

# Incorporating Ecosystem Services into the Genuine Progress Indicator (GPI)



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# Outline

- I. What is the GPI and why is it useful?
- II. How are ecosystem services currently used in the GPI?
- III. What are the implications of
  - ES as a cost vs. benefit
  - Inclusive vs. exclusive valuation
  - ES Valuation Methodology
- IV. Recommendations for future work

# It's All Greek: Ecology and Economy

**“Eco” is based on Greek word *Oikos* for Home**

## Ecology

Study of the Home



## Economy

Study of Managing the Home



# Gross Domestic/State Product

## Current Definition of *Prosperity*? The GDP/GSP

- “total monetary value of all final goods and services produced domestically”
- Does **NOT** include externalities
- Does **NOT** include social contributions
- Does **NOT** address social equity
- Encourages defensive spending
- ‘Enjoys’ disasters



Cleaning up the spill will likely be enough to slightly offset the negative GDP muscle through Economy Impact of all this on GDP, J.P. Morgan said. (WIS.J., June 15, 2010)

(Reuters, October 28, 2005)





*“GDP...measures everything except that which makes life worthwhile.”*

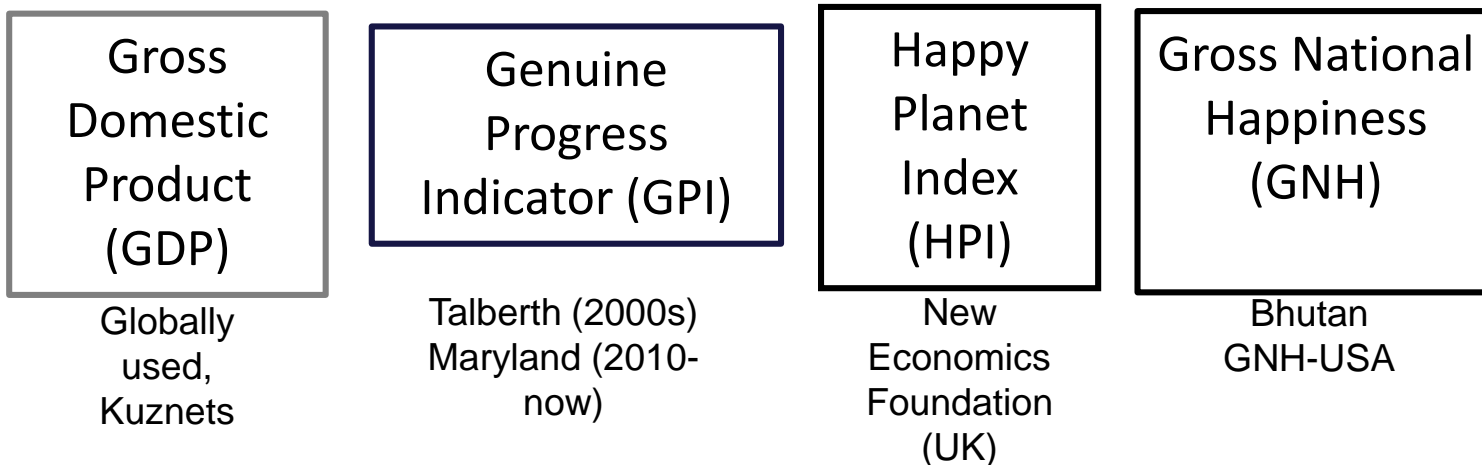
- Robert F. Kennedy  
March 18, 1968



*"The welfare of a nation can scarcely be inferred from a measurement of national income"*

- Simon Kuznets, Father of the GDP, 1934

# Scale of Indicators of Prosperity



Economic

Well-Being

Happiness

Data/Objective

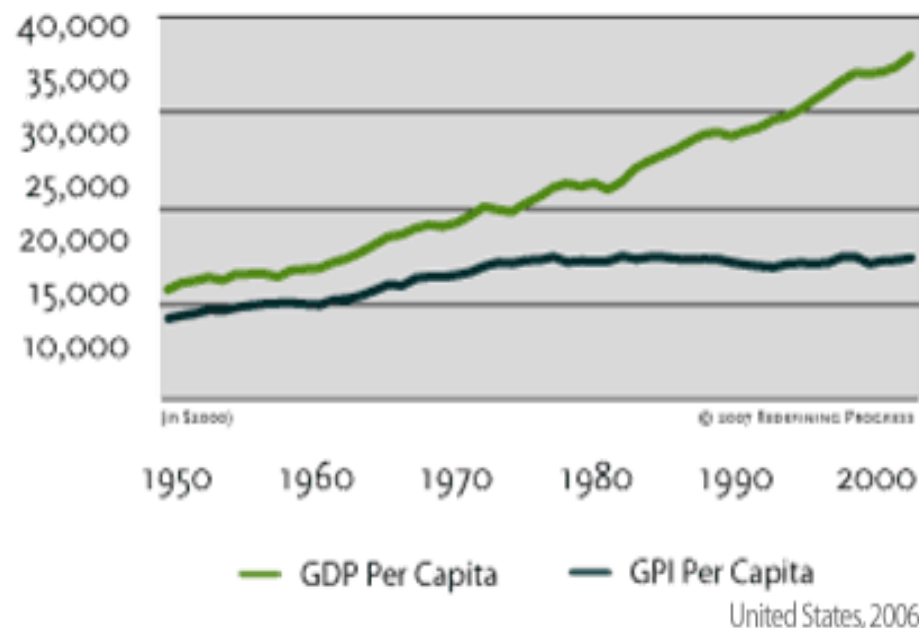
Polling/Subjective

# Genuine Progress Indicator (GPI)

## Better Metric of Prosperity

- Quantifies & Values Impacts of Economic Activity on Experienced Welfare on a National/State Scale; Based on Academic Studies or Government research
- Modifies GDP by Including “triple bottom line”
  - Income Inequality
  - Non-market social benefits
  - Negative environmental & social externalities
- Part of “Beyond GDP” and “New Economy” Movements

GROSS PRODUCTION VS. GENUINE PROGRESS, 1950-2004





# Includes 26 Indicators

## Economic Indicators

Personal Consumption Expenditures



Income Inequality



Adjusted Personal Consumption



Services of Consumer Durables



Cost of Consumer Durables



Cost of Underemployment



Net Capital Investment



## Environmental Indicators

Cost of Water Pollution



Cost of Air Pollution



Cost of Noise Pollution



Cost of Net Wetlands Change



Cost of Net Farmland Change



Cost of Net Forest Cover Change



Cost of Climate Change



Cost of Ozone Depletion



Cost of Non-Renewable Energy Resource Depletion



## Social Indicators

Value of Housework



Cost of Family Changes



Cost of Crime



Cost of Personal Pollution Abatement



Value of Volunteer Work



Cost of Lost Leisure Time



Value of Higher Education



Services of Highways & Streets



Cost of Commuting



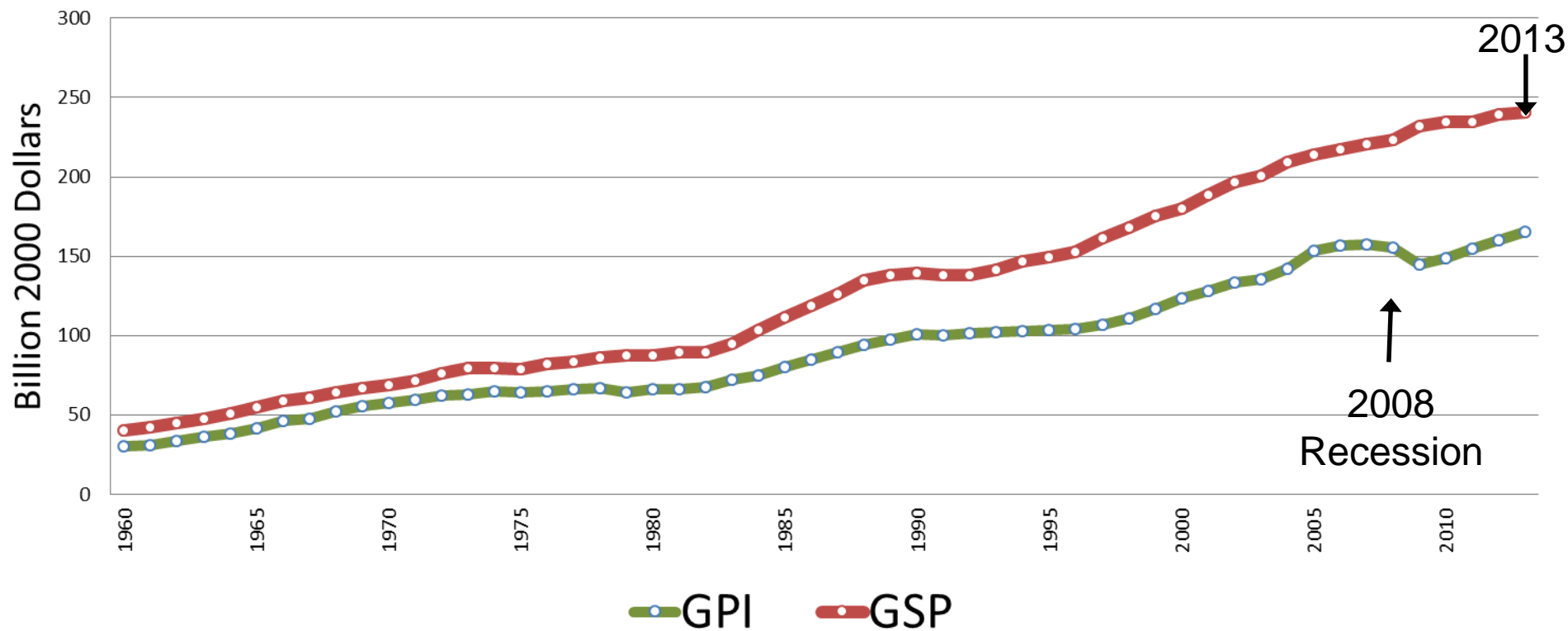
Cost of Motor Vehicle Crashes



Search: "Maryland GPI"

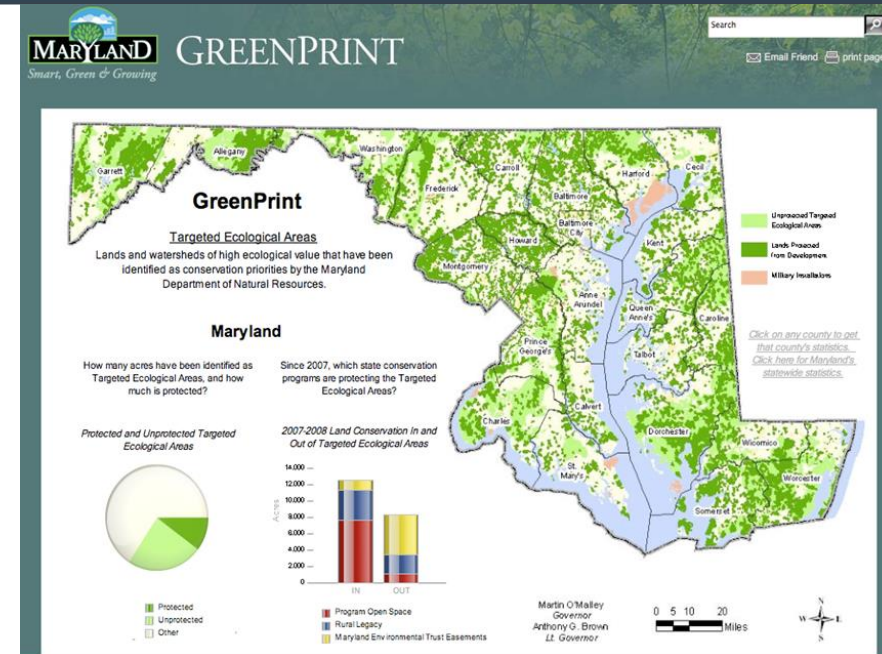
<http://www.dnr.maryland.gov/mdgpi>

## Overview



# Where are Ecosystem Services in the GPI?

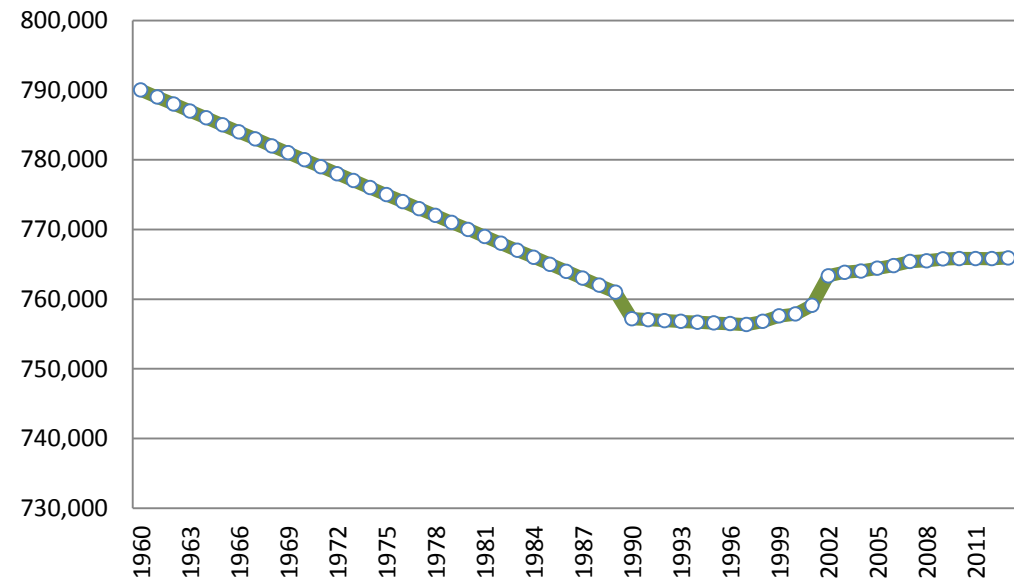
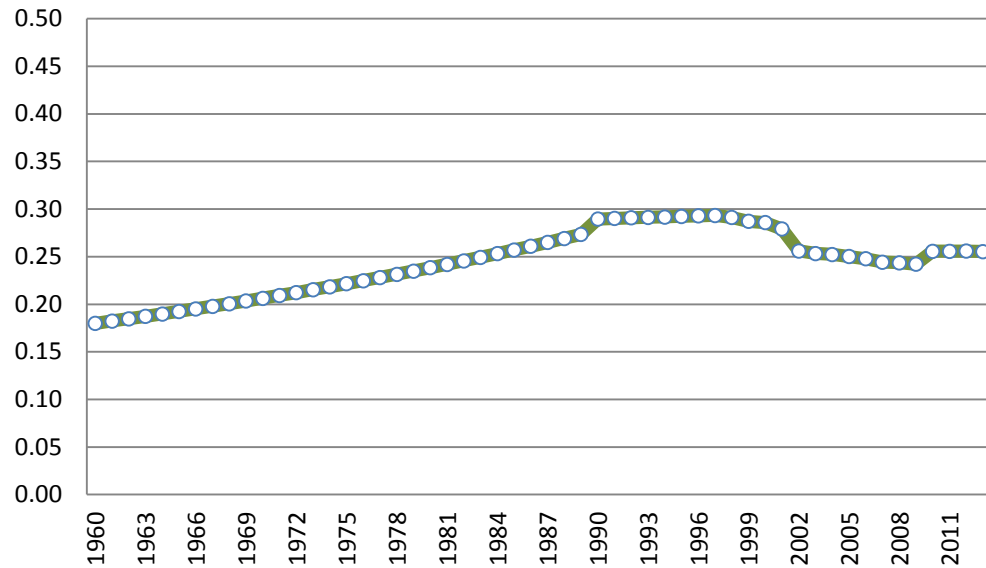
- Cost of Net Wetlands Change
- Cost of Net Forest Land Change
- Cost of Net Farmland Change



Tracks annual value lost from baseline conditions

Value gained from the work of the environment is not included

# Wetlands



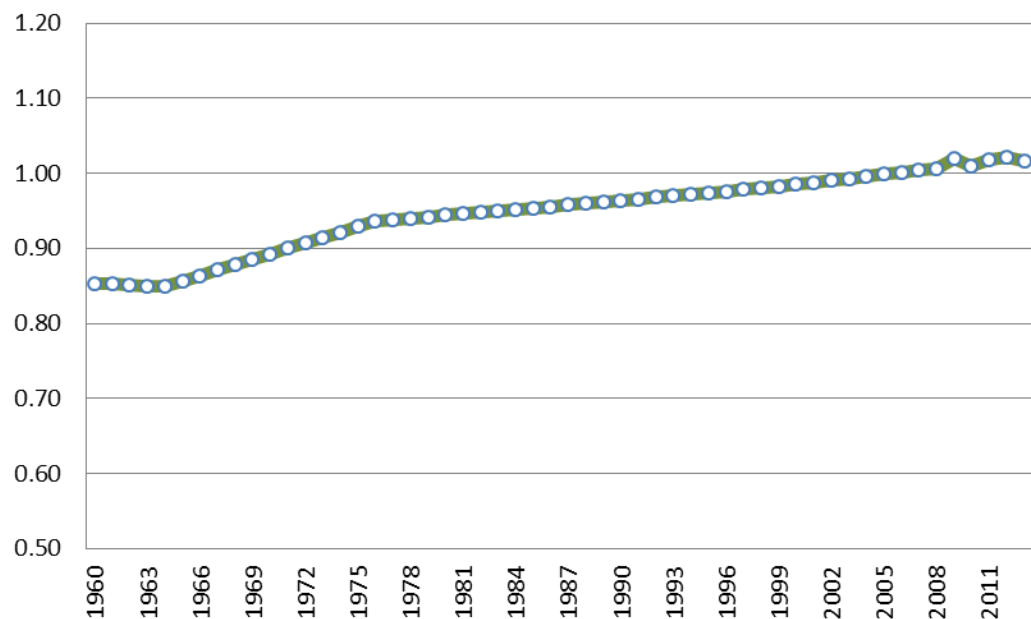
Cost of wetland change over time (in billions of dollars)

Change in wetland acreage over time

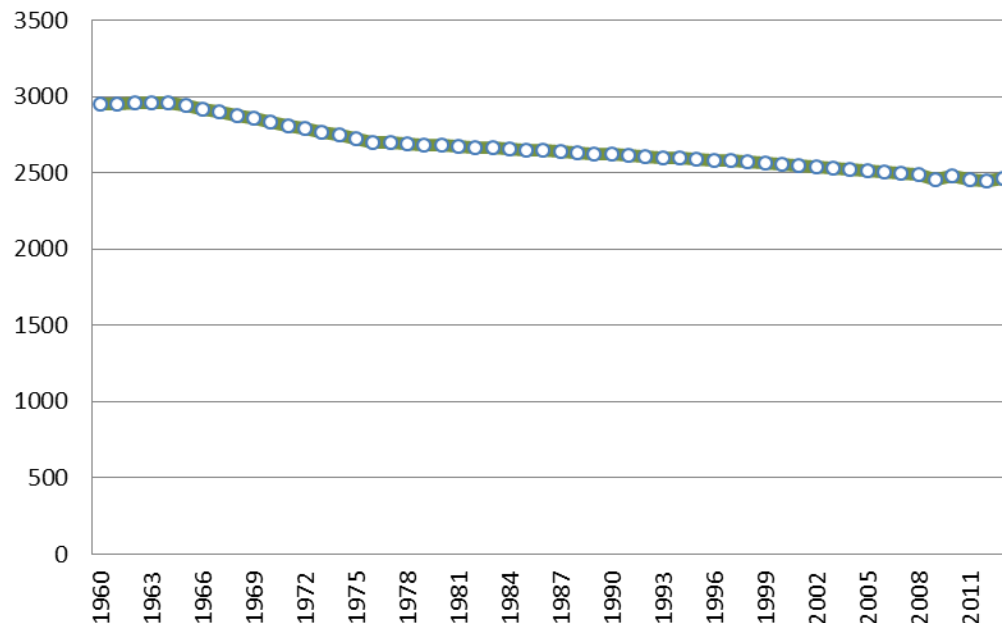
Uses ES value of wetlands from Costanza, 2004- Value increases with scarcity, starting at \$1973 acre<sup>-1</sup> year<sup>-1</sup> in 1960, averages ~\$3400 acre<sup>-1</sup> year<sup>-1</sup> over the 53 years

Non-Market Valuation, positive value not included in GPI calculation

# Forests



Cost of net forest change, in billions of dollars

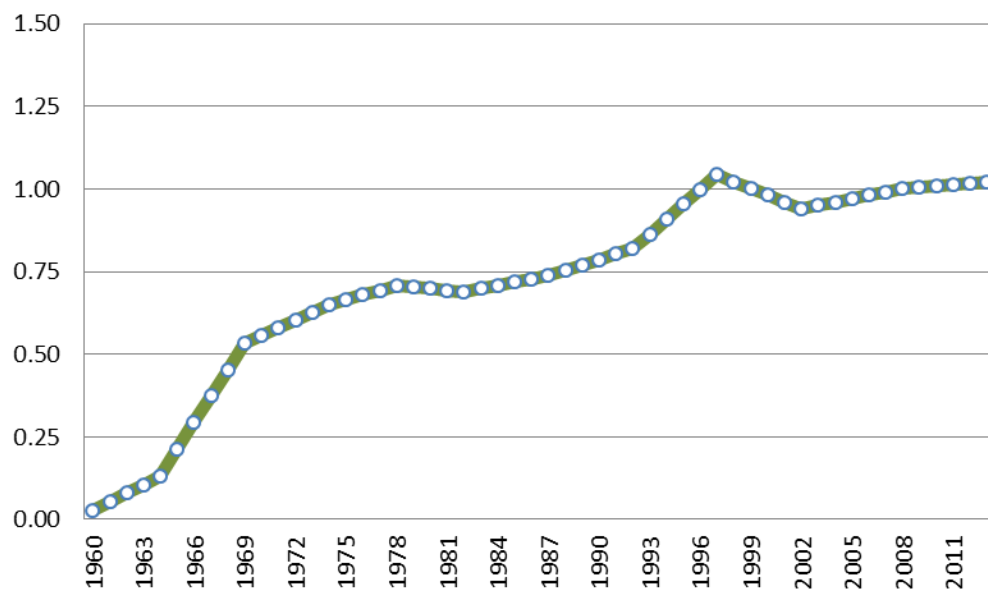


Change in MD forest Acreage, in thousands Of acres

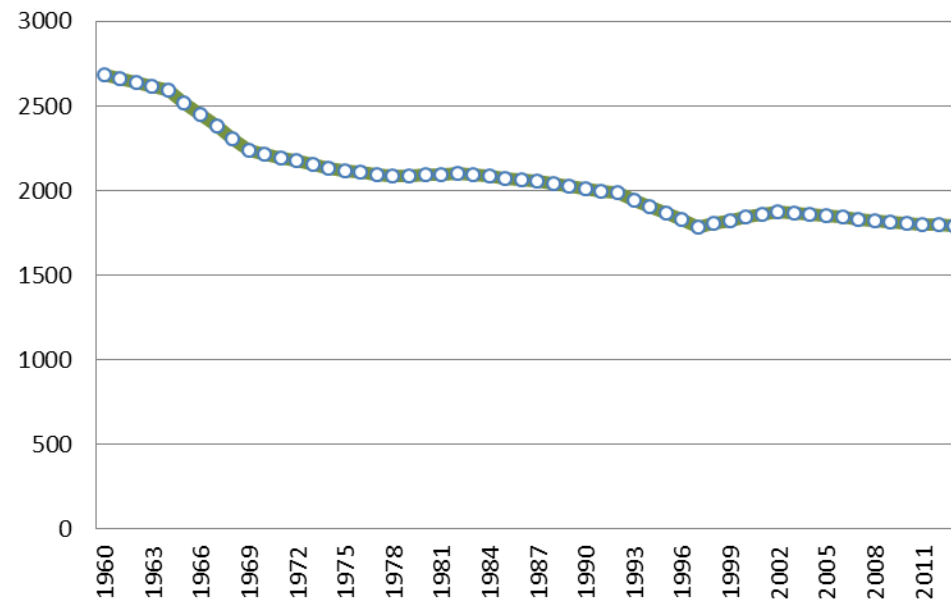
Value of \$318 acre<sup>-1</sup> year<sup>-1</sup>, calculated from literature review,  
Non-market value, positive value not included in GPI calculation



# Farmland



Cost of net farmland change, in billions of dollars



Change in MD farmland acreage, in  
Thousands of acres

Value per acre of \$1,131 per year based on average productivity of farmland in Maryland

Market Value, including value as a positive would double count welfare contribution

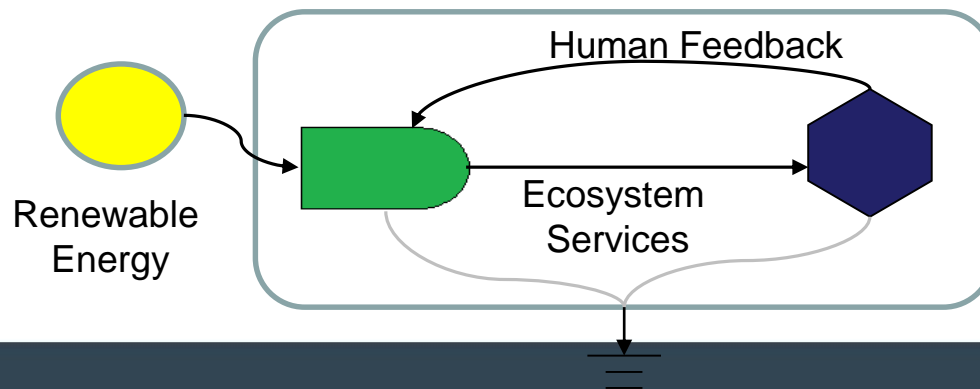
# Environmental Accounting for ES Valuation

- Quantify each ecosystem service in terms of biophysical flow on a consistent baseline (i.e. joules of solar energy) using environmental accounting (i.e. emergy accounting)
- Relate biophysical flow to currency by observing instances where people have exhibited monetary preference for the work of the environment (i.e. market payments, cost of regulatory programs, costs avoided), termed “eco-price”
- Quantify ES in both biophysical and monetary, differentiation between expressed preference and public value, terms allow for flexibility of the model



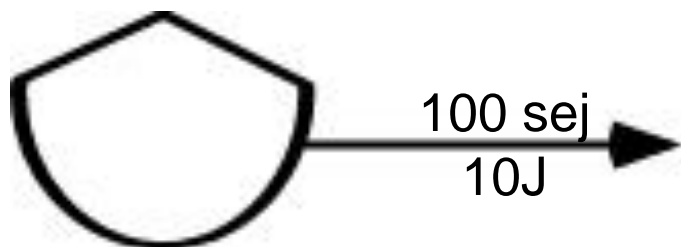
# What is Emergy?

- Yes, I spelled it right
- Created by renowned ecologist H.T. Odum
- Method for accounting for the difference in ability to do work
  - i.e. a joule of electricity can do more work than a joule of sunlight
- Part of systems ecology, a function of the larger system of which the process is a part.



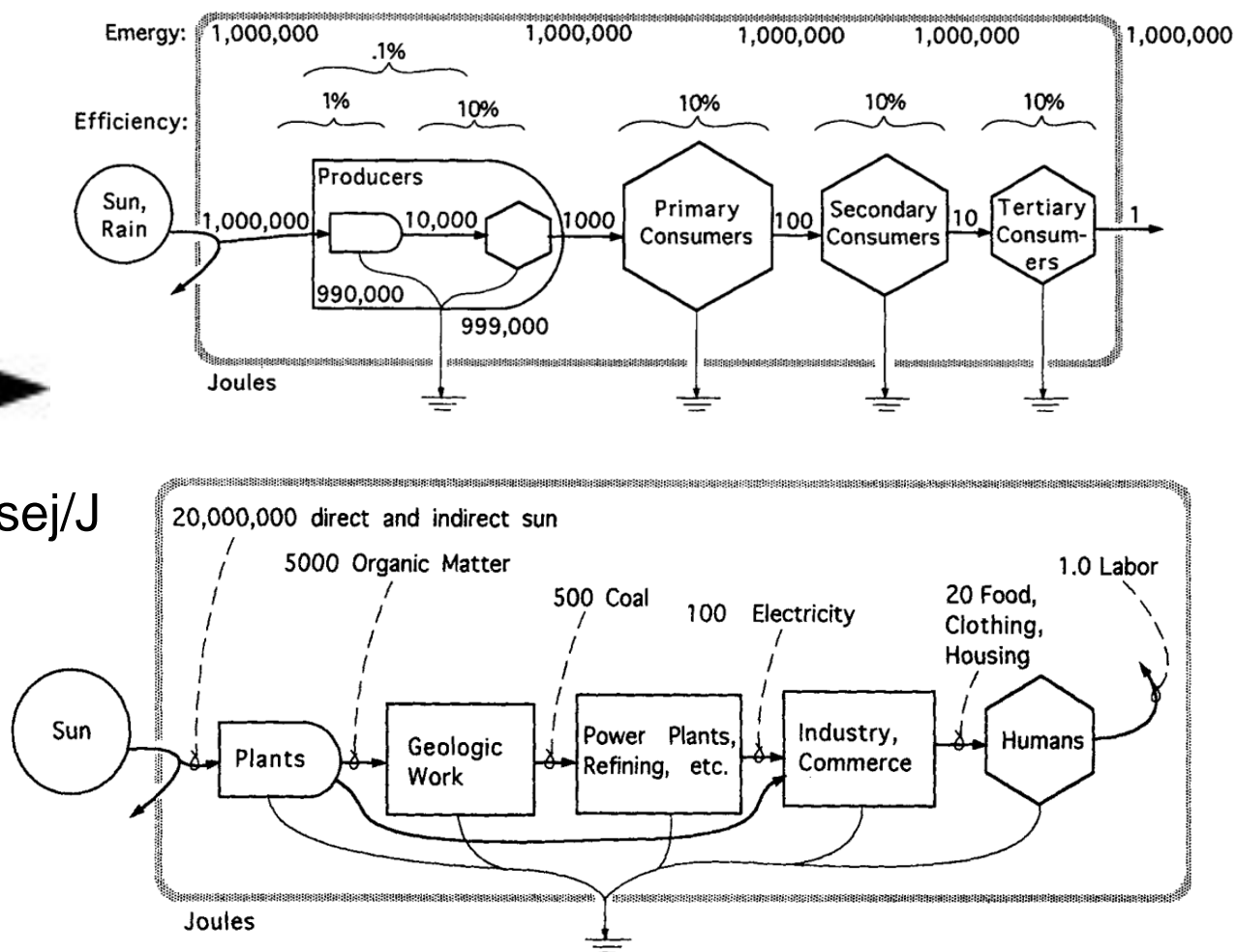
# Example: A Food Chain

## Ecological Food Chain



Transformity = 10 sej/J

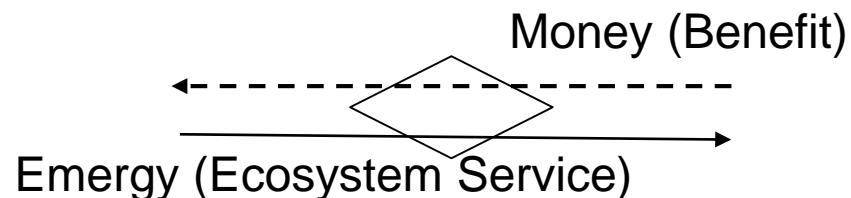
## Ecological/Industrial "Food" Chain



# Eco-Price

Ratio of emergy (the energy of one form necessary to make something) of a environmental good or service or analog to a monetary investment in said service

## Examples



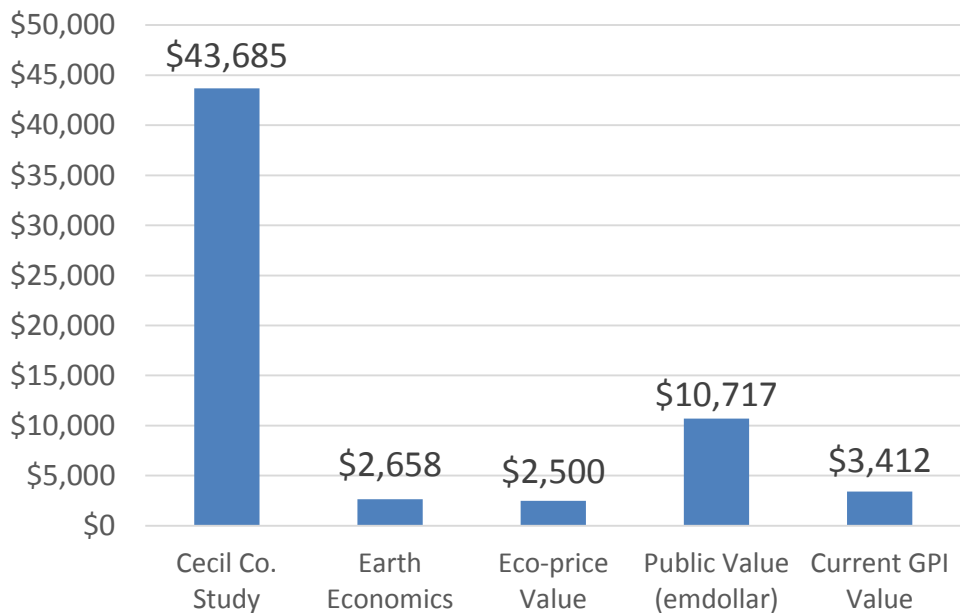
- The emergy of one ton of carbon divided by the trading price per ton in the Regional Greenhouse Gas Initiative (RGGI) marketplace
- The emergy of runoff from a taxed land area divided by the tax charged through the Stormwater Fee law
- Emergy of nutrients avoided through BMP implementation divided by the cost of establishment

Avoids biases of stated preference and hedonic pricing, acknowledges that society values ES different ways, end-use is not constant

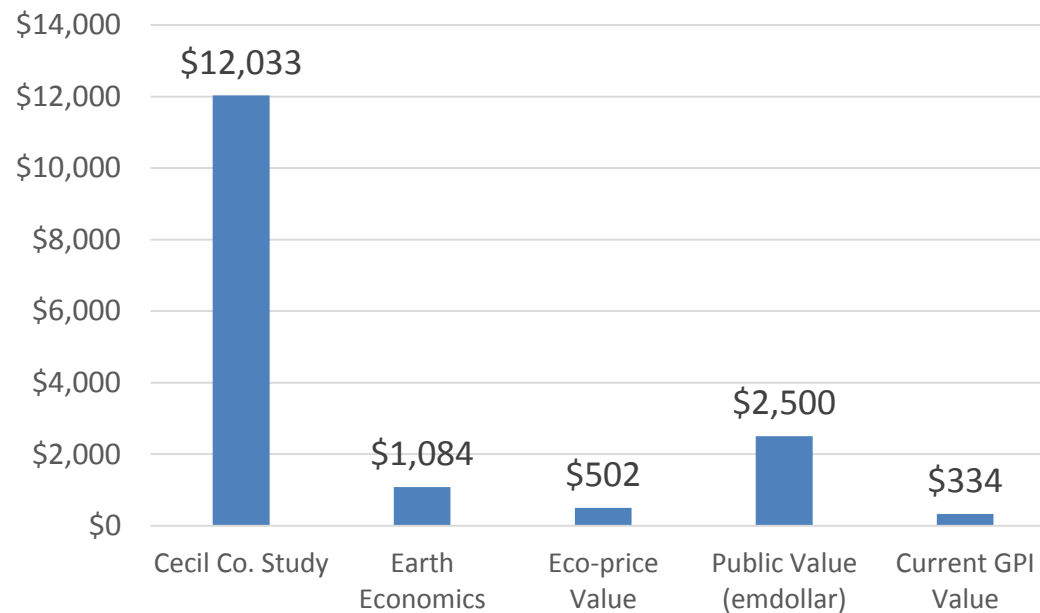


# ES Values Considered

ES Value per Acre of Wetland Over 1 Year

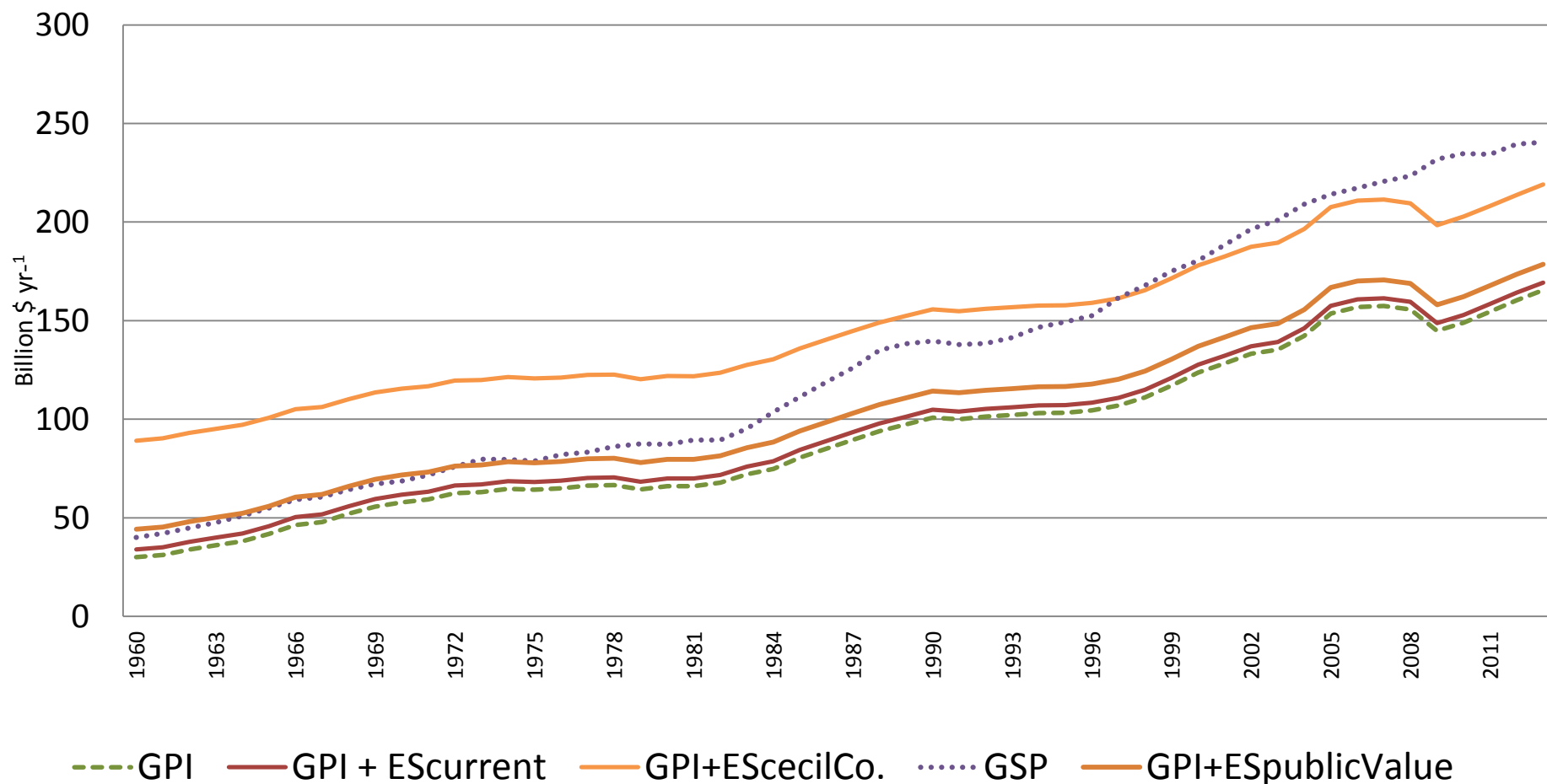


ES Value per Acre of Forest Land Over 1 Year



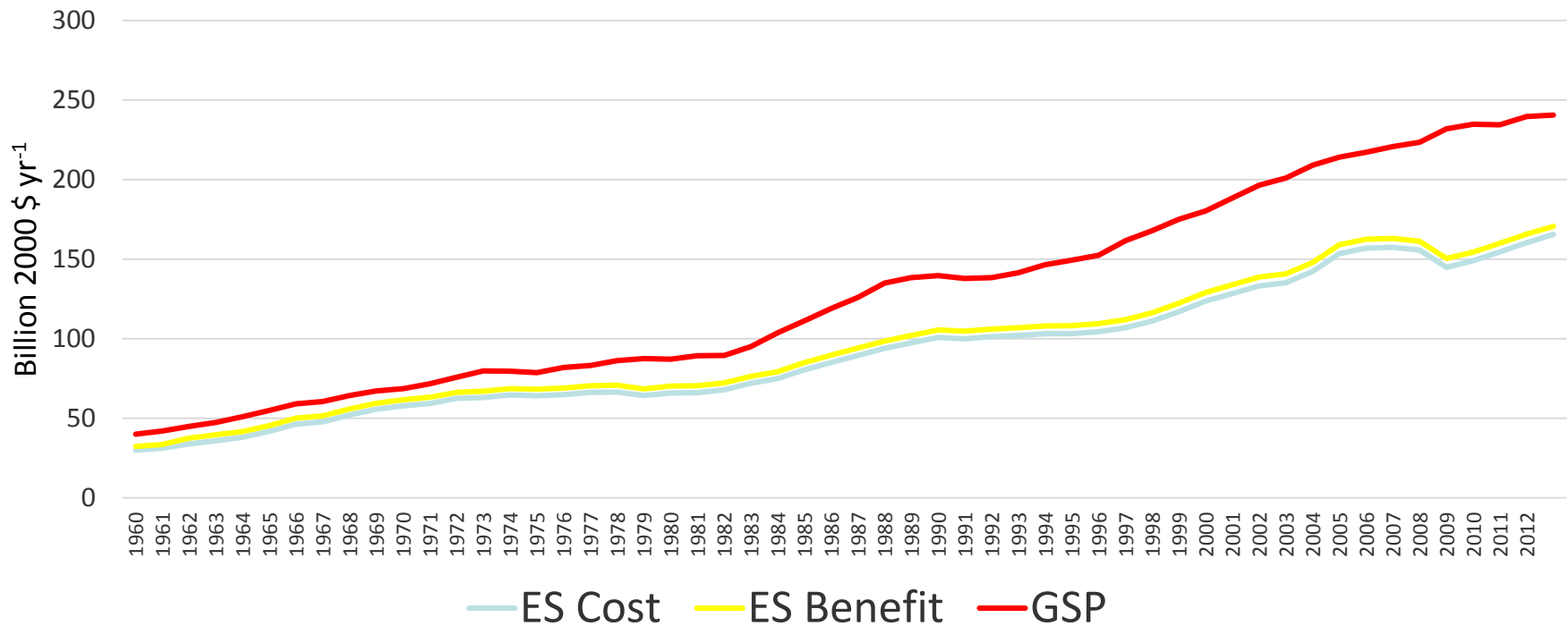
The Cecil County study (Weber 2007), Earth Economics and current GPI value used are all Literature reviews of ES values. The Eco-Price and Public values are from Campbell, 2014, Calculated using environmental accounting

# What is the appropriate value framework for ES to be included in the GPI?



# ES as a Cost vs. Benefit

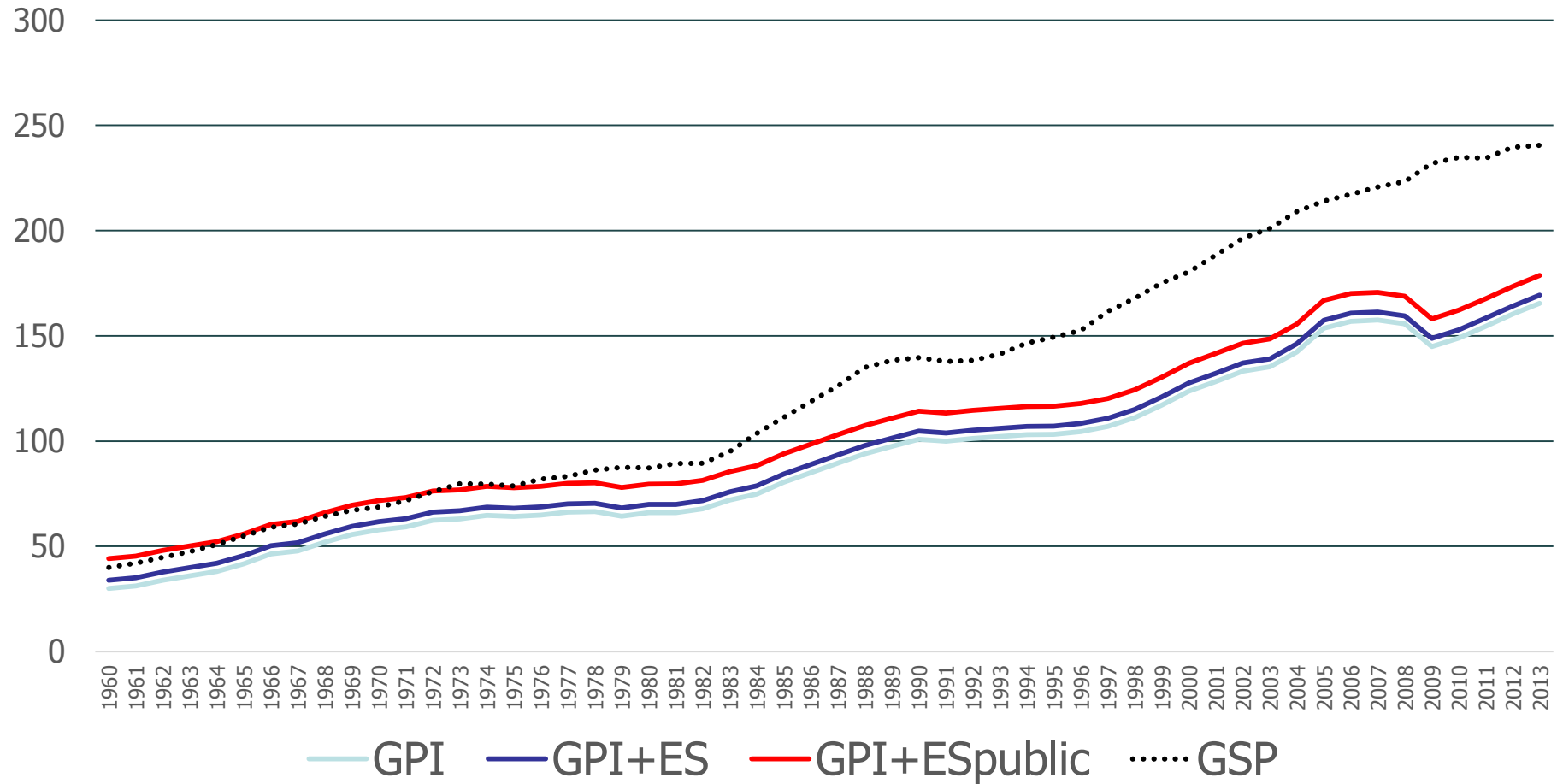
If losing natural lands decreases experienced welfare, then the existence of natural lands must increase experienced welfare!  
So if the same values currently in the model are applied...



Average difference of Including ES as a benefit is 4.5 billion per year

# Environmental Accounting for ES Valuation

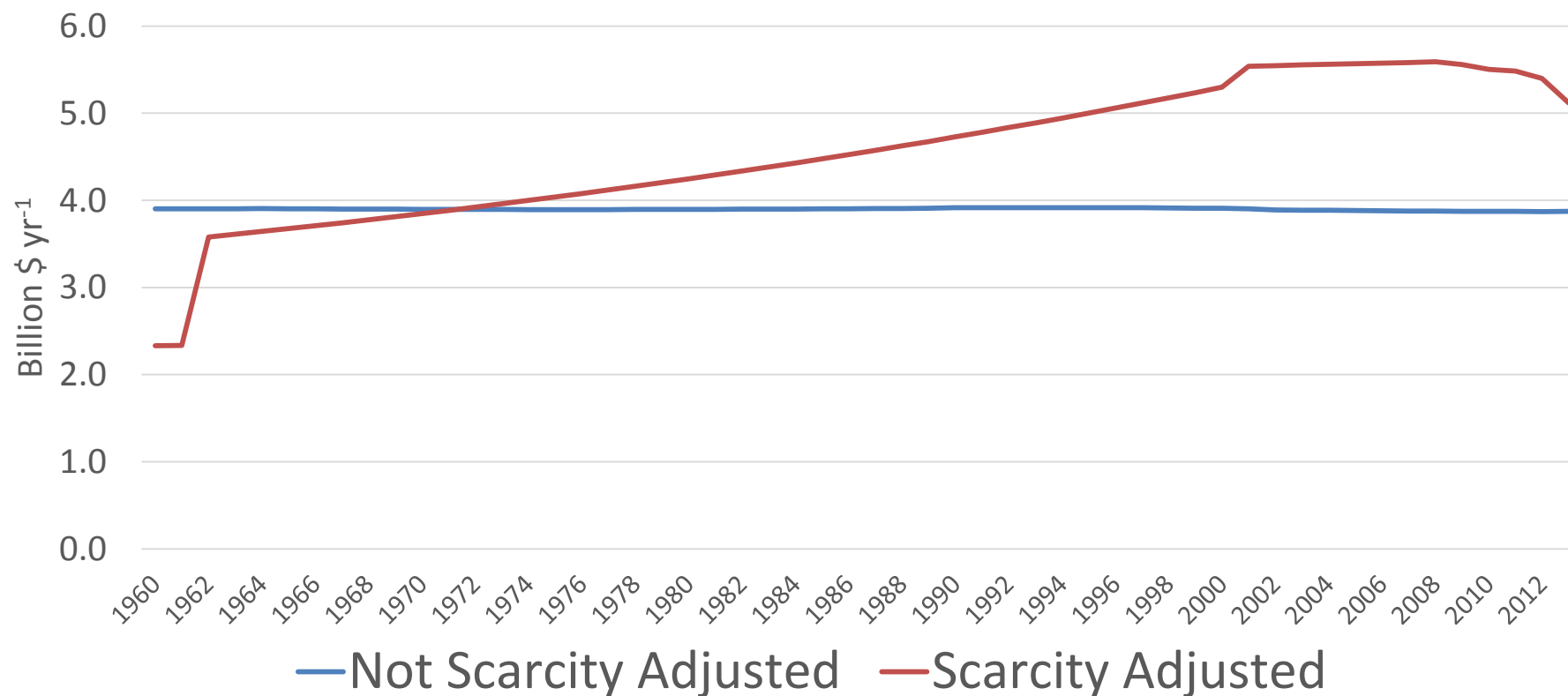
Comparison Using Environmental Accounting ES Values



Average difference of Including ES as a benefit is 3.9 billion per year

# Adjustment for Scarcity

## Ecosystem Service Value





# ES Framework Considerations

- Intermediate ES vs. Final ES vs. Benefits
- Temporal and spatial provision
- Value vs. price
- Adjust for Scarcity?
- Market vs. Non-market
- Avoiding double counting

- Only final Ecosystem Services should be included in the GPI (following Boyd and Banzhaf 2007)
  - *Final ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being. – Boyd and Banzhaf, 2007*
- Ecosystem services should be on the time scale (1 year) and spatial scale of the GPI being calculated, as much as possible (following Fisher et al. 2009)

# GPI Ecosystem Service Recommendations

- The GPI calculation relies on market based contributions to welfare
- As such, to most accurately reflect the equation WTP for final ecosystem services should be used, estimated through proxy markets, non-market valuation methods or the eco-price, mindful of social equity and iterated upon over time
- Given the context of the GPI, an attempt to better estimate experienced well-being, ES should be treated as a positive in the equation
- If reasonable ES values are considered general trend of the GPI and relationship to GDP/GSP is unchanged

# Questions?

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