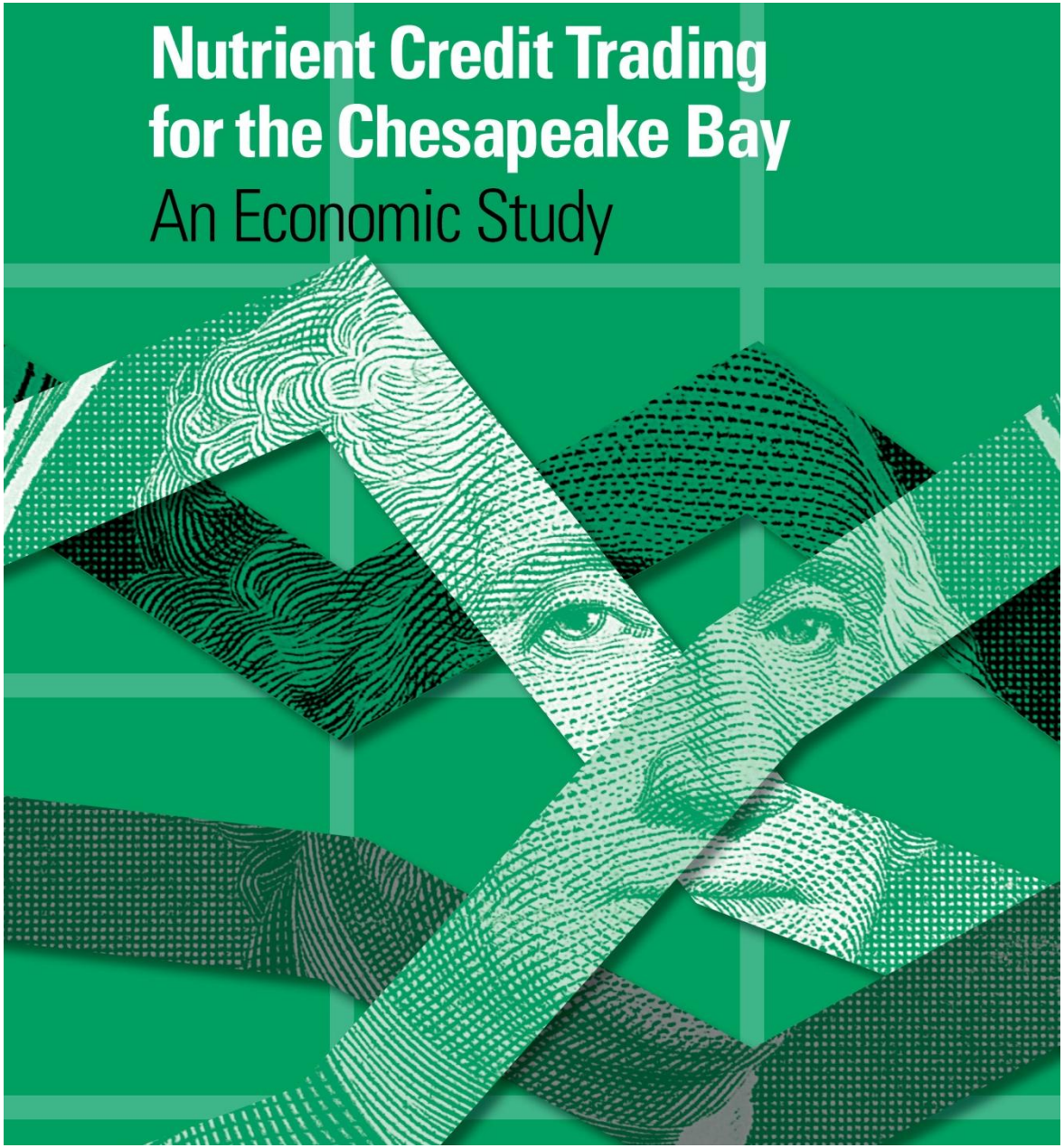

PRESENTED BY

George Van Houtven
(RTI International)

PRESENTED TO

Scientific and Technical Advisory Committee (STAC)
Quarterly Meeting
Annapolis, MD
June 19-20, 2012

RTI INTERNATIONAL

Acknowledgments

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- Co-authors at RTI
  - Ross Loomis
  - Justin Baker
  - Robert Beach
  - Sara Casey

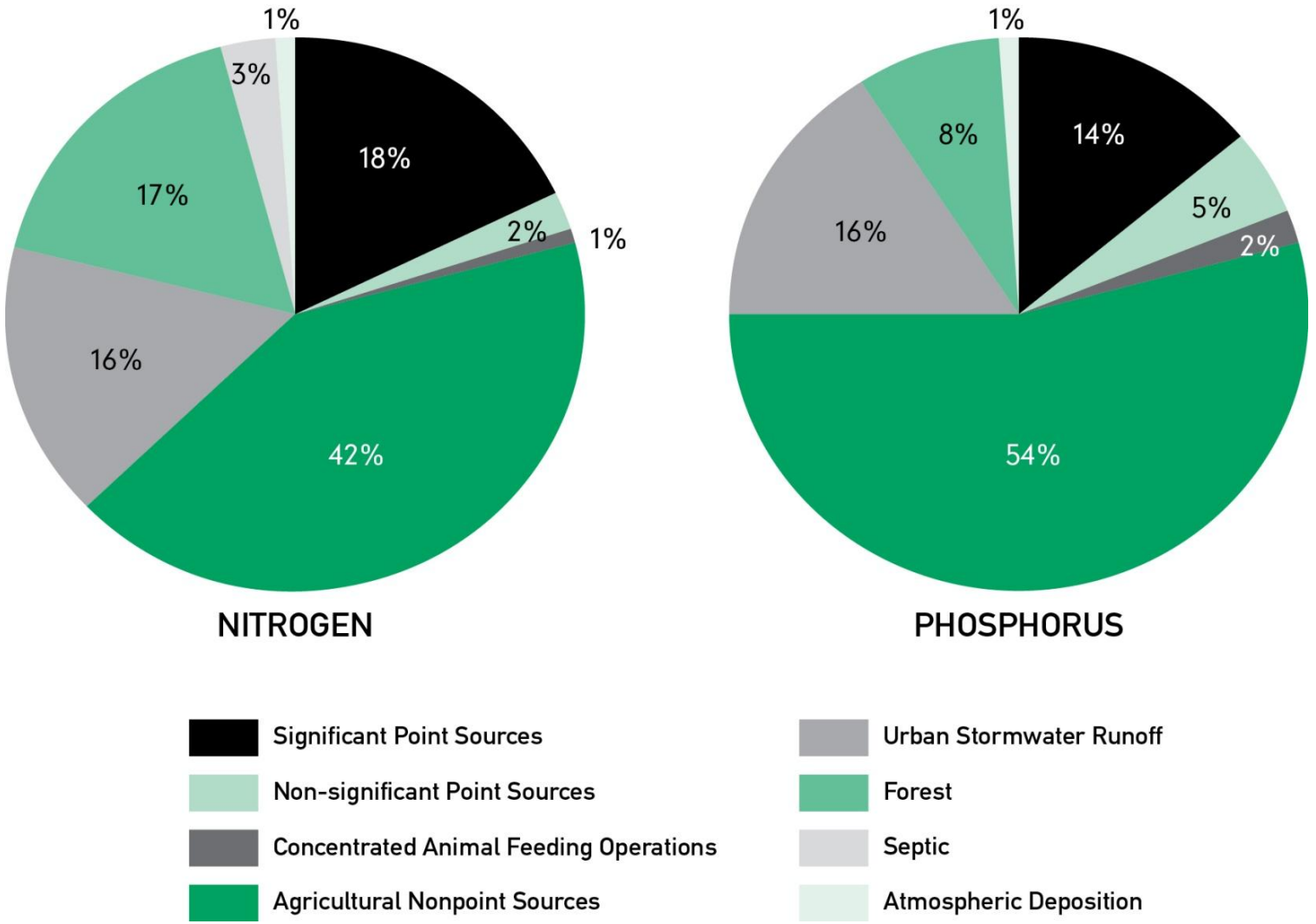
Outline of the Presentation

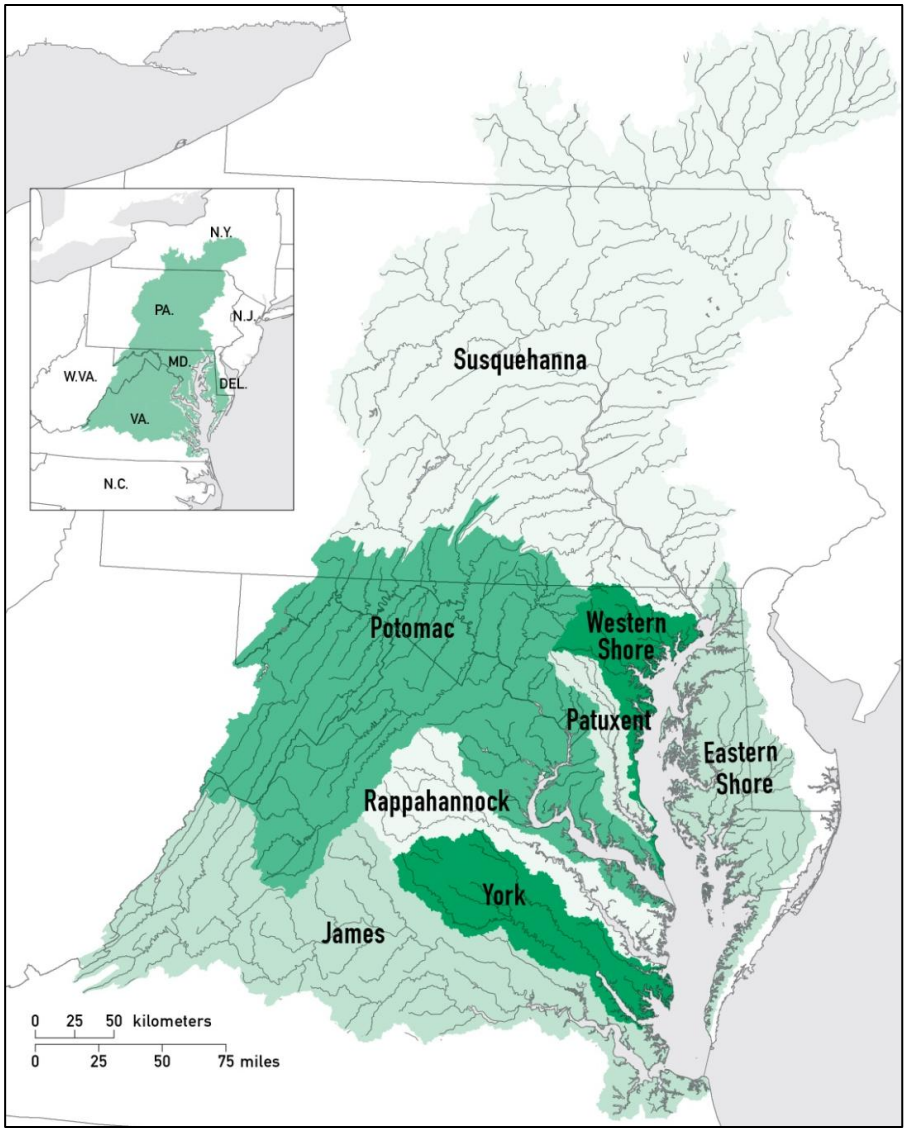
- Key questions and objectives for the study
- Methods – analytical framework
- Data sources and model inputs
- Trading scenarios and modeling assumptions
- Summary of main findings

Background and Context for the Study

- The Chesapeake Bay is under stress from multiple sources
- Large reductions in nutrient loads are needed to restore the estuary's ecosystem
- The Bay TMDL establishes the load limits that are needed to achieve water quality goals, but it will not come without a price
- Strategies to limit these costs need consideration
- Nutrient credit trading offers one approach for achieving water quality goals in a more cost-effective way

Current Nutrient Load Contributions by Different Sources





TMDL Defines Load Limits

for Nitrogen and Phosphorus

- By basin
  - 8 major river basins in the watershed
- By state
  - 6 states plus DC
- By states' share within each basin
  - 19 "Basin-State" combinations
- By tidal portions of the Bay
  - 92 tidal segments

Objectives of the Study

- Investigate the potential costs savings from including nutrient trading in strategies to meet the Bay TMDL requirements
- Estimate how the potential costs savings are affected by different trading scenarios
  - Participation by different source categories
  - Different geographic boundaries on trades
- The purpose is not to model specific state programs or predict future trading levels

How Can Trading Reduce Costs?

NO TRADING

	Facility A	Facility B	Total
Cost of technology upgrade ($/yr)	$200,000	—	$200,000
N credits bought ($/yr)	—	—	—
N credits sold ($/yr)	—	—	—
Net cost (revenue) ($/yr)	$200,000	—	$200,000
Reduced N load to the Bay (lb/yr)	10,000	—	10,000

$80,000 savings from trade

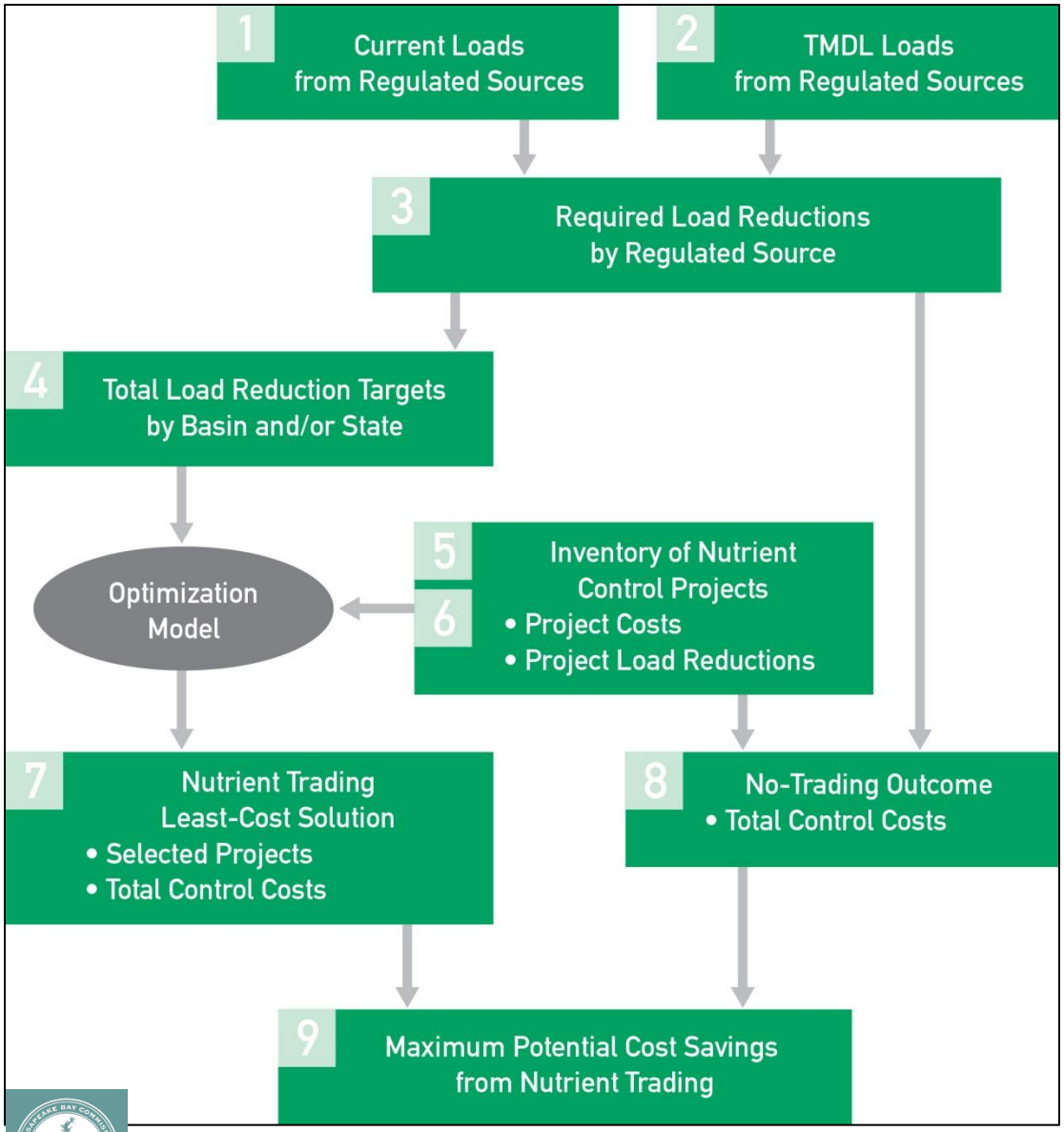
TRADING

	Facility A	Facility B	Total
Cost of technology upgrade ($/yr)	—	$120,000	$120,000
N credits bought ($/yr)	$140,000	—	$140,000
N credits sold ($/yr)	—	$140,000	$140,000
Net cost (revenue) ($/yr)	$140,000	$(20,000)	$120,000
Reduced N load to the Bay (lb/yr)	—	10,000	10,000

10,000 credits at $14 each

Why **Potential** Cost Savings?

- A trading program gives participants the incentive to find trades that achieve load reductions at a lower cost
- Our analysis estimates what the cost savings would be if all of these opportunities were identified and acted on
- In practice, we know that trading will not exhaust all of these cost-saving opportunities
  - Markets do not work perfectly
  - Regulators must consider other objectives besides cost savings
- Our analysis includes some of these obstacles (as feasible), but the results should be interpreted as "best-case" or "upper bound" estimates of cost savings



Analytical Framework

9 step process to

- identify the least-cost solution (representing the trading outcome)
- compare it to costs that would occur without trading

Key Inputs for Developing the Framework

- Bay Program's Chesapeake Bay Watershed Model (CBWM) Phase 5.3.2
  - **Watershed network and segmentation**— subdivides the Bay watershed into a linked network of ~2,500 "land-river segments"
  - **Land use/cover**—30 land use categories, which we regroup into 3 crop, 2 pasture, and 2 urban categories
  - **Delivered loads**— annual N and P loads delivered to the Bay's tidal waters from each land use in each land-river segment
  - **BMP nutrient removal rates**—for AgrNPS and urban stormwater best management practices (BMPs)
  - **Acres of BMP implementation**—by land-river segment for
    - Current (2010) conditions
    - TMDL conditions, based on states' Phase 1 watershed implementation plans (WIPs)

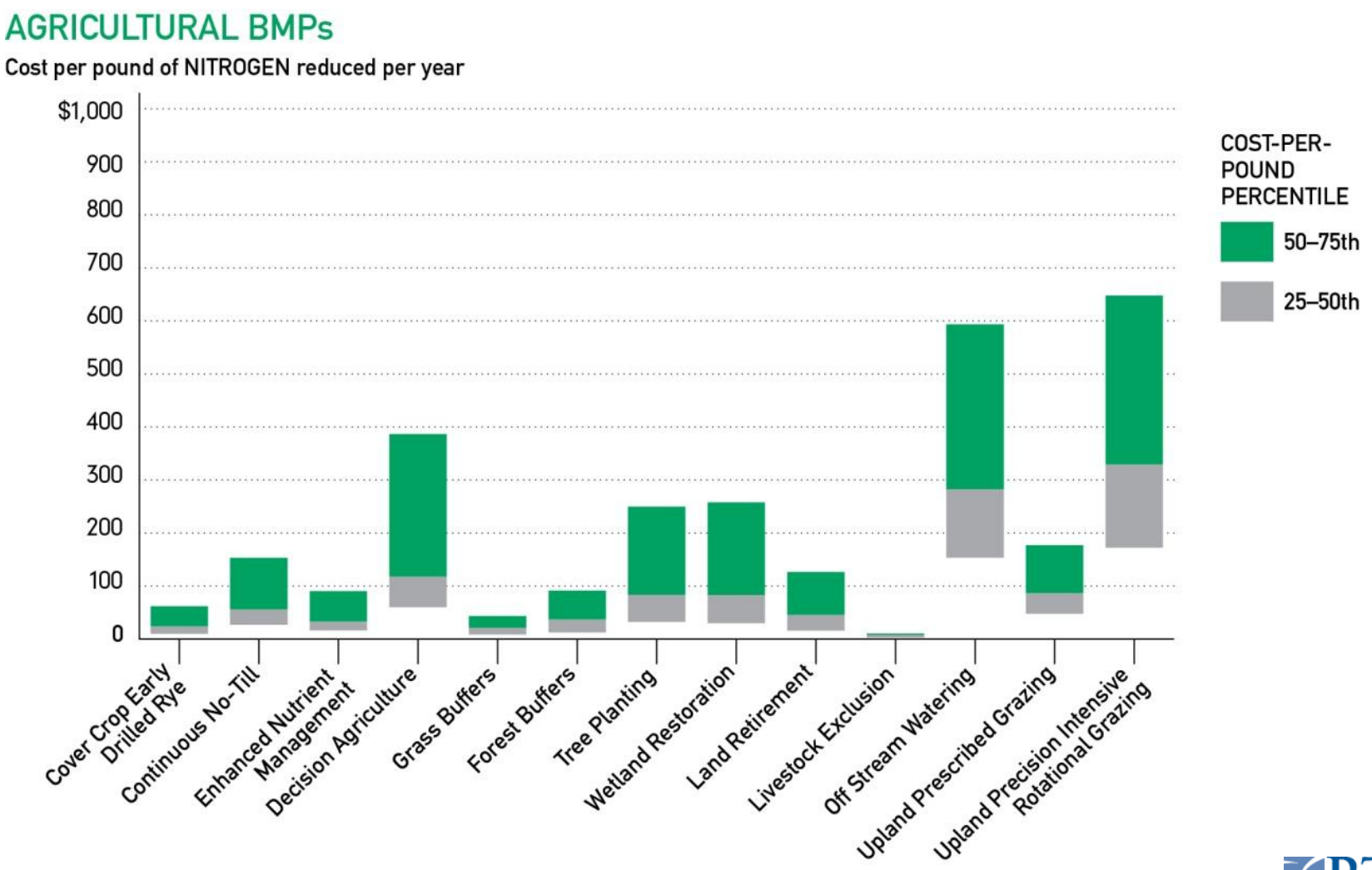
Control Projects, Load Reductions, and Annual Costs

- Significant Point Sources (SigPS)
  - Multiple (16) tiers of wastewater treatment at 475 "significant" municipal and industrial facilities
    - Reducing nitrogen to 8, 5, or 3 mg/L
    - Reducing phosphorus to 1, 0.5, or 0.1 mg/L
  - Annualized costs (capital and O&M) and nutrient removal estimates based on EPA's ongoing cost analysis of the Bay TMDL

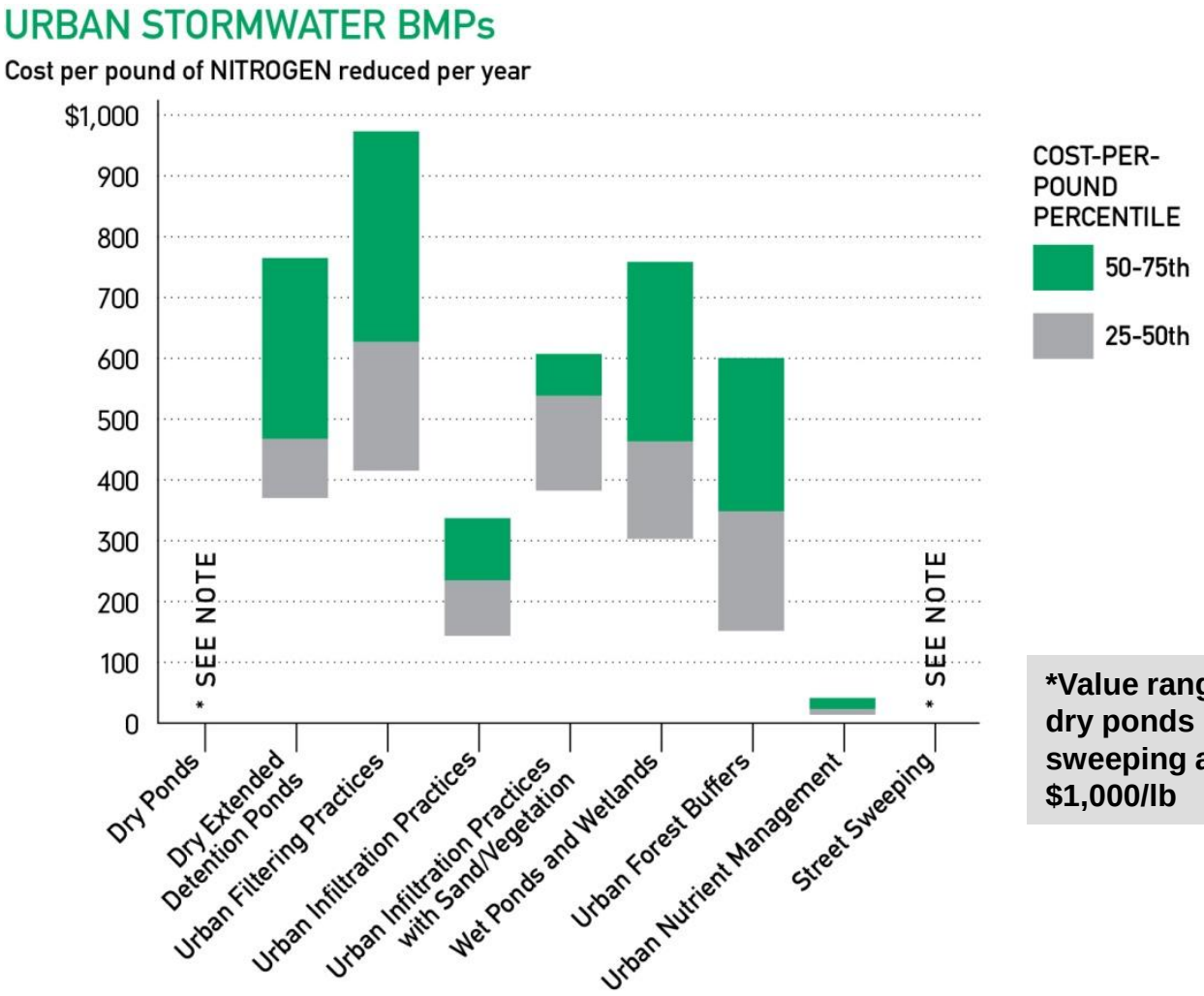
Control Projects, Load Reductions, and Annual Costs

- Agricultural and Urban Stormwater BMPs
  - Annualized unit costs ($/acre/yr) based on EPA's ongoing cost analysis of the Bay TMDL
    - based on a detailed review and summary of existing studies and data sources
    - includes land, installation, and O&M costs

Cost-Effectiveness of AgrNPS BMPs for N Removal

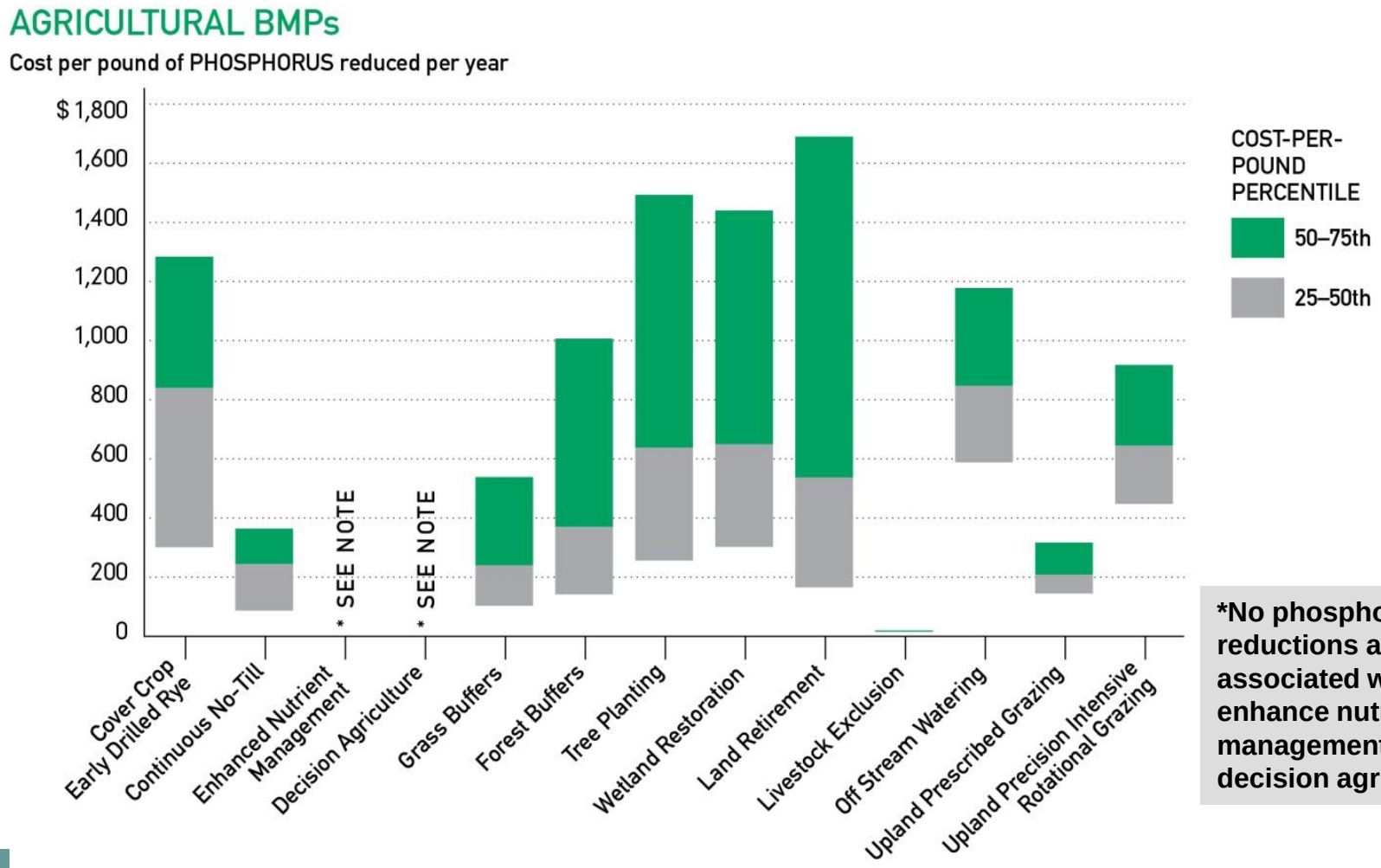


Cost-Effectiveness of Urban BMPs for N Removal



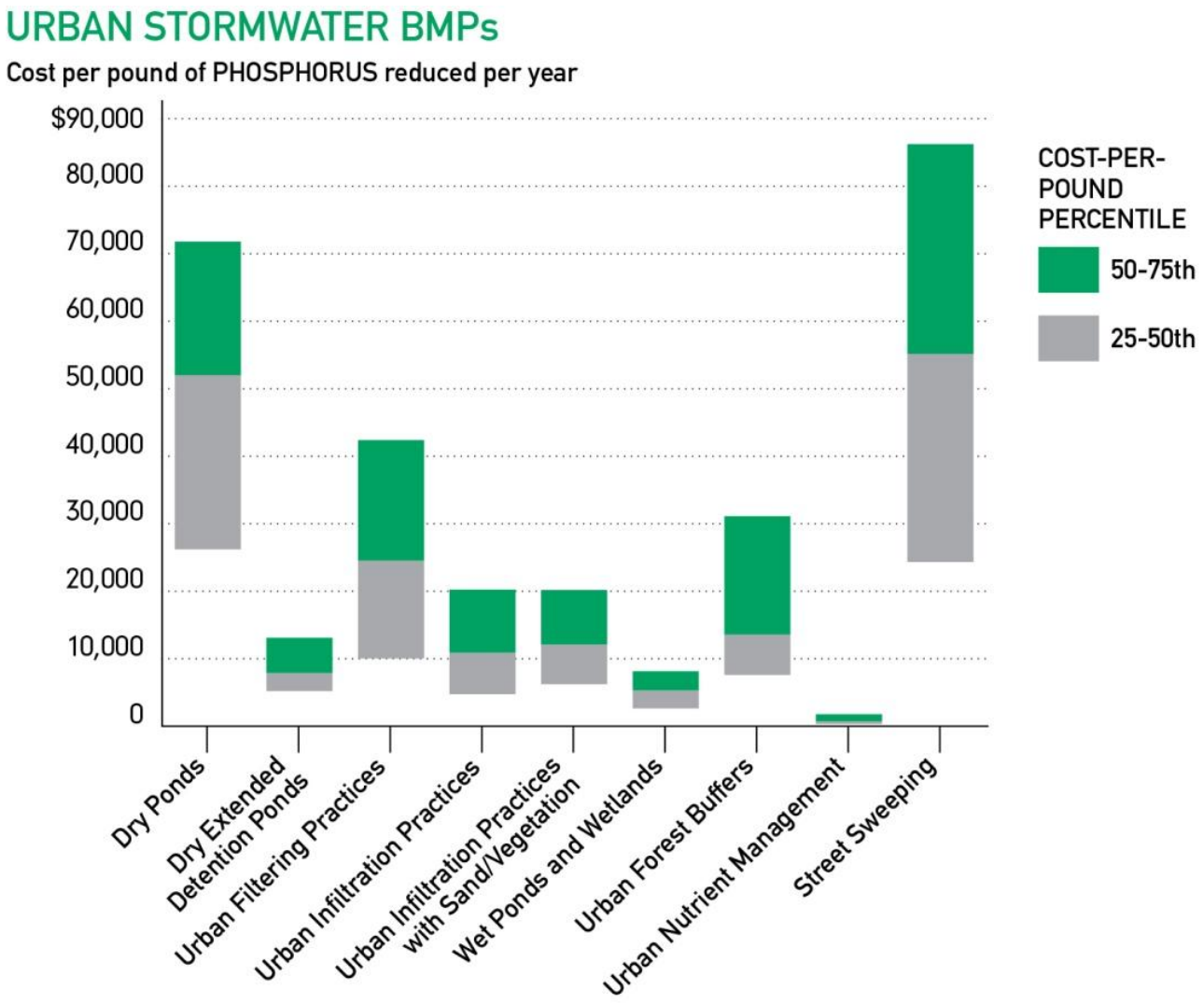
***Value ranges for dry ponds and street sweeping are above $1,000/lb**

Cost-Effectiveness of AgrNPS BMPs for P Removal



***No phosphorus reductions are associated with enhance nutrient management or decision agriculture**

Cost-Effectiveness of Urban BMPs for P Removal



Nutrient Trading Scenarios: Sources

- Which sources are eligible to participate in the market?

3 short term scenarios

- **SigPS-Only**: Trading only among significant point sources
- **SigPS-AgrNPS**: Trading among SigPS and agricultural nonpoint sources
- **SigPS-AgrNPS-Urban**: Trading among SigPS, AgrNPS, and regulated urban stormwater sources

1 long term scenario

- **Offset-Only**: Trading only to offset future growth in wastewater treatment capacity at municipal SigPSs

Nutrient Trading Scenarios: Geography

- What geographic limits are placed on participation in the market?
  - **In-Basin-State**: Trading only allowed between sources located in the same basin and the same state
  - **In-State**: Trading only allowed between sources located in the same state
  - **In-Basin**: Trading only allowed between sources located in the same basin
  - **Watershed-wide**: Trading allowed between any sources located within the Chesapeake Bay watershed

Additional Trading Conditions and Restrictions

- Baseline requirements for AgrNPS
  - Only BMPs above and beyond TMDL are eligible to generate credits
- Baseline requirements for SigPS
  - Only load reductions relative to (1) 2010 level or (2) TMDL waste load allocation (whichever is less) are eligible to generate credits
- Transaction costs
  - 38% mark-up for AgrNPS costs to account for relatively high monitoring, verification, reporting and related trading costs
- Trading ratio (2:1)
  - To buy credits from AgrNPS, SigPS and urban sources must buy 2 credits for each 1 credit needed
  - Accounts for relative uncertainty associated with performance of agricultural BMPs

Additional Conditions and Restrictions (cont'd)

- Limits on Loss of Productive Farmland
  - No more than 25% of farmland within each land-river segment and land-use category can be idled for BMP implementation
- Limits on total credit trades
  - EPA analysis indicates that a maximum of 9 million lbs of N and 200,000 lbs of P could be traded between the 92 tidal segments without causing water quality impairments in these tidal areas

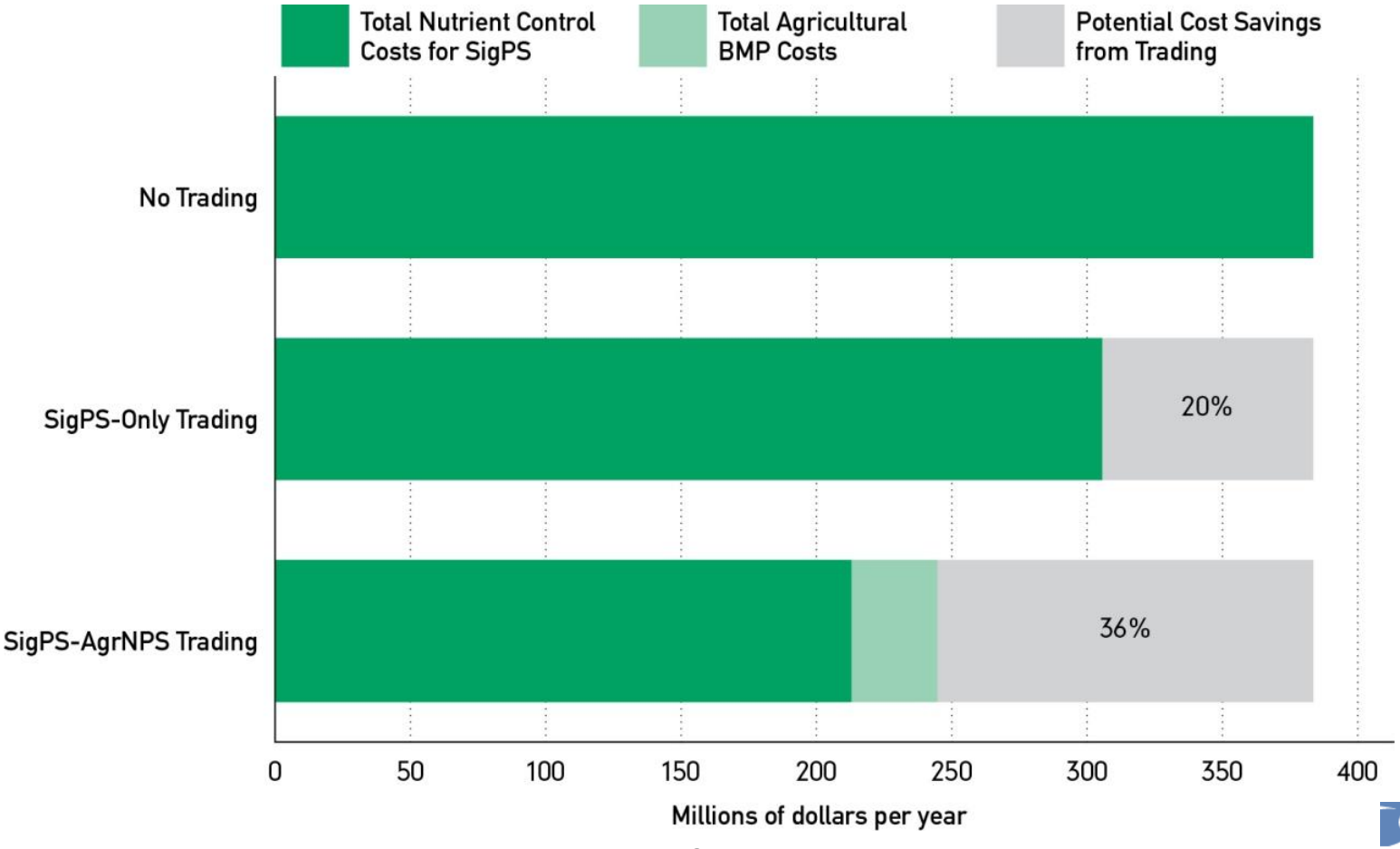
Key Conditions for a Successful Trading Program

- Verification
  - A robust system for verifying load reductions by credit sellers (in particular agricultural NPSs) is essential
- Local water quality protection
  - The geo-spatial redistribution of load reductions resulting from trading must not violate local water quality standards
- Measurable and enforceable cap
  - The maximum total allowable pollution loads across all regulated sources must be firmly established

Summary of Findings…

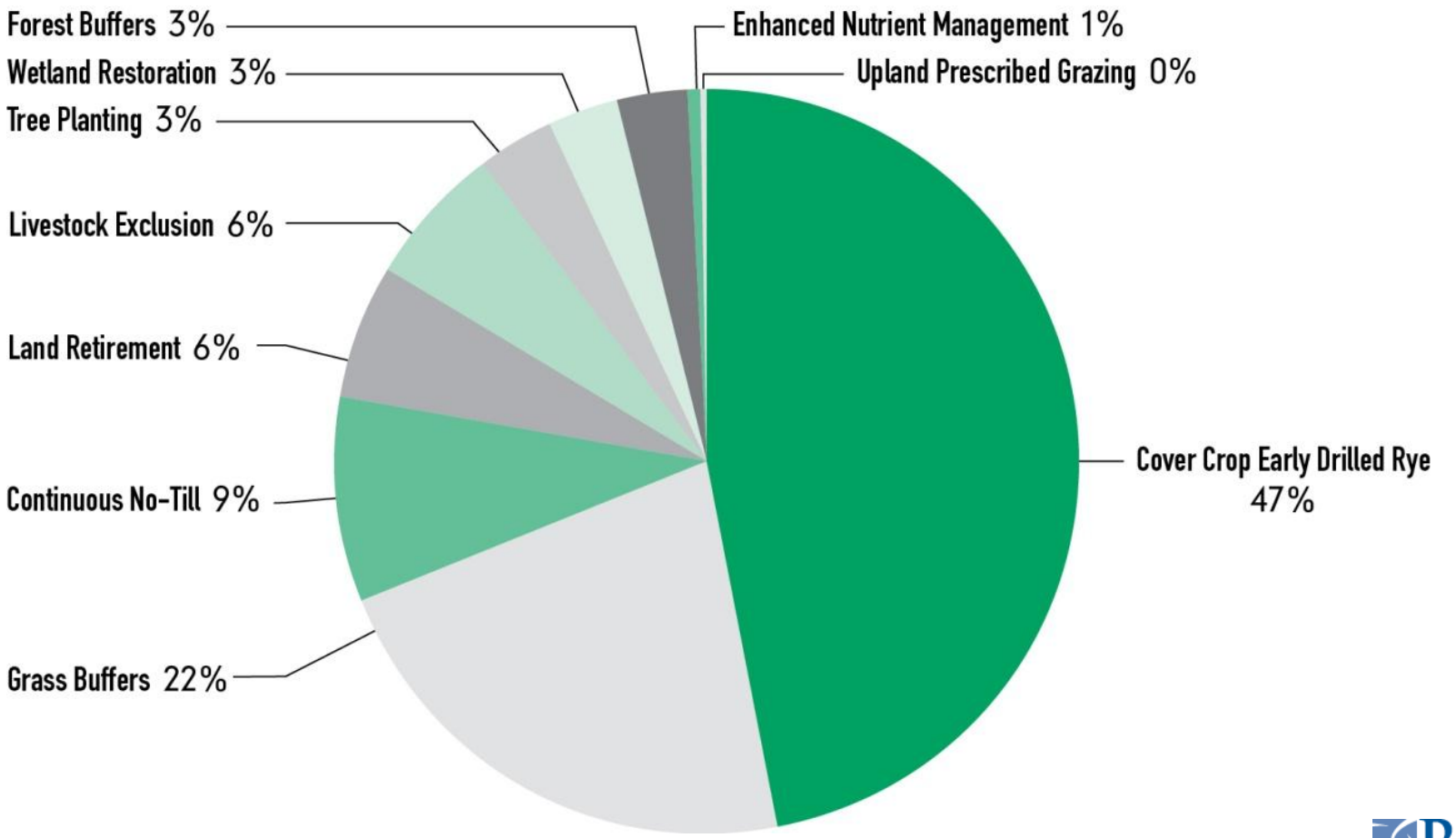
Costs of Meeting SigPS Load Reduction Targets

No Trading vs. In-Basin-State Trading

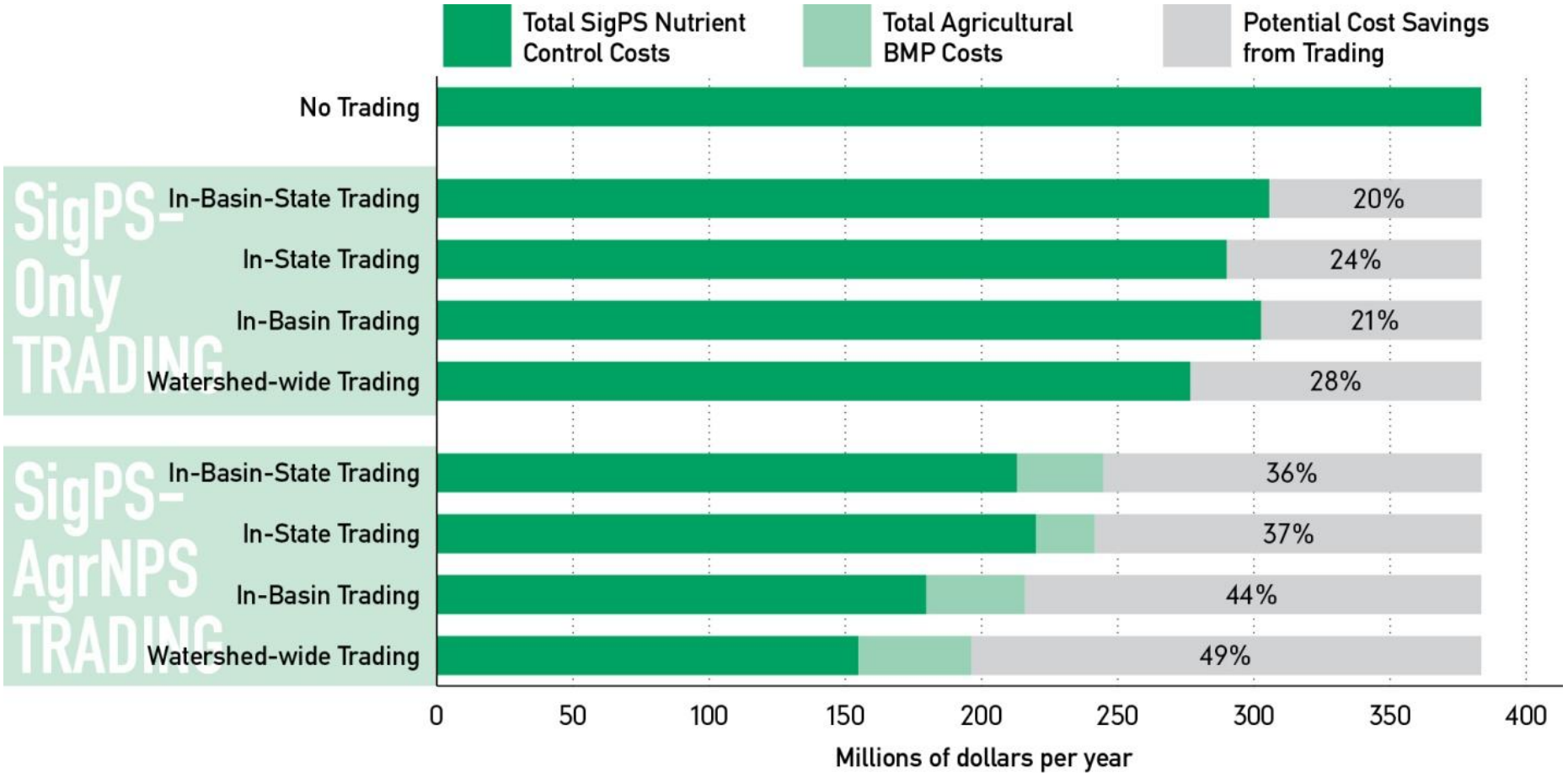


Distribution of Costs Across Agricultural BMPs

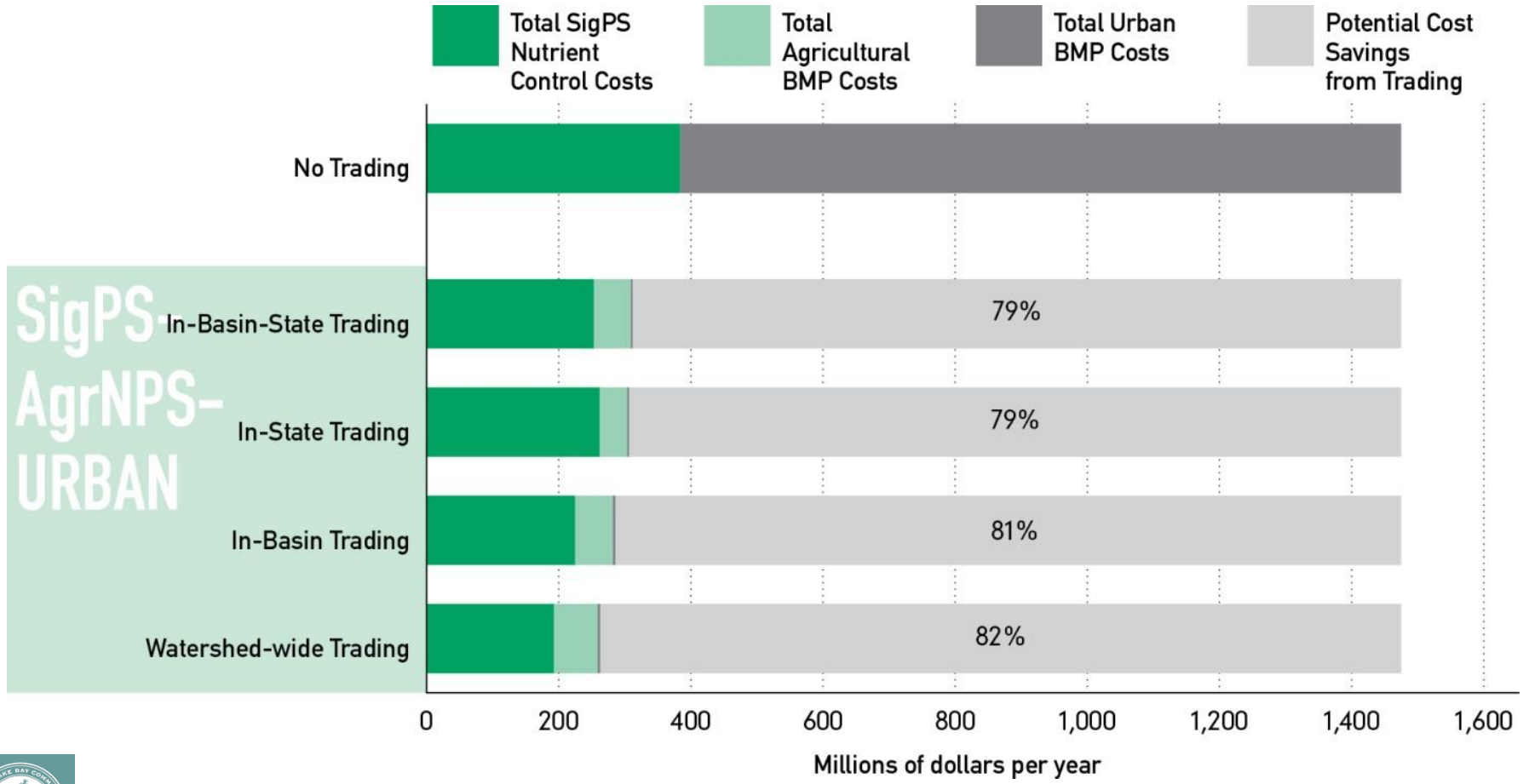
SigPS-AgrNPS & In-Basin-State Trading



Costs of Meeting SigPS Load Reduction Targets

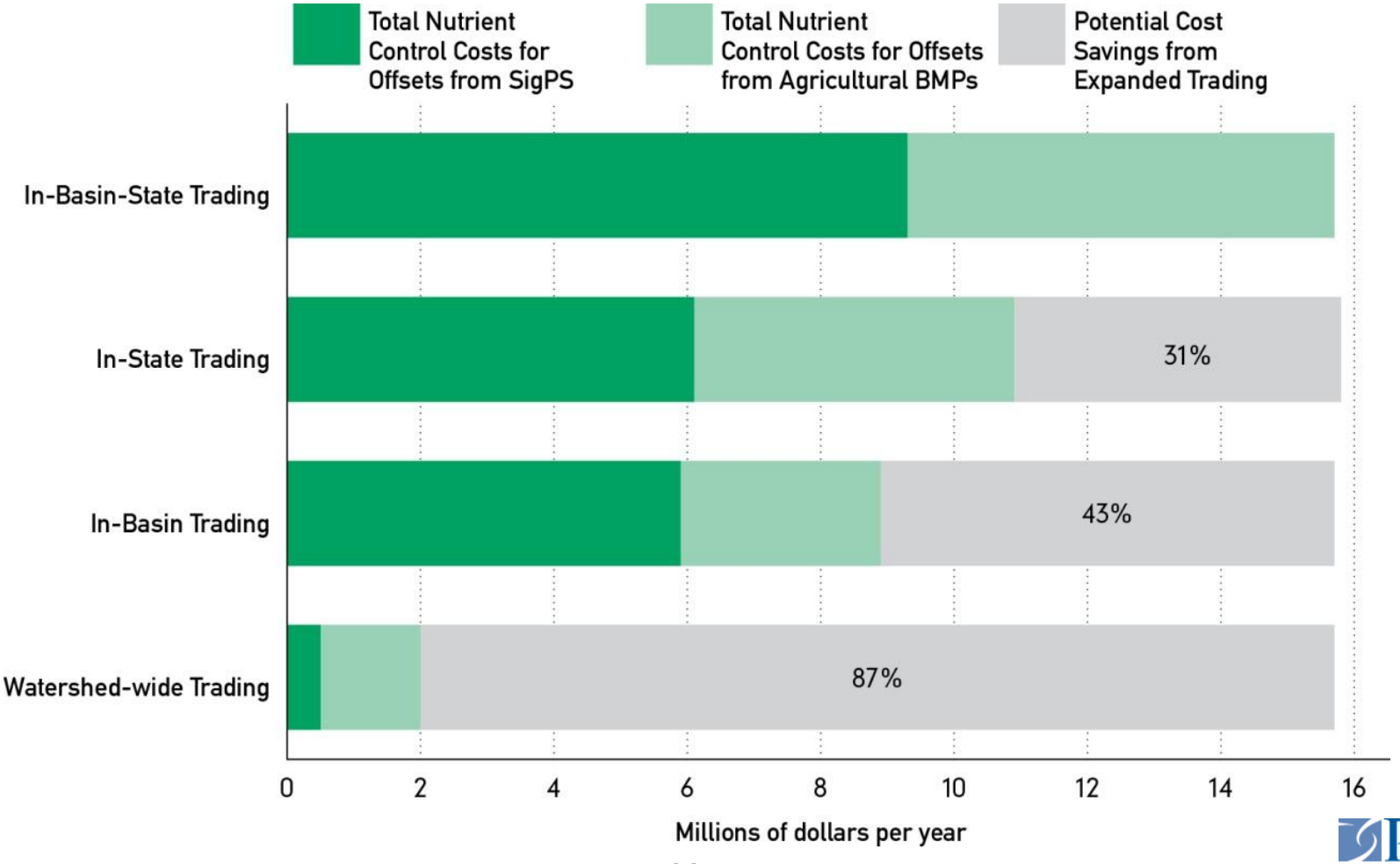


Costs of Meeting SigPS and Regulated Urban Stormwater Load Reduction Targets



Costs of Offsets for Added Capacity at Municipal SigPS

Long Term Offset-Only Trading Scenarios



Caveats and Uncertainties

- Other regulatory requirements (e.g., other local TMDLs or stormwater requirements) and geospatial considerations may limit trades
- Limitations and uncertainties associated with CBWM carry over to this analysis
- Nutrient control technology and BMP cost estimates are based on average values and subject to uncertainty
- Trades involving AgrNPS assume prior and full compliance with their TMDL load allocations
- The timing and duration of credits is simplified in our analysis by expressing everything in annualized terms

Key Findings

- Nutrient credit trading has the potential to substantially reduce the costs of achieving TMDL limits for the Bay
- The costs of meeting SigPS load reduction requirements could be reduced by
  - as much as 20-28% with SigPS-Only trading
  - as much as 36-49% with SigPS-AgrNPS trading
- These potential cost savings are greatest when trading is allowed across the entire watershed
- The potential costs savings are particularly high when regulated urban sources are allowed to purchase credits