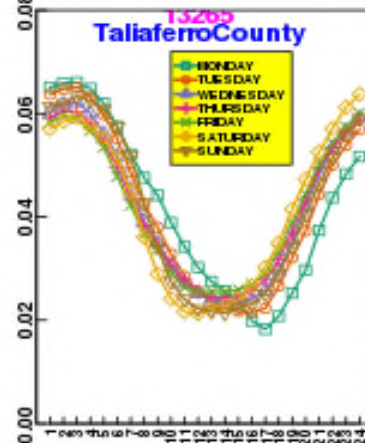
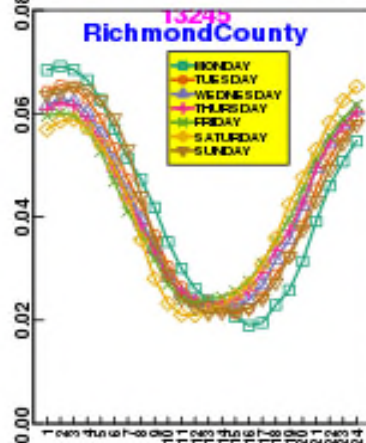
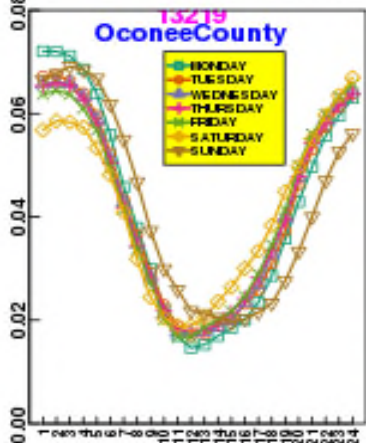
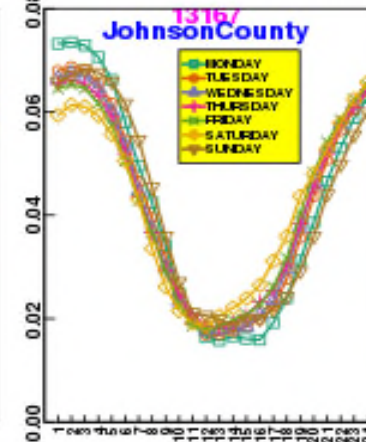
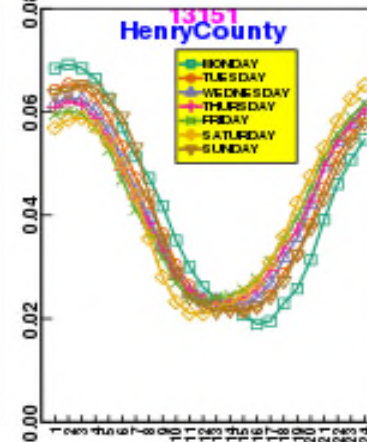
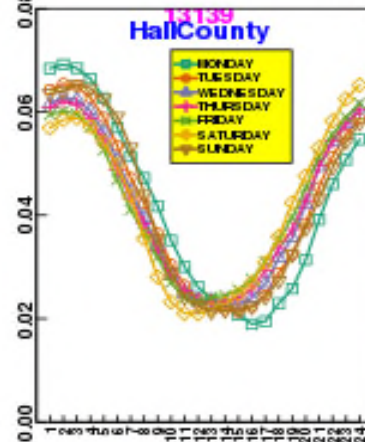
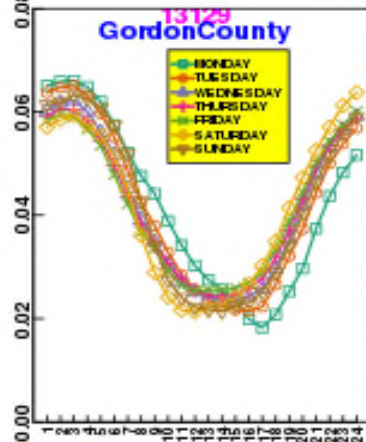
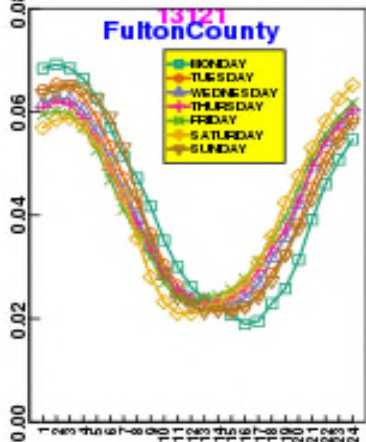
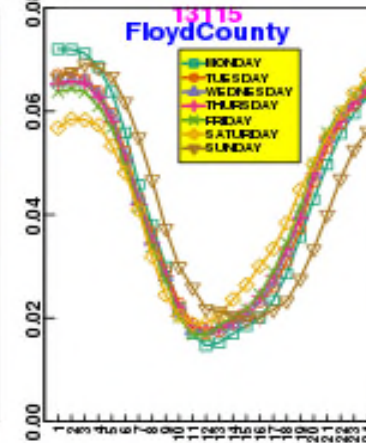
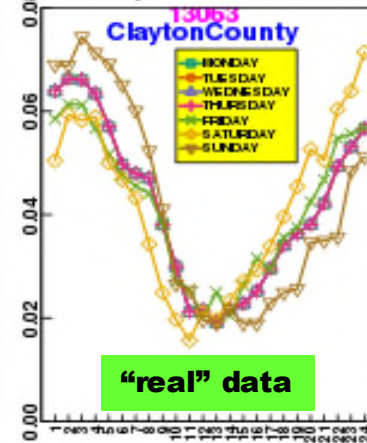
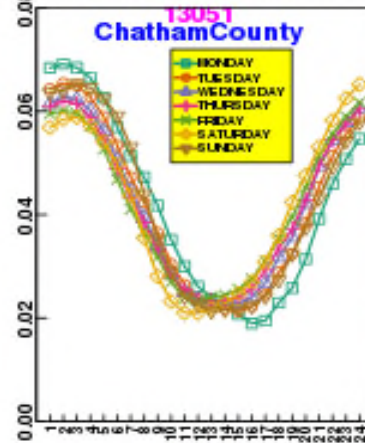
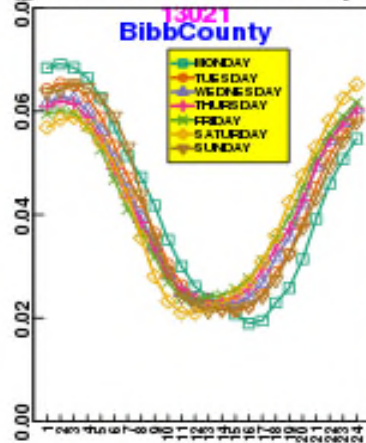
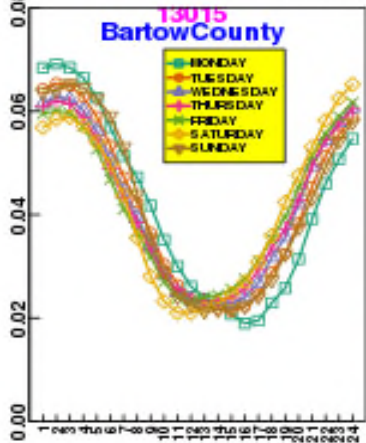
“real” data



“real” data

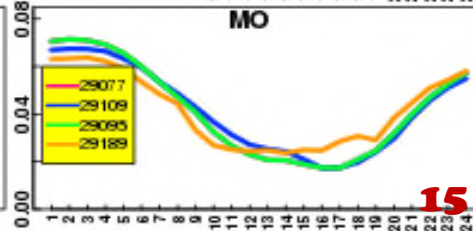
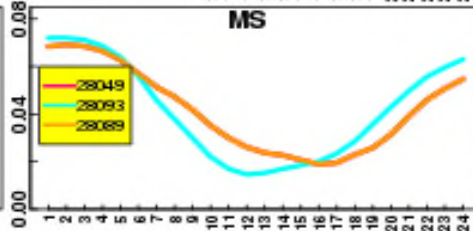
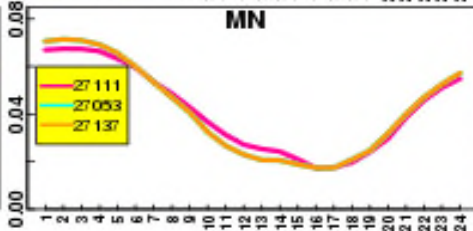
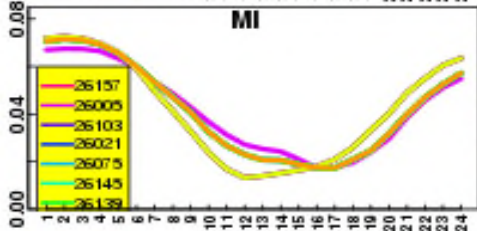
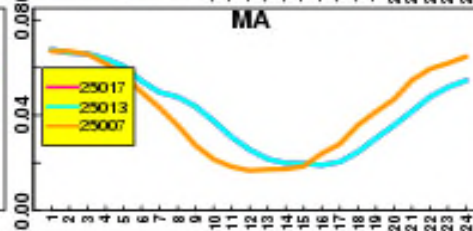
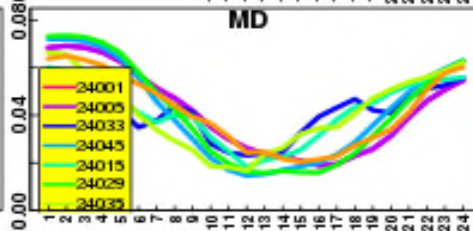
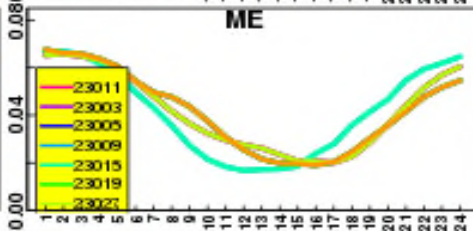
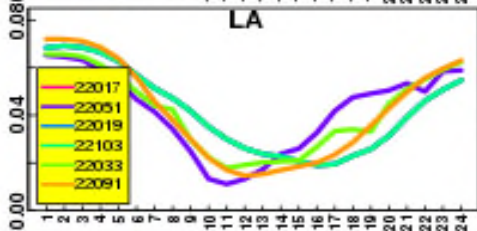
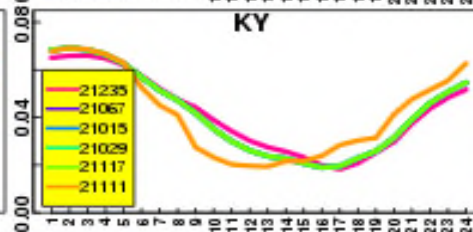
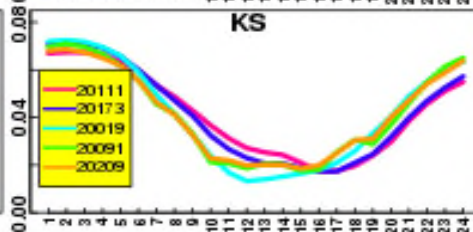
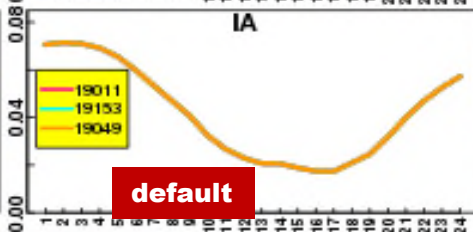
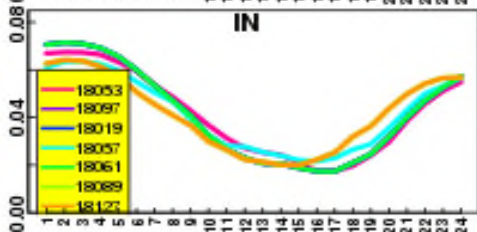
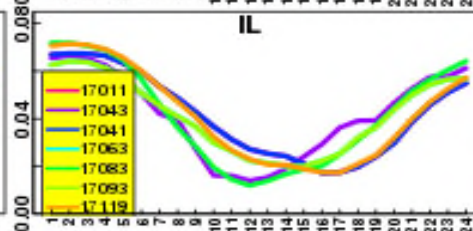
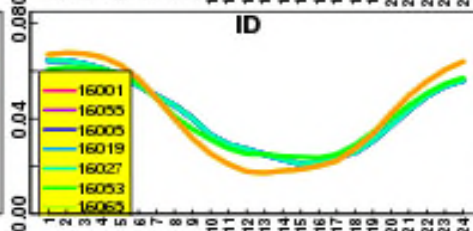
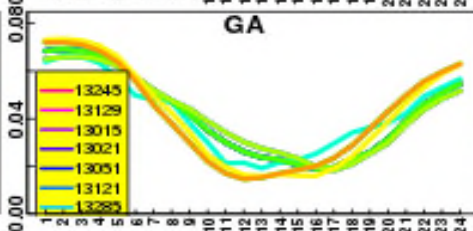
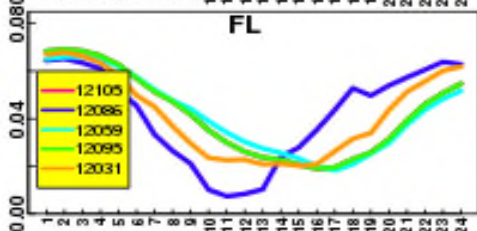
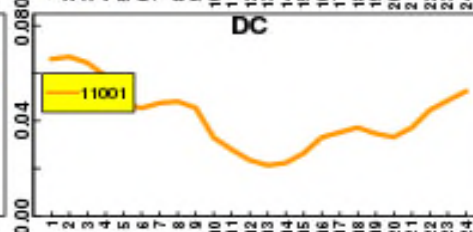
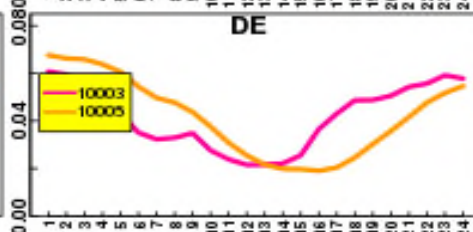
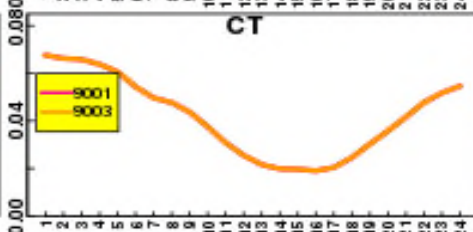
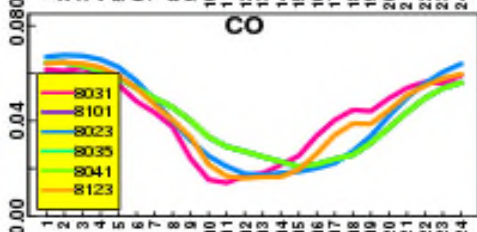
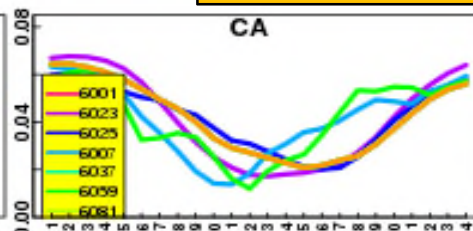
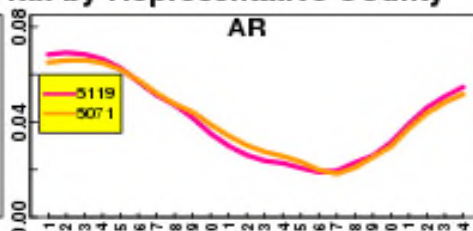
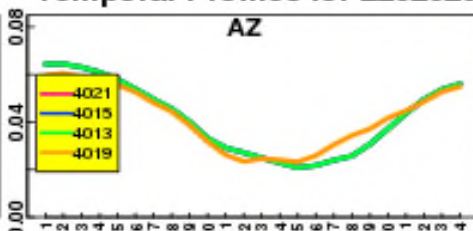
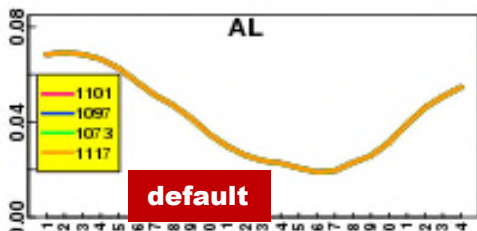
“real” data

Weekdays and Weekend Temporal Profiles for 22026201xx 14 Representative Counties

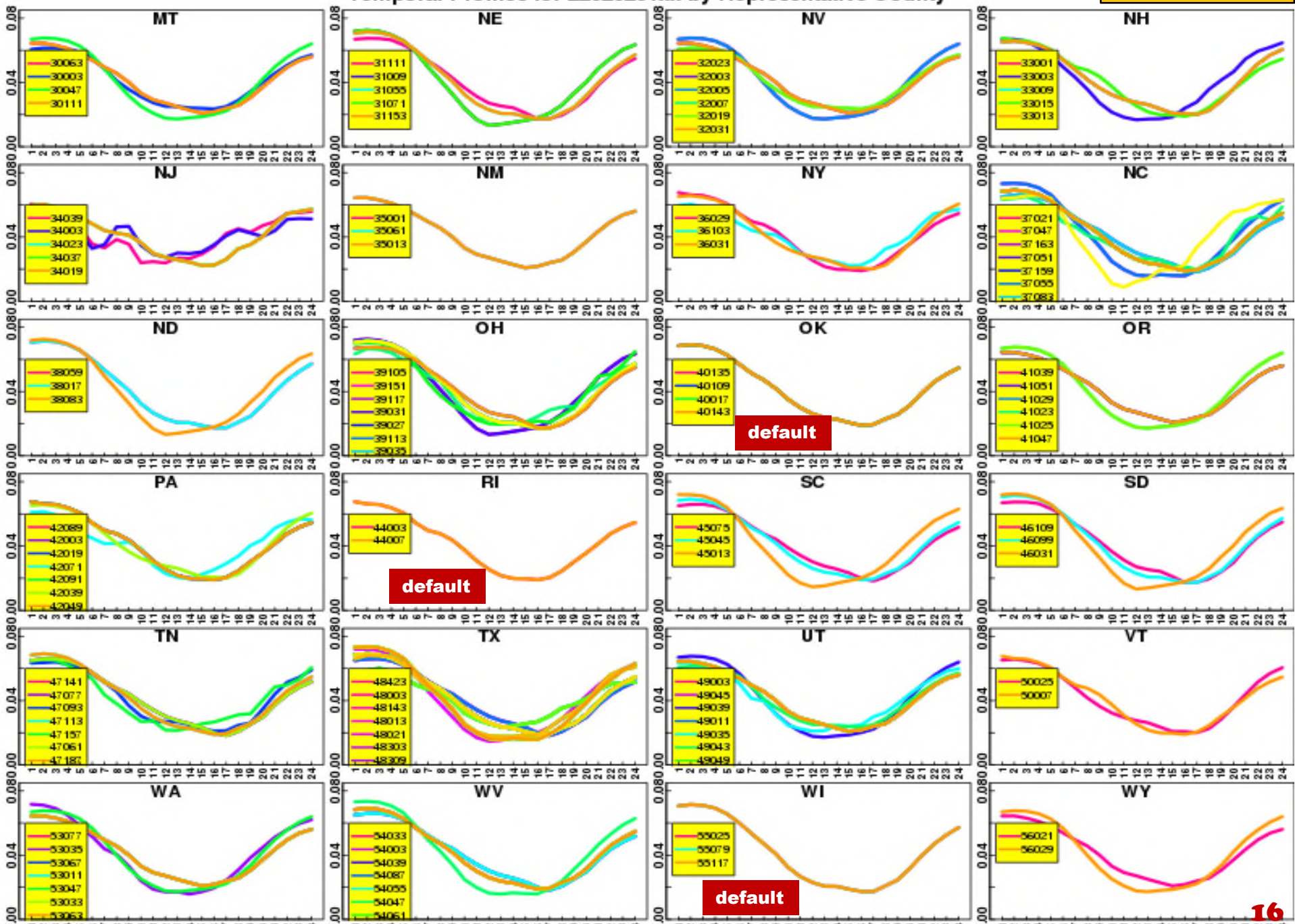


Minor differences among days of week

Temporal Profiles for 22026201xx by Representative County



Temporal Profiles for 22026201xx by Representative County



Summary

- **Only diesel (02) combination long-haul trucks (62) traveling on rural restricted roads (02) and urban restricted roads (04) contribute to extended idling**
- **Percentage for auxiliary power unit (APU) increases from 2011NEI to 2014NEI**
- **EXT has much higher hourly NO_x rate (~10 times higher) than APU**
- **EXT and APU have identical temporal profiles**
- **Temporal profiles for extended idling = idling hours allocation or distribution**
- **Hoteling temporalization shows a bowl (or V) shape with lows in mid-day and highs at night and wee hours**
- **Differences in hoteling temporal profiles among days of the week are minor**
- **Temporal profiles for some states have no county variation (default) in 2014NEI**