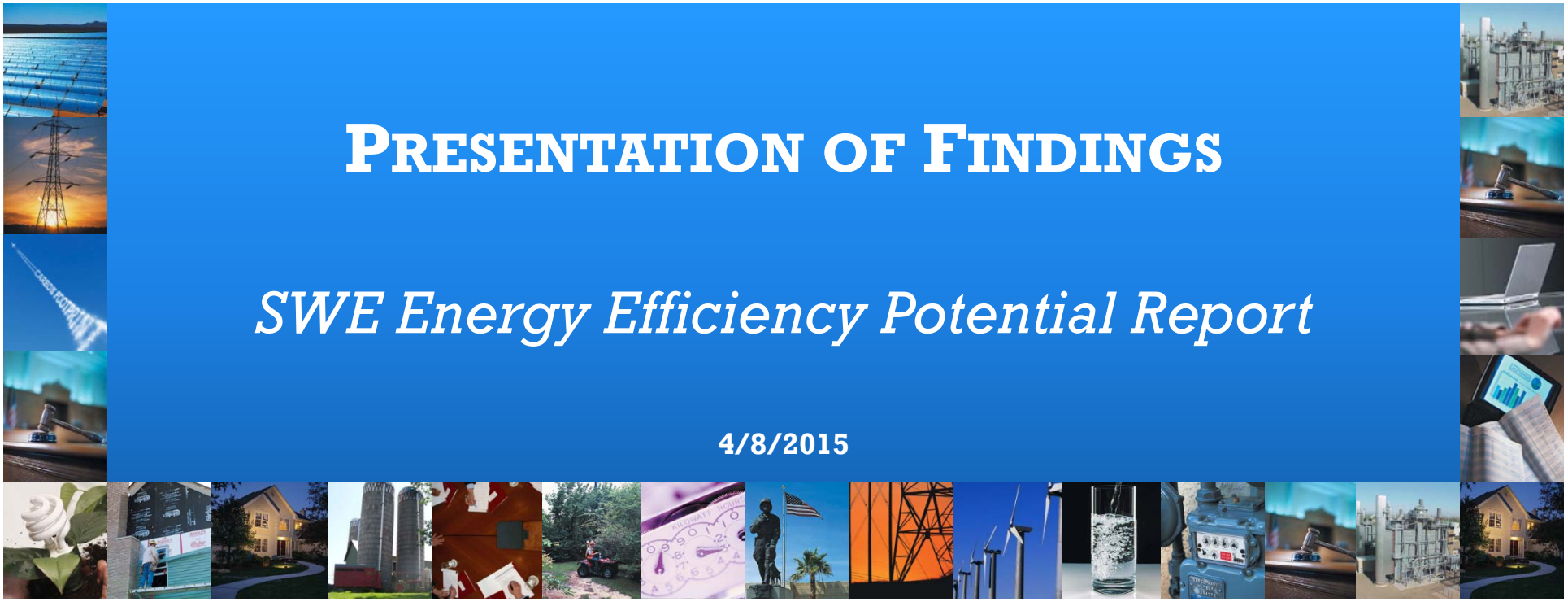


# Presentation of Findings

## *SWE Energy Efficiency Potential Report*

**4/8/2015**

***Presented by the Statewide Evaluation Team:***

GDS Associates, Inc.
Engineers and Consultants

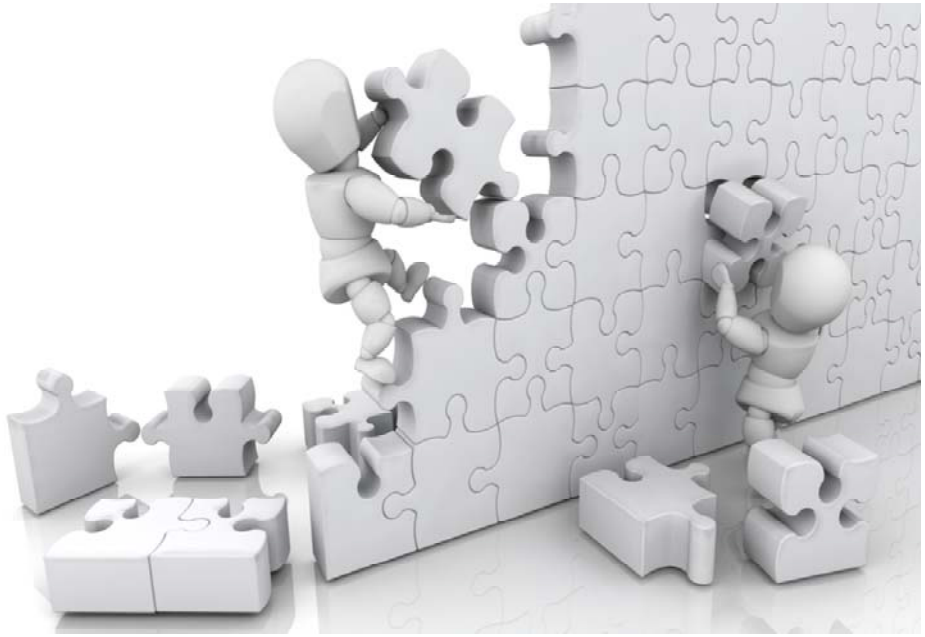
Nexant

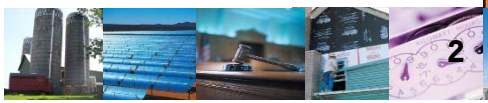
research into action

APEX ANALYTICS, LLC

# Agenda Outline

- **Overview of Program Potential Results**
- Measure Development & Characterization
- General Methodology
  - Approach Overview
  - Technical & Economic Potential
  - Achievable Potential
- Key Assumptions
  - Lighting
- Sector Level Results
  - Residential
  - Commercial
  - Industrial
- All Sector Combined Recap
- Program Potential Recap
  - Methodology and Scaling
  - Results





# Act 129 PY1 – PY5 Benchmarking

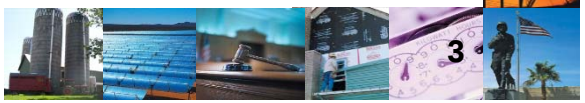
## Statewide Cumulative Five-Year Program Savings and Costs by Sector

| Sector | Verified Impact (MWh) | % of 2010 Load | Total Incentive $ | Participant $ | Incentive Rate | Admin Cost $/1st-YR kWh-saved |
|---|---|---|---|---|---|---|
| **Residential** | 3,210,689 | 2.2% | $177,832,506 | $309,659,924 | 57% | $0.076 |
| **Nonresidential** | 2,829,403 | 1.9% | $206,874,090 | $853,868,453 | 24% | $0.060 |
| ***Portfolio*** | ***6,040,092*** | ***4.1%*** | ***$384,706,596*** | ***$1,163,528,376*** | ***33%*** | ***$0.069*** |

## Incremental Annual Acquisition Cost by Sector, by Program Year ($/1stYr kWh Saved)

| Sector | PY1 | PY2 | PY3 | PY4 | PY5 |
|---|---|---|---|---|---|
| **Residential** | $0.114 | $0.123 | $0.149 | $0.111 | $0.161 |
| **Nonresidential** | $0.172 | $0.134 | $0.140 | $0.129 | $0.169 |
| ***Portfolio*** | ***$0.126*** | ***$0.128*** | ***$0.144*** | ***$0.121*** | ***$0.164*** |

- Historical EDC Acquisitions costs are below those assumed in the prior potential study



# Program Potential Findings

| | Portfolio Spending Ceiling (Million $) | Program Acquisition Costs ($/1st-YR MWh Saved) | 2016-2020 Potential Savings (MWh) | % of 2010 Forecast |
|---|---|---|---|---|
| **2016-2020 Five-Year Program Potential** | | | | |
| **Duquesne** | $97.7 | $186.9 | 522,837 | 3.7% |
| **FE: Met-Ed** | $124.3 | $182.2 | 682,474 | 4.6% |
| **FE: Penelec** | $114.9 | $191.9 | 598,704 | 4.2% |
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| ***Statewide*** | ***$1,222.5*** | ***$184.4*** | ***6,629,460*** | ***4.5%*** |

- Still significant amount of cost effective energy efficiency potential in PA: TRC = 1.8
- Acquisition cost ($184/MWh) slightly lower than prior study
  - Unlike prior study, cost uncertainty adder not included in $184/MWh
  - "Cheap" CFLs still a significant share of program potential
  - Some "expensive" measures like unitary A/C systems no longer cost effective, and therefore not part of program potential acquisition cost
- Program potential is therefore higher than prior study
- Program potential estimates based on sum of incremental annual savings

# Measure Development & Characterization

## SWE EE Potential Report

# Measure Development

- Potential study includes all measures in the 2015 PA Technical Reference Manual
  - 70% of all measures included in the potential study are from the TRM
- 400 total measure types
  - 69 residential
  - 209 commercial
  - 122 industrial
- Over 95,000 measure permutations

# Measure characterization

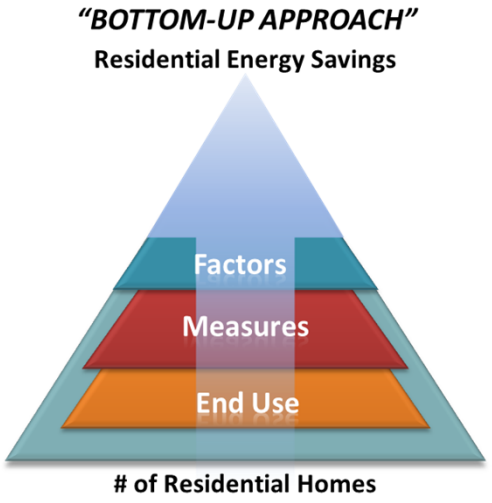
- Sources included:
  - 2015 TRM (deemed savings, algorithms, and useful lives)
  - 2014 PA Incremental Cost Database (measure costs)
  - BEopt Energy Modeling (residential HVAC shell & equipment energy/demand savings)
  - 2014 residential and nonresidential baseline studies (baseline and efficient saturation data)
  - EDC-specific Saturation Studies (residential baseline data)
  - 2014 residential & nonresidential lighting metering studies (lighting hours of use & coincidence factors)
  - 2014 California Statewide "Ex Ante Measure Cost Study"

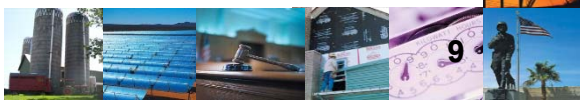
# General Methodology

## SWE EE Potential Report

# Approach Overview

- SWE used a "bottom-up" approach in the residential sector
  - Begins with characterizing equipment stock and summing measure savings by end-use and service territory levels
- Nonresidential used a bottom-up approach to first estimate measure-level savings, costs, and cost-effectiveness estimates
  - Then applied cost-effectiveness measure savings to all applicable shares of energy load



# Technical & Economic Potential

- Technical Potential
  - Theoretical maximum amount of energy use that could be displaced by efficiency
  - Only constraints are technical feasibility or applicability of measures
  - Priority for competing measures assigned to measure with largest savings percentage of technical potential
- Economic Potential
  - Subset of technical potential that is economically cost-effective (based on PA TRC Test)
  - Priority for competing measures shifts to most cost-effective measures in economic potential, and all subsequent estimates of potential
  - Roughly 50% of measures passed the TRC screening

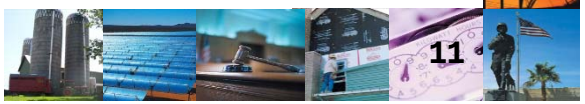
# Maximum & Base Achievable Potential

## Base Achievable

- Assumes incentives are based on historical levels
  - 57.5% of measure cost in residential sector
  - 35% of measure cost in nonresidential sector
- Measure adoption rate in Year 1 of analysis ~ 30%

## Maximum Achievable

- Assumes incentives are 100% of incremental measure cost for both sectors
- Initial year market adoption rate higher in maximum achievable to reflect higher incentive levels

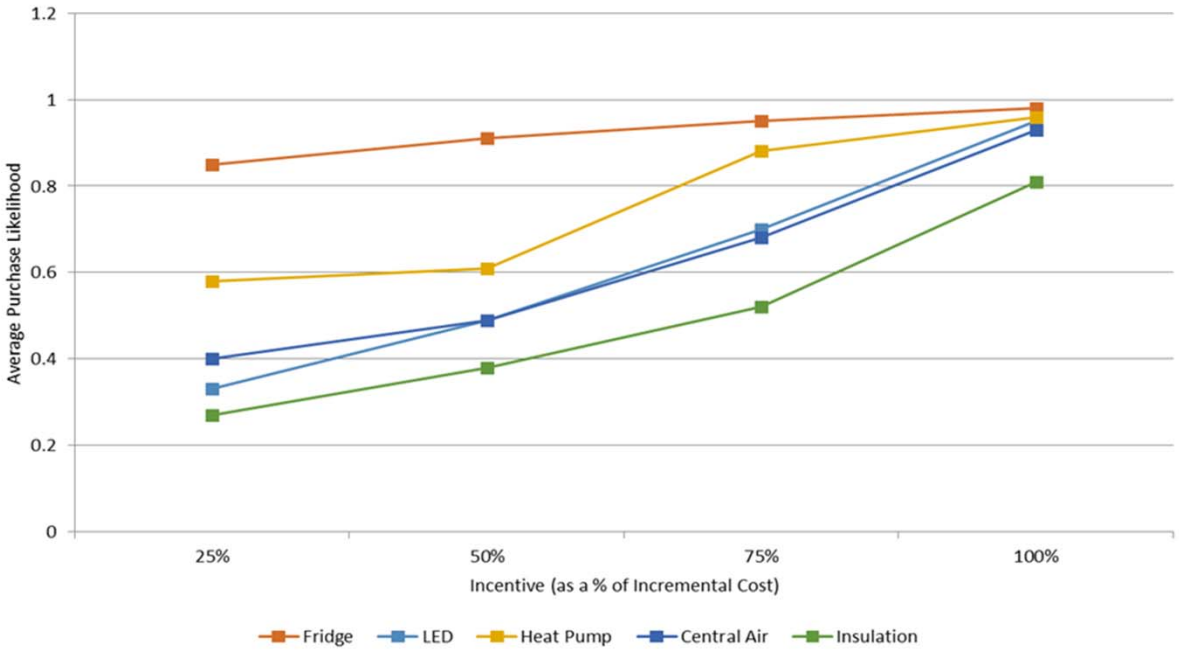


# Estimating Market Adoption

- Informed by historical achievement of the EDCs in Phase I & II program years as well as willingness-to-participate (WTP) research from the baseline studies
- Historical achievements helped inform the initial year market adoption rate ; WTP research informed long-term market adoption rate estimates
  - Year 1 market adoption is assumed to be ~30% in base achievable potential (higher in maximum achievable)
  - Long term market adoption capped at 85%
- Linear growth rate between Year 1 and Year 10

# Example: Long Term Market Adoption

- Residential surveys asked homeowners about equipment across various end-uses and incentive levels
- Ex: At base achievable incentive levels (57.5%), long term market adoption of insulation is estimated to be ~40%. For maximum achievable (100% incentives), long term market adoption is estimated to be near 80%.
- Long term market adoption capped at 85%



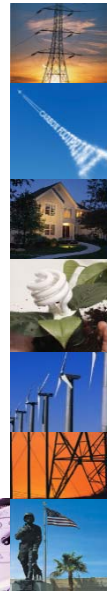
# Key Assumption- Lighting

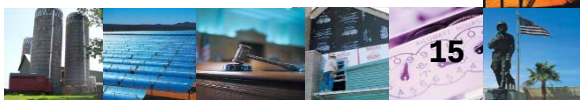
## SWE EE Potential Report

# UNDERSTANDING THE 2020 LIGHTING BASELINE SHIFT #1

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| Installing the code baseline |  |  |  |  |  | | | | |
| Installing an LED |  | | | | | | | | |
| Annual Measure Savings | 45 kWh | 45 kWh | 45 kWh | 45 kWh | 5.5 kWh | 5.5 kWh | 5.5 kWh | 5.5 kWh | 5.5 kWh |

Example based on single socket installation





# UNDERSTANDING THE 2020 LIGHTING BASELINE SHIFT #2

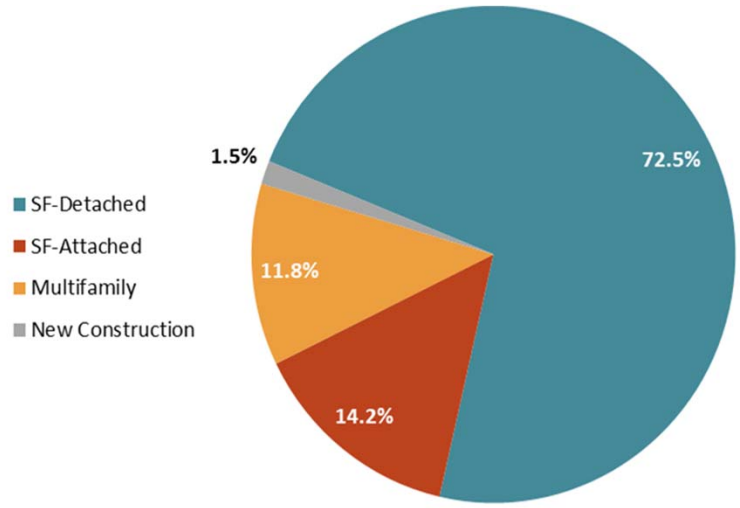
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| Per Unit Annual Measure Savings | 45 kWh | 45 kWh | 45 kWh | 45 kWh | 5.5 kWh | 5.5 kWh | 5.5 kWh | 5.5 kWh | 5.5 kWh |
| # of LED bulbs installed each year | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 |
| Total # of LED bulbs installed | 100 | 210 | 330 | 460 | 600 | 750 | 910 | 1080 | 1260 |
| Incremental Annual Savings (from new installations) | 4500 kWh | 4950 kWh | 5400 kWh | 5850 kWh | 770 kWh | 825 kWh | 880 kWh | 935 kWh | 990 kWh |
| Cumulative Annual Savings (from all bulbs) | 4500 kWh | 9450 kWh | 14850 kWh | 20700 kWh | 3300 kWh | 4125 kWh | 5005 kWh | 5940 kWh | 6930 kWh |

# Residential Sector Results

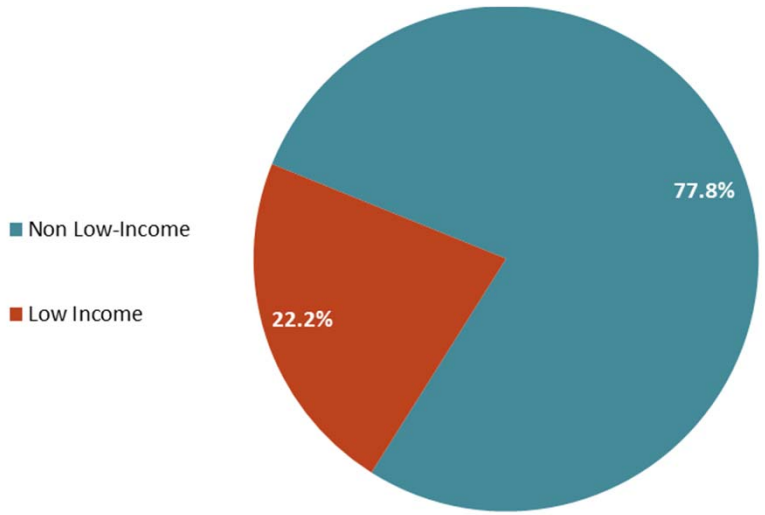
## SWE EE Potential Report

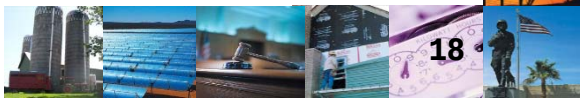
# Residential Sector Results by Market Segment

2020 Base Achievable MWh Savings by Housing Type




2020 Base Achievable MWh Savings by Income Status

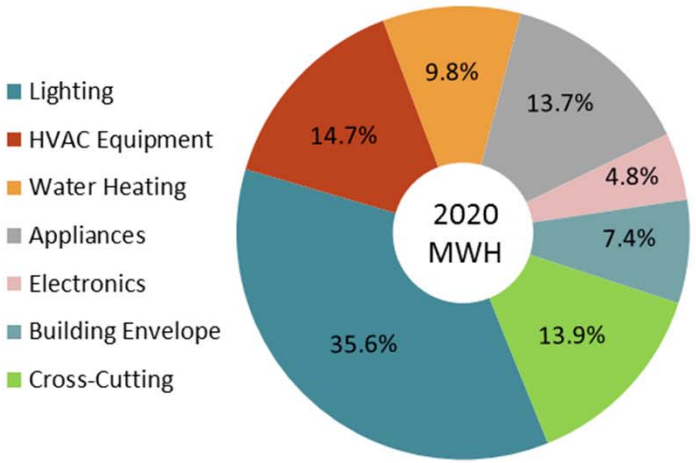


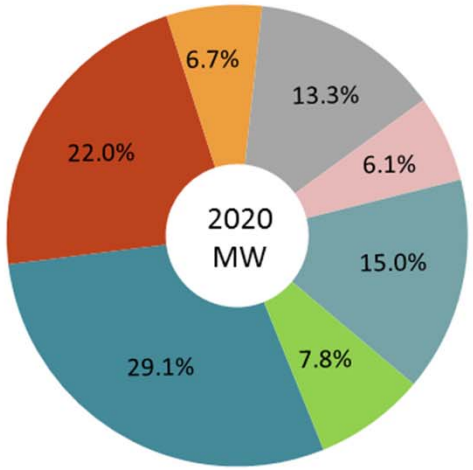



# Residential Sector Results by End-Use

- Lighting remains end-use with largest savings potential despite CFL baseline for standards bulbs.
- Additional savings from specialty bulbs and reflector bulbs
- HVAC Equipment includes savings from ASHPs, mini-splits, maintenance, programmable thermostats
- "Cross-Cutting" end-use includes behavioral programs.

2020 Cumulative Annual Base Achievable MWh and MW Savings Potential by End-Use



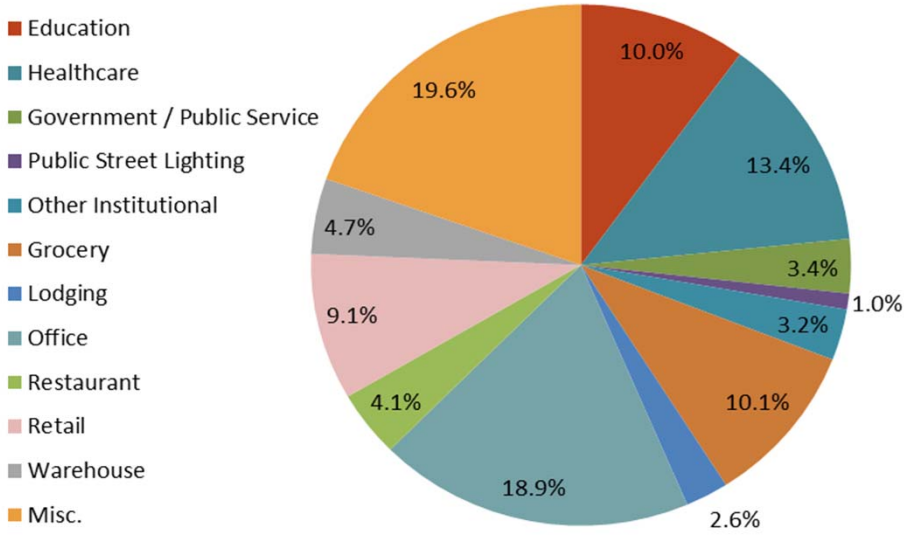




# Commercial Sector Results

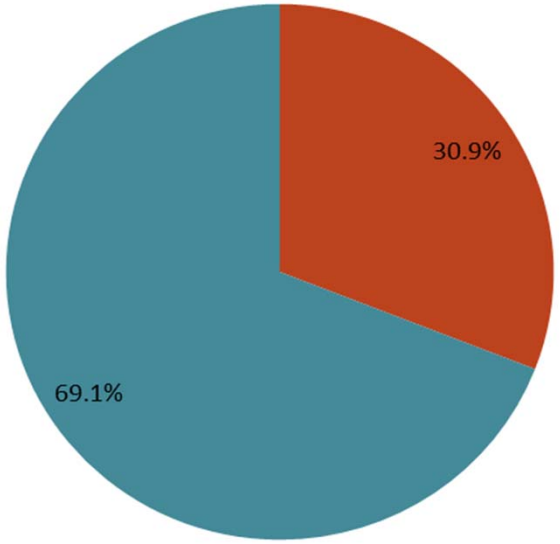
## SWE EE Potential Report

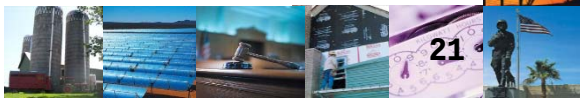
# Commercial Results by Market Segment

2020 Base Achievable MWh Savings by Segment




2020 Base Achievable MWh Savings by Commercial Sector

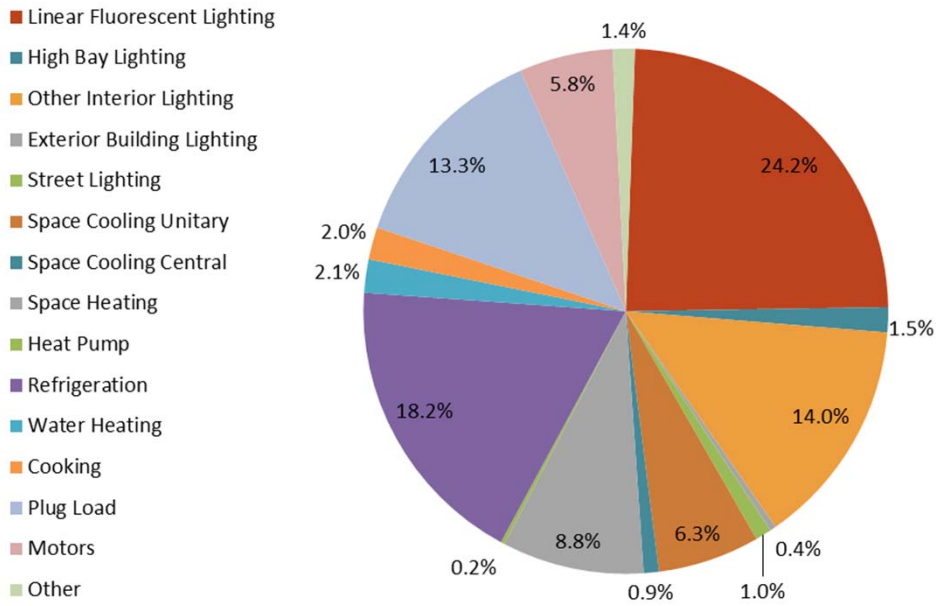


# Commercial Results by End-Use

- Lighting remains end-use with largest savings potential (~ 40%) despite CFL & T8 baseline
- CFL (through 2019) and LEDs (2020 & beyond) comprise Other Interior Lighting savings
- Space Cooling Unitary equipment measures no longer cost-effective in PA
- Large share of Plug Load and Refrigeration end use savings comprised on non-equipment measures

2020 Cumulative Annual Base Achievable MWh Savings Potential by End-Use



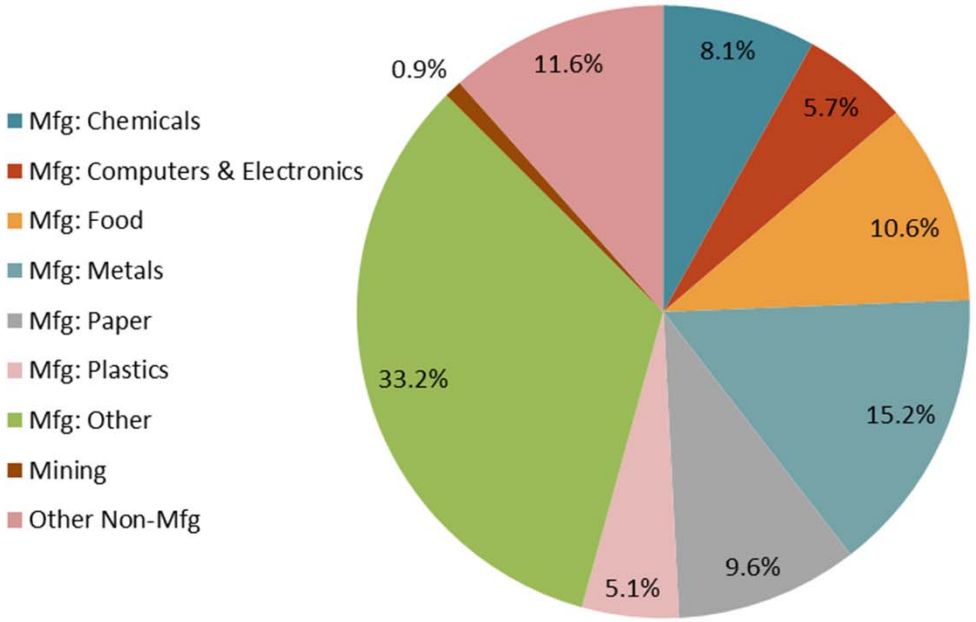

# Industrial Sector Results

## SWE EE Potential Report

Nexant research into action APEX ANALYTICS

# Industrial Results by Market Segment

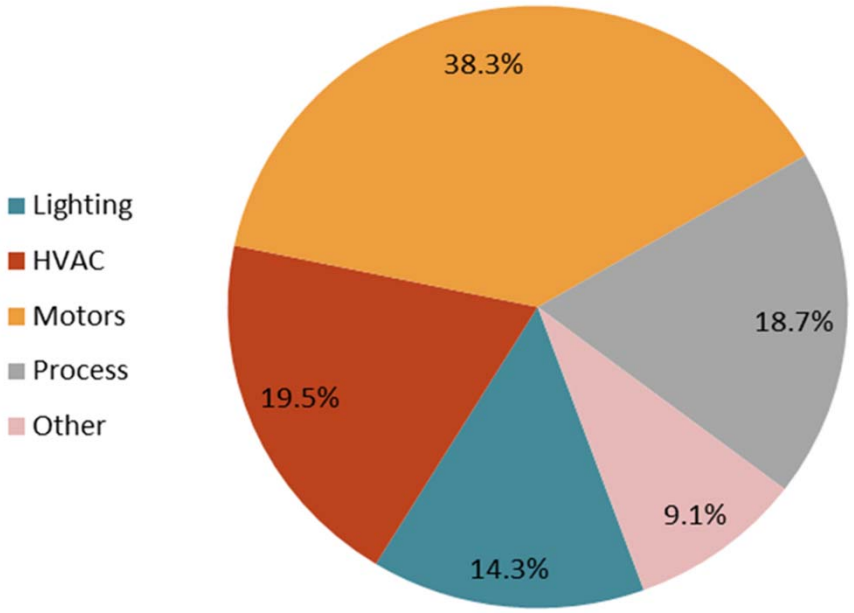
2020 Base Achievable MWh Savings by Segment

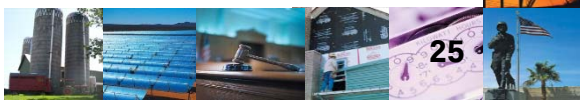


# Industrial Results by End-Use

- Largest savings potential remains in motors end use (motors, pumps & fans)
- Again, still a sizeable share of potential in lighting end use despite T8 and CFL baseline
- Space Cooling Unitary equipment measures no longer cost-effective in PA (only some chiller measure sizes/applications cost effective)

2020 Cumulative Annual Base Achievable MWh Savings Potential by End-Use



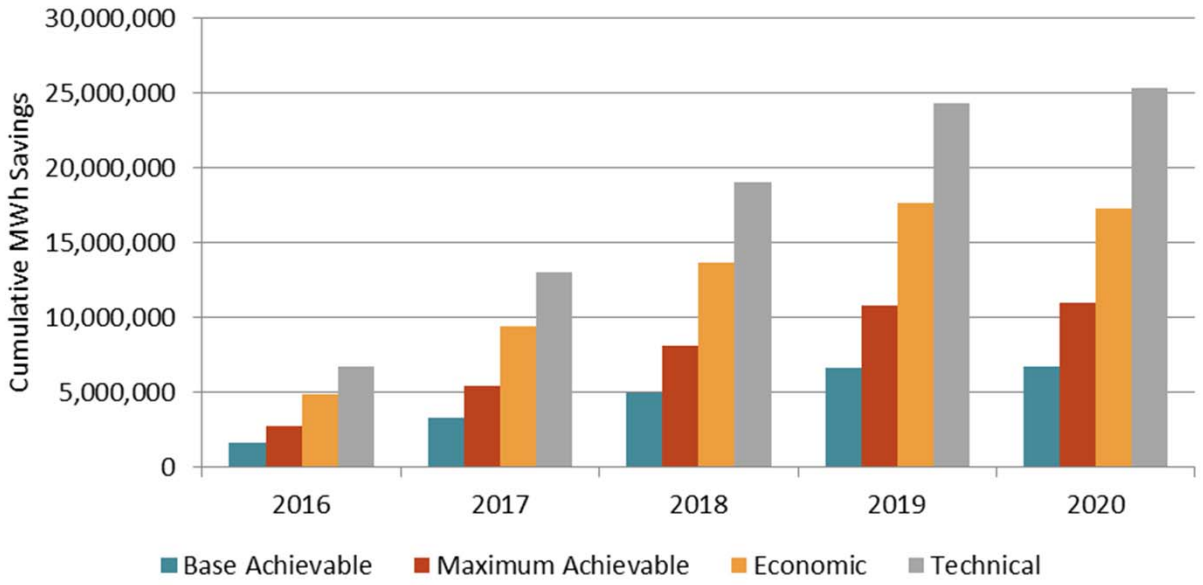



# All Sectors Combined Recap

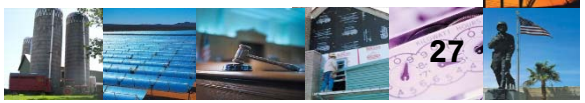
## SWE EE Potential Report

# All Sectors Combined Results Overview

Cumulative Annual Savings Potential by Scenario by Year

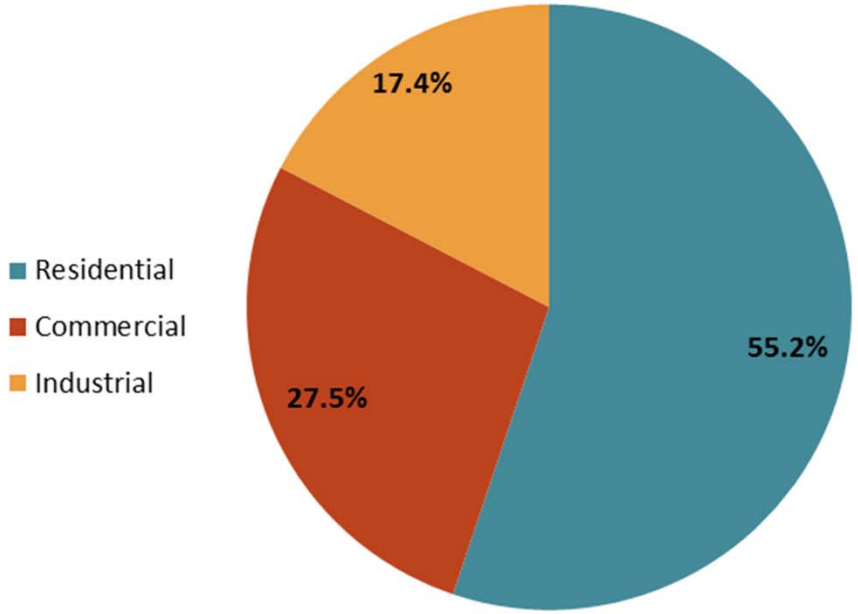



- 5-year technical potential is 25 million MWh on a cumulative annual basis
- Maximum Achievable is 11 million MWh in 2020, or 7.5% of 2010 load
- Base Achievable 6.75 million MWh in 2020, or 4.6% of 2010 load
- Cumulative Annual MW savings in 2020 is ~1650 MW (Maximum Achievable) and ~975 MW (Base Achievable)



# Portfolio Results by Sector

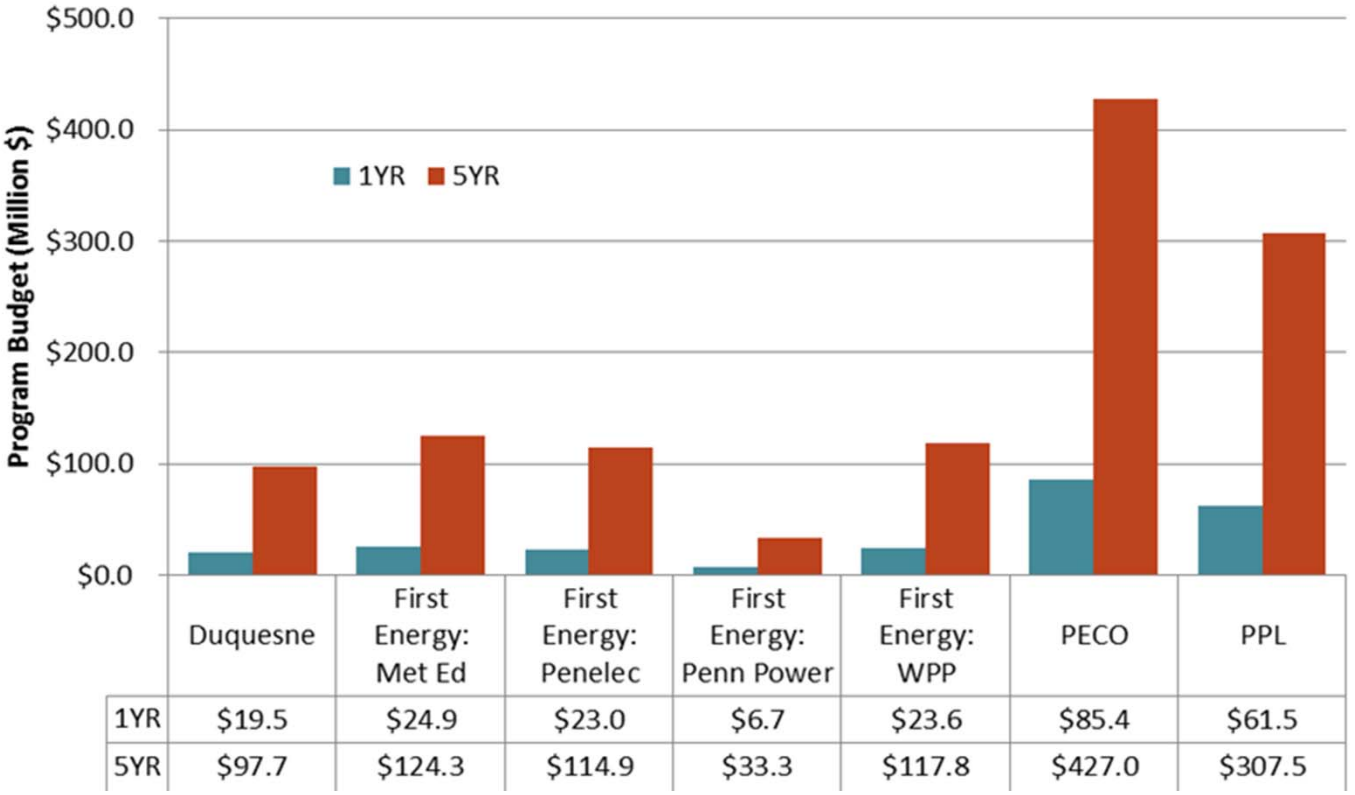
2020 Cumulative Annual Base Achievable MWh Savings Potential by Sector



# Program Potential Recap

## SWE EE Potential Report

# EDC Program Spending Caps




| | Duquesne | First Energy: Met Ed | First Energy: Penelec | First Energy: Penn Power | First Energy: WPP | PECO | PPL |
|---|---|---|---|---|---|---|---|
| 1YR | $19.5 | $24.9 | $23.0 | $6.7 | $23.6 | $85.4 | $61.5 |
| 5YR | $97.7 | $124.3 | $114.9 | $33.3 | $117.8 | $427.0 | $307.5 |

# Program Potential Methodology & Scaling

- Followed same methodology as prior study
  - Step 1: If Base Ach costs > budget, divide available budget by Base Ach acquisition cost
  - Step 2: If Base Ach costs < budget, calculate slope btw. Base Ach and Max Ach acquisition cost and "scale" savings/costs along line
- The assumption here is that Act 129 Targets would be based on a mix of measures identical to the Base Achievable scenario…no decisions on which measures to prioritize

# Program Potential Findings

| | Portfolio Spending Ceiling (Million $) | Program Acquisition Costs ($/1st-YR MWh Saved) | 2016-2020 Potential Savings (MWh) | % of 2010 Forecast |
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| **2016-2020 Five-Year Program Potential** | | | | |
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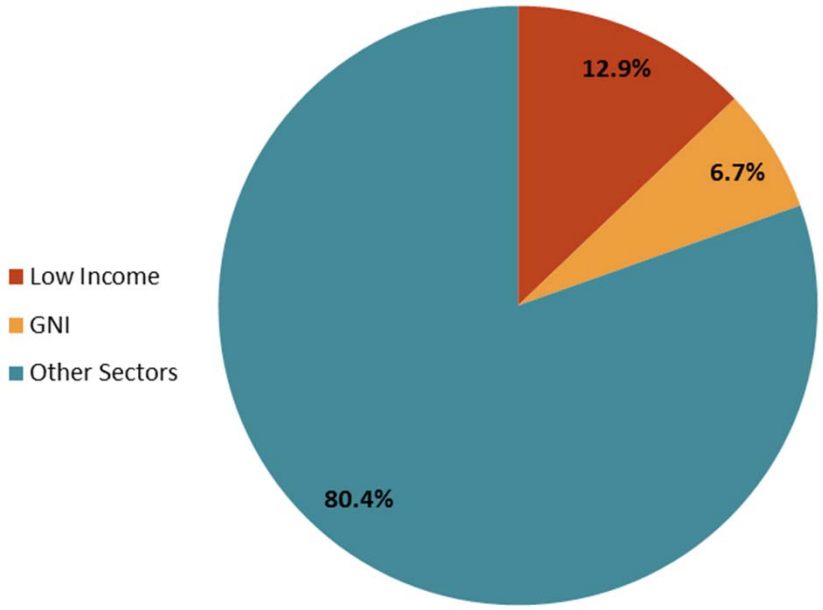
# Program Potential Findings




- Presented in an addendum to the 2015 SWE Market Potential Studies

- GNI "carve out" sector is comprised of education, healthcare, government/public service, public street lighting, and other institutional buildings
  - Education and healthcare buildings were used as a proxy for nonprofit customers since many of these building types are occupied by nonprofits
- Low income potential includes savings stemming directly from low income-specific measures as well as additional savings attributed to low income participants in non-low income-specific programs.