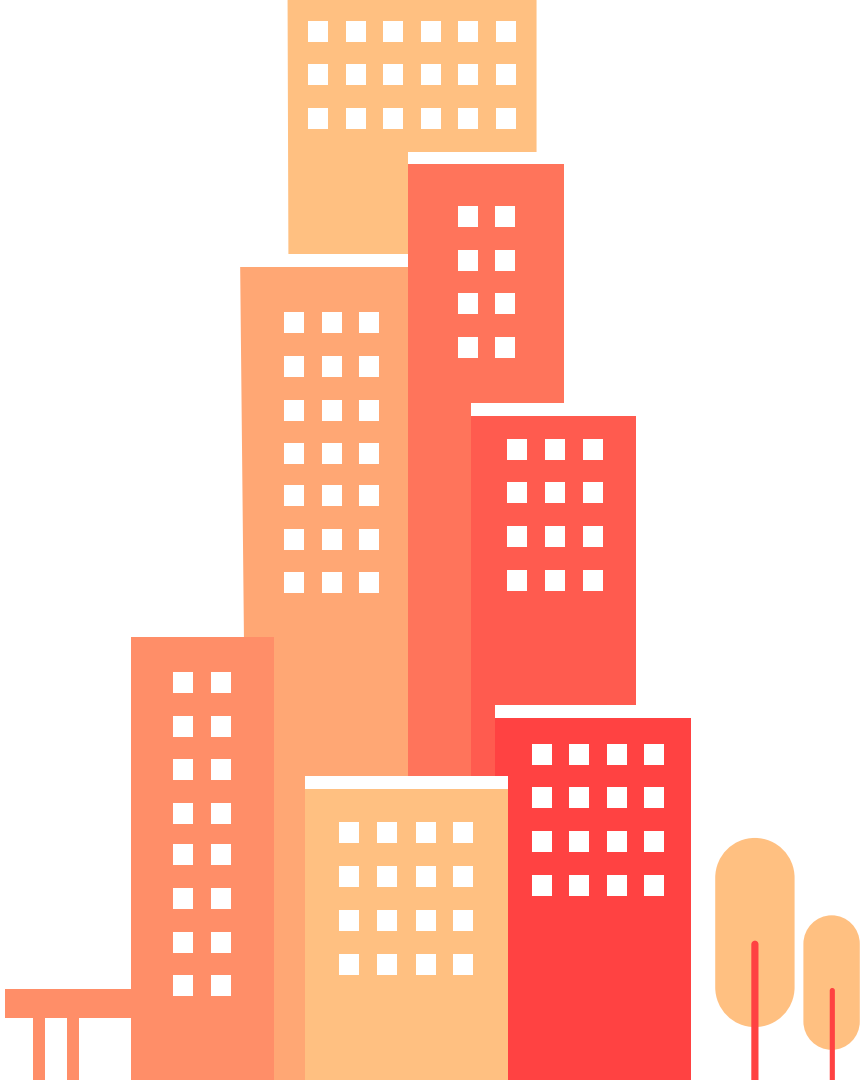
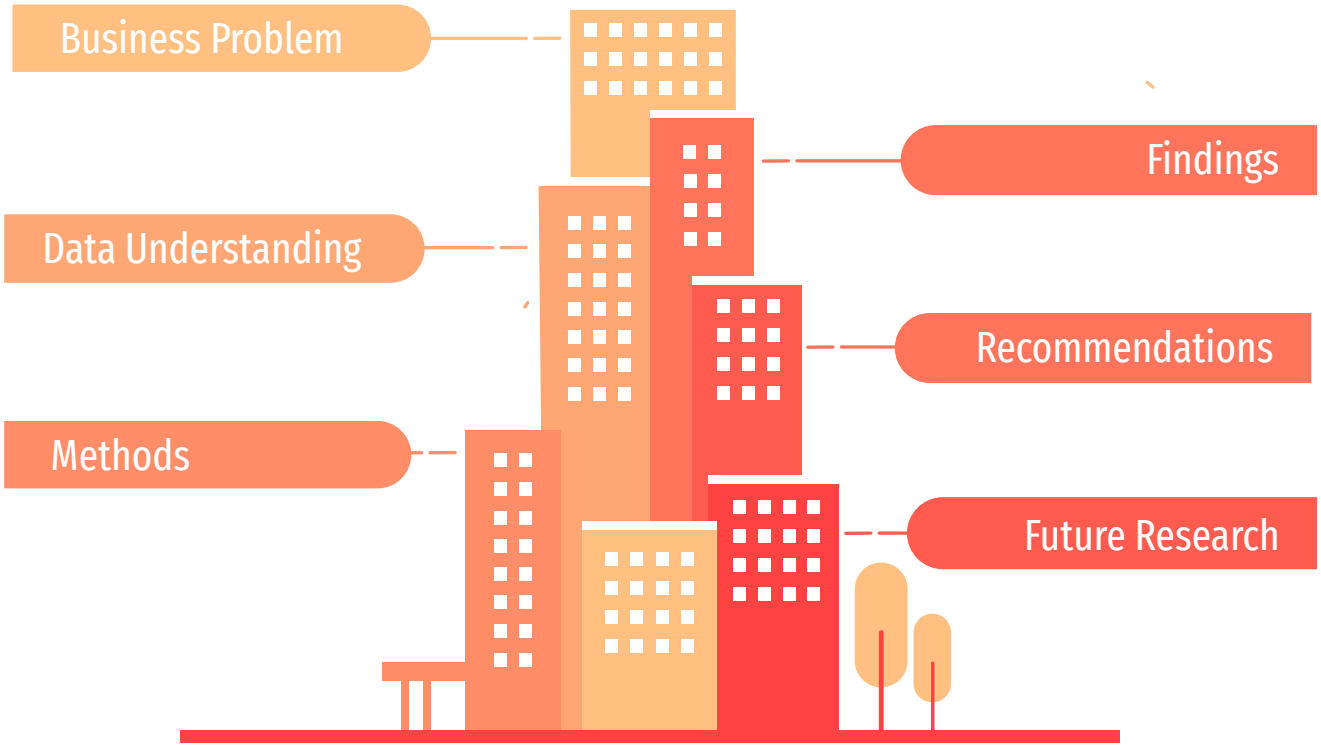


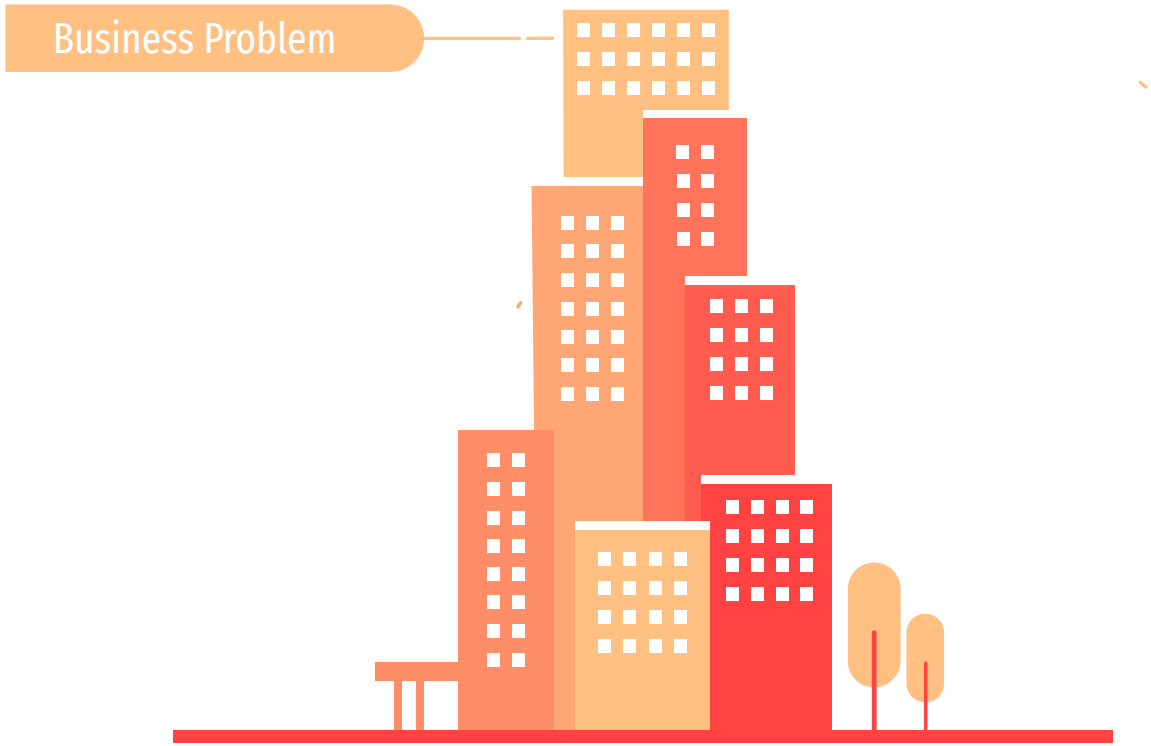
Predicting Building Energy Usage

Evan Johnson

Agenda


Business Problem
Findings
Data Understanding
Recommendations
Methods
Future Research

Business Problem



Business Problem

- Stakeholder - City of New York
- Business Problem - Support New York State Energy Plan
  - 40% reduction in greenhouse gas emissions from 1990 levels
  - 50% of energy generation from renewable energy sources
  - 600 trillion Btu increase in statewide energy efficiency
- Model that can predict building's annual energy usage
- **City Planning** - project future energy consumption
- **Identify Energy Abusers** - target buildings that are consuming more than their predicted amount and engage them in reduction actions

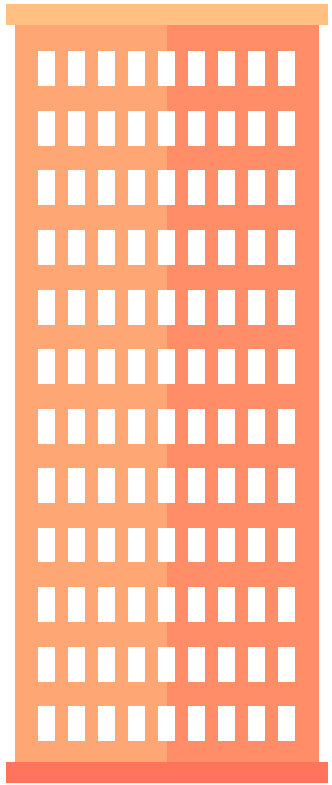
Data Understanding

Data Understanding

01 Energy Efficiency

02 Size (sqft)

03 Primary Use



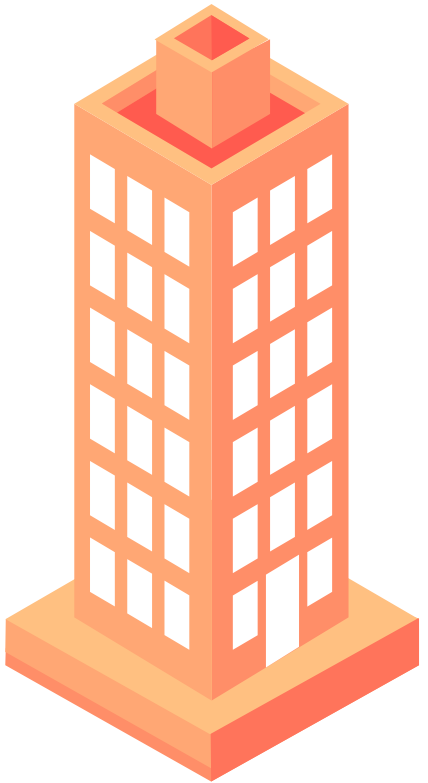
Methods

Methods

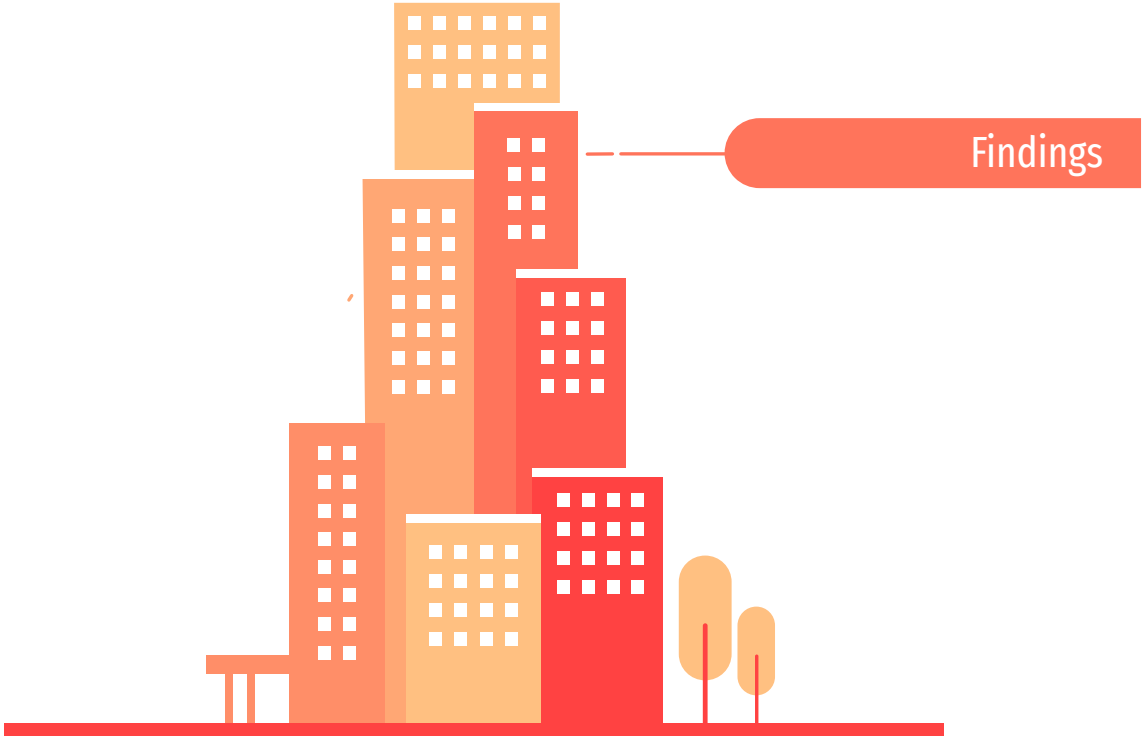
01 Occupied Buildings Only

02 Annual Electricity Calculated from Grid Purchase

03 Energy Efficiency Determined from EnergyStar Score



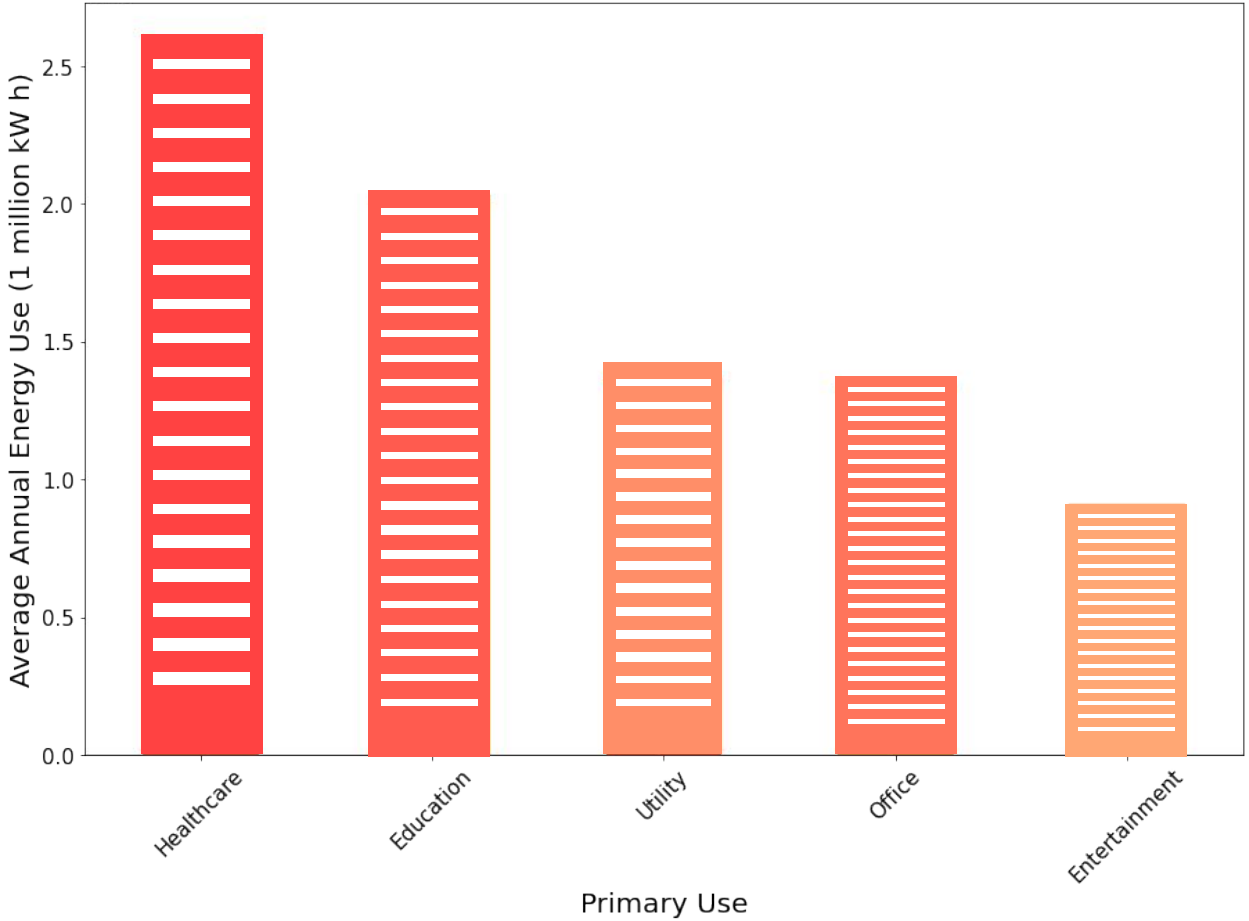
Findings



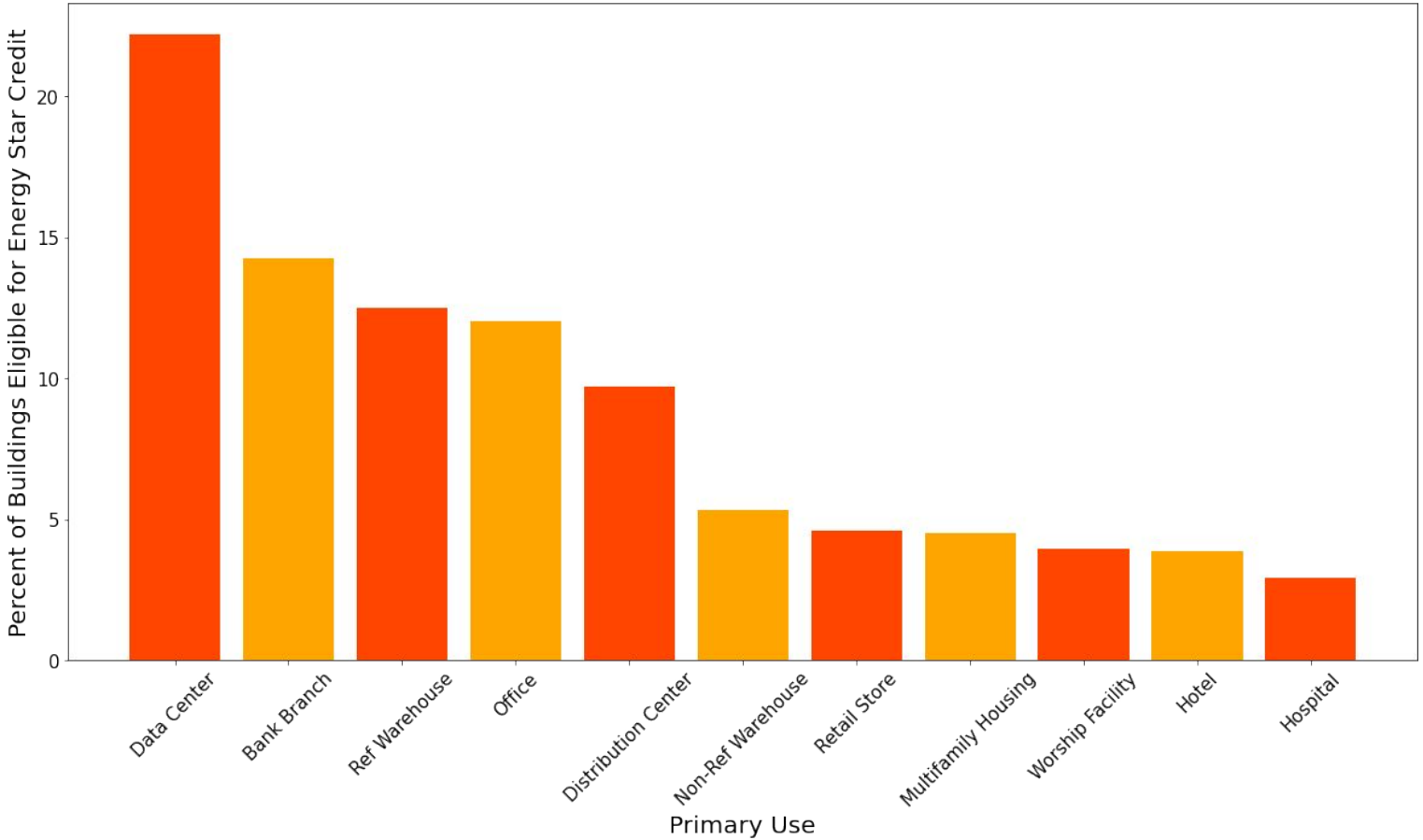
Findings

- RMSE of 664,300 kW h on test data and 226,600 on train data
- Final Model: RandomForest
- Simple Model: LinearRegression

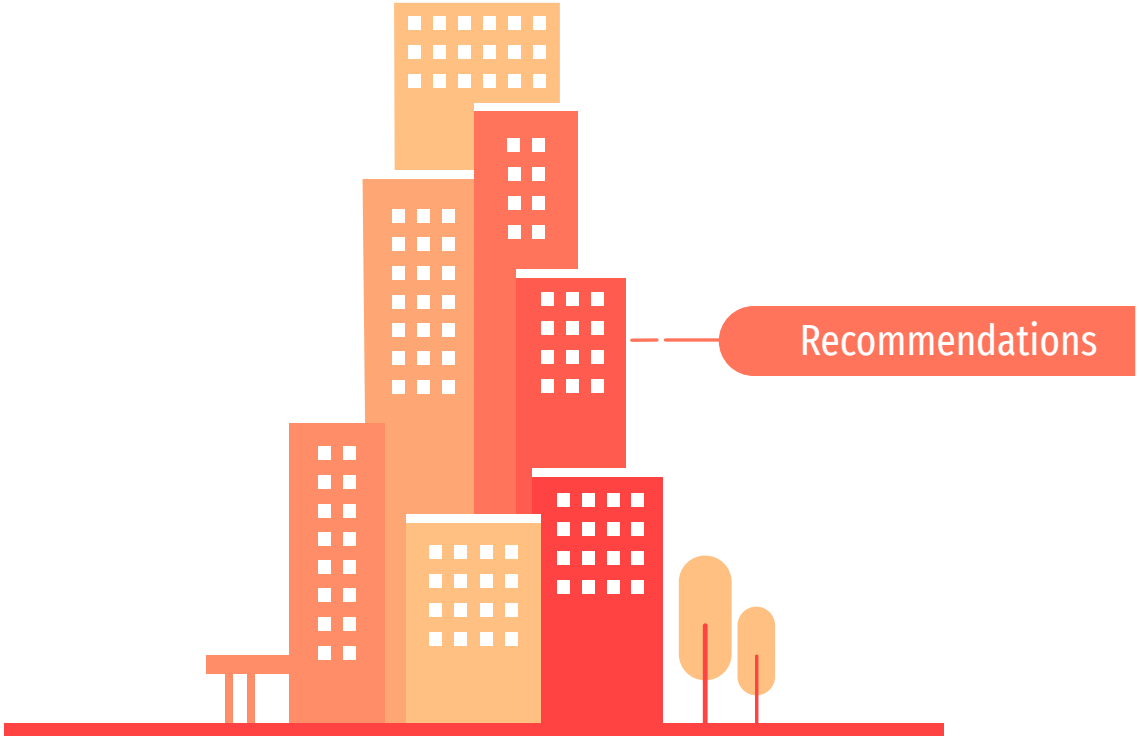
Average Annual Energy Use by Building Type



Percentage of Energy Efficient Buildings by Primary Use



Recommendations

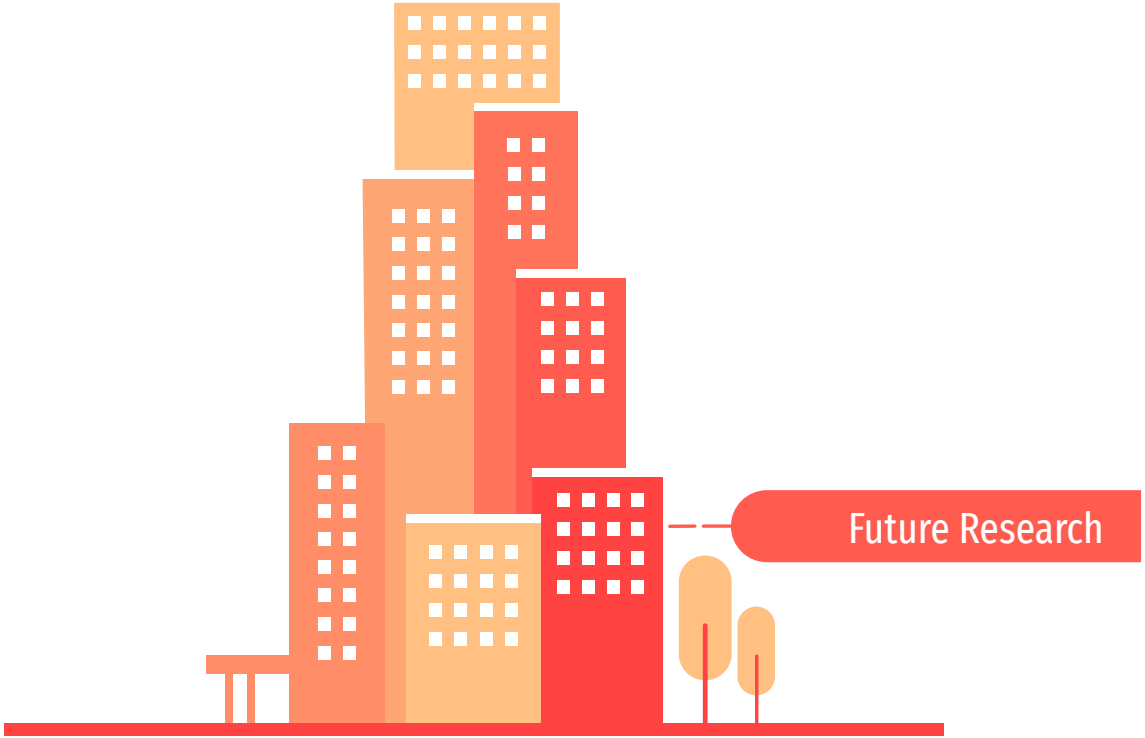


Recommendations

- Focus energy efficiency incentive programs on high energy use buildings that have the highest percentage of low EnergyStar Scores (Prisons, Surgical Centers, Wastewater Treatment Plants)

- Forecast Energy Annual Usage by making predictions with targeted EnergyStar Scores

Future Research

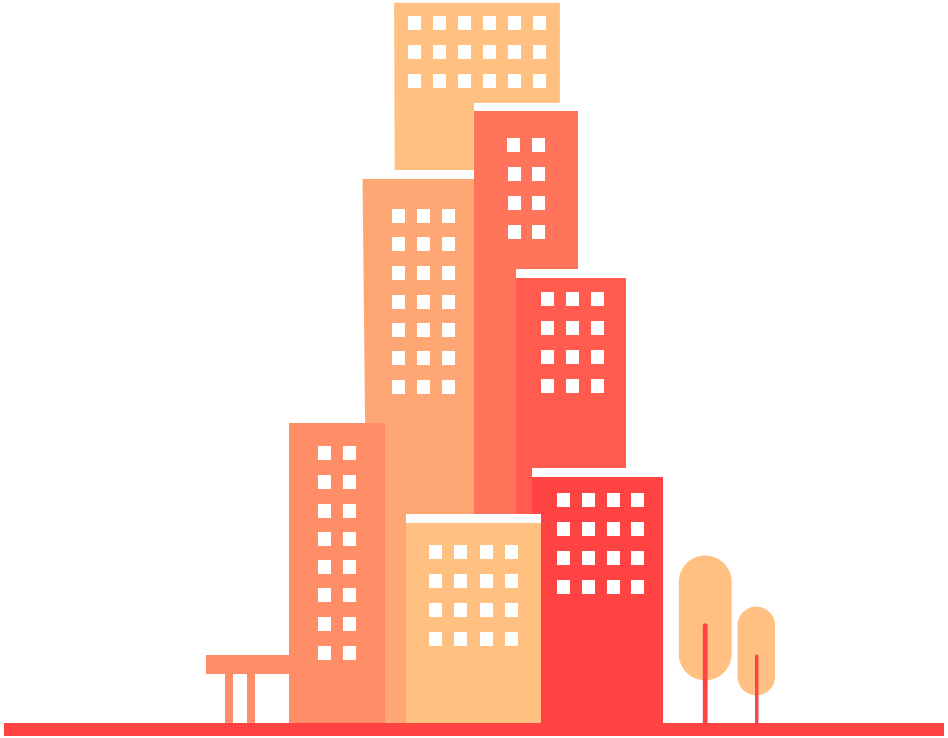


Future Research

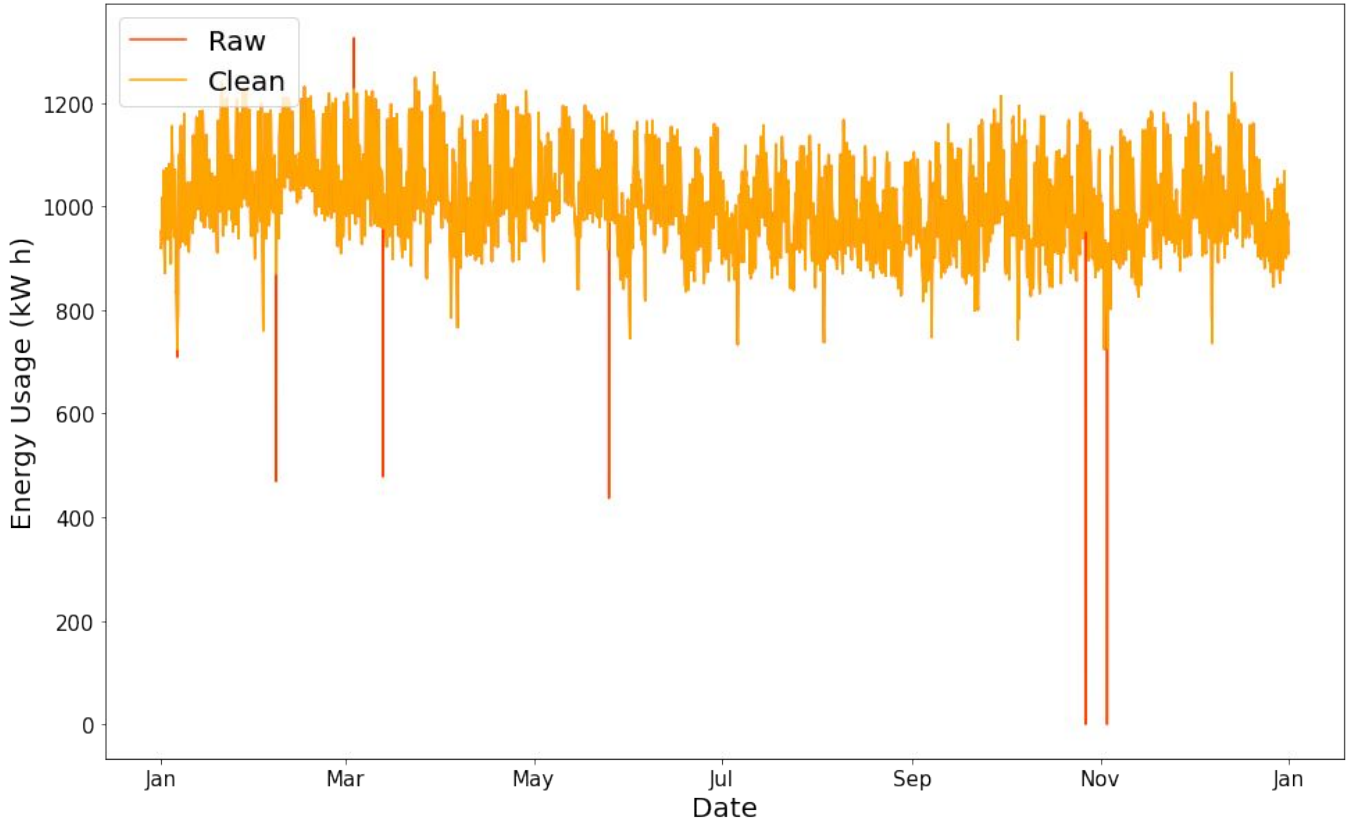
- Use sub-metering data in the model to include the exact energy use (HVAC,Lighting,Computers). For example, understanding which energy use by primary use of the building could help with creating more targeted incentive programs and recommended solutions.

- Incorporate weather data to show effects of seasonality on energy use

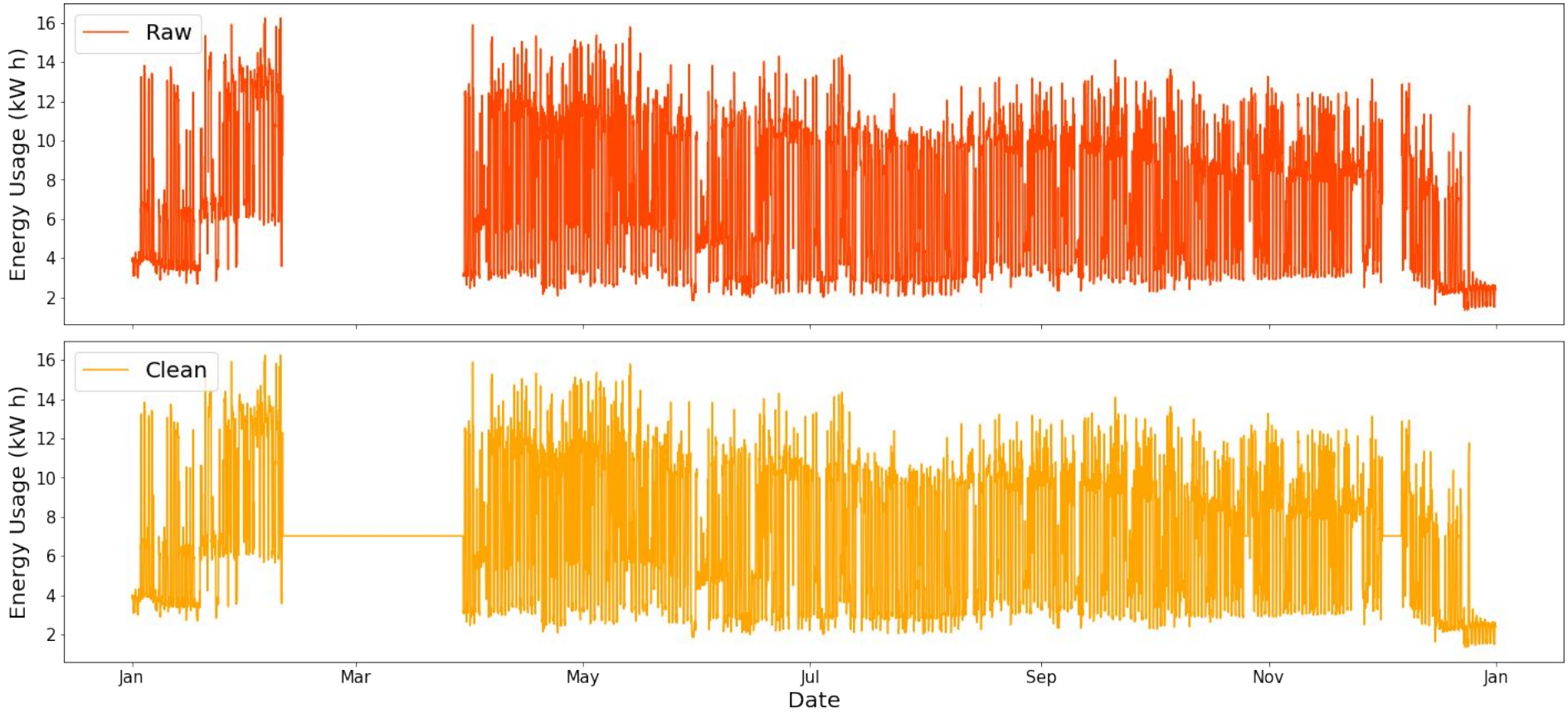
APPENDIX



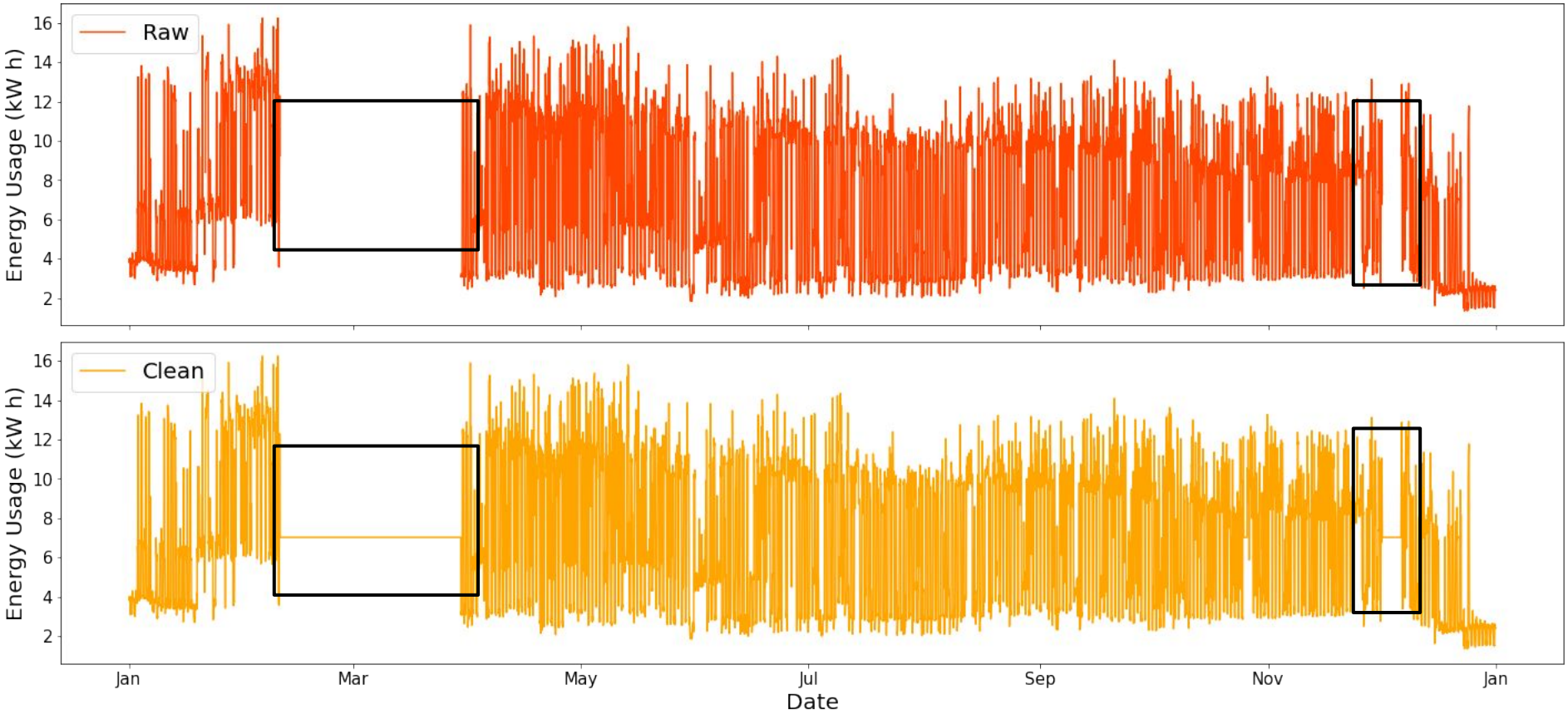
Annual Energy Usage - Minneapolis - Building #1212



Filling In Gaps During Periods of Missing Me



Annual Energy Usage - Toronto - Building #1353



Methods

01

Mercury

Mercury is the closest planet to the Sun

02

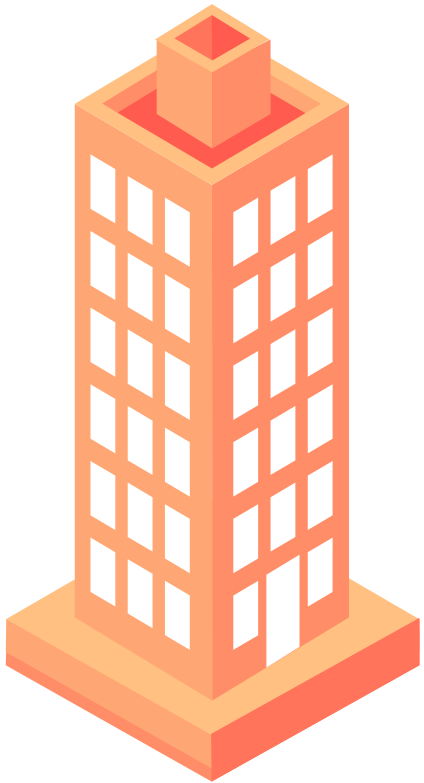
Mars

Despite being red, Mars is actually a cold place

03

Saturn

Saturn is the ringed one and a gas giant



Venus

Venus has a beautiful name, but it’s very hot

04

Neptune

Neptune is the farthest planet from the Sun

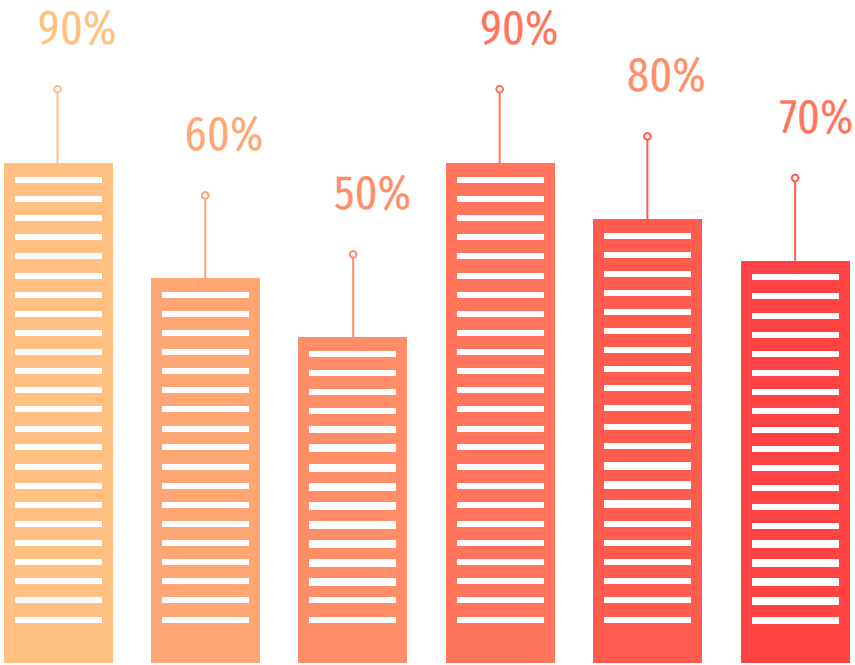
05

Jupiter

Jupiter is the biggest planet in the Solar System

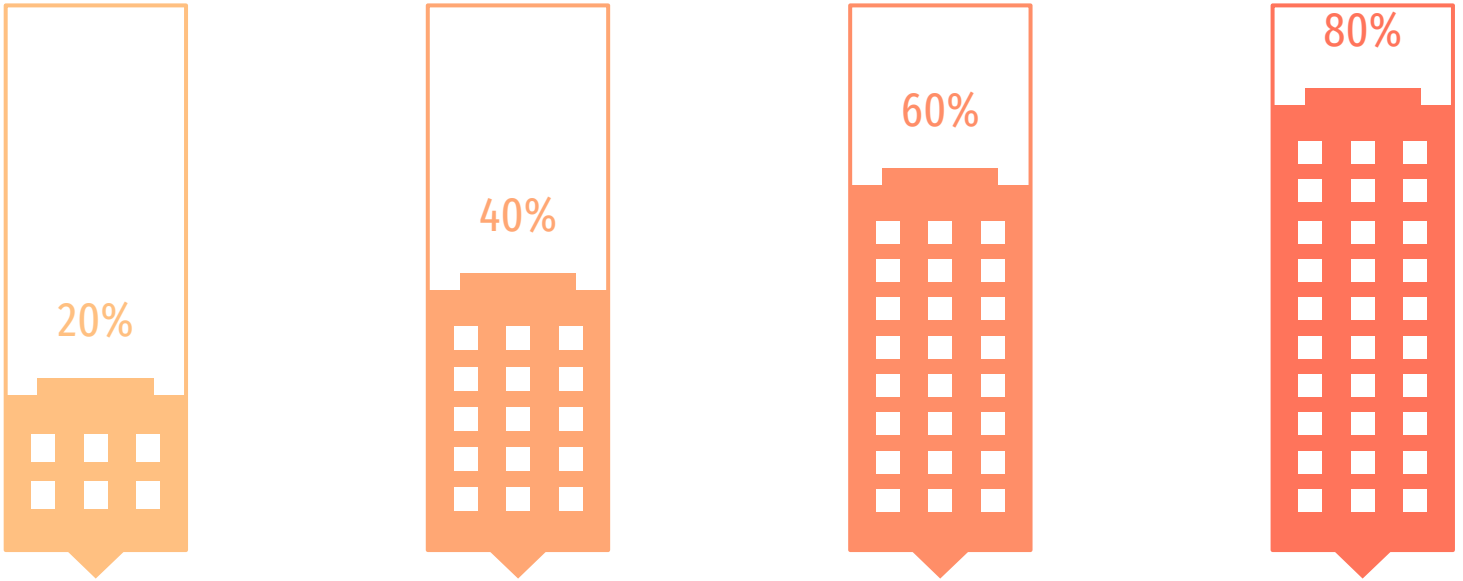
06

FINDINGS



- Venus has a beautiful name, but it’s very hot
- Neptune is the farthest planet from the Sun
- Jupiter is the biggest planet in the Solar System
- Despite being red, Mars is actually a cold place
- Mercury is the closest planet to the Sun
- Planet Saturn is the ringed one and a gas giant

FINDINGS



Mercury is the closest planet to the Sun

Despite being red, Mars is a cold place

Venus has a pretty name, but it’s hot

Neptune is the farthest planet

Building Infographics

Mercury

Mercury is the closest planet to the Sun

Venus

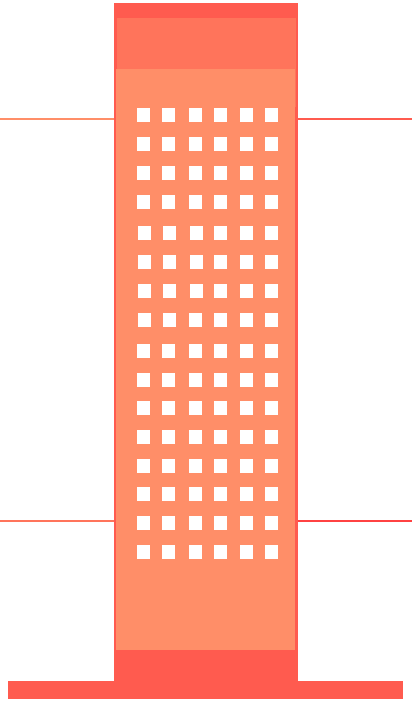
Venus has a beautiful name, but it’s very hot

Mars

Despite being red, Mars is actually a cold place

Jupiter

It’s the biggest in the Solar System and a gas giant



Building Infographics

Mercury

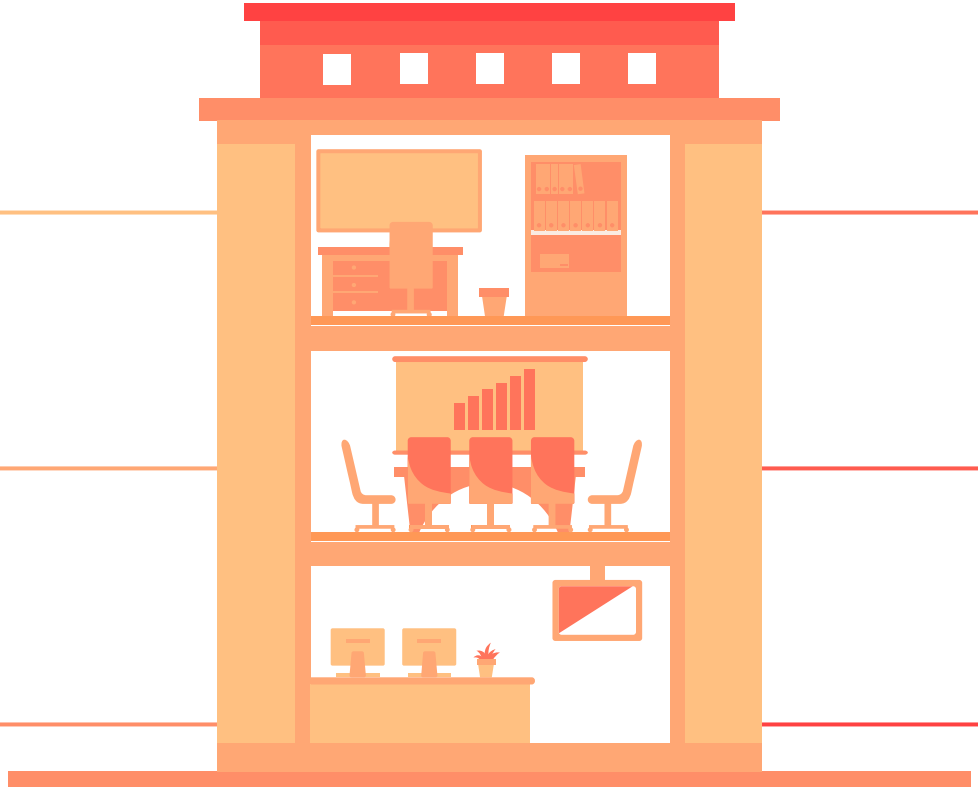
Mercury is the closest planet to the Sun and small

Mars

Despite being red, Mars is a cold place, not hot

Saturn

Saturn is the ringed one and a gas giant



Venus

Venus has a beautiful name, but it's very hot

Neptune

Neptune is the farthest planet from the Sun

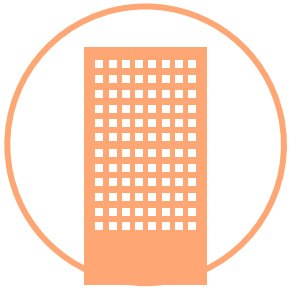
Jupiter

Jupiter is the biggest planet in the Solar System

Building Infographics

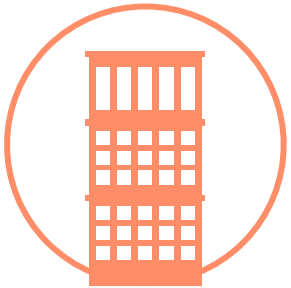
Mercury

Mercury is the closest planet to the Sun



Mars

Despite being red, Mars is a cold place



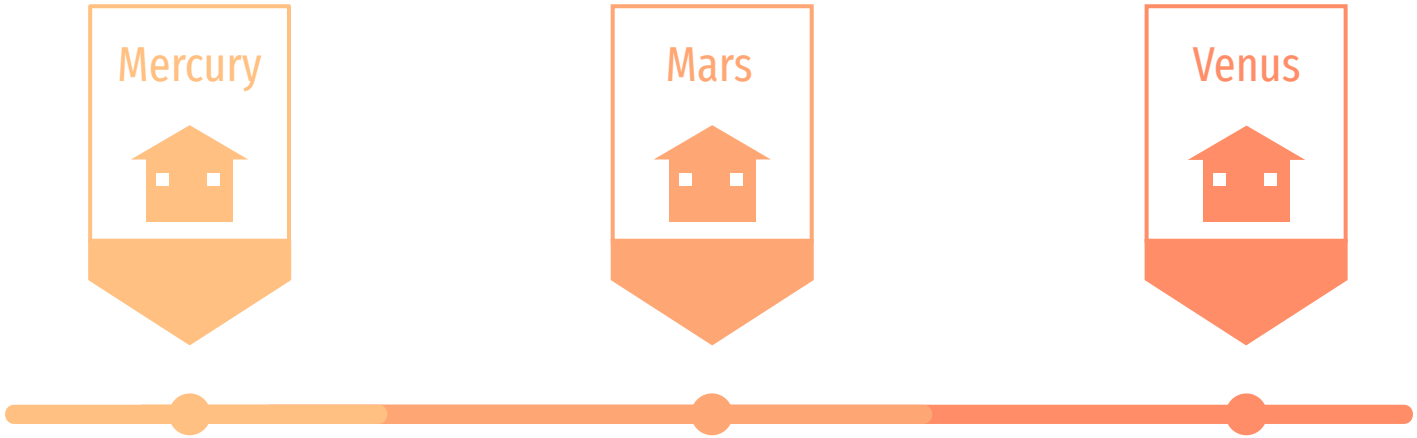
Venus

Venus has a pretty name, but it’s hot

Neptune

Neptune is the farthest from the Sun

Building Infographics



Building Infographics

Neptune

Free

Neptune is the farthest planet from the Sun

Mars

$9,99

Despite being red, Mars is actually a cold place

Mercury

$19,99

Mercury is the closest planet to the Sun and the smallest

Venus

$29,99

Planet Venus has a pretty name, but it’s terribly hot

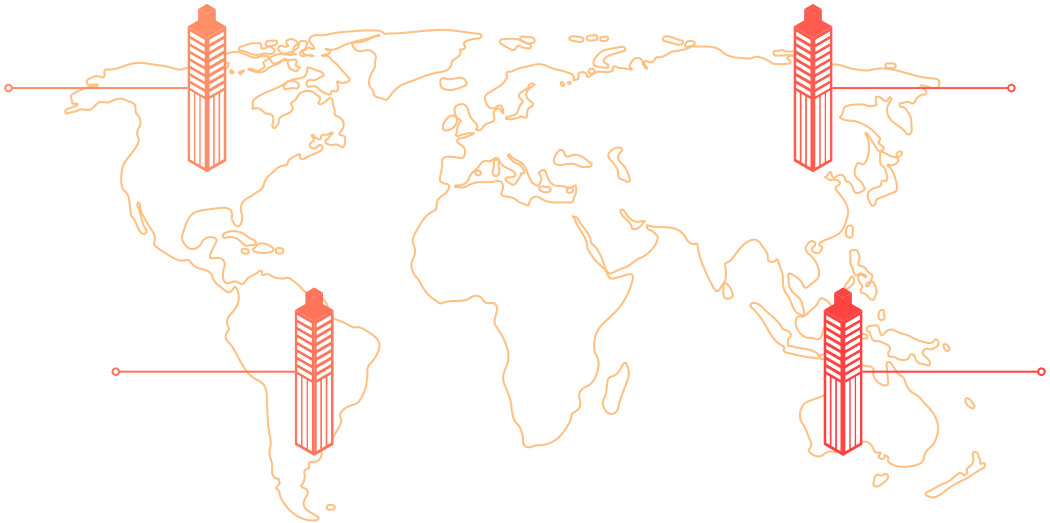
Building Infographics

Mercury

Mercury is the closest planet to the Sun and small

Mars

Despite being red, Mars is actually a cold place



Venus

Venus has a beautiful name, but it’s very hot

Neptune

Neptune is the farthest planet from the Sun

Building Infographics

Mercury

Mercury is the closest planet to the Sun and small

Mars

Despite being red, Mars is actually a cold place

Saturn

Saturn is the ringed one and a gas giant

Venus

Venus has a beautiful name, but it’s very hot

Neptune

Neptune is the farthest planet from the Sun

Jupiter

Jupiter is the biggest planet in the Solar System

Building Infographics

Mercury

Mercury is the closest planet to the Sun and small

Venus

Venus has a beautiful name, but it's very hot

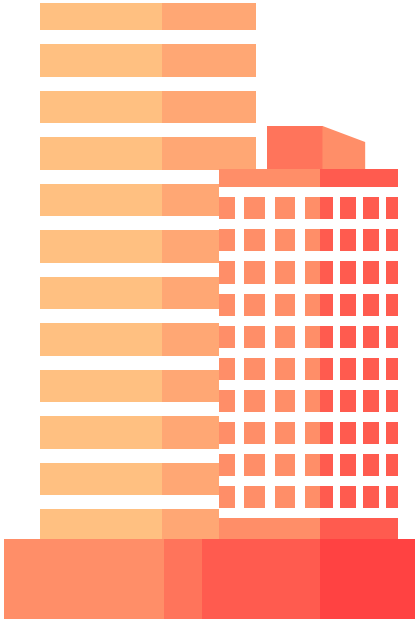
Mars

Despite being red, Mars is actually a cold place

Neptune

Neptune is the farthest planet from the Sun

Building Infographics



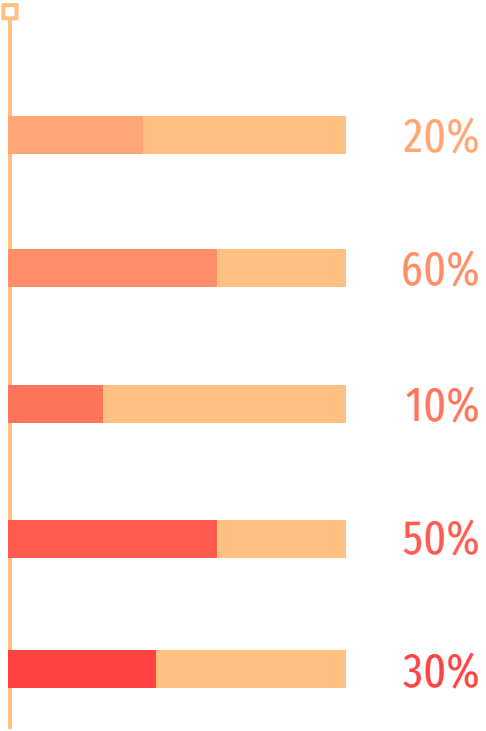
Venus has a beautiful name, but it’s very hot

Neptune is the farthest planet from the Sun

Jupiter is the biggest planet in the Solar System

Despite being red, Mars is actually a cold place

Mercury is the closest planet to the Sun



Building Infographics

01 Venus has a beautiful name, but it’s very hot

02 Neptune is the farthest planet from the Sun

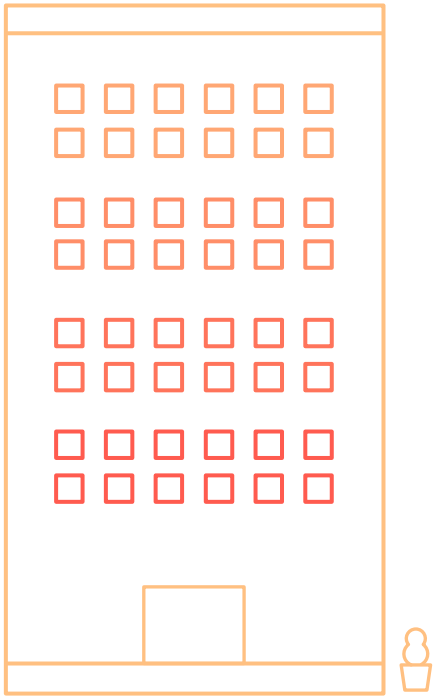
03 Jupiter is the biggest planet in the Solar System

04 Despite being red, Mars is actually a cold place

05 Mercury is the closest planet to the Sun

06 Planet Saturn is the ringed one and a gas giant

Building Infographics



Mercury

Mercury is the closest planet to the Sun and small

Mars

Despite being red, Mars is actually a cold place

Saturn

Saturn is the ringed one and a gas giant

Jupiter

Jupiter is the biggest planet in the Solar System

Building Infographics

2017

Mercury is the closest planet to the Sun and small

2018

Saturn is the ringed planet and a gas giant

2019

Despite being red, Mars is actually a cold place

Now

Jupiter is the biggest planet in the Solar System

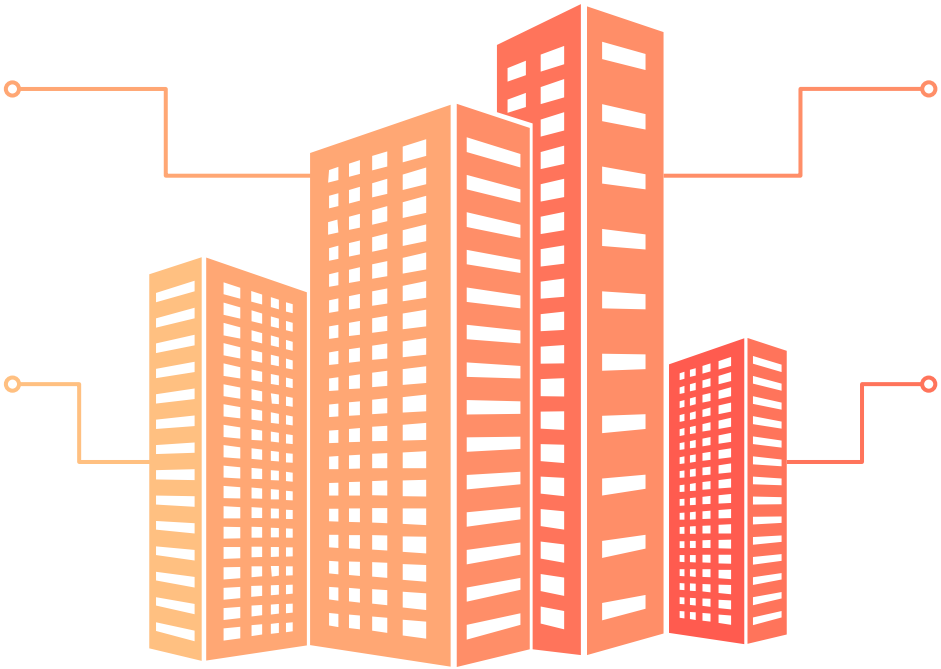
Building Infographics

Mars

Despite being red, Mars is actually a cold place

Saturn

Saturn is the ringed one and a gas giant



Venus

Venus has a beautiful name, but it's very hot

Neptune

Neptune is the farthest planet from the Sun

Building Infographics

Step 1

Mercury is the closest planet to the Sun

Step 2

Despite being red, Mars is a cold place

Step 3

Venus has a pretty name, but it's hot

Step 4

Neptune is the farthest from the Sun

Building Infographics

Venus

Venus has a beautiful name, but it’s terribly hot. It’s the second planet

Neptune

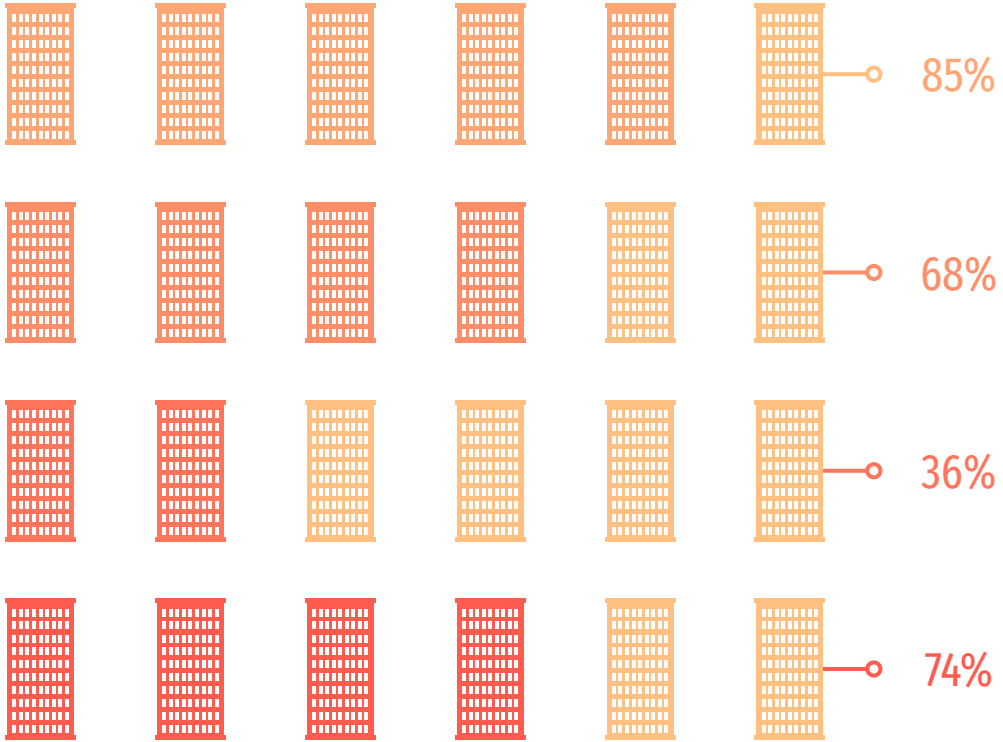
Neptune is the farthest planet from the Sun and the eighth

Jupiter

Jupiter is the biggest planet in the Solar System and a gas giant

Mars

Despite being red, Mars is a cold place. It’s full of iron oxide dust



Building Infographics

Mars

Despite being red, Mars is actually a cold place

Venus

Venus has a beautiful but it's terribly hot

Saturn

Saturn is the ringed one and a gas giant

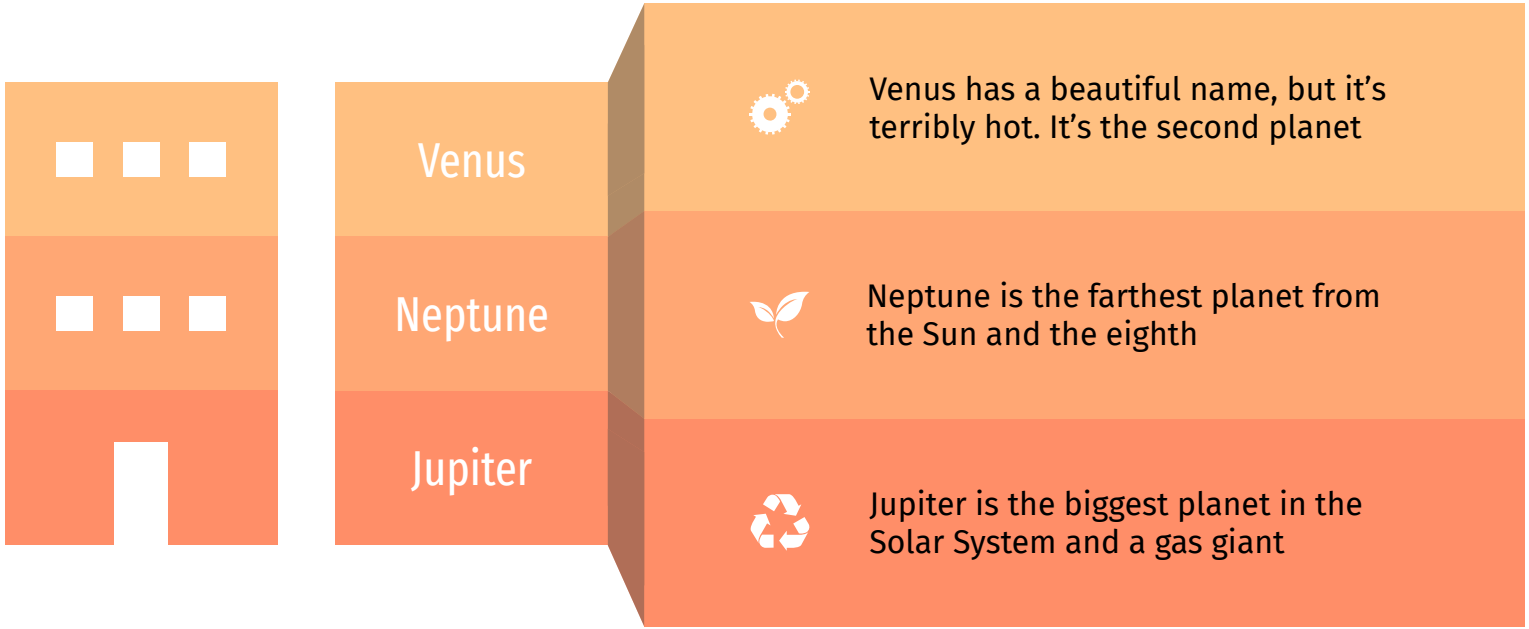
Mercury

Mercury is the closest planet to the Sun

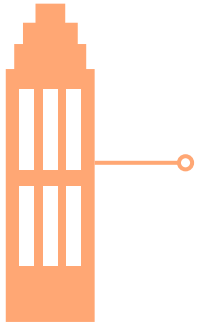
Neptune

Neptune is the farthest planet from the Sun

Building Infographics



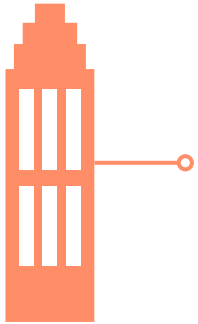
Building Infographics



Mercury

Mercury is the closest planet to the Sun and small

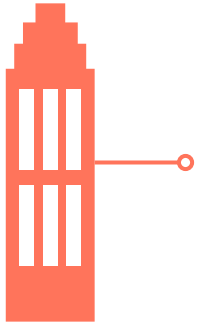
36%



Venus

Venus has a beautiful name, but it’s very hot

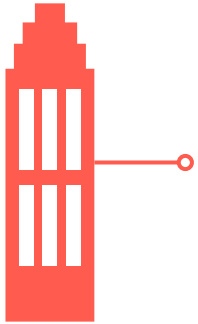
45%



Mars

Despite being red, Mars is actually a cold place

82%

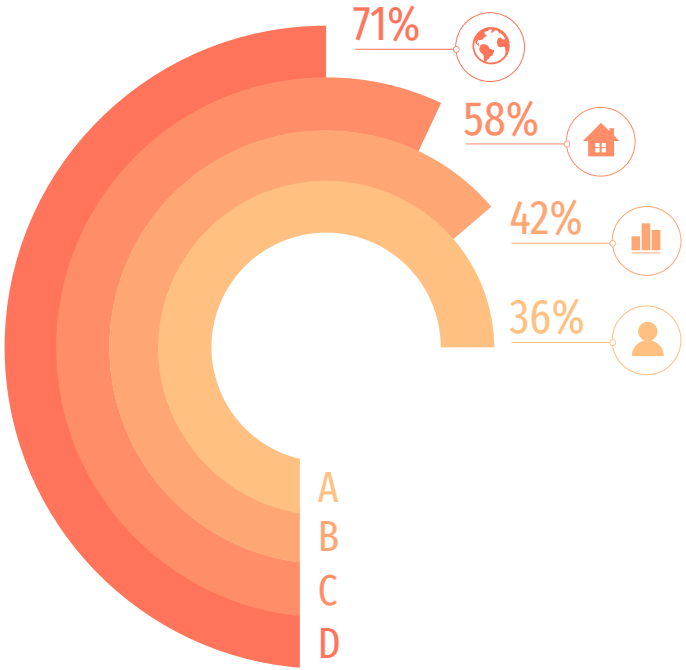


Neptune

Neptune is the farthest planet from the Sun

69%

Building Infographics

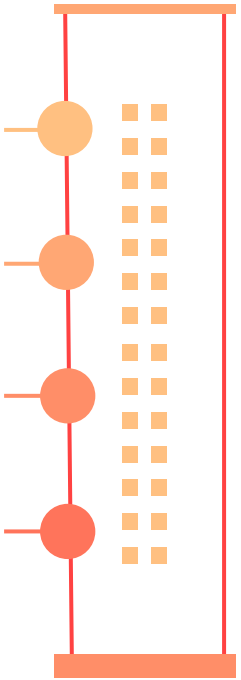


Venus has a beautiful name, but it’s very hot

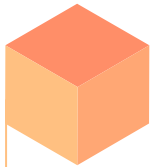
Neptune is the farthest planet from the Sun

Jupiter is the biggest planet in the Solar System

Despite being red, Mars is actually a cold place

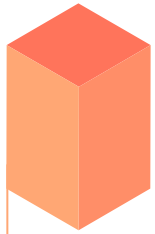


Building Infographics



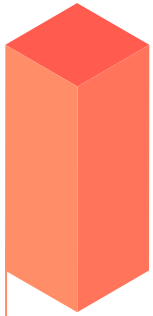
Mercury

Mercury is the closest planet to the Sun and small



Mars

Despite being red, Mars is actually a cold place



Venus

Venus has a beautiful name, but it’s very hot

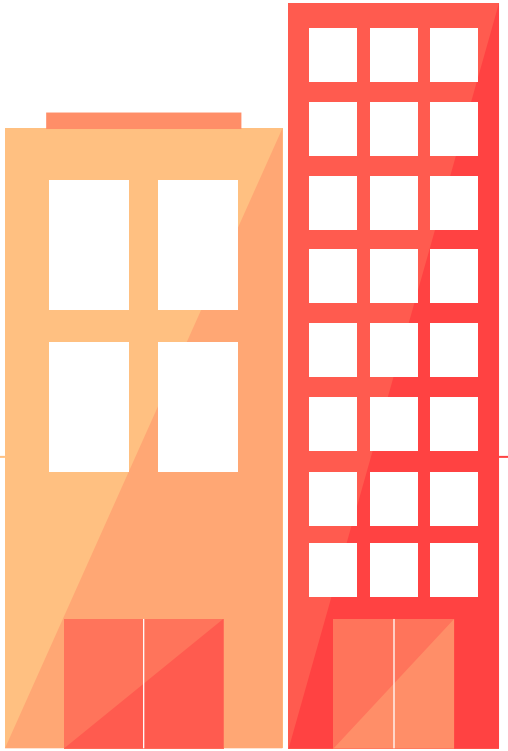
Neptune

Neptune is the farthest planet from the Sun

Building Infographics

58%

Mercury is the closest planet to the Sun and small



42%

Despite being red, Mars is actually a cold place

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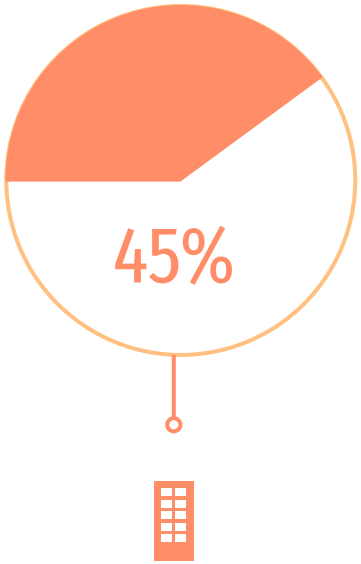
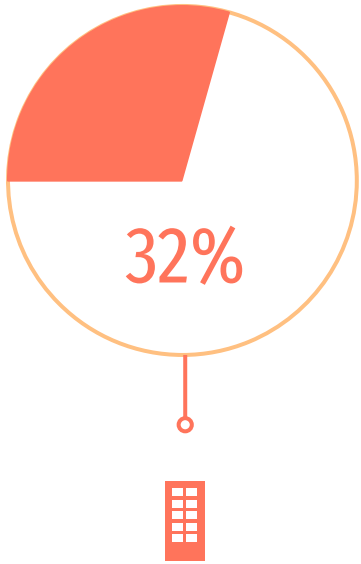


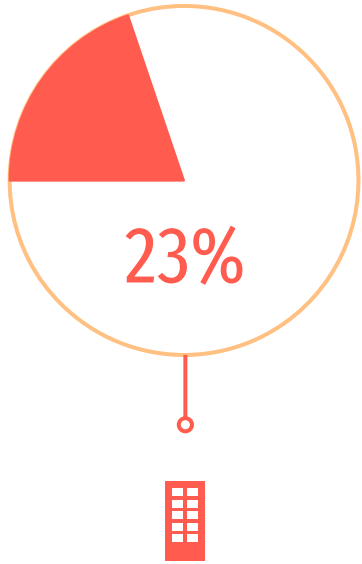
Mercury

Mercury is the closest planet to the Sun



Mars

Despite being red, Mars is a cold place



Venus

Venus has a pretty name, but it’s hot

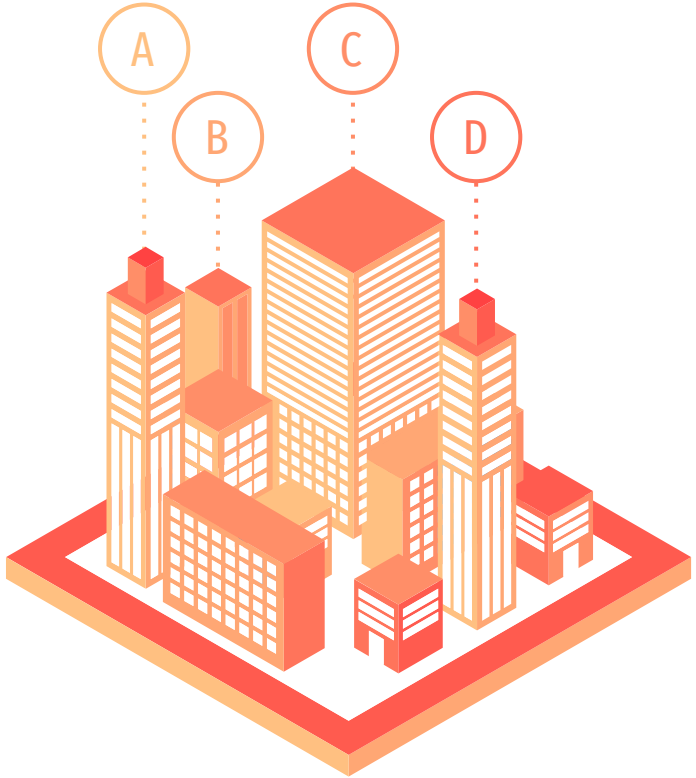
Building Infographics

Mars

Despite being red, Mars is actually a cold place

Saturn

Saturn is the ringed one and a gas giant



Venus

Venus has a beautiful name, but it’s very hot

Neptune

Neptune is the farthest planet from the Sun

Building Infographics

01

Neptune

Neptune is the farthest planet

02

Saturn

It’s the ringed one and a gas giant

03

Mars

Despite being red, Mars is a cold place

04

Mercury

Mercury is the closest planet to the Sun

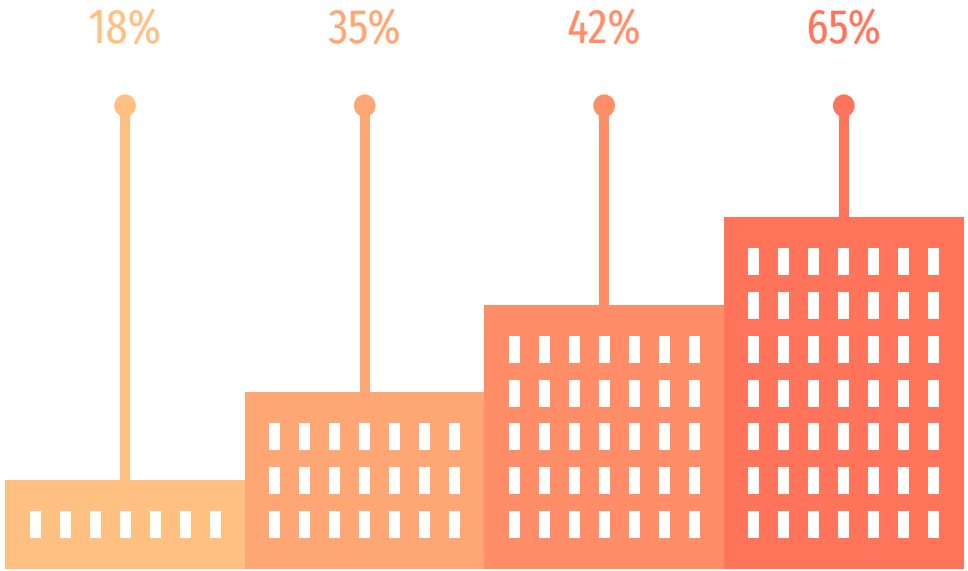
Building Infographics

Mars

Despite being red, Mars is actually a cold place

Saturn

Saturn is the ringed one and a gas giant



Venus

Venus has a beautiful name, but it’s very hot

Neptune

Neptune is the farthest planet from the Sun

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