



Data Analytics: The Future of Utility Planning

2023 ALDC Spring Meeting

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REC's Chief Strategy, Technology, and Innovation Officer

BrilliT's Executive VP and General Manager

Three areas of services offered:



Cybersecurity



Data Analytics



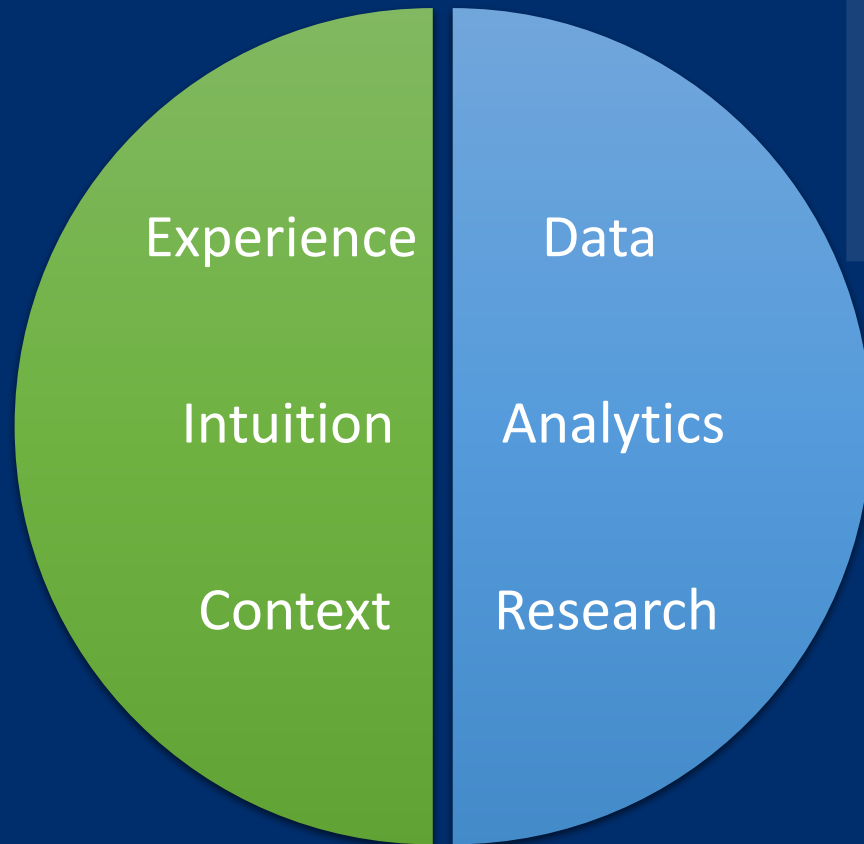
**IT Consulting and
Planning**



Data Analytics

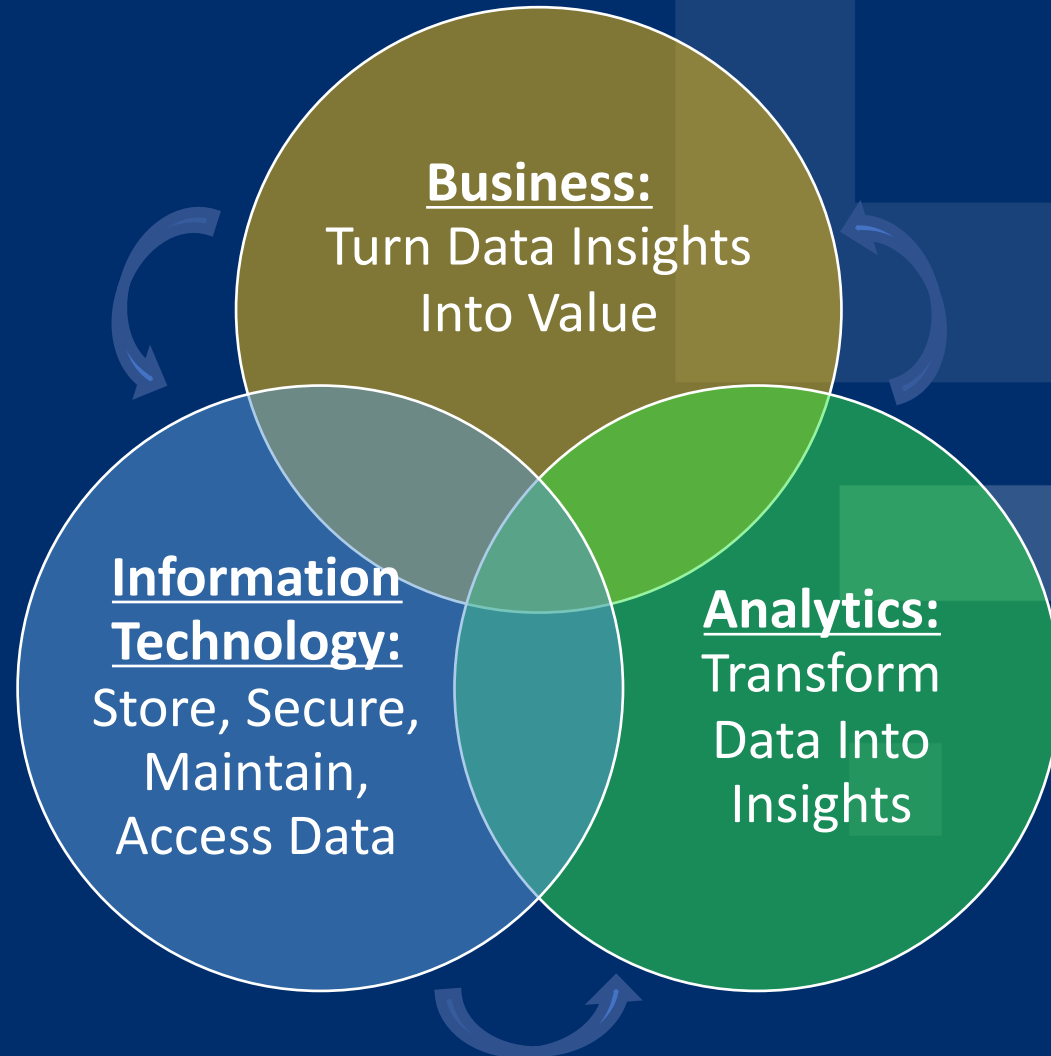


Why Analytics? Effective Decision Making



"Information is the oil of the 21st Century, and analytics is the combustion engine." – Gartner

Analytics Center of Excellence (ACE)



ACE Model Overview

Analytics Center of Excellence is an environment of experimentation, empowerment, curiosity, critical thinking, and collaboration. It is enabled by five key elements:

WHY



Vision

- Unified vision
- Shared strategy
- KPIs
- Business/ value case
- Leadership sponsorship & investment

WHAT



Analytics Architecture & Business Intelligence

(See the data)

- Architecture & infrastructure
- Delivery & consumption
- Data accessibility
- Modern tools & analytics
- Business Intelligence Use



Data Governance

Unlock the power of data

(Trust the data)

- Privacy & security
- Ethics
- Data management & interpretation
- Data quality



Data literacy

(Use the data)

- Data usage
- Communications
- Data mindset
- Data culture

HOW



Ways of working

- Operating model & organizational structure
- Talent
- Incentives & behaviors
- Data & process alignment
- Business operations

**A New Look on
Vegetation
Management
Planning**

TCO: Species/Height/Health

District

- BLUERIDGE
- BOWLING GREEN
- CULPEPER

Substation

- Select all
- A P HILL
- BARBOURSVILLE DP
- BARTONVILLE
- BRANDY
- BROKENBURG
- BRUINGTON

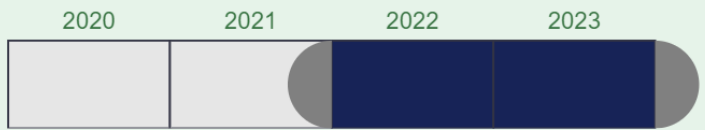
| District | Unique Number |
|---------------|---------------|
| BLUERIDGE | 187 |
| BOWLING GREEN | 163 |
| CULPEPER | 371 |
| Total | 721 |



Date & Time

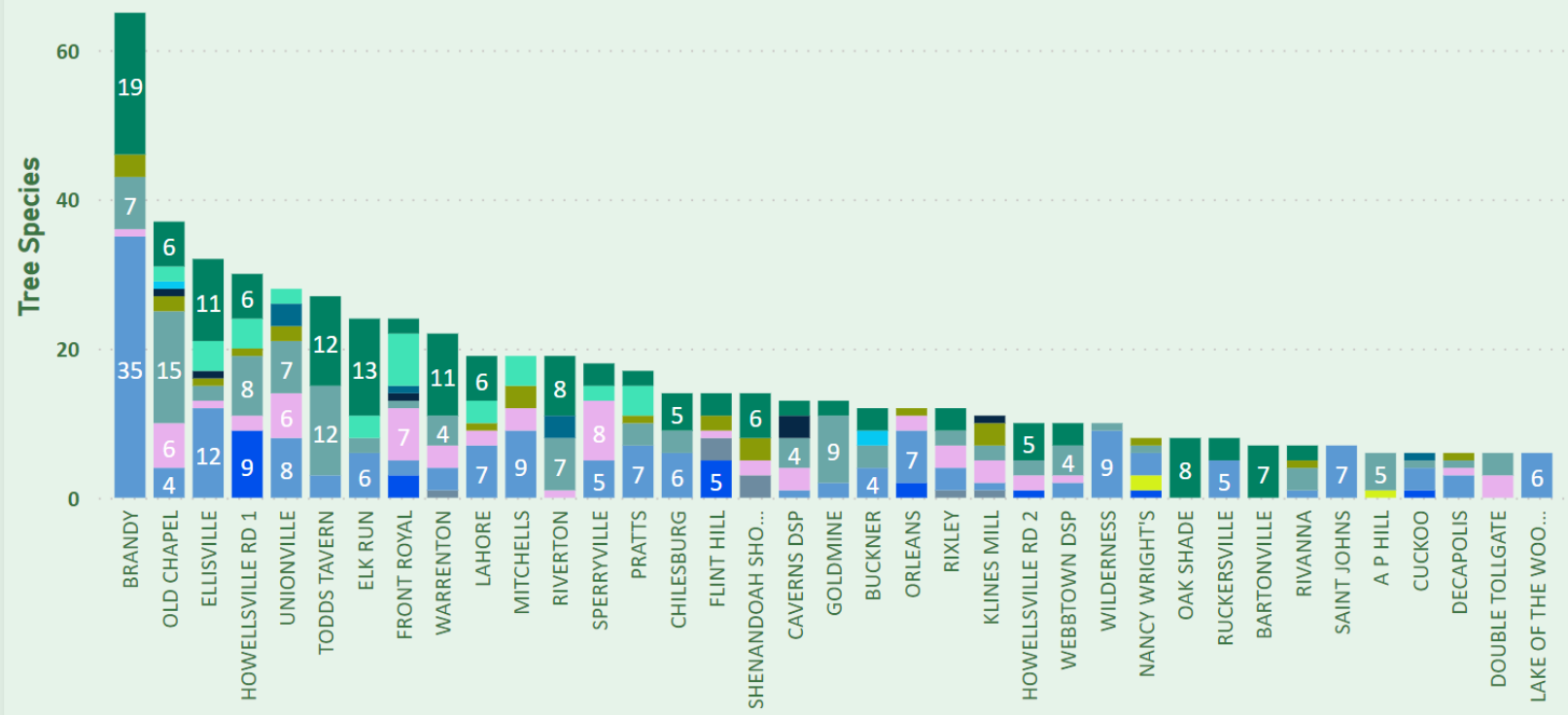


2022 - 2023

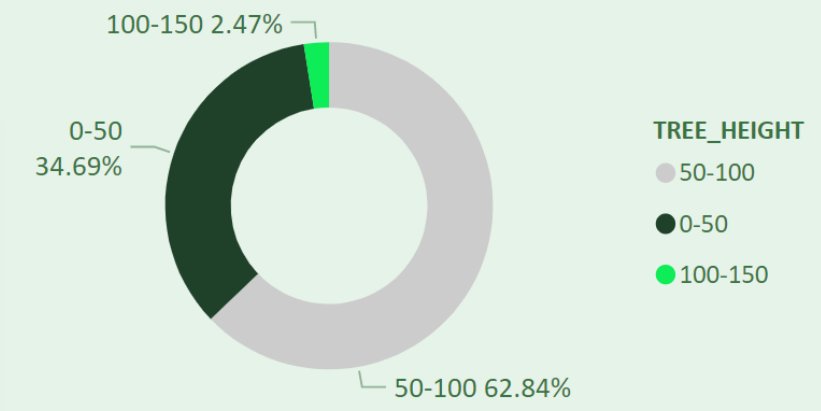


TCO by Tree Species

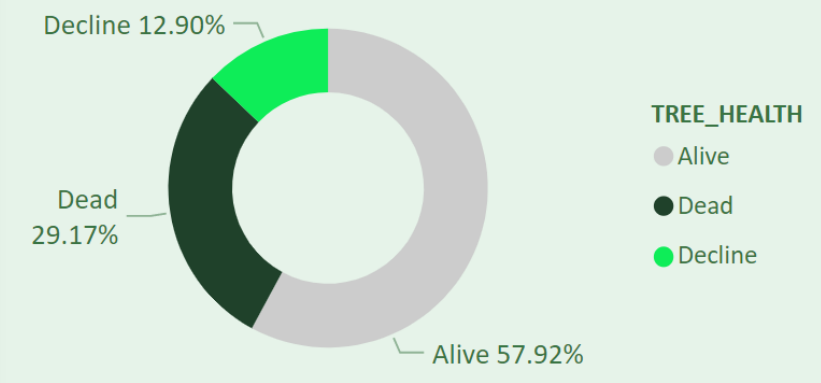
Tree Species: Ash, Beech, Hickory, Locust, Maple, Oak, Other, Pine, Sweet gum, Sycamore, Yellow-poplar



TCO by Tree Height



TCO by Tree Health



TCO: Map/Soil/Slope/Soil Moisture

Date & Time



- ### District
- BLUERIDGE
 - BOWLING GREEN
 - CULPEPER

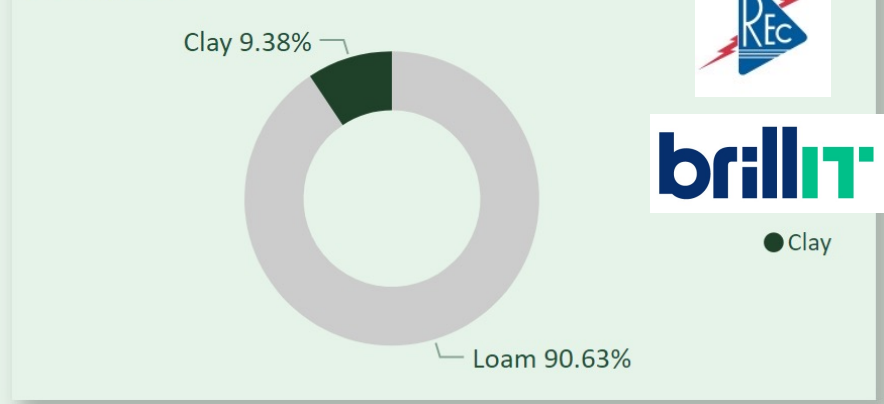
- ### Substation
- Select all
 - A P HILL
 - BROKENBURG
 - BRUINGTON
 - BUCKNER
 - CARET
 - CHILESBURG

Tree Species

All

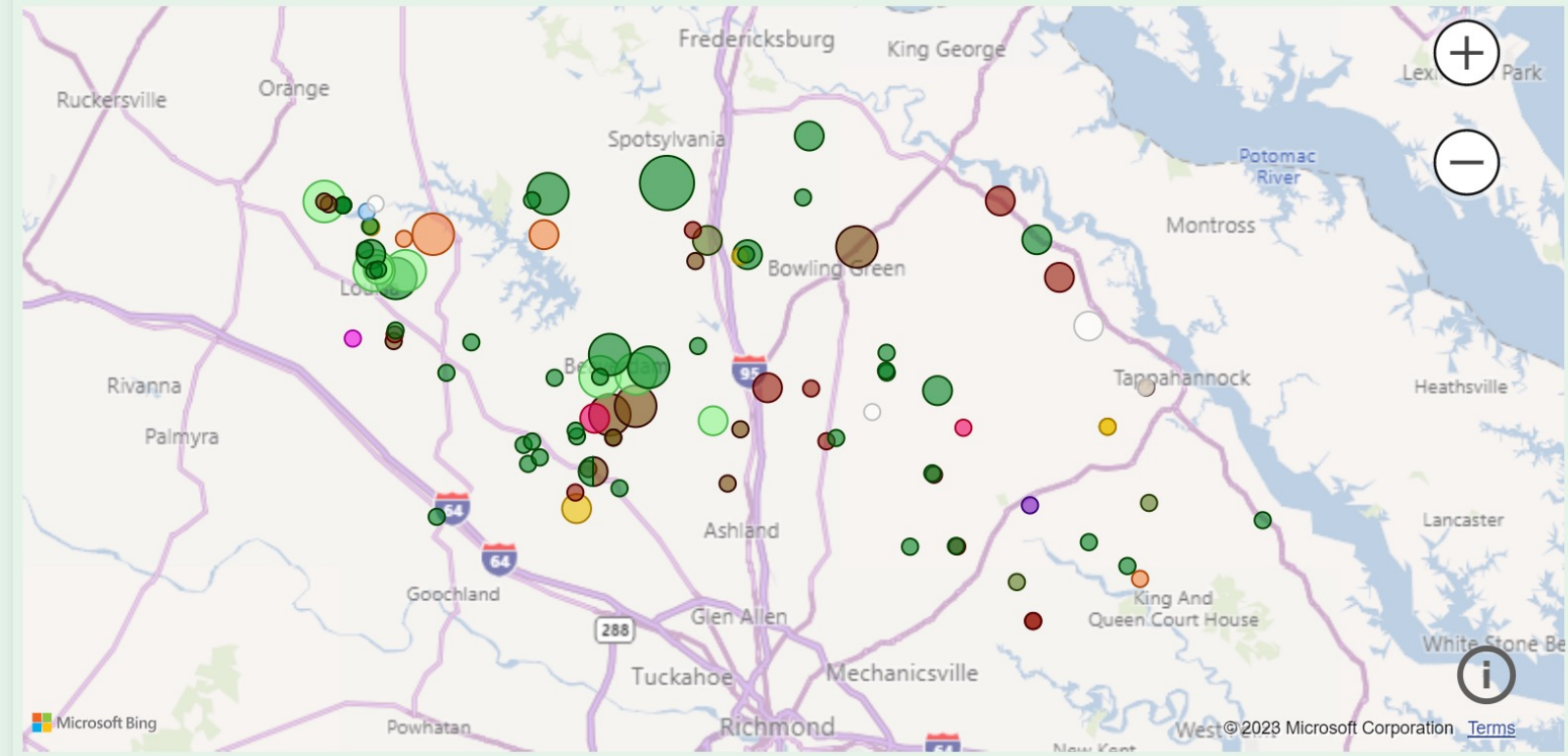


TCO by Soil

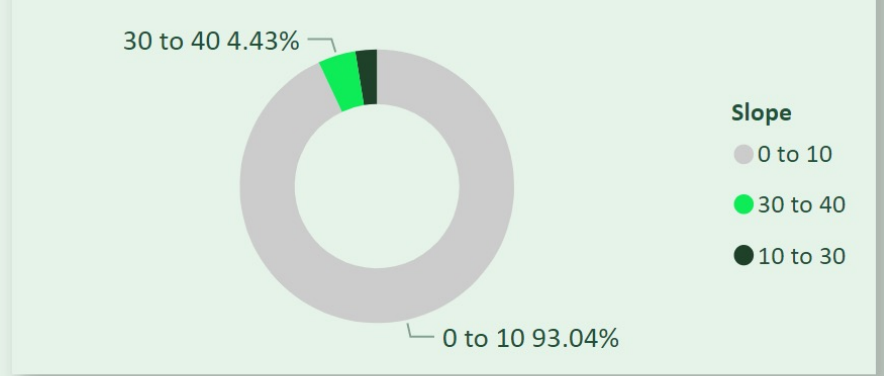


TCO by Tree Species

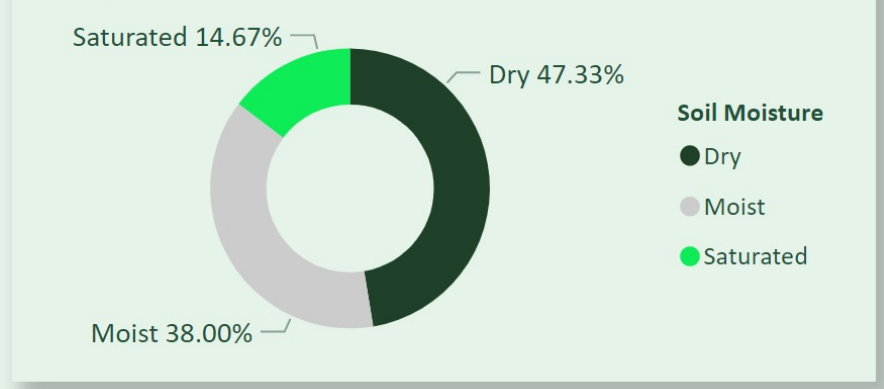
- ### Tree Species
- Ash
 - Beech
 - Hickory
 - Locust
 - Maple
 - Oak
 - Other
 - Pine
 - Sweet gum
 - Sycamore
 - Yellow-poplar



TCO by Slope



TCO by Soil Moisture



TCO: Failure Type/Event per Mile



District

BOWLING GREEN

Substation

Select all
 DUNBROOKE

Unique Number

72
 84
 90
 93
 1035
 1086
 1087
 1117

Date & time

Y Q M W D
Year

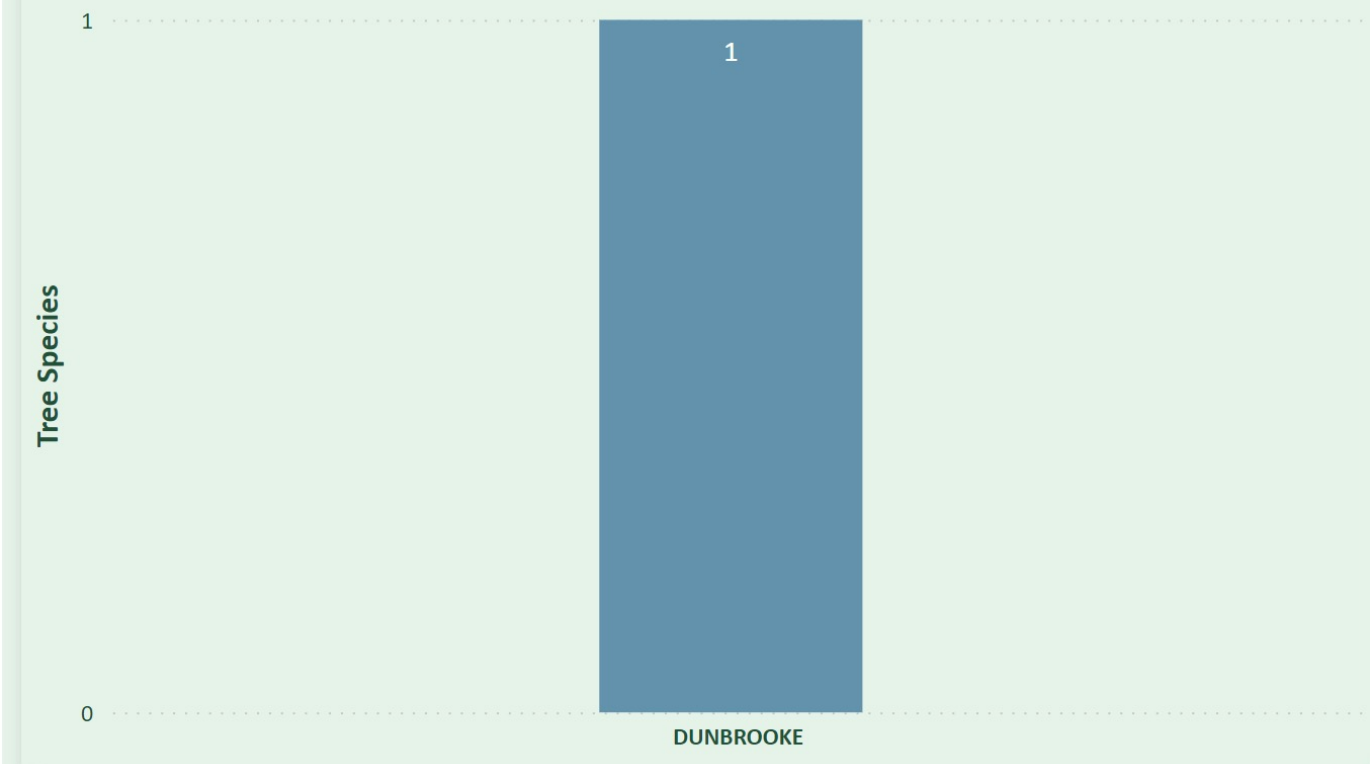
2022 - 2022

2022



TCO by Failure Type

Failure type ● Branch-Overhang



**Assessing Aging
Infrastructure in a
New Way/
Engineering
Planning**

Age

55

99

COUNTY

Multiple selections

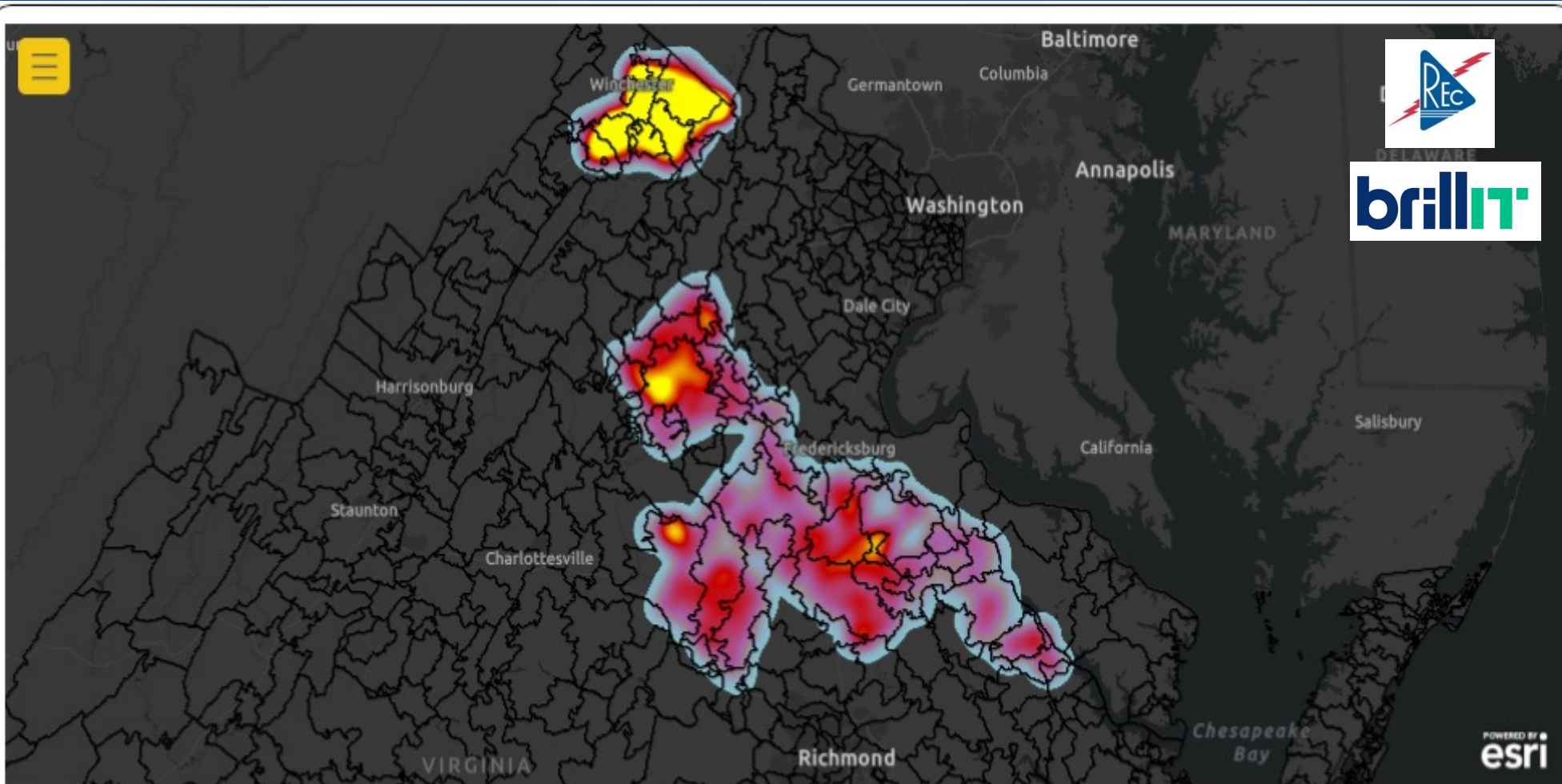
Zip Code

All

Total Poles*

19K

*For map to render correctly total poles cannot exceed 30k

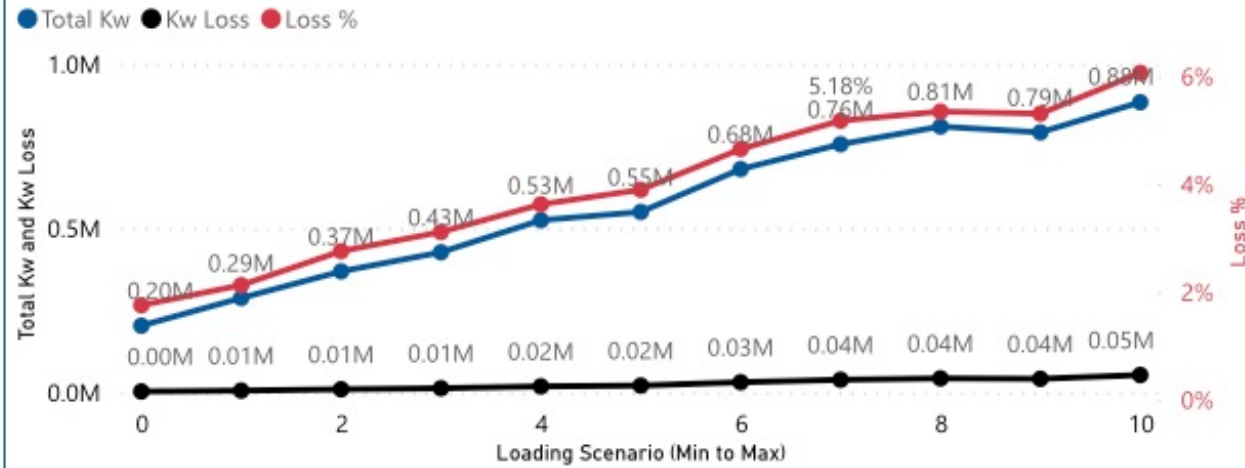


| COUNTY | POSTCODE | Total |
|--------------|----------|--------------|
| CAROLINE | 22408 | 55 |
| CAROLINE | 22427 | 575 |
| CAROLINE | 22476 | 6 |
| CAROLINE | 22514 | 496 |
| CAROLINE | 22535 | 79 |
| CAROLINE | 22538 | 42 |
| Total | | 18906 |

| COUNTY | Total |
|--------------|--------------|
| CAROLINE | 3199 |
| CLARKE | 4093 |
| CULPEPER | 3401 |
| ESSEX | 1163 |
| FREDERICK | 3070 |
| LOUISA | 2319 |
| Total | 18906 |

| BIRTHYEAR | HEIGHT | CLASS | COUNTY | POSTCODE | Total |
|--------------|--------|-------|--------------|----------|--------------|
| 1930 | 30 | 6 | CAROLINE | 22427 | 1 |
| 1930 | 30 | 7 | SPOTSYLVANIA | 22553 | 1 |
| 1930 | 35 | 7 | CAROLINE | 22546 | 1 |
| 1931 | 25 | 7 | CLARKE | 22611 | 1 |
| 1931 | 30 | 4 | CLARKE | 22611 | 1 |
| 1931 | 35 | 1 | CLARKE | 22620 | 1 |
| Total | | | | | 18906 |

System-Wide Kw by Scenario



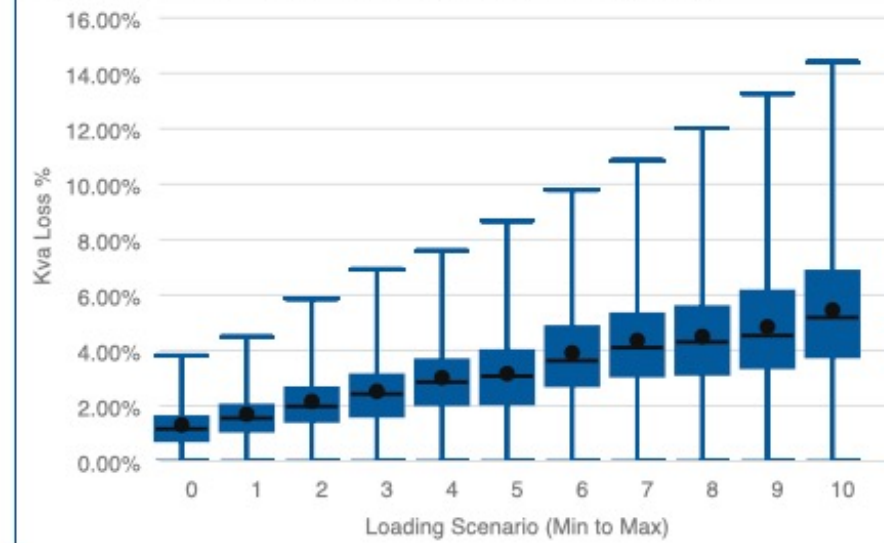
Total Phase Losses (Kw) by Scenario

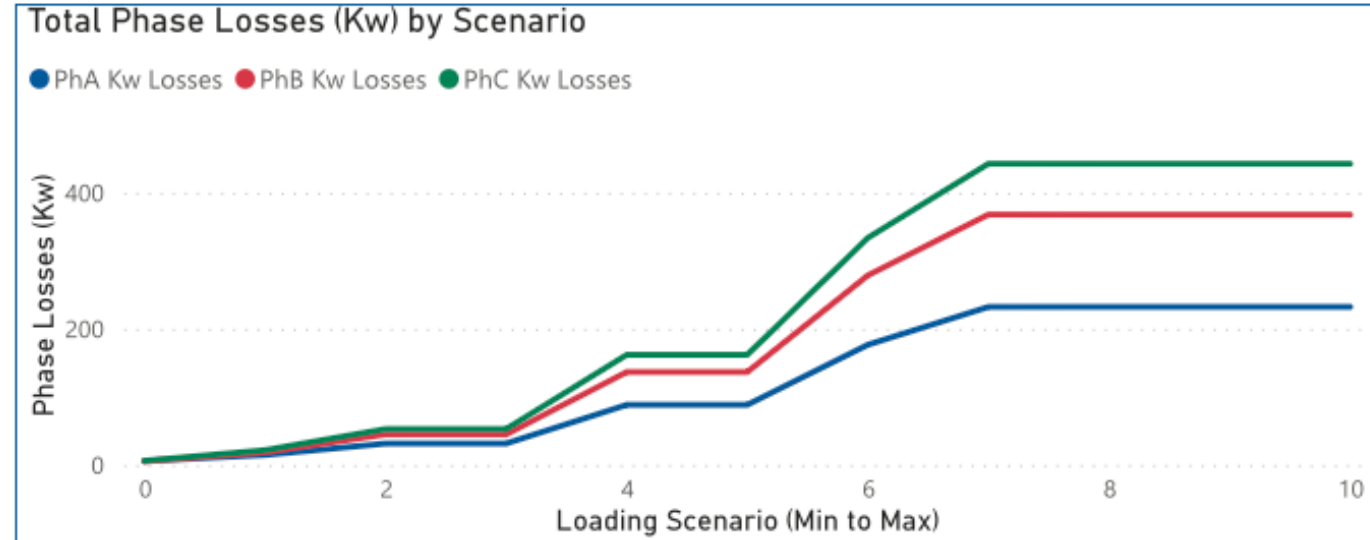
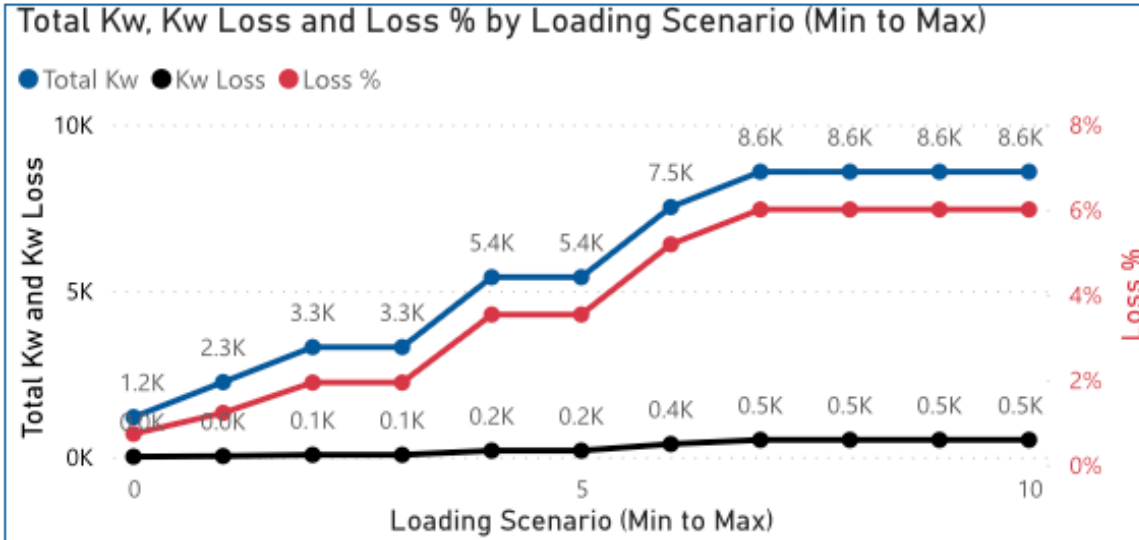


Substation Kw Losses by Scenario

| Substation | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| A P HILL | 0.53% | 0.60% | 0.69% | 0.77% | 0.86% | 0.86% | 1.05% | 1.14% | 1.23% | 1.32% | 1.42% |
| BARTONVILLE | 3.18% | 3.82% | 4.51% | 5.23% | 5.97% | 5.97% | 7.46% | 8.21% | 8.21% | 8.21% | 10.47% |
| BELLS CROSSROADS | 0.42% | 0.67% | 0.92% | 1.17% | 1.42% | 1.42% | 1.93% | 2.19% | 2.19% | 2.19% | 2.96% |
| BERRYVILLE | 0.75% | 1.12% | 1.48% | 1.84% | 2.21% | 2.21% | 2.94% | 3.29% | 3.28% | 3.28% | 4.37% |
| BRANDY | 1.28% | 1.42% | 1.54% | 1.67% | 1.78% | 1.78% | 2.03% | 2.13% | 2.28% | 2.40% | 2.51% |
| BROKENBURG | 0.74% | 1.23% | 1.94% | 1.94% | 3.54% | 3.54% | 5.19% | 6.01% | 6.01% | 6.01% | 6.01% |
| BRUINGTON_DSP | 1.53% | 1.58% | 1.72% | 1.88% | 2.07% | 2.07% | 2.48% | 2.71% | 2.94% | 3.18% | 3.41% |
| BUCKNER | 2.64% | 3.13% | 3.61% | 4.09% | 4.64% | 4.64% | 5.69% | 6.25% | 6.78% | 7.29% | 7.81% |
| CARET | 1.23% | 1.59% | 1.97% | 2.35% | 2.73% | 2.73% | 3.54% | 3.95% | 3.93% | 3.93% | 5.09% |
| CATALPA_DSP | 0.56% | 0.87% | 1.19% | 1.19% | 1.83% | 1.83% | 2.47% | 2.80% | 2.80% | 2.80% | 2.80% |
| CAVERNS_DSP | 2.97% | 3.67% | 4.39% | 4.39% | 5.86% | 5.86% | 7.36% | 8.19% | 8.11% | 8.11% | 8.11% |
| CHILESBURG | 1.56% | 2.16% | 2.80% | 3.47% | 4.15% | 4.15% | 5.51% | 6.17% | 6.17% | 6.17% | 8.17% |
| CLANCY | 1.00% | 1.50% | 1.97% | 2.44% | 2.91% | 2.91% | 3.77% | 4.45% | 4.45% | 4.45% | 5.40% |

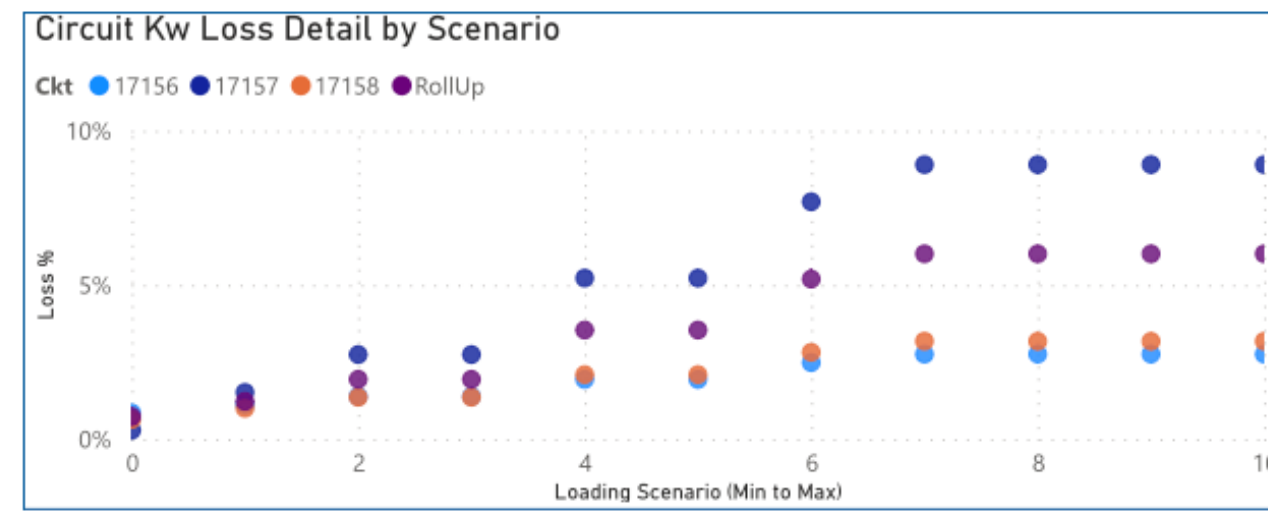
Substation Kw Loss Distribution by Scenario





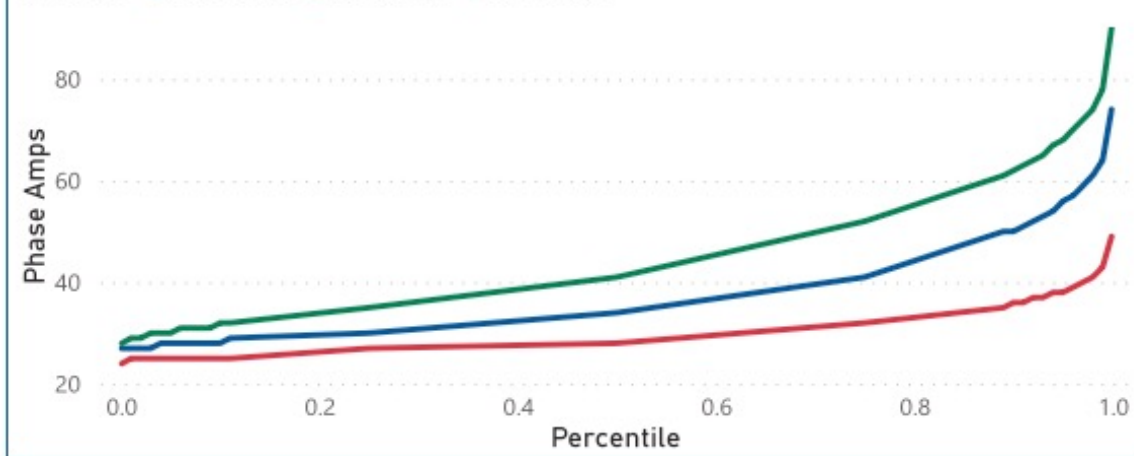
Circuit Kw Losses by Scenario

| Ckt | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 17156 | 0.85% | 1.12% | 1.39% | 1.39% | 1.94% | 1.94% | 2.48% | 2.76% | 2.76% | 2.76% | 2.76% |
| 17157 | 0.29% | 1.52% | 2.74% | 2.74% | 5.22% | 5.22% | 7.70% | 8.90% | 8.90% | 8.90% | 8.90% |
| 17158 | 0.64% | 1.00% | 1.36% | 1.36% | 2.09% | 2.09% | 2.81% | 3.18% | 3.17% | 3.17% | 3.17% |
| RollUp | 0.74% | 1.23% | 1.94% | 1.94% | 3.54% | 3.54% | 5.19% | 6.01% | 6.01% | 6.01% | 6.01% |



Phase Amp Percentile Values

Attribute ● PhA_Amps ● PhB_Amps ● PhC_Amps



Phase Amp Percentile Values

Percentile PhA_Amps PhB_Amps PhC_Amps

| Percentile | PhA_Amps | PhB_Amps | PhC_Amps |
|------------|----------|----------|----------|
| 1.00 | 74 | 49 | 90 |
| 0.99 | 64 | 43 | 78 |
| 0.98 | 61 | 41 | 74 |
| 0.97 | 59 | 40 | 72 |
| 0.96 | 57 | 39 | 70 |
| 0.95 | 56 | 38 | 68 |
| 0.94 | 54 | 38 | 67 |
| 0.93 | 53 | 37 | 65 |
| 0.92 | 52 | 37 | 64 |
| 0.91 | 51 | 36 | 63 |
| 0.90 | 50 | 36 | 62 |
| 0.89 | 50 | 35 | 61 |
| 0.75 | 41 | 32 | 52 |
| 0.50 | 34 | 28 | 41 |
| 0.25 | 30 | 27 | 35 |
| 0.11 | 29 | 25 | 32 |
| 0.10 | 28 | 25 | 32 |
| 0.09 | 28 | 25 | 31 |
| 0.08 | 28 | 25 | 31 |
| 0.07 | 28 | 25 | 31 |
| 0.06 | 28 | 25 | 31 |
| 0.05 | 28 | 25 | 30 |
| 0.04 | 28 | 25 | 30 |
| 0.03 | 27 | 25 | 30 |
| 0.02 | 27 | 25 | 29 |
| 0.01 | 27 | 25 | 29 |
| 0.00 | 27 | 24 | 28 |

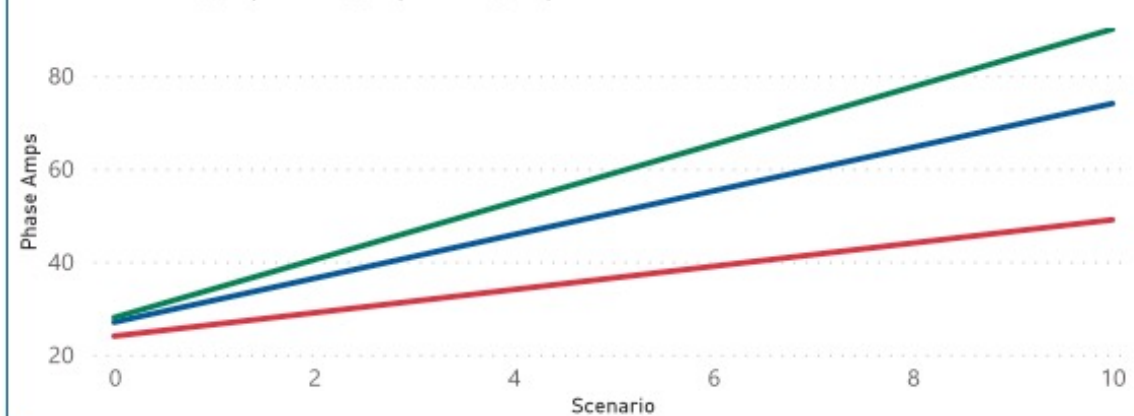
Phase Amp Scenario Values

Scenario PhA_Amps PhB_Amps PhC_Amps

| Scenario | PhA_Amps | PhB_Amps | PhC_Amps |
|----------|----------|----------|----------|
| 10 | 74.00 | 49.00 | 90.00 |
| 9 | 69.30 | 46.50 | 83.80 |
| 8 | 64.60 | 44.00 | 77.60 |
| 7 | 59.90 | 41.50 | 71.40 |
| 6 | 55.20 | 39.00 | 65.20 |
| 5 | 50.50 | 36.50 | 59.00 |
| 4 | 45.80 | 34.00 | 52.80 |
| 3 | 41.10 | 31.50 | 46.60 |
| 2 | 36.40 | 29.00 | 40.40 |
| 1 | 31.70 | 26.50 | 34.20 |
| 0 | 27.00 | 24.00 | 28.00 |

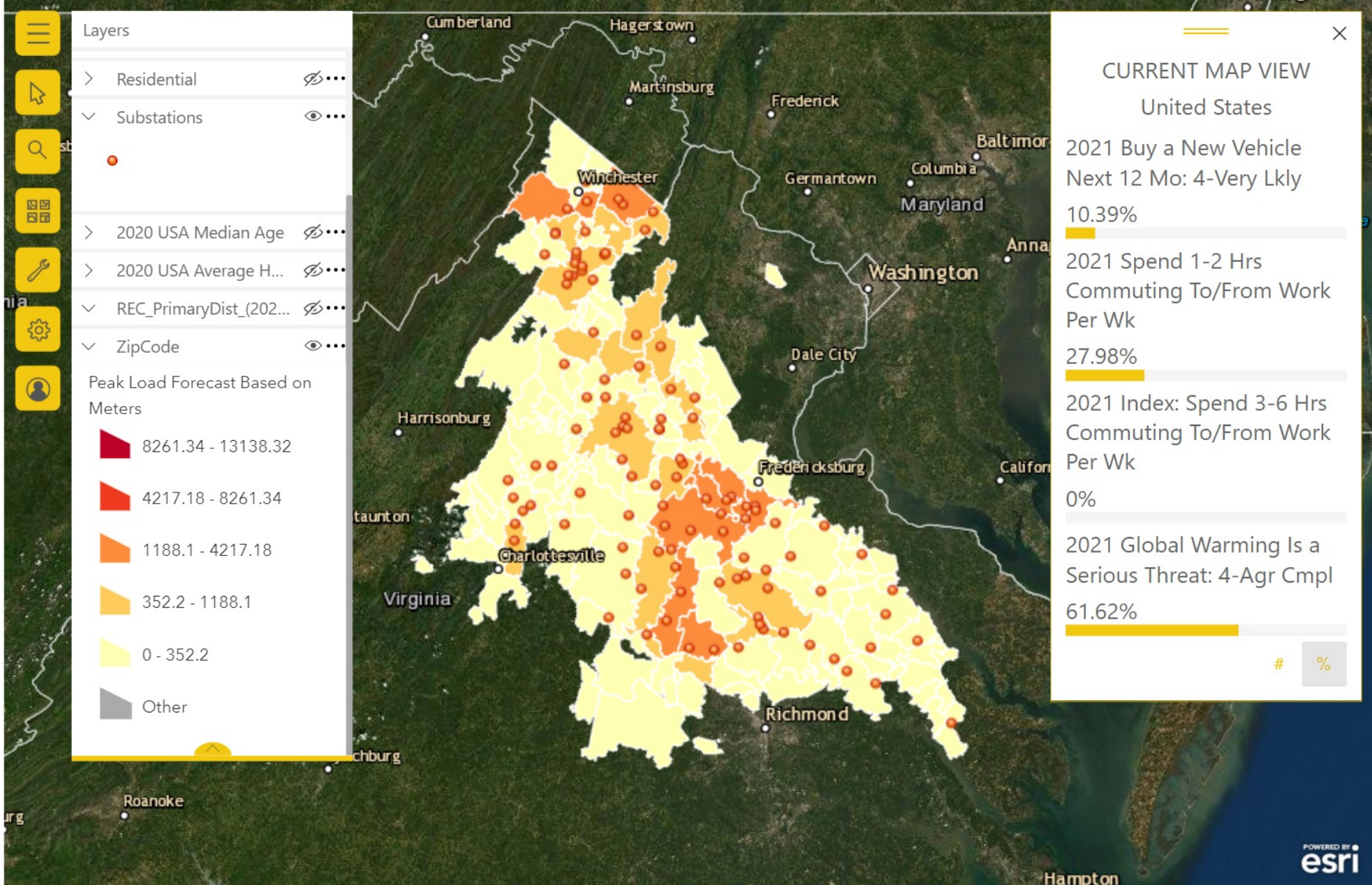
Phase Amp Scenario Values

Attribute ● PhA_Amps ● PhB_Amps ● PhC_Amps



**The Electric
Vehicle Wave –
Planning for the
Future**

Peak Load Forecast Based on Meters and Vehicle Count by ZipCode



CURRENT MAP VIEW
United States

2021 Buy a New Vehicle
Next 12 Mo: 4-Very Lkly
10.39%

2021 Spend 1-2 Hrs
Commuting To/From Work
Per Wk
27.98%

2021 Index: Spend 3-6 Hrs
Commuting To/From Work
Per Wk
0%

2021 Global Warming Is a
Serious Threat: 4-Agr Cmpl
61.62%

%

34.64K
Potential Peak kW

16K
EV Forecast Based on Meters

315K
Vehicle Count Based on Meters

| Year | Forecast | Average of %Forecast |
|--------------|----------|----------------------|
| 2030 | Low | 4.87% |
| Total | | 4.87% |

Forecast

High

Low

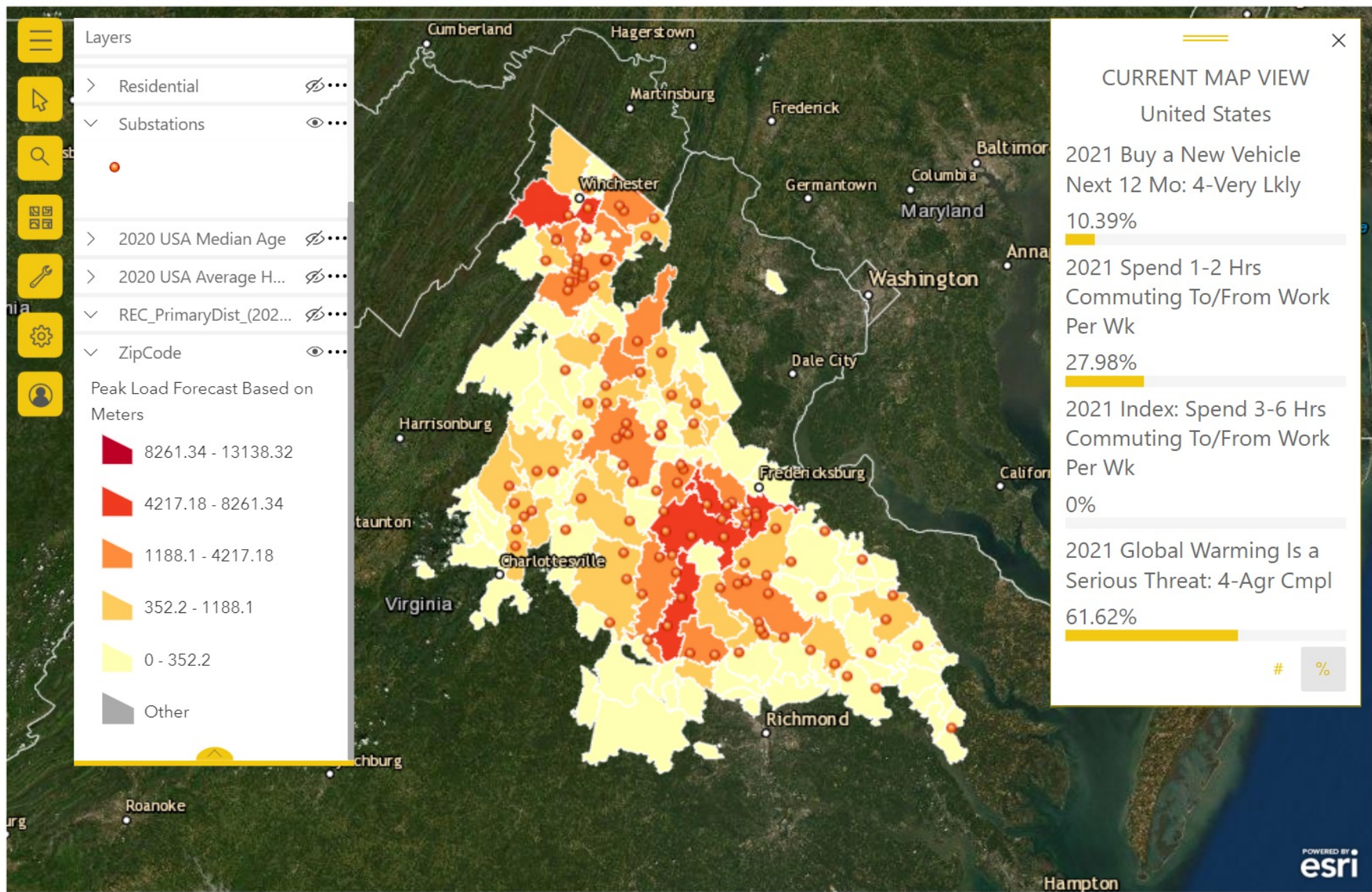
Medium

Year

2030

2030

Peak Load Forecast Based on Meters and Vehicle Count by ZipCode



80.45K

Potential Peak kW

37K

EV Forecast Based on Meters

315K

Vehicle Count Based on Meters

| Year | Forecast | Average of %Forecast |
|--------------|----------|----------------------|
| 2030 | Medium | 11.28% |
| Total | | 11.28% |

Forecast

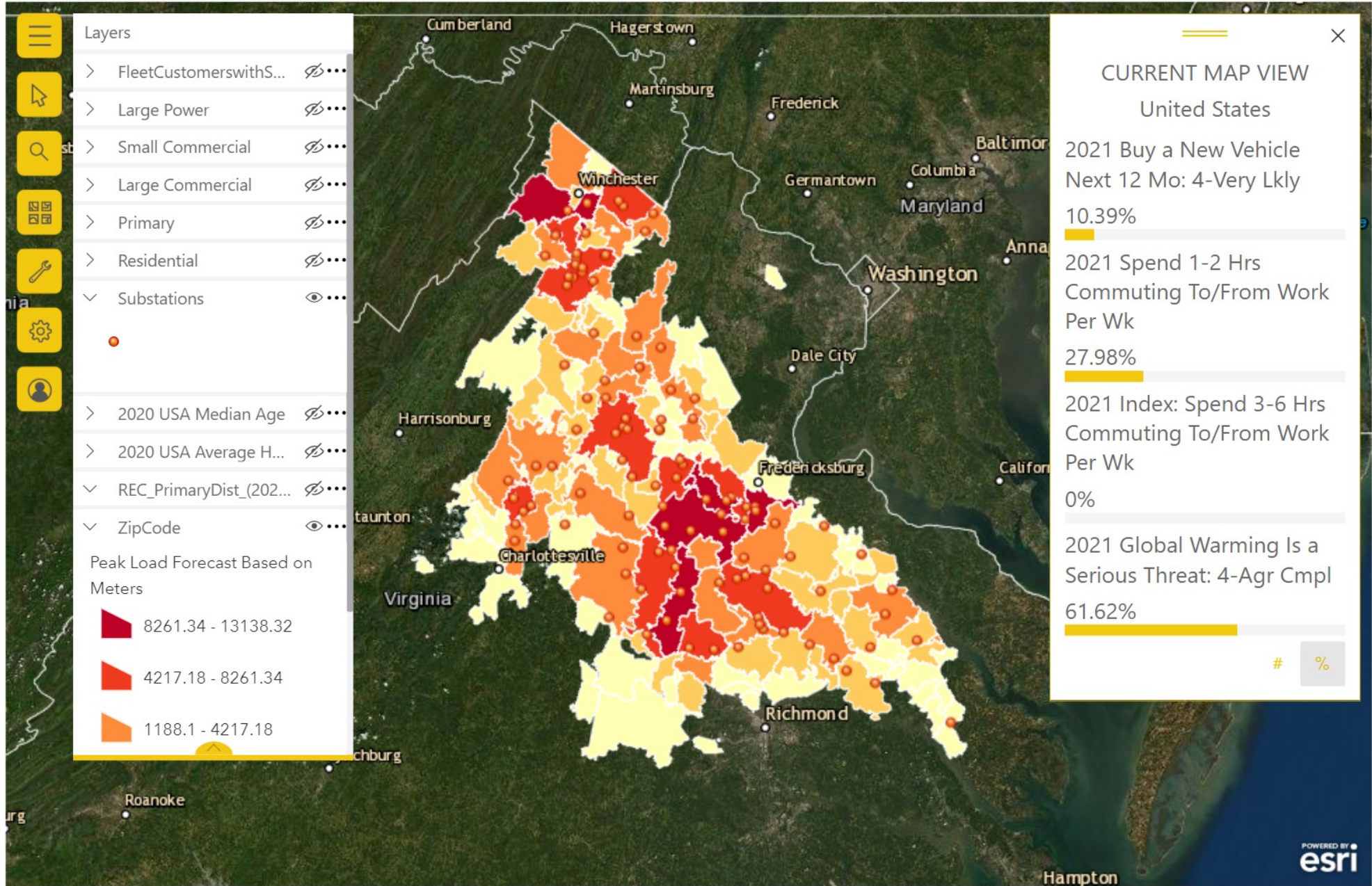
- High
- Low
- Medium

Year

2030

2030

Peak Load Forecast Based on Meters and Vehicle Count by ZipCode



Layers

- > FleetCustomerswithS...
- > Large Power
- > Small Commercial
- > Large Commercial
- > Primary
- > Residential
- ▼ Substations
- > 2020 USA Median Age
- > 2020 USA Average H...
- ▼ REC_PrimaryDist_(202...
- ▼ ZipCode

Peak Load Forecast Based on Meters

- 8261.34 - 13138.32
- 4217.18 - 8261.34
- 1188.1 - 4217.18

CURRENT MAP VIEW

United States

2021 Buy a New Vehicle Next 12 Mo: 4-Very Lkly 10.39%

2021 Spend 1-2 Hrs Commuting To/From Work Per Wk 27.98%

2021 Index: Spend 3-6 Hrs Commuting To/From Work Per Wk 0%

2021 Global Warming Is a Serious Threat: 4-Agr Cmpl 61.62%

205.49K

Potential Peak kW

93K

EV Forecast Based on Meters

315K

Vehicle Count Based on Meters

| Year | Forecast | Average of %Forecast |
|--------------|----------|----------------------|
| 2030 | High | 28.89% |
| Total | | 28.89% |

Distribution-Transformer-Location EV-Charging Potential at Seasonal Peak Loads

| | |
|------------------|-----|
| Summer Overloads | 131 |
| Winter Overloads | 723 |

Considers only distribution-transformer locations (and circuits) that have one-or-more meters with rate schedule of A1 or AO1, the two most common residential rate codes.

Rated Transformer Capacity

Temperature-Scaled Capacity

Substation, Circuit

Todd's Tavern

Tx Bank Total Rated kVA

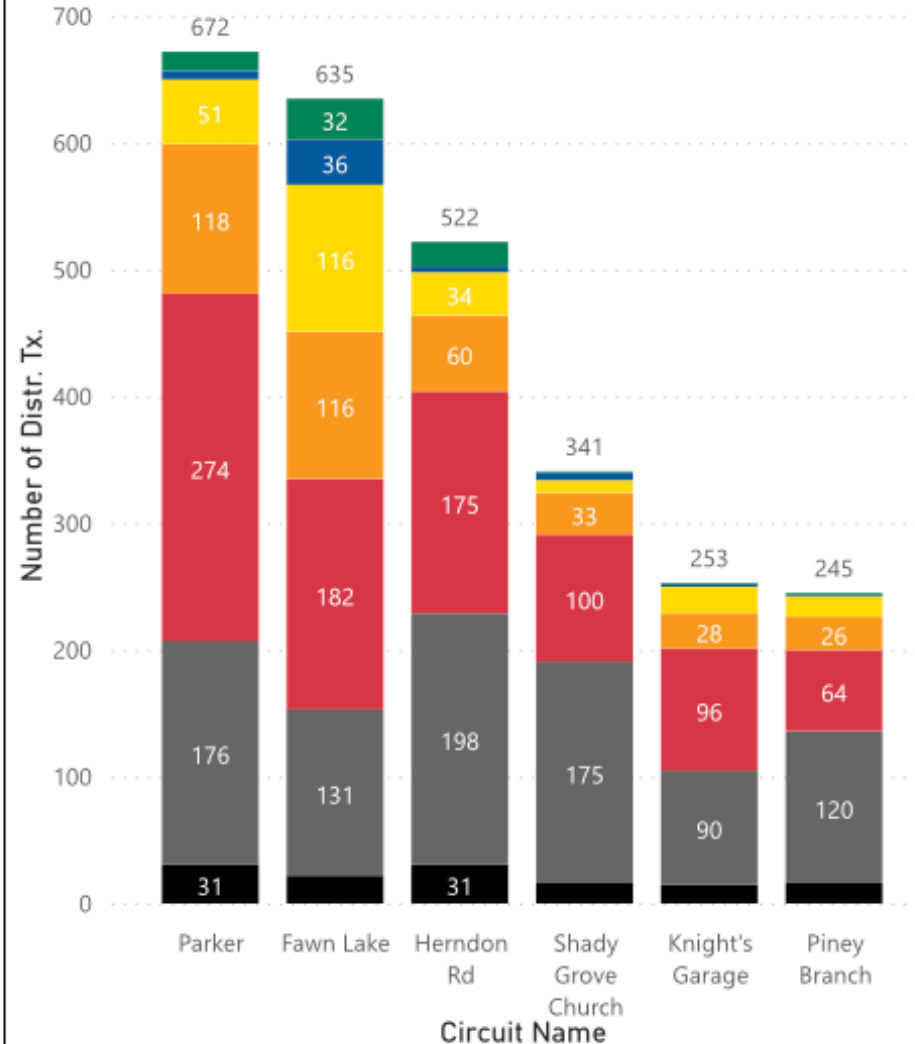
All

Legend

| Bin | Additional Tx. Capacity | Additional EV Cars (7.7 kW) | Additional EV Pickups (19.2 kW) |
|-----|-------------------------|-----------------------------|---------------------------------|
| 6 | 38.5+ kW | 5+ | 2+ |
| 5 | 30.8-38.4 kW | 4 | 1 (but 2 at 38.4) |
| 4 | 23.1-30.7 kW | 3 | 1 |
| 3 | 15.4-23.0 kW | 2 | Maybe 1 (at 19.2) |
| 2 | 7.7-15.3 kW | 1 | 0+ |
| 1 | 0-7.6 kW | 0+ | 0+ |
| 0 | < 0 kW | 0- | 0- |

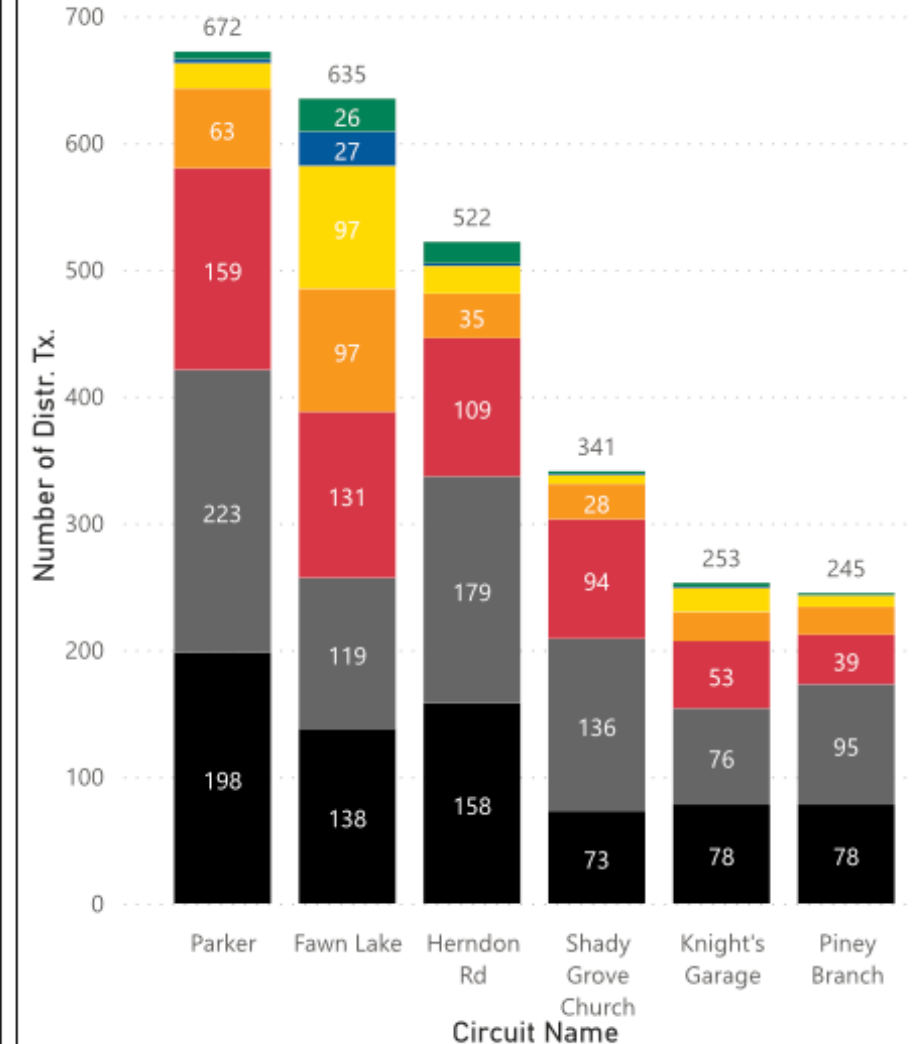
Distr. Tx by Additional EV Cars that Can Charge at Summer Peak

7.7 kW EV Cars ● 0- ● 0+ ● 1 ● 2 ● 3 ● 4 ● 5+



Distr. Tx. by Additional EV Cars That Can Charge at Winter Peak

7.7 kW EV Cars ● 0- ● 0+ ● 1 ● 2 ● 3 ● 4 ● 5+



Meter-Transformer Detail Report

Member Meter Number

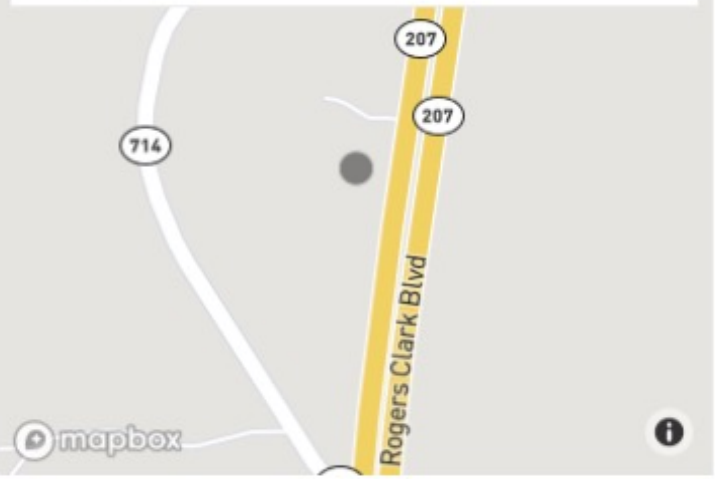
All ▼

Tx Location Number, Company Tx Number

T0000221 (Tx Location Number) + 64415 (Company ... ^

Search

- T0000195
- T0000207
- T0000221
- 64415
- T0000222
- T0000223



Meter Data

A93718911
Meter Number

54578
Location Number

1
Phase Count

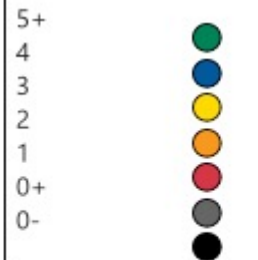
A1
Rate Schedule

[REDACTED]
Address

Ruther Glen
City

VA
state

Additional EV Cars
(7.7 kW) on Meter's
Transformer Bank



Transformer Data

64415
Company Number

1
Phase Count

A
Phasing

15.00
Rated kVA

14.25
Rated kW (95% PF)

Meters on Transformer

| Rate | Tx No. | Connected Meters |
|--------------|--------|------------------|
| A1 | 64415 | 1 |
| Total | | 1 |

Transformer Bank Data

T0000221
Location Number

Caroline HS
Circuit

St. John's
Substation

1
Transformers in Bank

15.00
Total Bank kVA

14.25
Total Bank kW (95% PF)

Meters on Transformer Bank

| Rate | Meters |
|--------------|----------|
| A1 | 1 |
| Total | 1 |

Tx Bank EV Capacity

T0000221
Location Number

Summer
Peak Season

9.54
Annual Peak Load (kW)

4.71
Capacity (kW) at Max

0
Additional 7.7 kW EV Cap.

9.54
Summer Peak Load (kW)

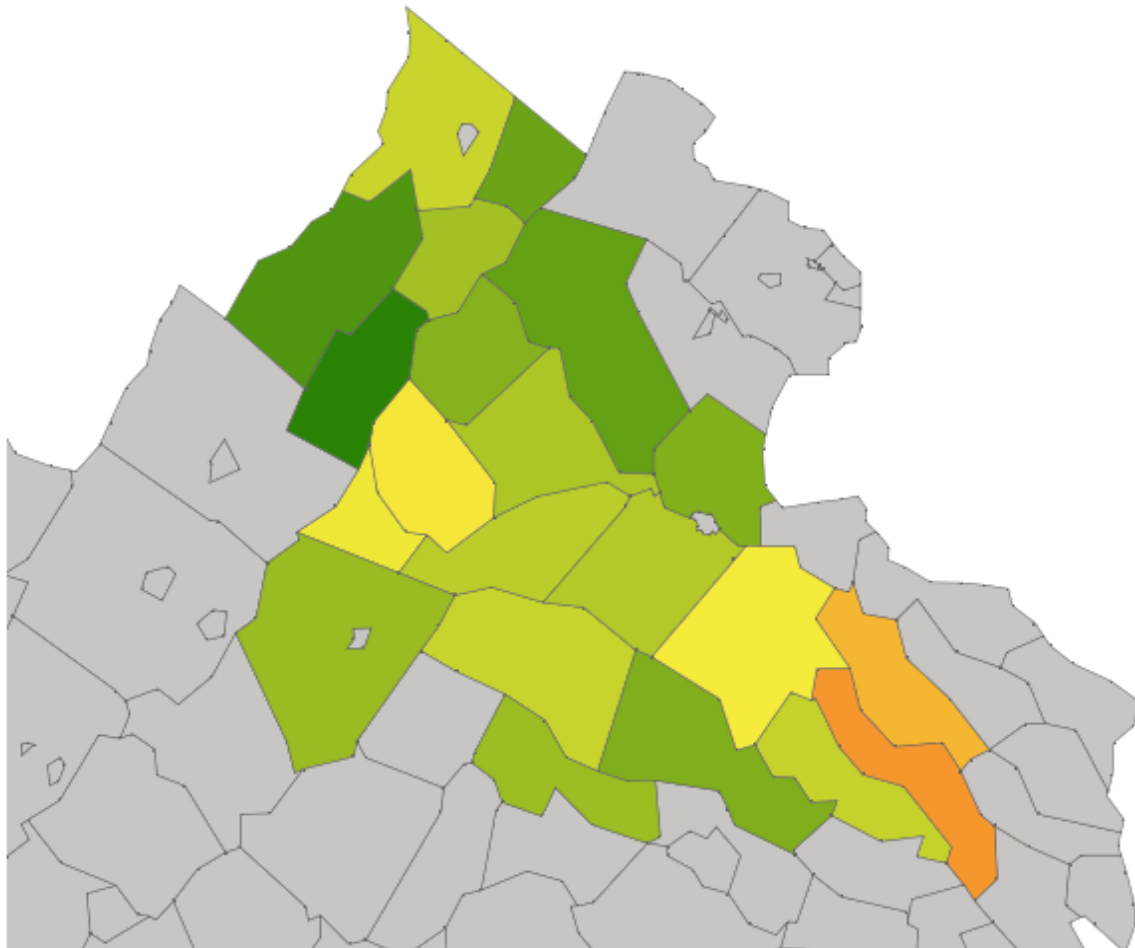
13.44
Winter Peak Load (kW)

**Member
Satisfaction –
Understanding
Your Members**

Average Income



Income Code - Estimated Household - 100% Income.USE by CNTY_DESCR



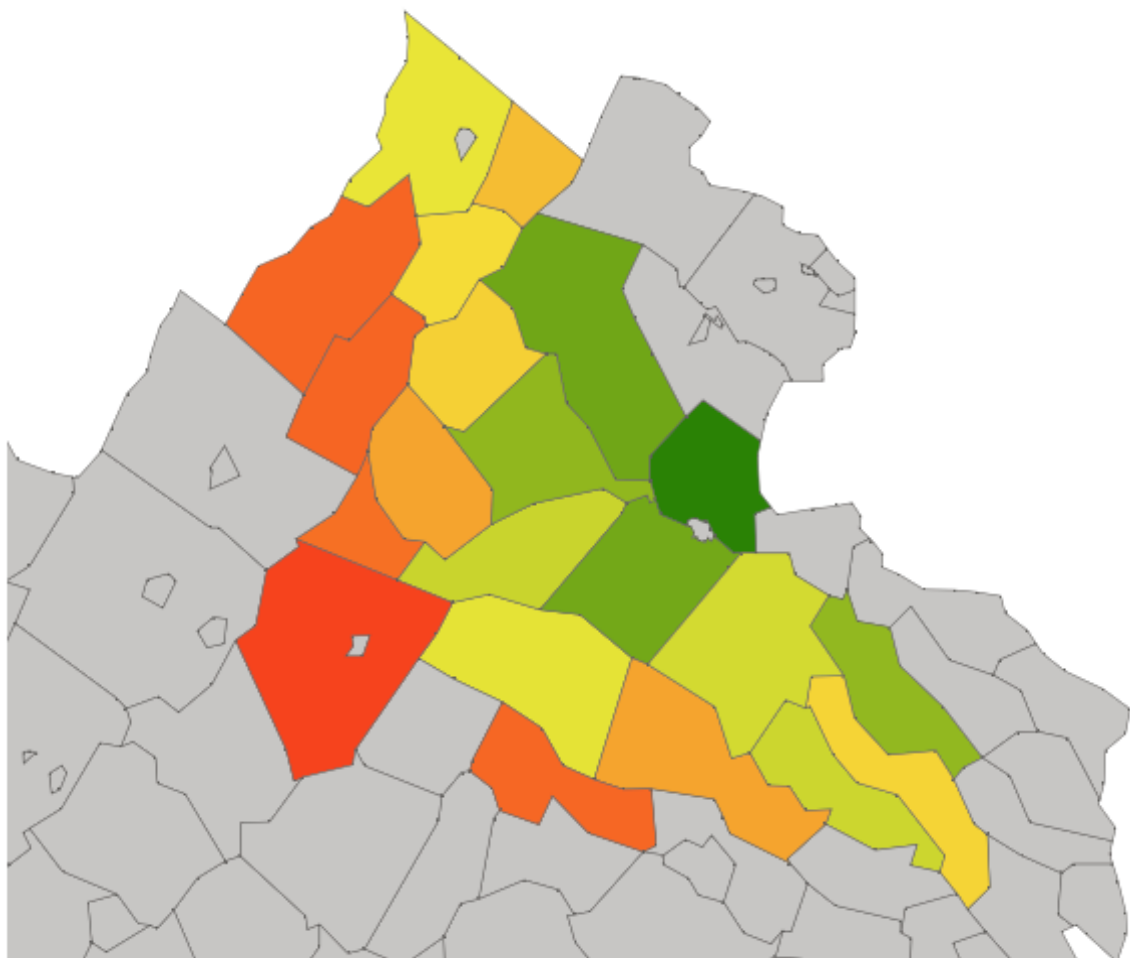
| CNTY_DESCR | Income Code - Estimated Household - 100% Income.USE |
|-----------------------|---|
| | \$70,910.4478 |
| Albemarle | \$73,189.8396 |
| Caroline | \$60,810.1392 |
| Clarke | \$79,155.0026 |
| Culpeper | \$70,477.9024 |
| Essex | \$52,864.8069 |
| Fauquier | \$80,285.4921 |
| Frederick | \$66,670.6484 |
| Goochland | \$72,857.1429 |
| Greene | \$61,531.7097 |
| Hanover | \$76,557.6253 |
| King and Queen | \$48,062.9021 |
| King William | \$67,198.2336 |
| Louisa | \$66,824.6445 |
| Madison | \$59,987.5533 |
| Orange | \$68,510.995 |
| Page | \$88,125 |
| Rappahannock | \$75,541.2088 |
| Shenandoah | \$83,125 |
| Spotsylvania | \$69,559.0482 |
| Stafford | \$76,203.2086 |
| Town of Berryville | \$71,595.9596 |
| Town of Bowling Green | \$55,384.6154 |
| Total | \$67,920.5269 |

*Excludes Page, Stafford, Rockingham, & Shenandoah due to small membership percentage

Technology Propensity Score



Energy Consumer Dynamics - Technology Propensity Score by CNTY_DESCR



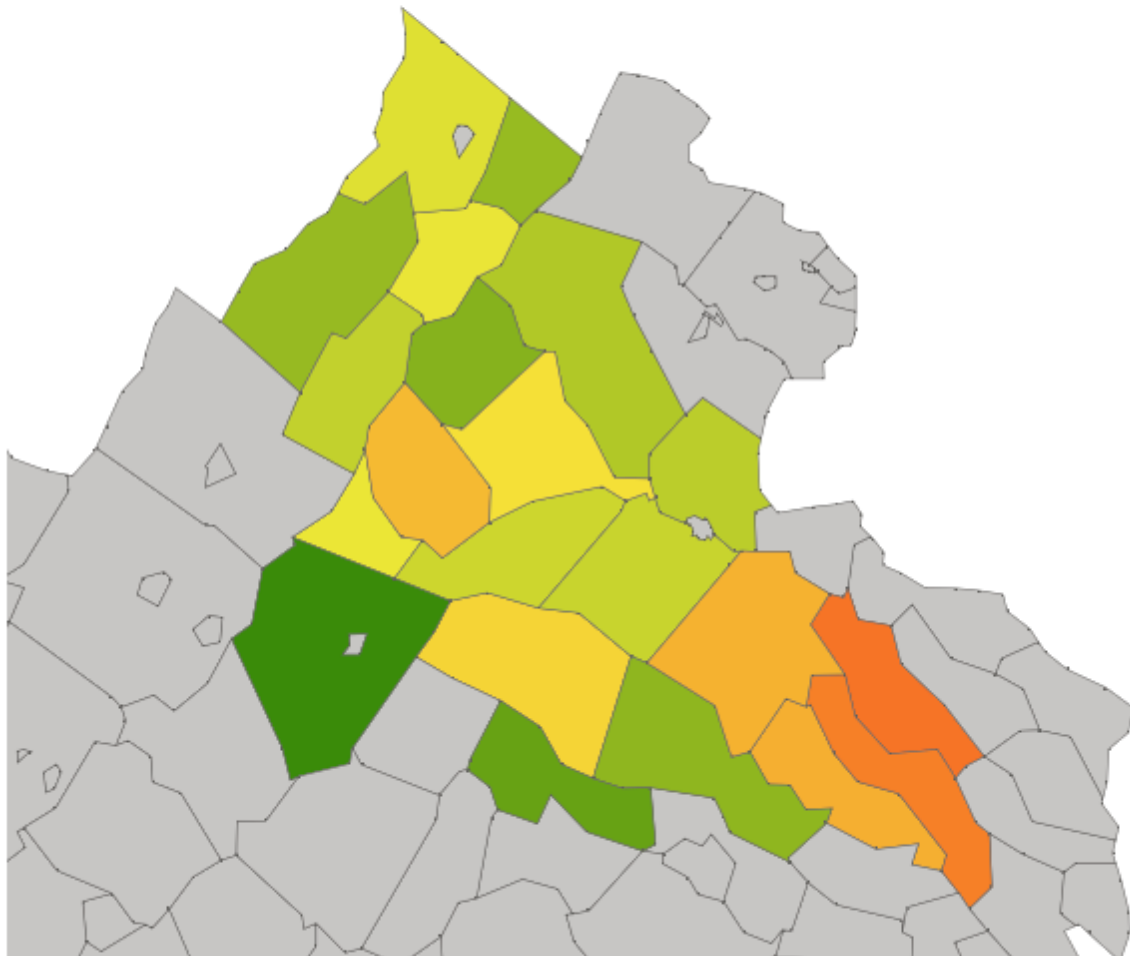
| CNTY_DESCR | Energy Consumer Dynamics - Technology Propensity Score |
|-----------------------|--|
| | 3.97 |
| Albemarle | 2.57 |
| Caroline | 3.60 |
| Clarke | 3.21 |
| Culpeper | 3.91 |
| Essex | 3.91 |
| Fauquier | 4.06 |
| Frederick | 3.50 |
| Goochland | 2.76 |
| Greene | 2.81 |
| Hanover | 3.08 |
| King and Queen | 3.33 |
| King William | 3.64 |
| Louisa | 3.52 |
| Madison | 3.08 |
| Orange | 3.65 |
| Page | 2.75 |
| Rappahannock | 3.31 |
| Shenandoah | 2.75 |
| Spotsylvania | 4.05 |
| Stafford | 4.39 |
| Town of Berryville | 3.51 |
| Town of Bowling Green | 3.60 |
| Total | 3.55 |

*Excludes Page, Stafford, Rockingham, & Shenandoah due to small membership percentage

Green Affinity



Energy Consumer Dynamics - Green Affinity Score by CNTY_DESCR



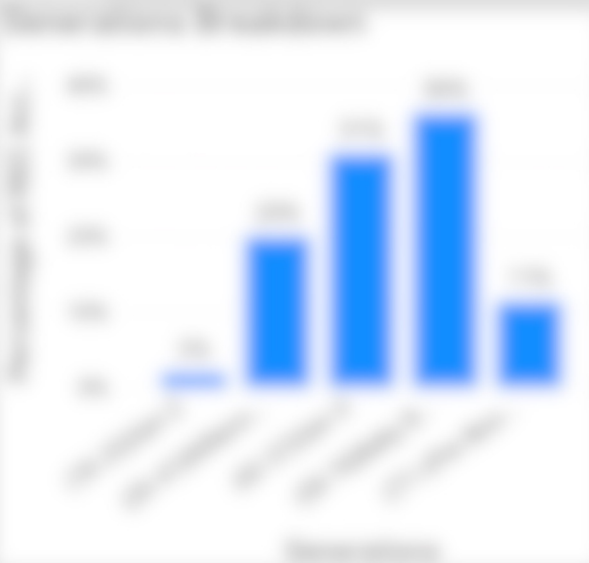
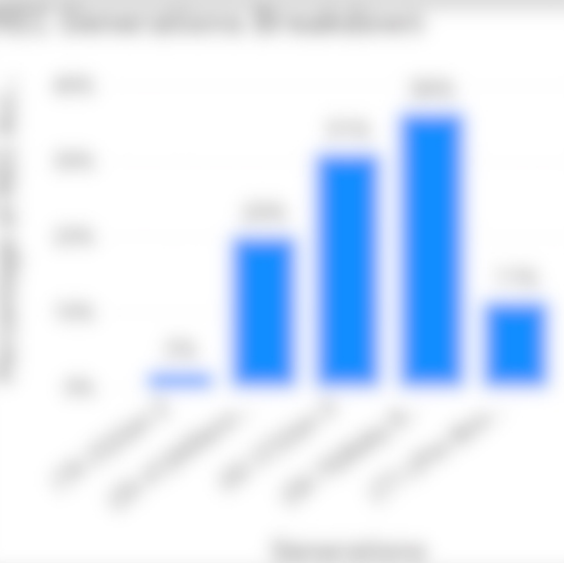
| CNTY_DESCR | Energy Consumer Dynamics - Green Affinity Score |
|-----------------------|---|
| | 3.97 |
| Albemarle | 4.90 |
| Caroline | 3.47 |
| Clarke | 4.37 |
| Culpeper | 3.76 |
| Essex | 3.07 |
| Fauquier | 4.22 |
| Frederick | 3.96 |
| Goochland | 4.65 |
| Greene | 3.89 |
| Hanover | 4.42 |
| King and Queen | 3.15 |
| King William | 3.45 |
| Louisa | 3.69 |
| Madison | 3.52 |
| Orange | 4.07 |
| Page | 4.13 |
| Rappahannock | 4.47 |
| Shenandoah | 4.38 |
| Spotsylvania | 4.09 |
| Stafford | 4.17 |
| Town of Berryville | 3.81 |
| Town of Bowling Green | 3.70 |
| Total | 3.91 |

*Excludes Page, Stafford, Rockingham, & Shenandoah due to small membership percentage

**Driving Policy to
Meet Members
Needs**

Political Insights Dashboard

Number of REC Accounts



| Category | Value |
|-------------------------|-------|
| Political Learning | 100 |
| Political Participation | 100 |
| Political Knowledge | 100 |
| Political Interest | 100 |
| Political Efficacy | 100 |
| Political Trust | 100 |

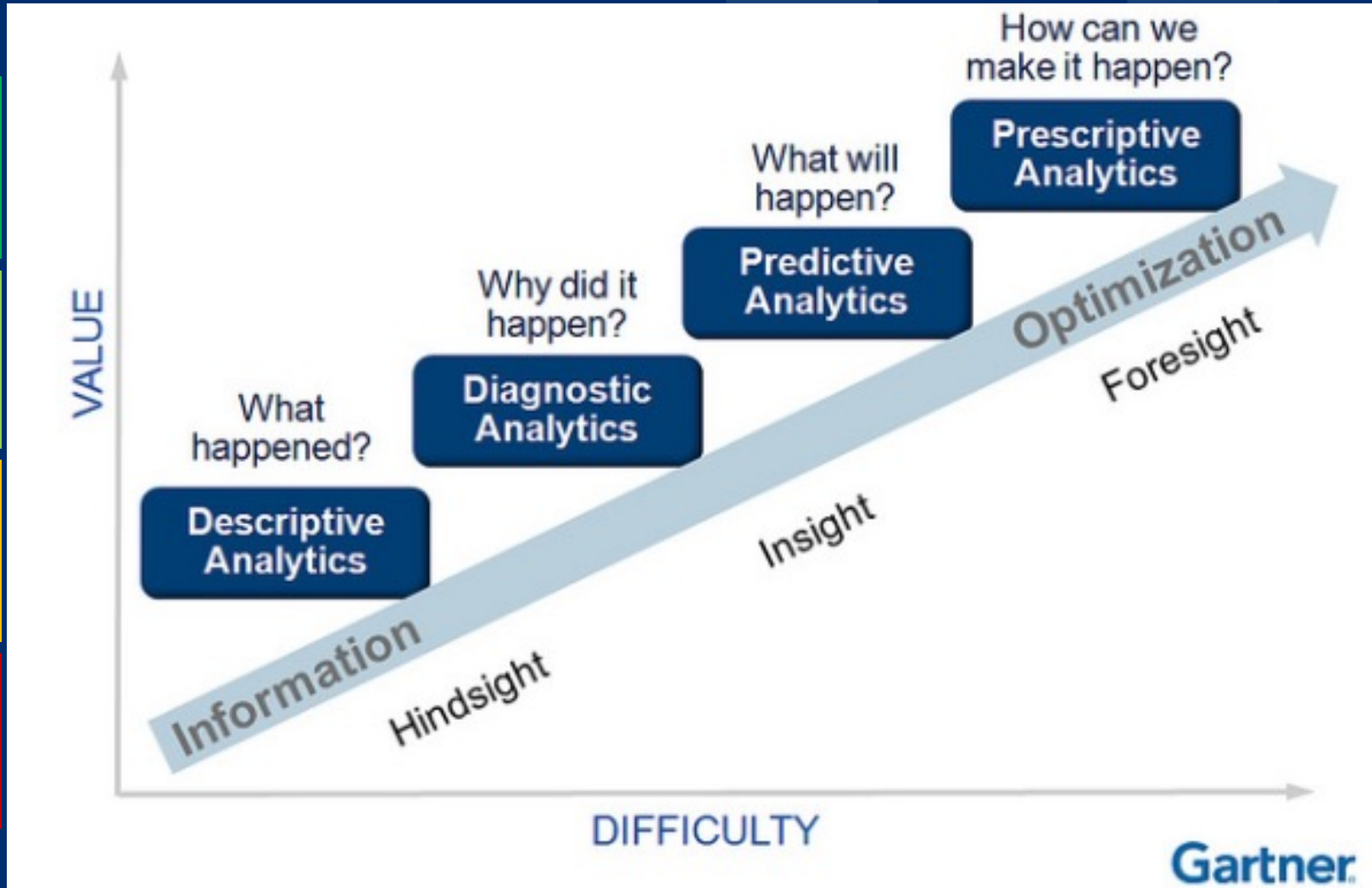
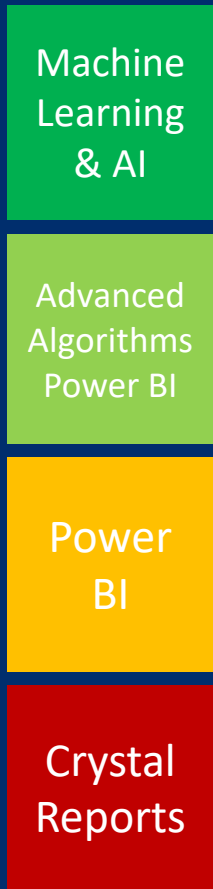


| Category | Value |
|-------------------------|-------|
| Political Learning | 100 |
| Political Participation | 100 |
| Political Knowledge | 100 |
| Political Interest | 100 |
| Political Efficacy | 100 |
| Political Trust | 100 |

CLOSING THOUGHTS



Analytics Capabilities Maturity Model



“What was once sacred may no longer be seen as such. Let analytics drive your dynamic planning to find the next sacred item.”



Peter Muhoro, Ph.D.

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