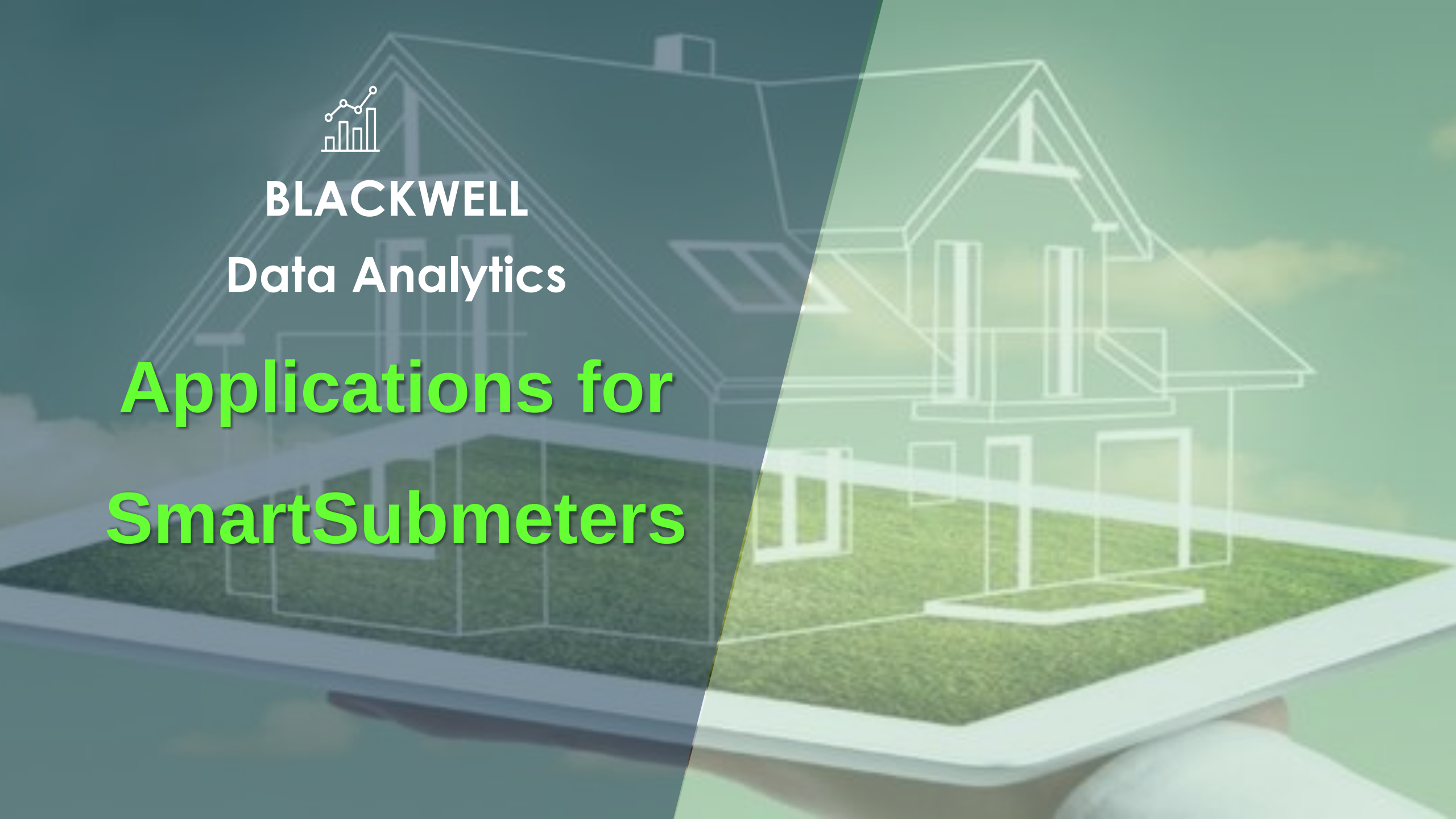


BLACKWELL

Data Analytics

Applications for SmartSubmeters

Agenda

1. Review: Smart Home and Smart Submeters
2. Applications
    - Forecasting Energy Costs
    - Energy Consumption & Temperature
    - Energy Consumption & Flexible Electricity Tariffs
    - Clean Energy: National Energy Mix & Private Consumption
    - Warnings: Damaged Appliances

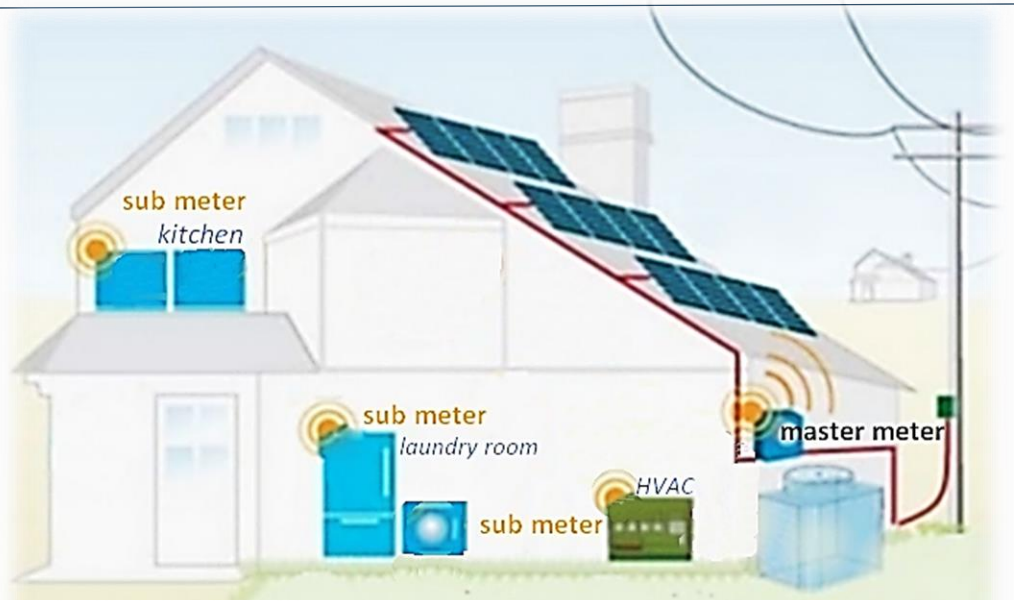
Review: Smart Homes/Submeters

3 Submeters

Kitchen: dishwasher, oven, microwave

Laundry: washing machine, tumble dryer refrigerator

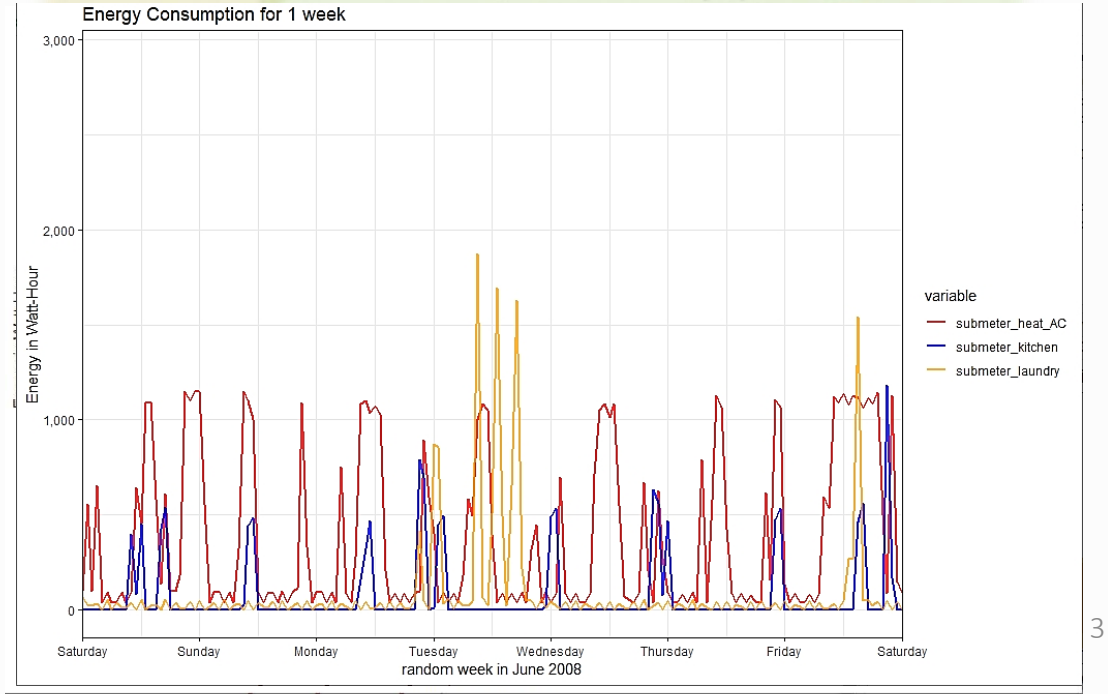
HVAC: electric water heater and AC



Kitchen : lunch & dinner

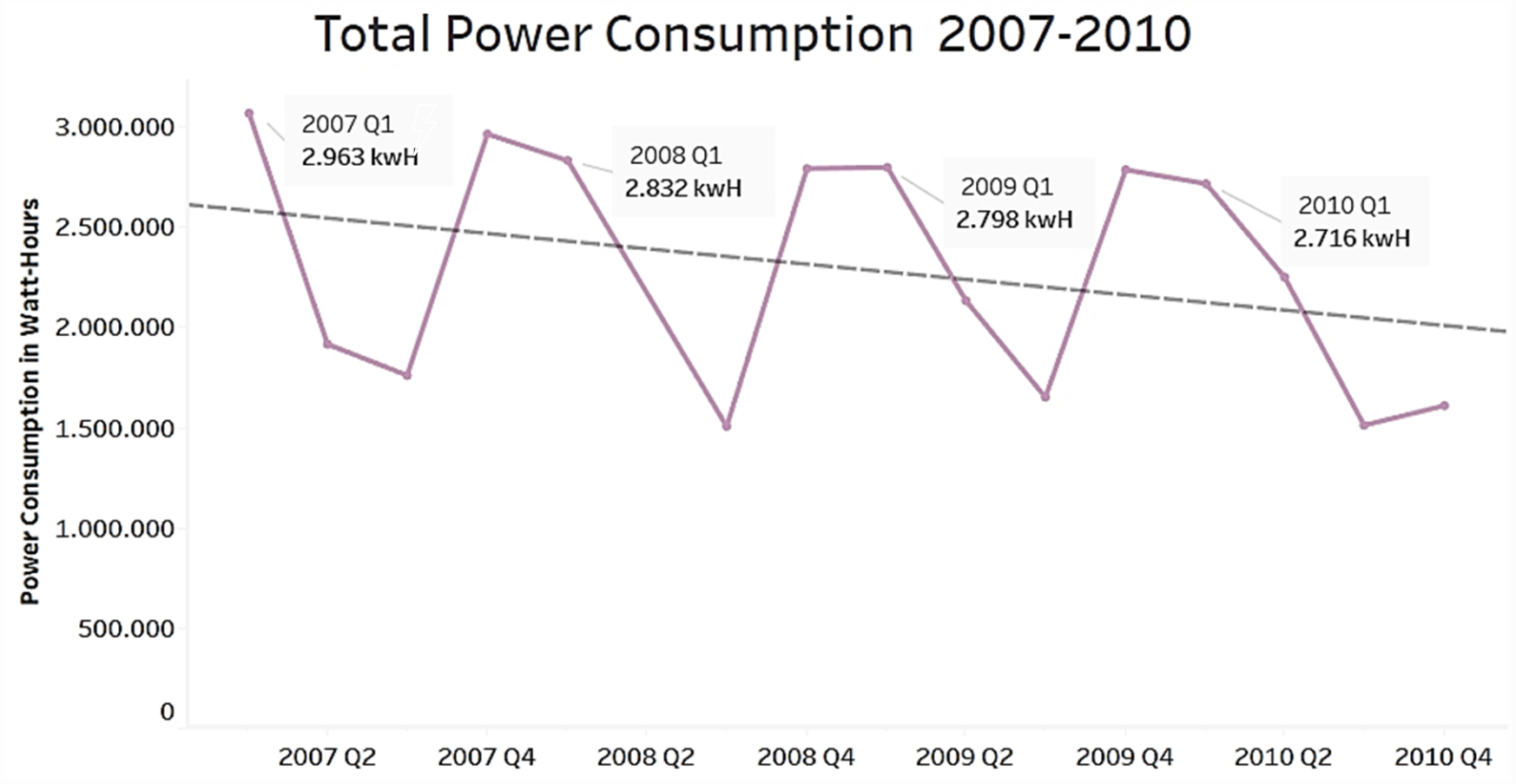
Laundry : laundry day, refigerator constantly used

HVAC : heating in the morning



Total Power Consumption

Year	Total Consumption
2007	9.710 kwH
2008	9.415 kwH
2009	9.370 kwH



I. Application
Forecasting Energy Costs

Submeter Data + Costs

Electricity Tariff for Paris (EDF)

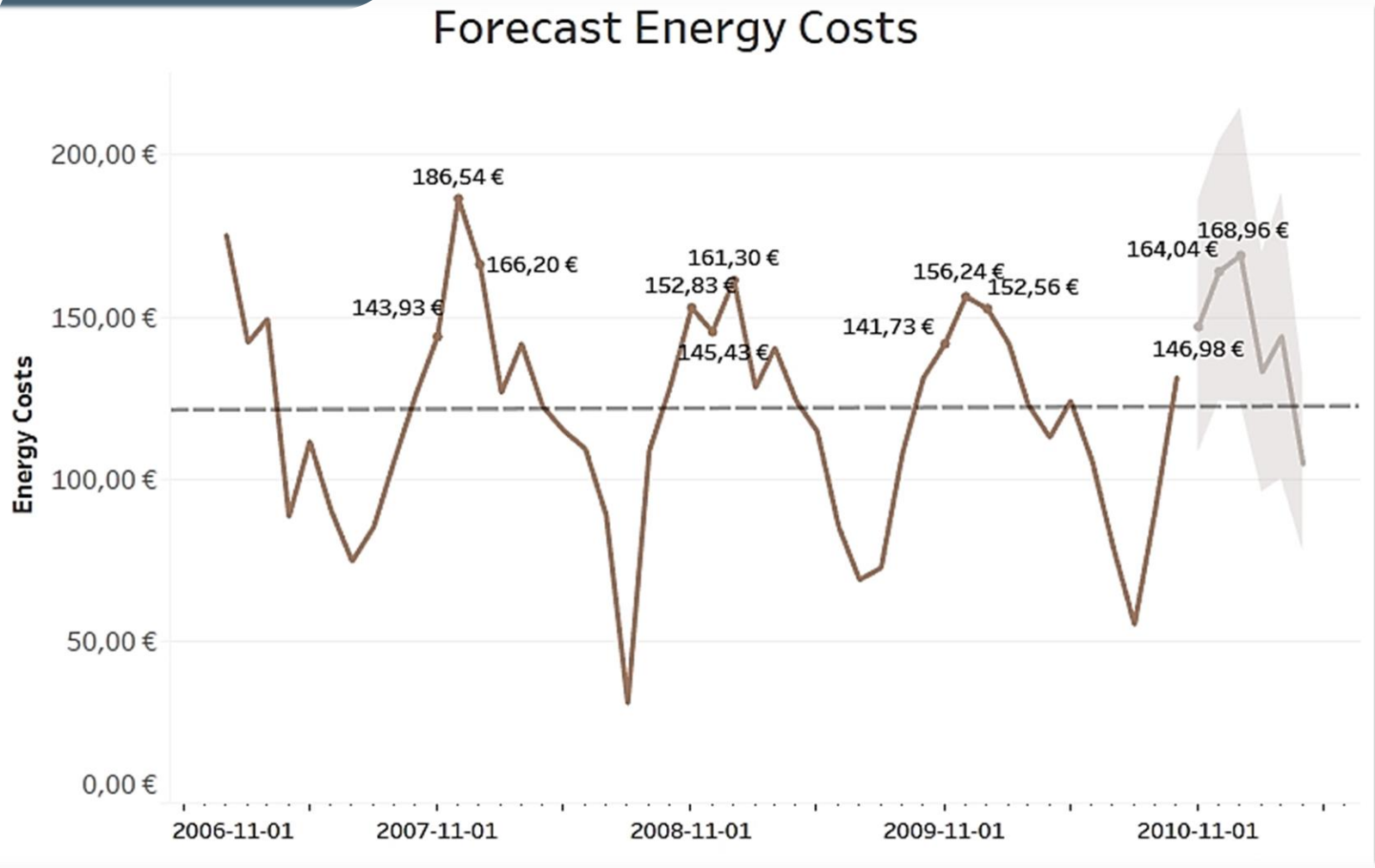
0.1244 €/kwH (00:00-07:00)

0.1593 €/kwH (07:00-00:00)

Forecasting Method: Expon. Smoothing

- regular pattern continued into future
- Weighted average of past values

transparency of annual costs



II. Application Adjustment to Temperature

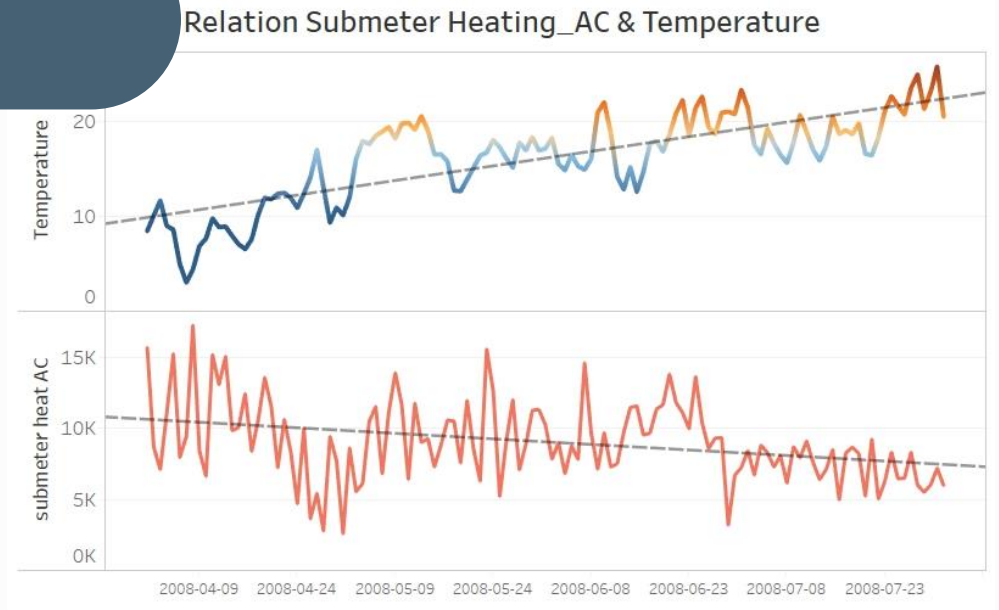
-Submeter combining Heating and AC

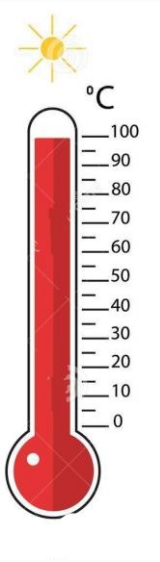
-Average household: 1/3 of energy for HVAC

-Heating dominates power consumption

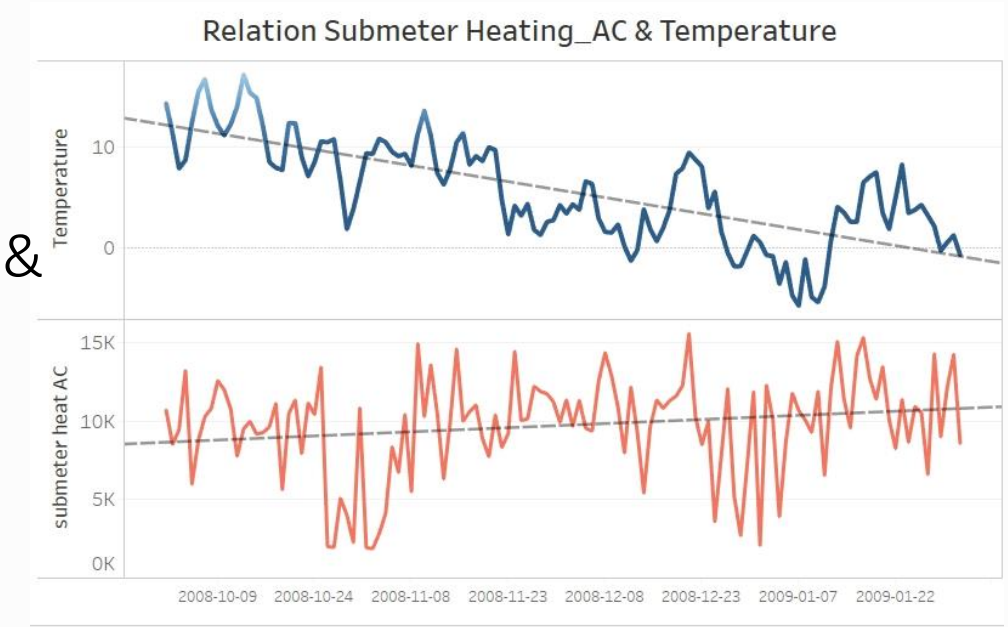
-Separation for deeper analysis necessary

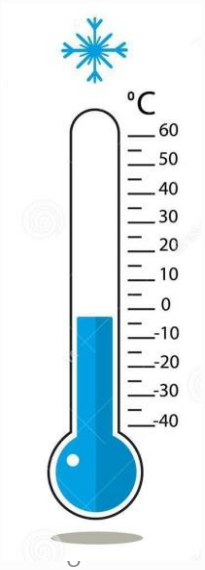
Spring & Summer





Autumn & Winter





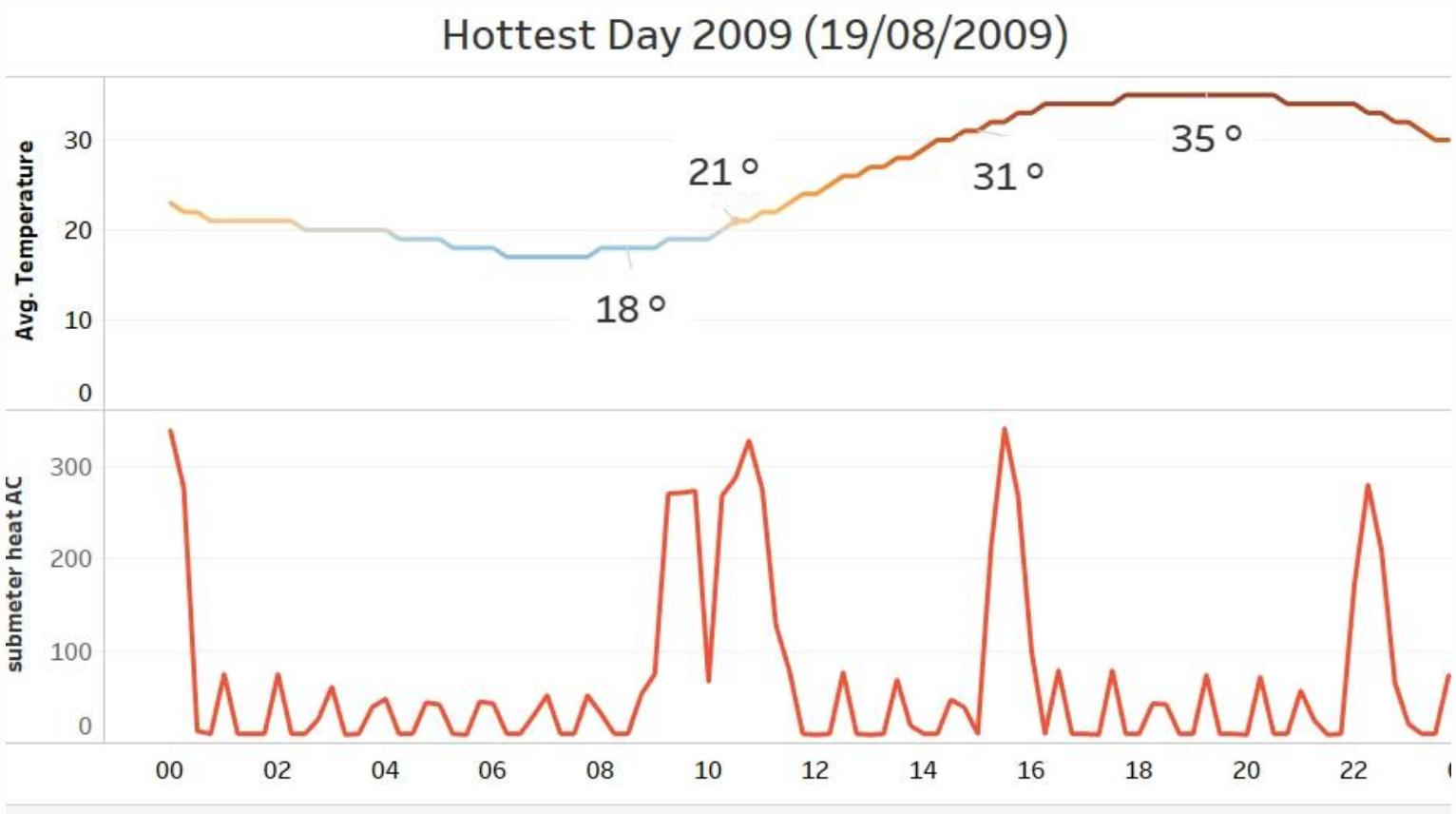
II. Application
Adjustment to Temperature

Submeter Data + Temperature

outside temperatures rise

- AC has to work harder
- adjusting T closer to outside T

saving energy



III. Application
Adjustment to flexible Tariffs

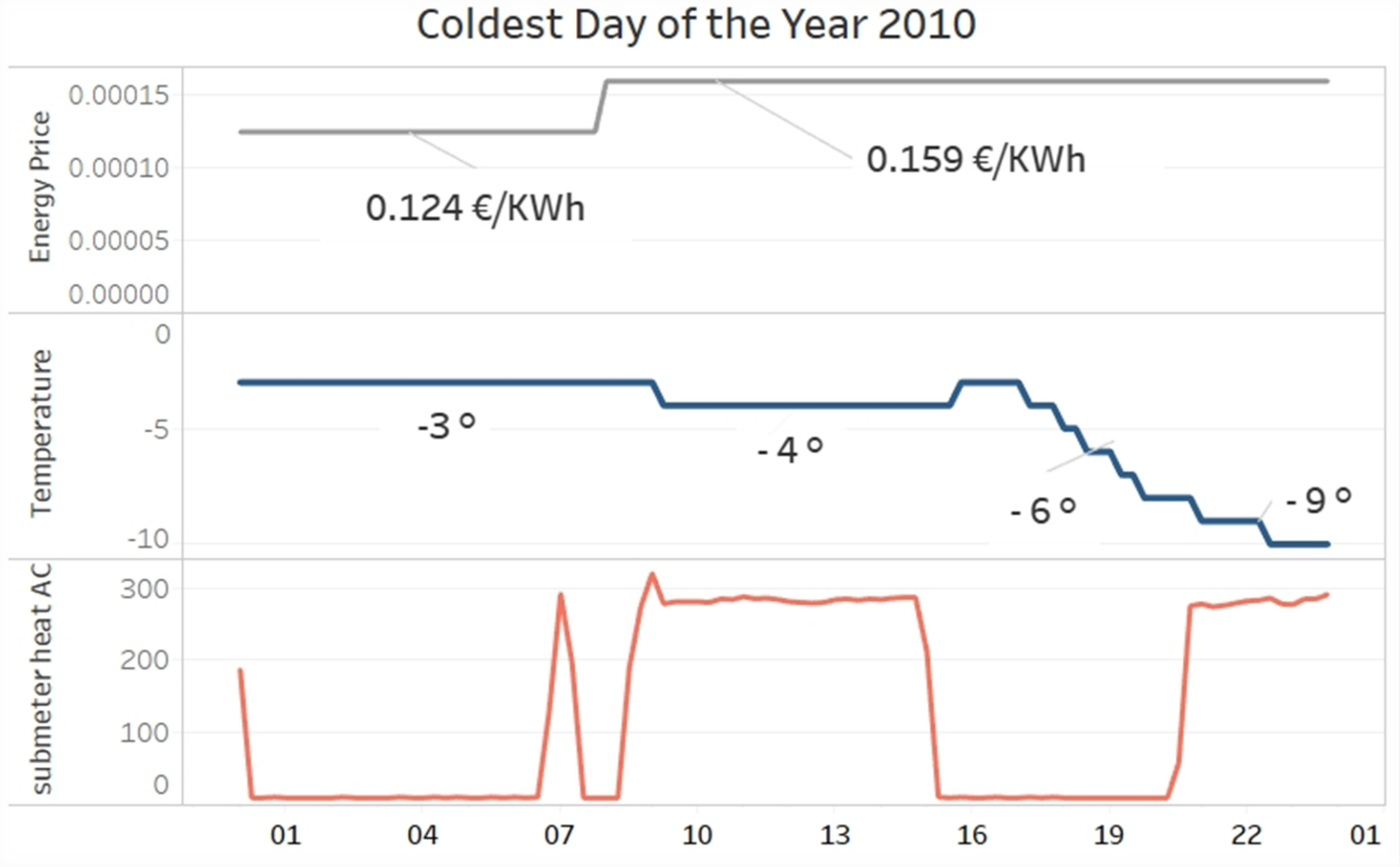
Submeter Data+ flexible Tariffs

Electricity Tariff for Paris (EDF)

0.1244 €/kwH (00:00-07:00)

0.1593 €/kwH (07:00-00:00)

saving costs

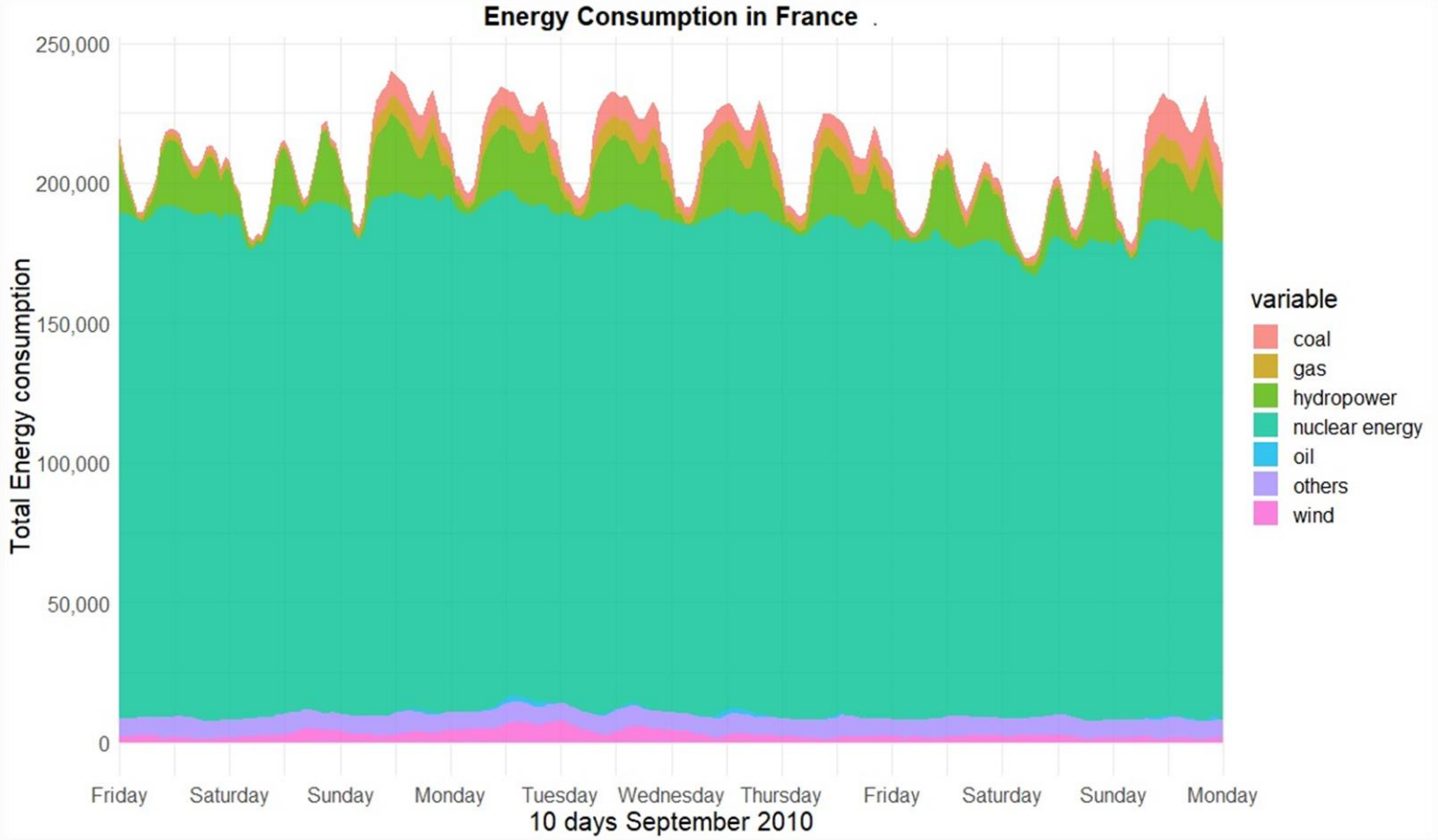


IV. Application
Clean Energy Mix

France‘s energy mix dominated by nuclear power

Hydropower very flexible used

Other markets more fitting: Germany, Denmark, Netherlands

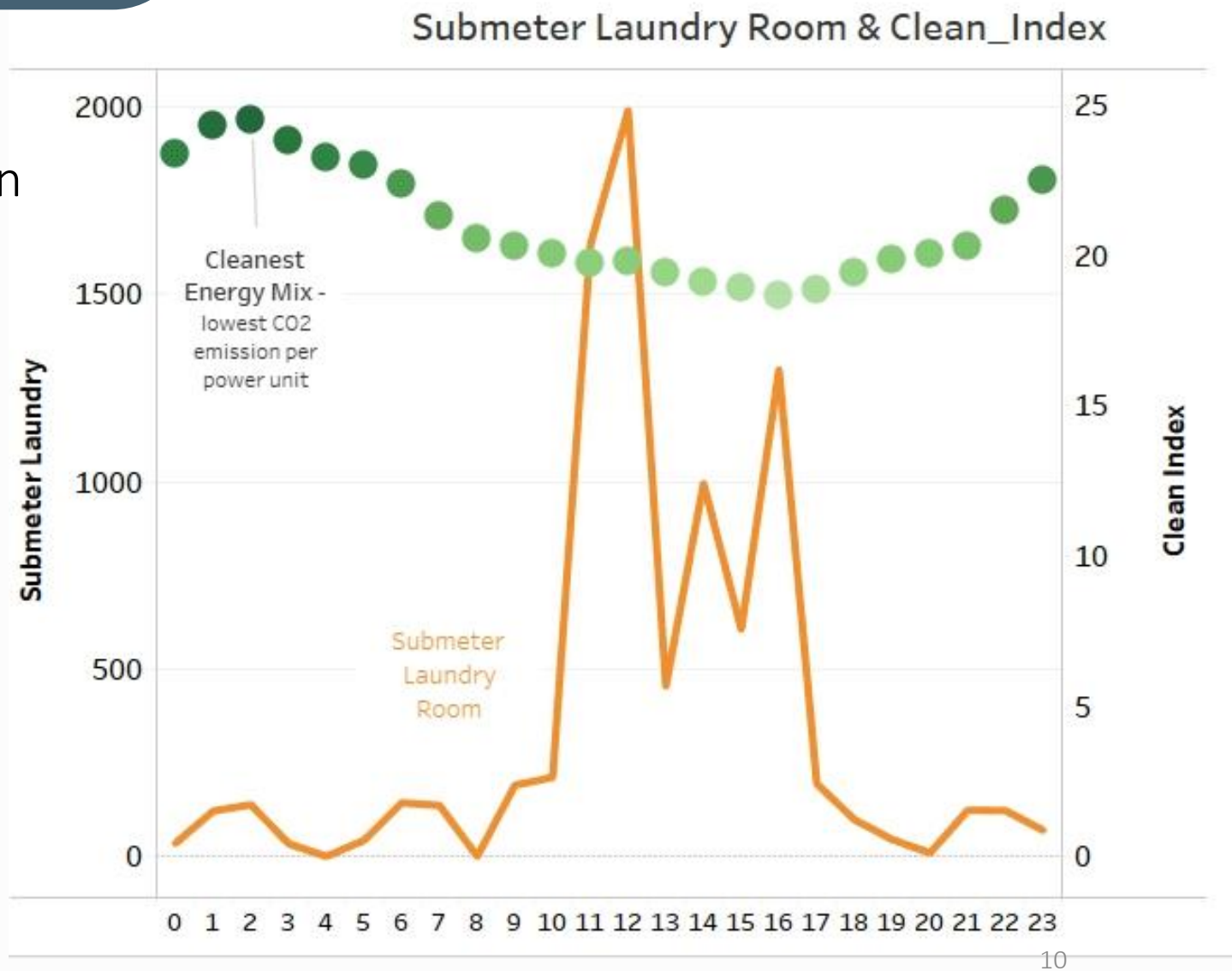


IV. Application
Clean Energy Mix

Clean Index = Power Units / CO2 Emission

cleaner energy, when less CO2 Emission for 1 produced power unit is needed

using cleaner energy



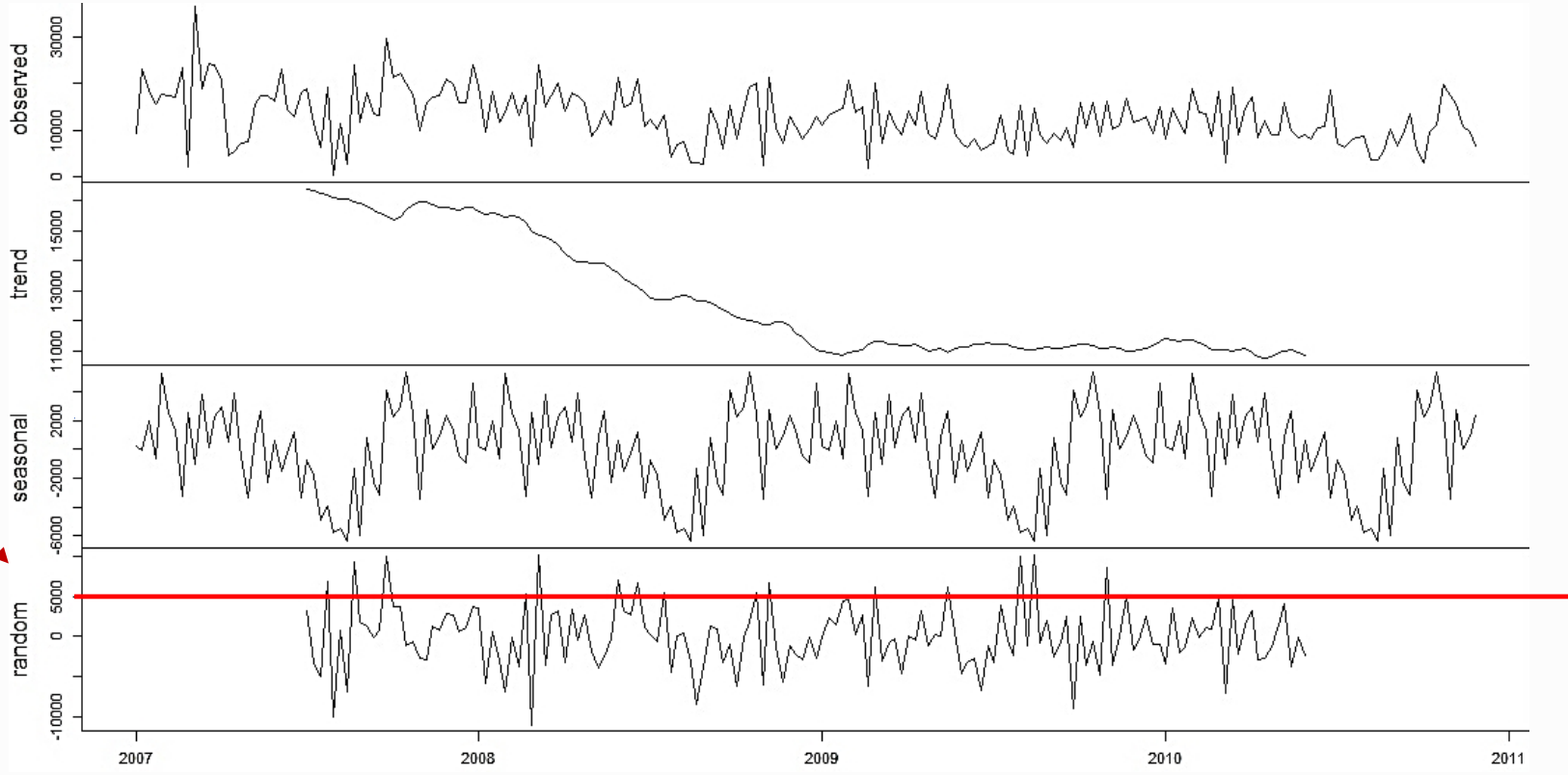
V. Application
Irregularities of Appliances

Decomposing Time Series identifies patterns: **trend, season and random**

Defining threshold for warning messages

e.g. damaged refrigerator,washing machine

Decomposition Time Series – Submeter Laundry (2007-2010)



detecting irregularities


THANK YOU