Economic Fundamentals of Nutrient Trading

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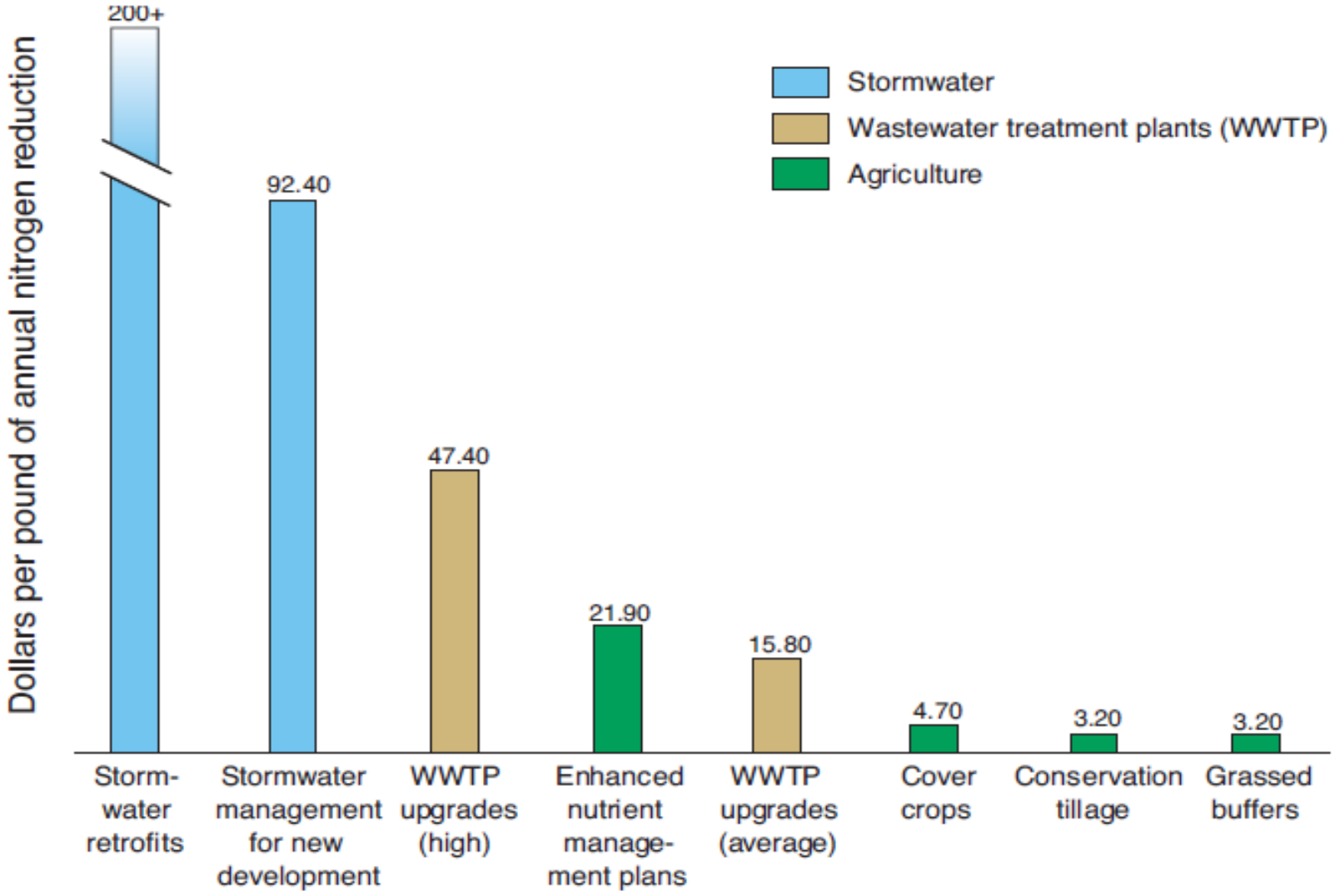
Estimated costs of TMDL compliance in Maryland

- **Watershed implementation plans (WIPs)**
  - MDE estimates that compliance with total maximum daily load (TMDL) in 2025 will cost $14.4 billion in Maryland
  - Urban stormwater management = $7.4 billion
    - Local government covers the majority of this expense
  - Municipal wastewater treatment = $2.4 billion
  - Septic systems = $3.7 billion
  - Agriculture = $0.9 billion

Variation in abatement cost per pound N



Source: Brainard, Chesapeake Bay Quarterly; World Resources Institute

Urban stormwater BMPs

Agricultural best management practices (BMPs)

Cover crops

Conservation tillage

Regulated sources

- **Clean Water Act (CWA)**
  - Focus mainly on point sources (PS) that discharge from pipe
    - Wastewater treatment plants (WWTPs)
    - Municipal separate stormwater sewer systems (MS4s) starting in 1987
  - National Pollution Discharge Elimination System
    - NPDES permits set regulated baseline for each entity
- **Pollution standards do not allow flexibility**
  - Each entity must meet the pollution standard
  - Some entities have higher abatement costs than others

Nutrient trading

- **Cost-effectiveness**
  - Lower overall cost of meeting the same environmental goal
  - Variation in abatement costs needed to create potential gains from trading
- **Voluntary participation and flexibility**
  - Without trading: Internal options only
  - With trading: Combination of internal options or offset credits allowed
- **Incentives**
  - Provides incentives for entities that already meet regulatory baseline to reduce pollution even further and sell offset credits
  - May spur innovative technologies

SO2 trading program

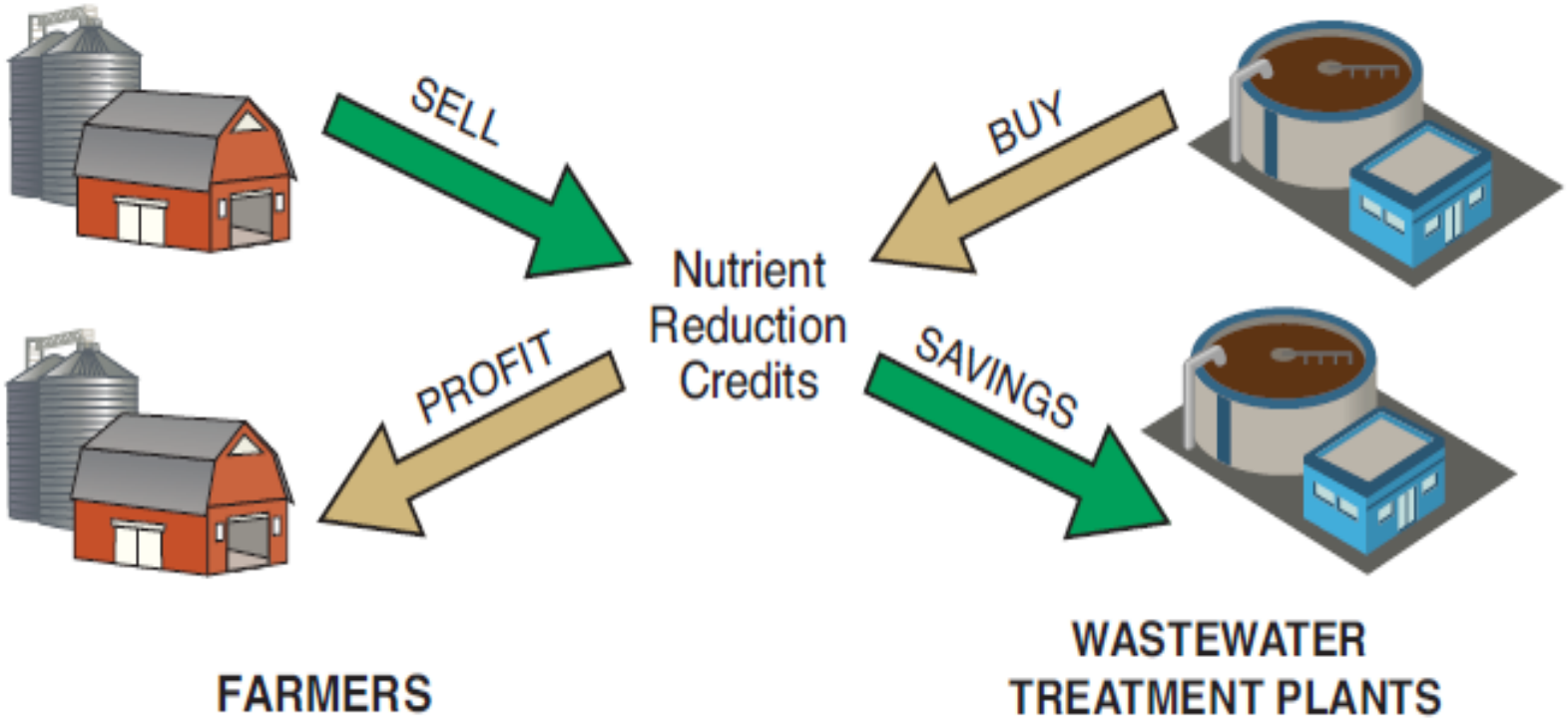
- **Sulfur dioxide (SO2) trading program**
  - Clean Air Act Amendments (1990)
  - Allowed large coal-fired power plants to trade SO2 pollution credits
  - Meet goal to reduce SO2 (and acid rain) at lower cost

- **PS-PS trading**
  - Within sector trading between regulated point sources (PS)
  - Allows trading in time and smooth upgrading schedule

- **Why did SO2 trading program work?**
  - Air emissions mixed broadly (large markets)
  - Easier to monitor and verify emissions at large point sources
  - Lower transaction costs

Cross sector (PS-NPS) trading

Treatment plant (point source)
Farm (non-point source)



Source: Brainard, Chesapeake Bay Quarterly

Example on PS-NPS trading

- **Without trading**
  - Point source (PS): wastewater treatment plant
    - Permit requires annual reduction of 1000 pounds of N
    - Annualized abatement cost = $30 per pound N
  - Total costs without trading = $30,000

- **With trading**
  - Assume agriculture adopts best management practice (BMP)
    - Agriculture sells offset credits at annualized cost = $10 per pound N
  - Assume treatment plant uses mixed strategy
    - Internal upgrade costs (50%) = 500 pounds N * $30 per pound= $15,000
    - Purchase offsets (50%) = 500 pounds N * $10 per pound= $5,000
  - Total costs with trading = $20,000

- **Potential gains from trading = $10,000**

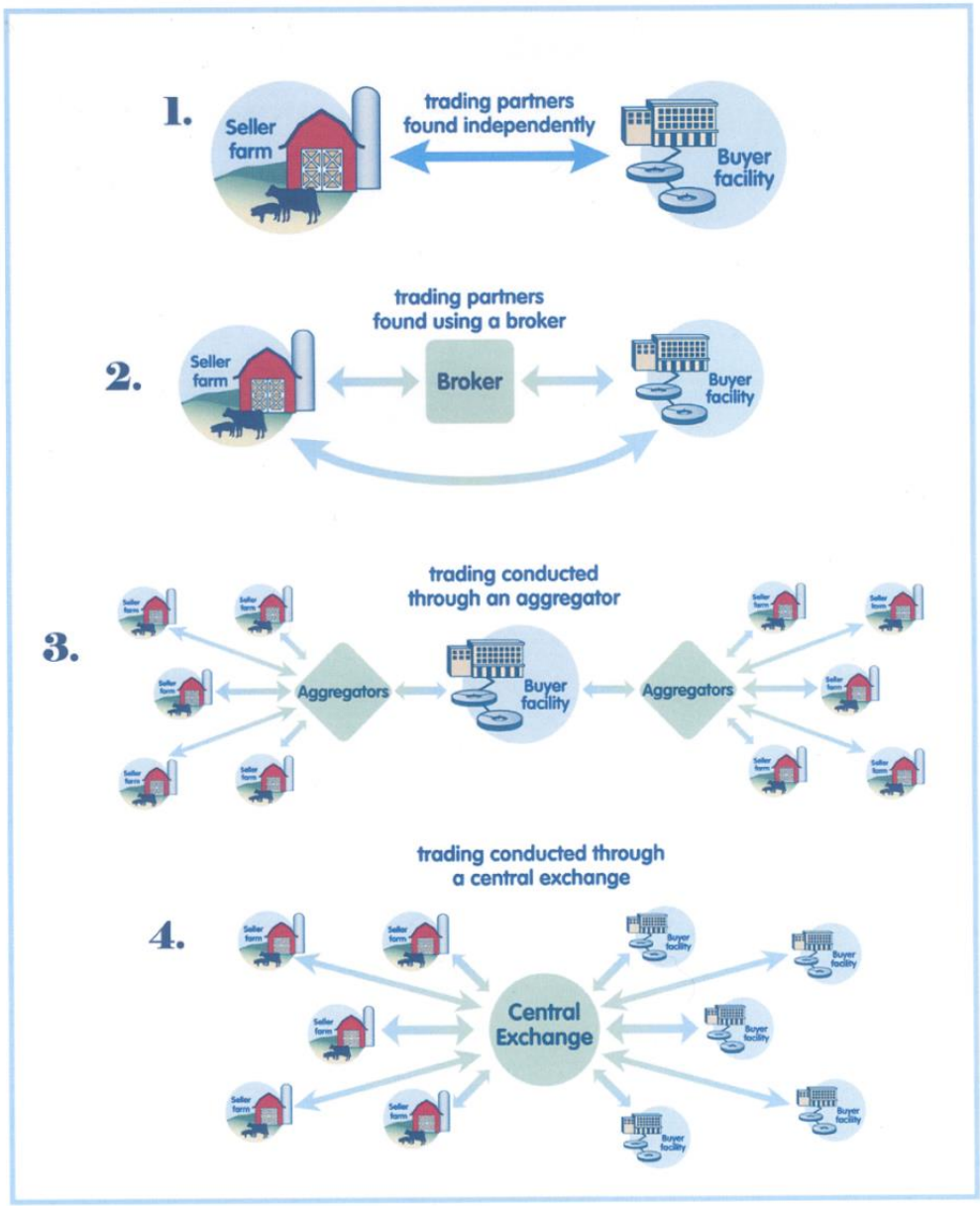
Agriculture

- **Agricultural best management practices (BMPs)**
  - Cost-share programs to incentivize BMP adoption
    - Federal programs (EQIP, CRP, CREP, CSP)
    - State program (MACS)

- **Baselines for agricultural operations**
  - Agriculture does not require NPDES permit (except CAFOs)
  - Baseline level of pollution load must be achieved before eligible to participate
  - Only reductions below the baseline can be traded as pollution credits

- **Tradeoff setting the baseline**
  - Strict baseline can generate additional reductions that would not occur otherwise but also discourages participation
  - Farmers far from baseline need to adopt more practices at their own costs before being eligible to participate

Market structures



Source: Payne, MDA

Market structures

- **Bilateral negotiation**
  - Individual buyers and sellers make contracts
  - Price set through negotiation (like used car market)
    - May likely involve brokers or aggregators

- **Reverse auction**
  - Clearinghouse ranks all bids based on lowest cost per pound nutrient reduction
  - Bidding behavior
    - Higher bid leads to higher payment but lower chance of being awarded funding
  - Cost-effective mechanism to reveal BMP cost

Challenges for nutrient trading

- **Transaction costs**
  - Finding and negotiating with trading partners
  - Monitoring and verification costs

- **Estimating pollution reductions for agricultural BMPs**
  - Average BMP efficiencies calculated based on expert panels and site-specific conditions (soil, slope, management)
  - Actual nutrient reductions may vary from average BMP efficiencies temporally and spatially

- **Liability for buyers**

- **Pollution hotspots**

Trading ratios

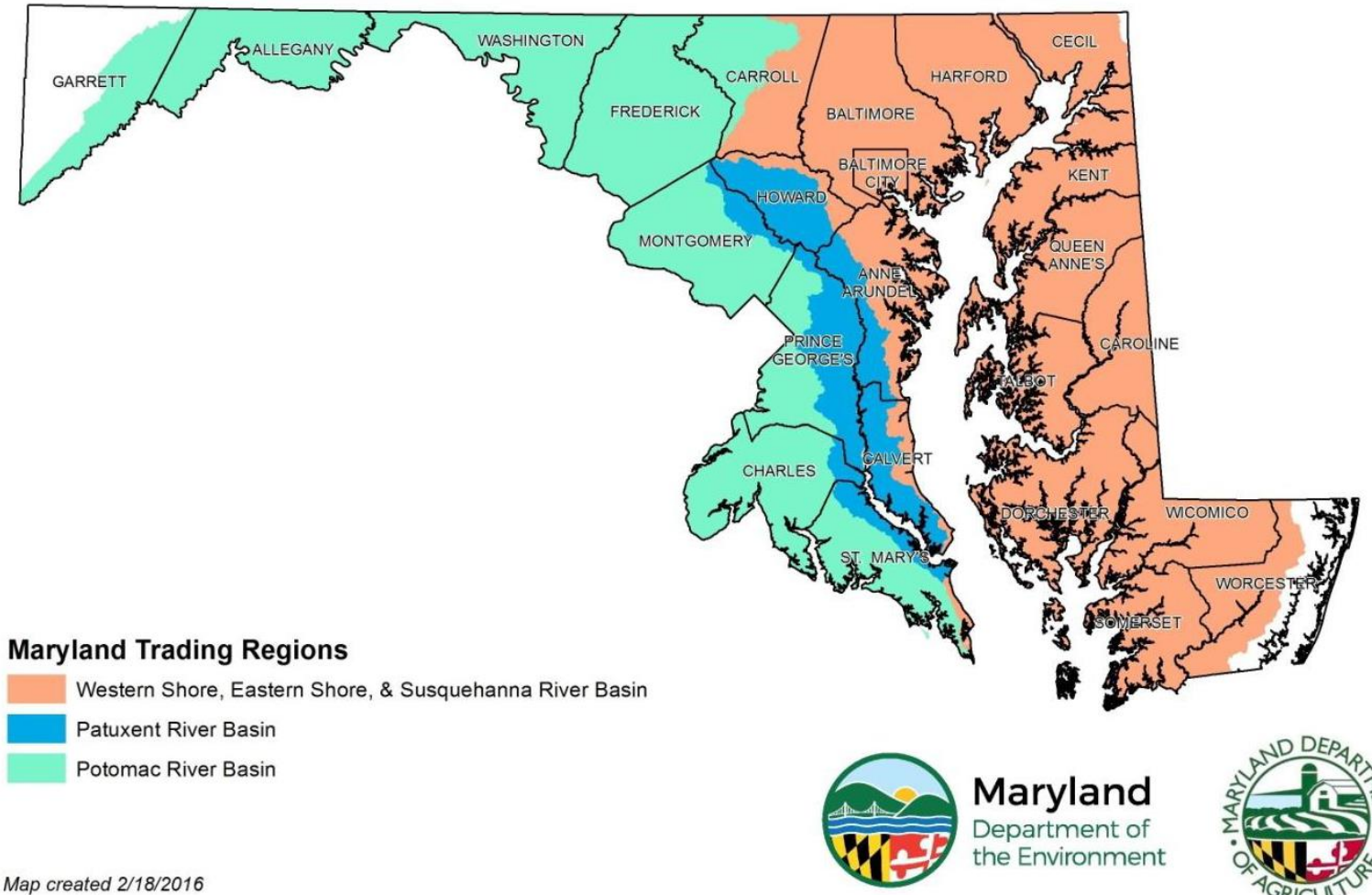
- **Safety factor to address uncertainty in load estimates**
  - Example with trading ratio at 2:1
  - 2 credits from seller (agriculture) = 1 credit for buyer (treatment plant)

- **Insurance pool for buyer**
  - NPDES permit requires buyer to be liable if purchased credits from individual agricultural BMP fail
  - Additional credits from high trading ratio creates insurance pool to reduce risk of buyer liability

- **But high trading ratio or strict baseline may reduce market activity**

Trading basins

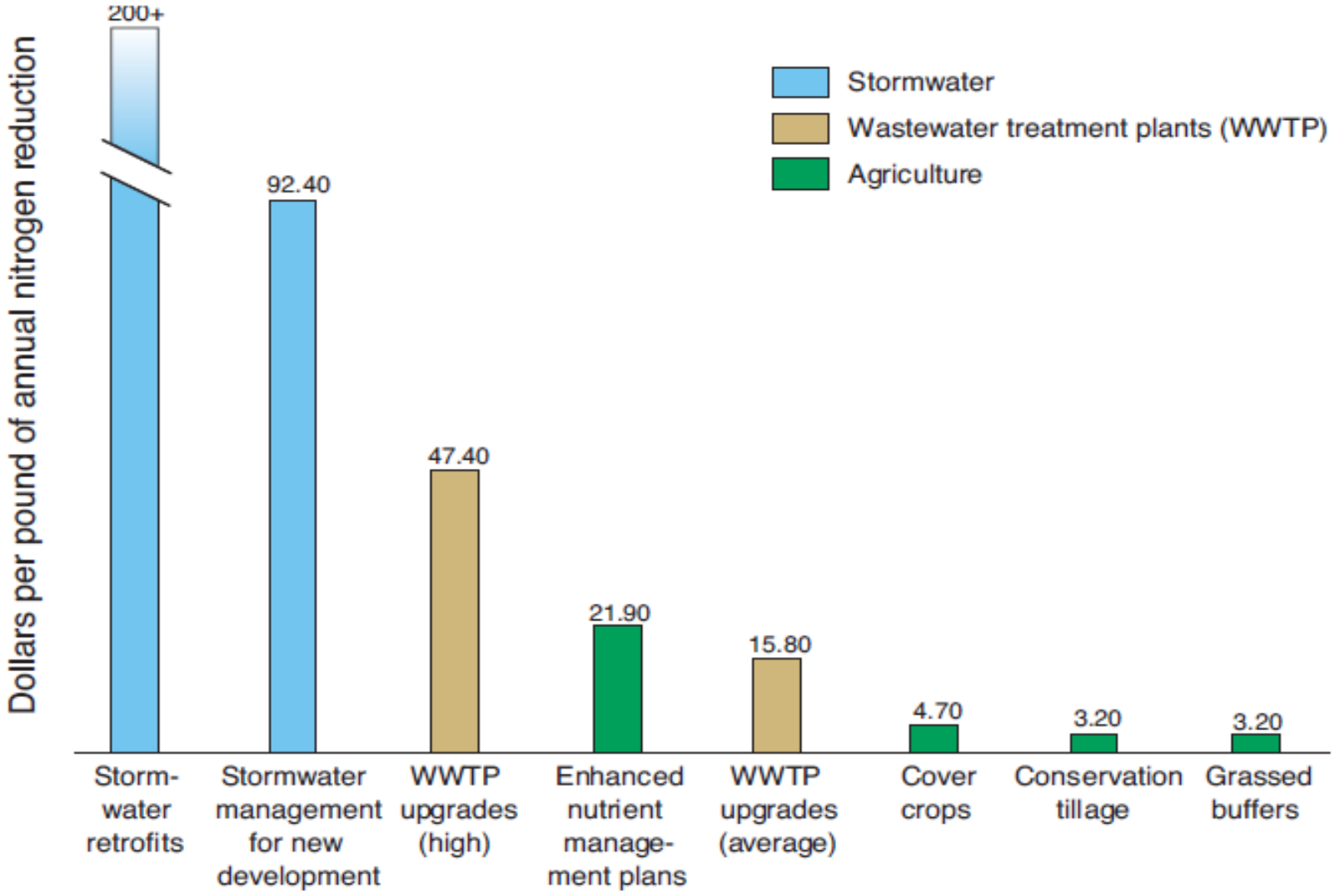
- **Geographic restrictions on trading with the same basin or watershed**
  - Trades between sources only in same basin or watershed
  - Reduces pollution hotspots



Why nutrient trading can play role in MD

- **Maryland has large urban sectors**
  - Large cost of compliance with TMDL in urban sectors
  - Urban stormwater management = $7.4 billion
  - Municipal wastewater treatment = $2.4 billion
  - Septic systems = $3.7 billion
- **Population growth in urbanized areas**
- **Significant variation in abatement costs between sectors**
  - Potential gains from trading

Variation in abatement cost per pound N



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