An environmental comparison between powdered activated carbon and biochar for tertiary wastewater treatment

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WHERE DISCOVERIES BEGIN

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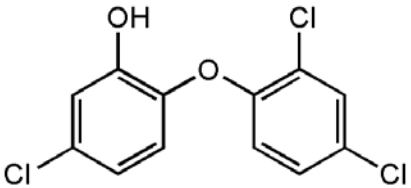
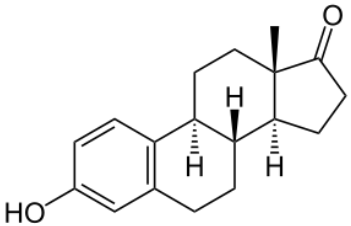
WHERE DISCOVERIES BEGIN

Organic micropollutants from wastewater are a pervasive threat to the aquatic environment.

Zoloft (sertraline HCl)

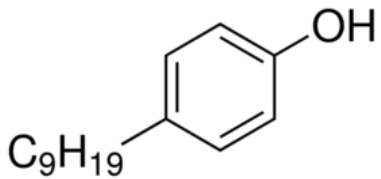


Triclosan



Estrone

PROZAC fluoxetine hydrochloride

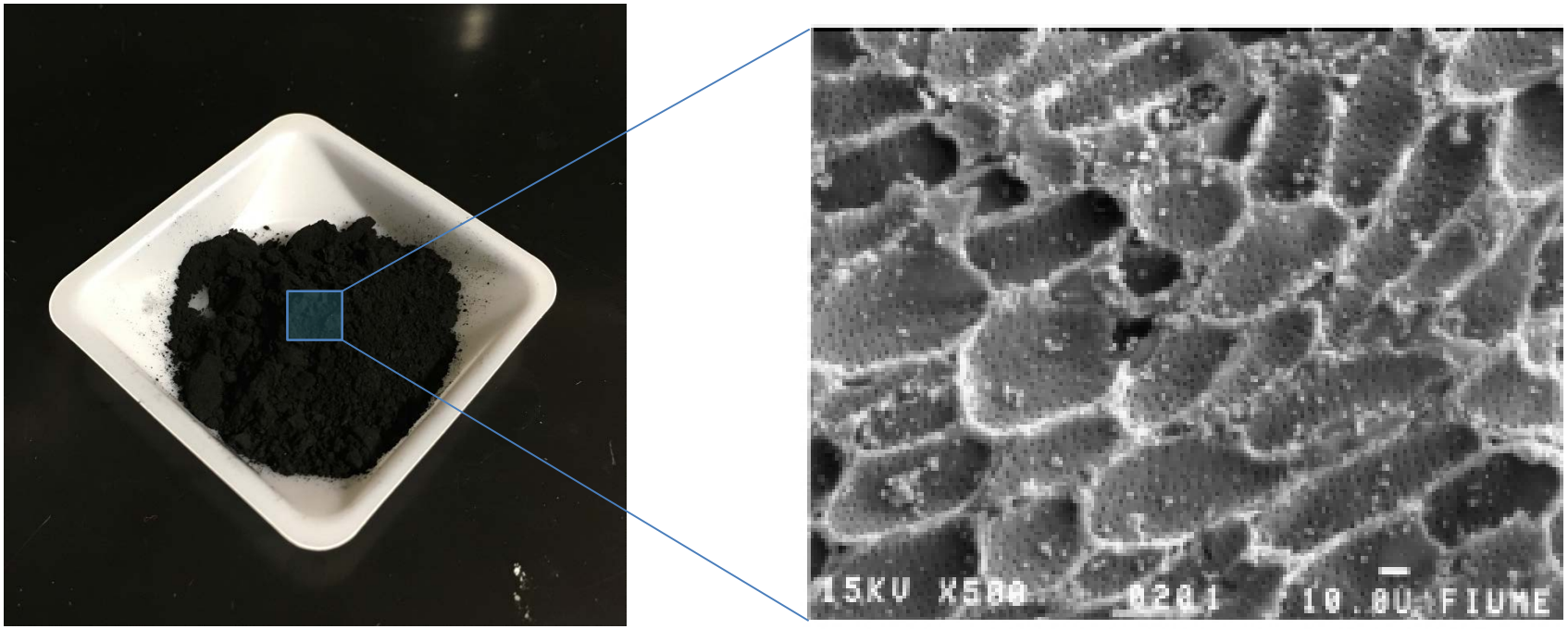


Nonylphenol

Glucophage metformin

Meador et al. *Environmental Pollution,* 2016, 213 (C).

Powdered activated carbon (PAC) is a relatively sustainable treatment method for organic micropollutants.



Tansel and Nagarajan. *Advances in Environmental Research,* 2004, 8 (3-4).

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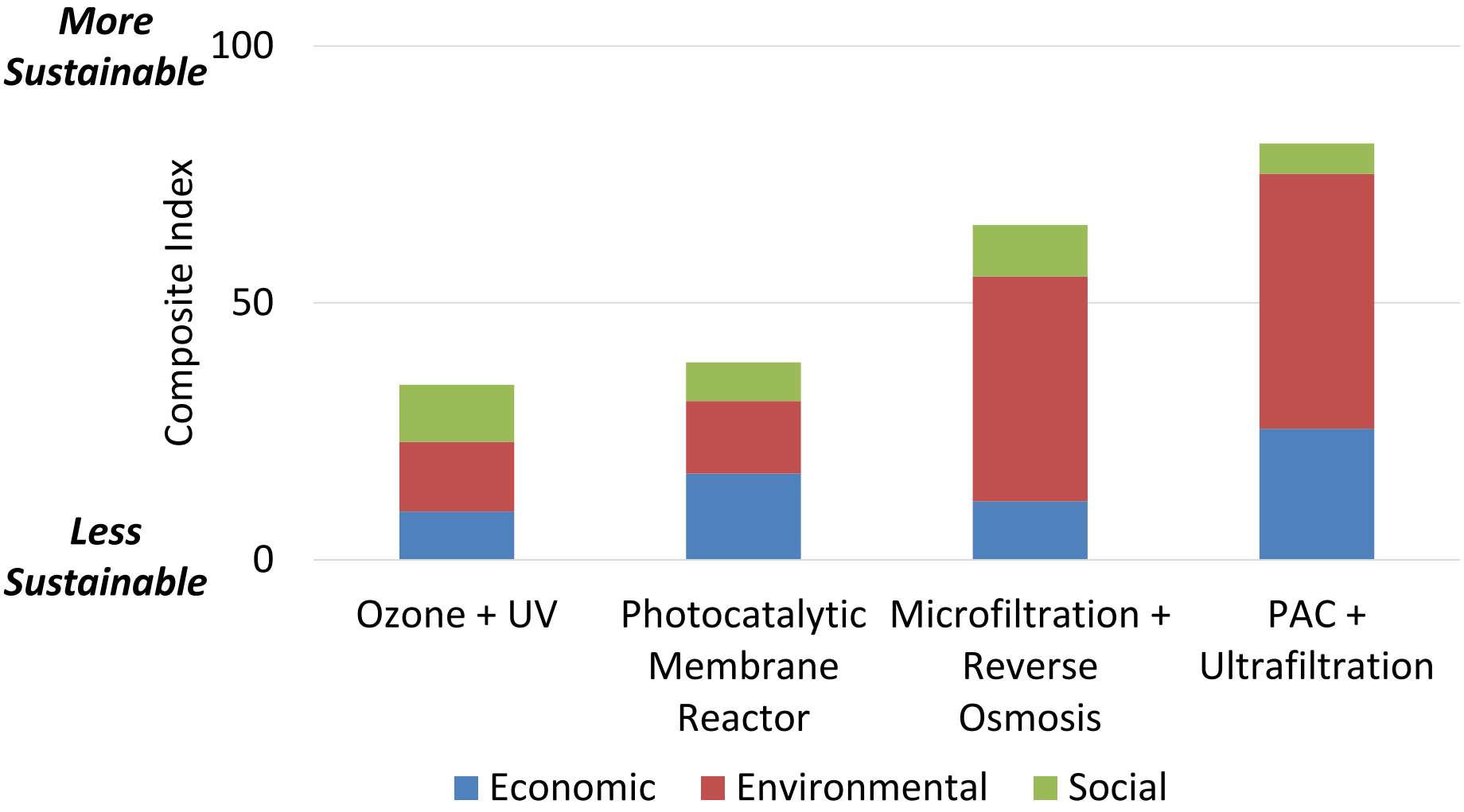
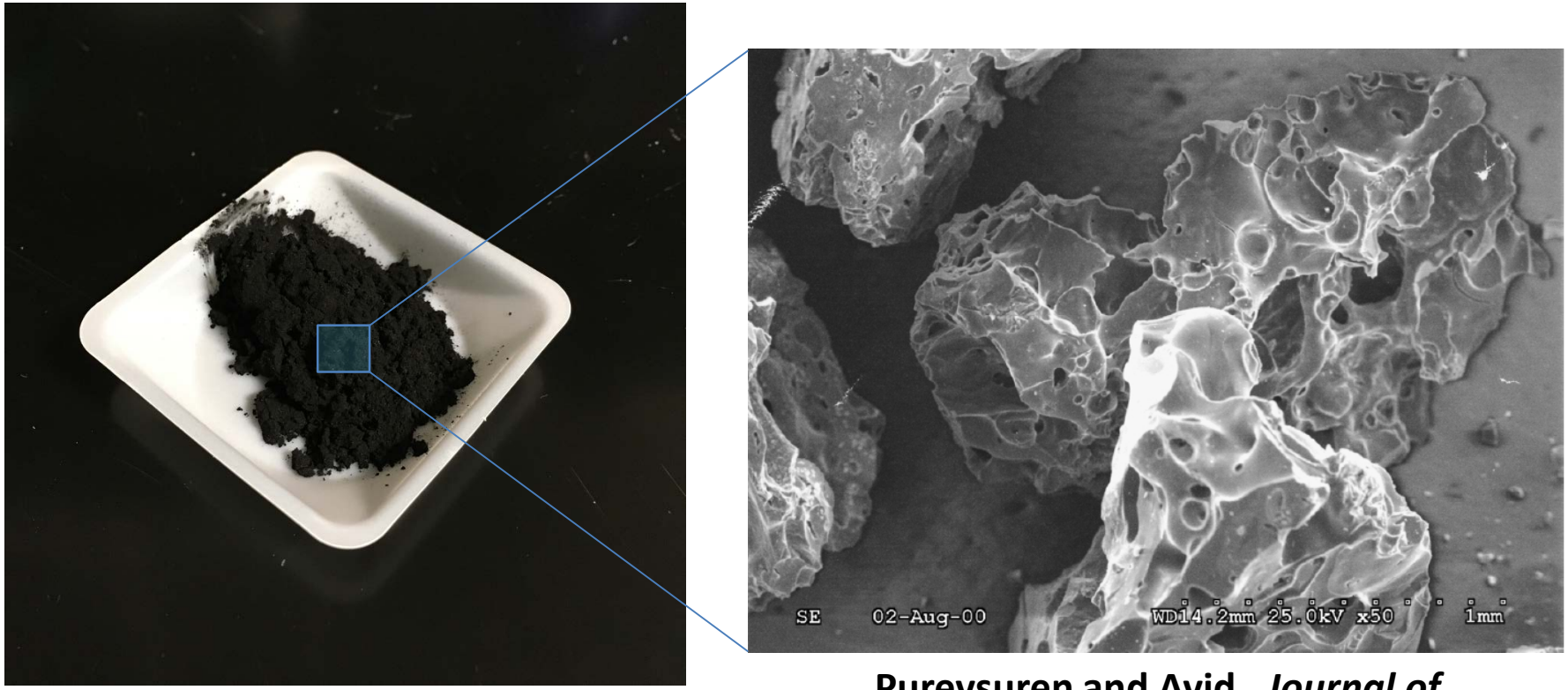


Plakas et al. *Water Science & Technology,* 2016, 73 (7).

Biochar can have a net environmental benefit due to renewable energy production and carbon sequestration.



Purevsuren and Avid. *Journal of Materials Science,* 2003, 38 (11).

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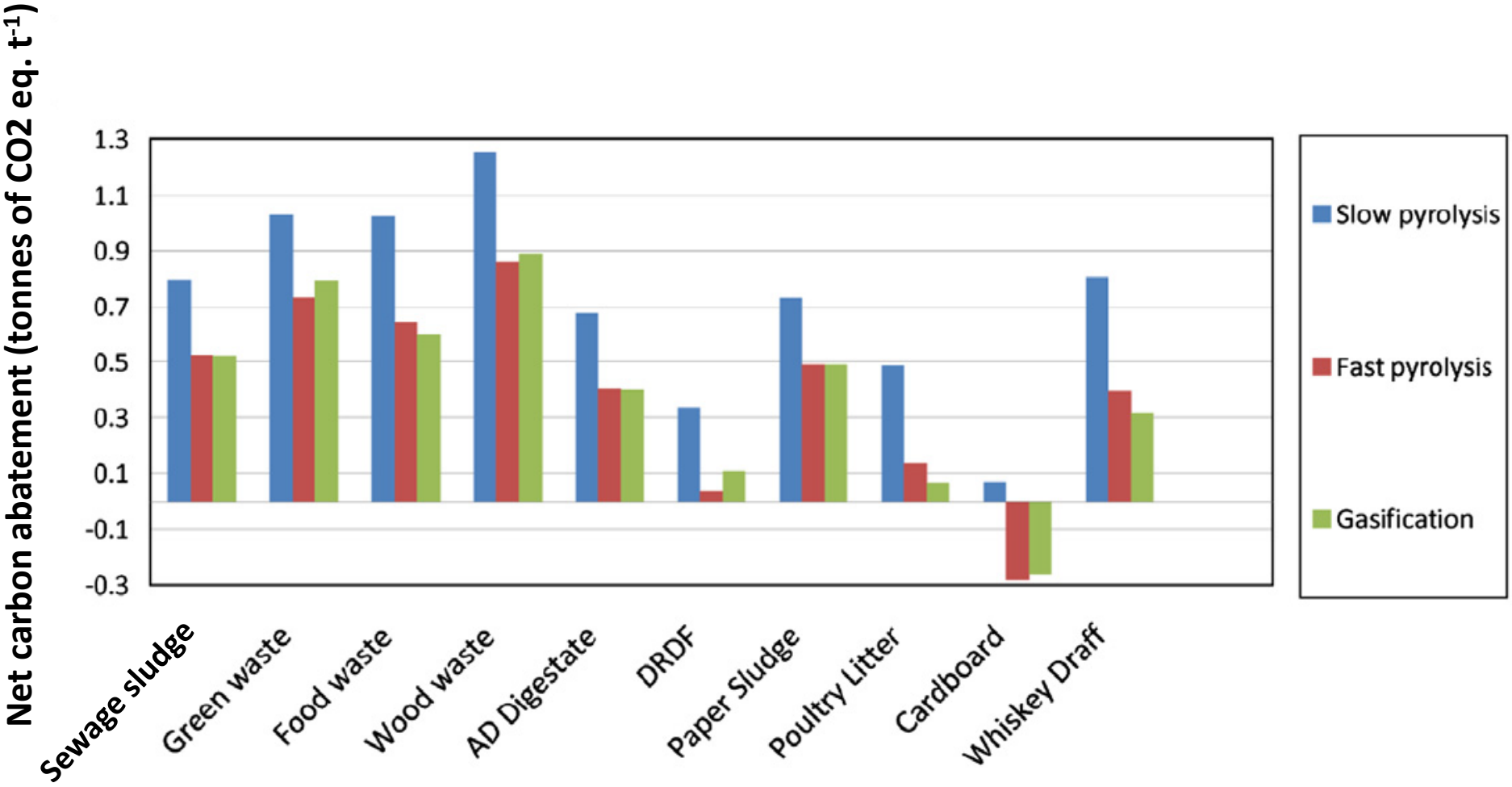
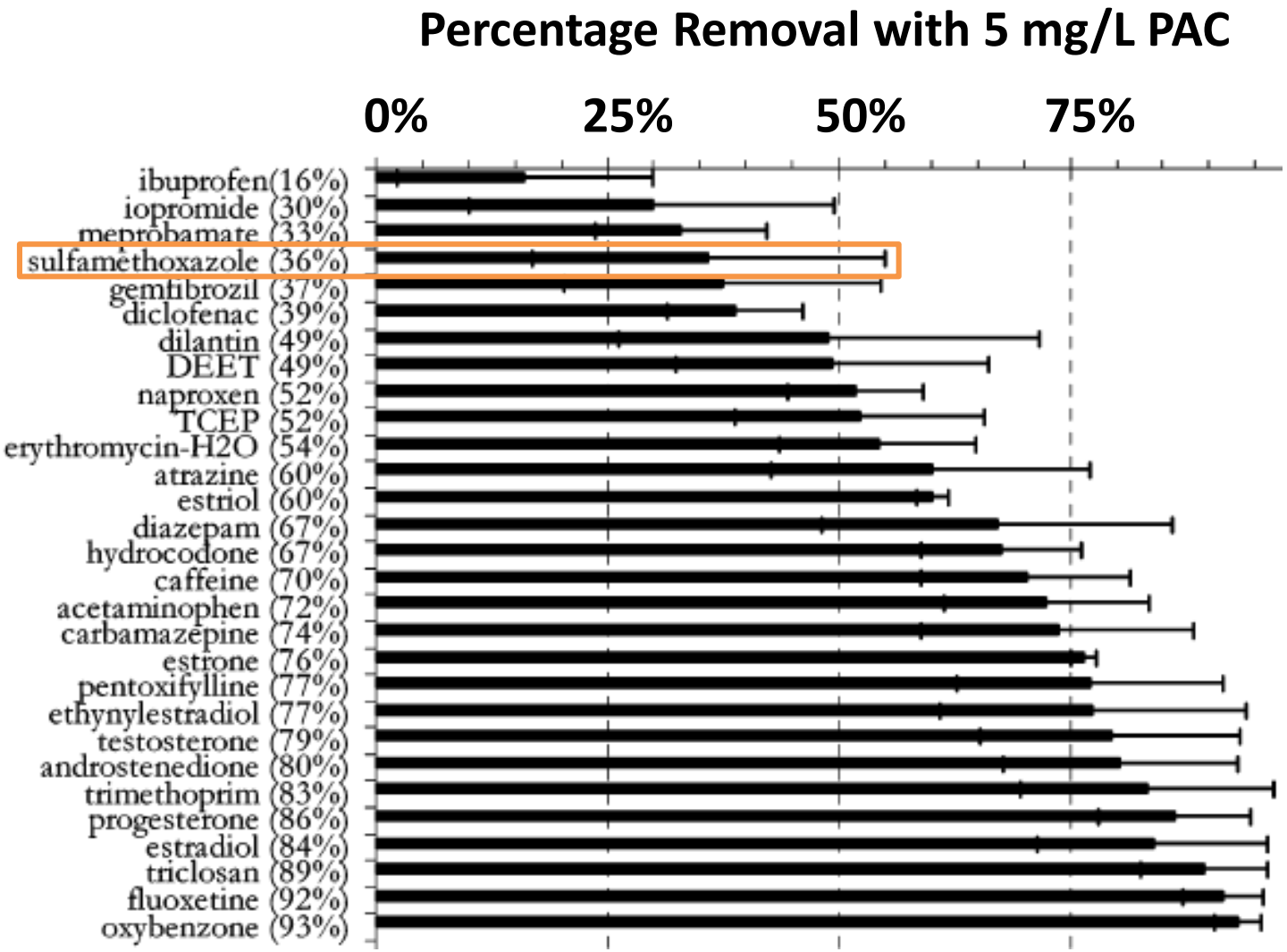


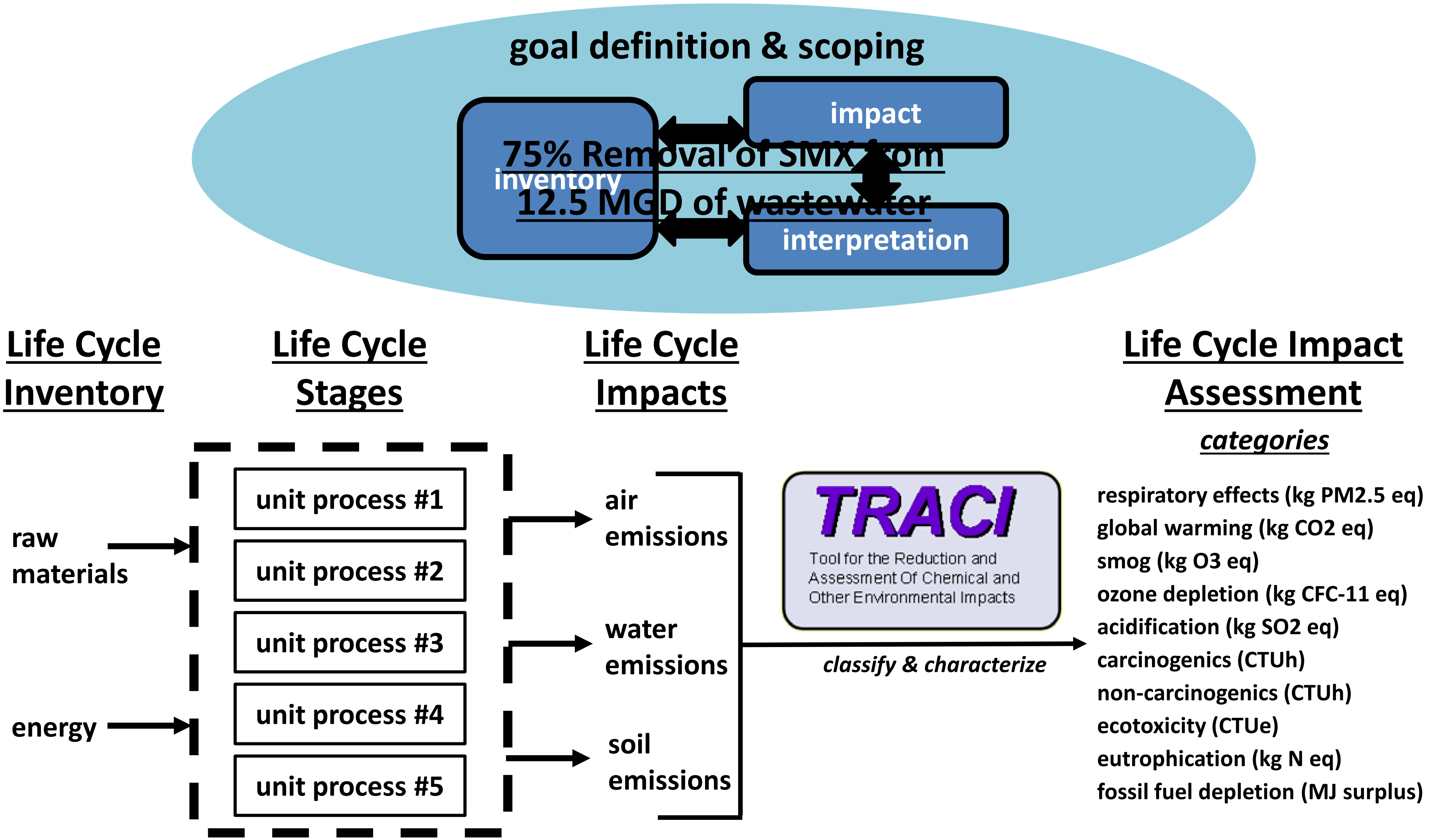
Ibarrola et al. *Waste Management,* 2012, 32 (5).

Sulfamethoxazole (SMX) is one of the most challenging organic micropollutants to remove by adsorption.

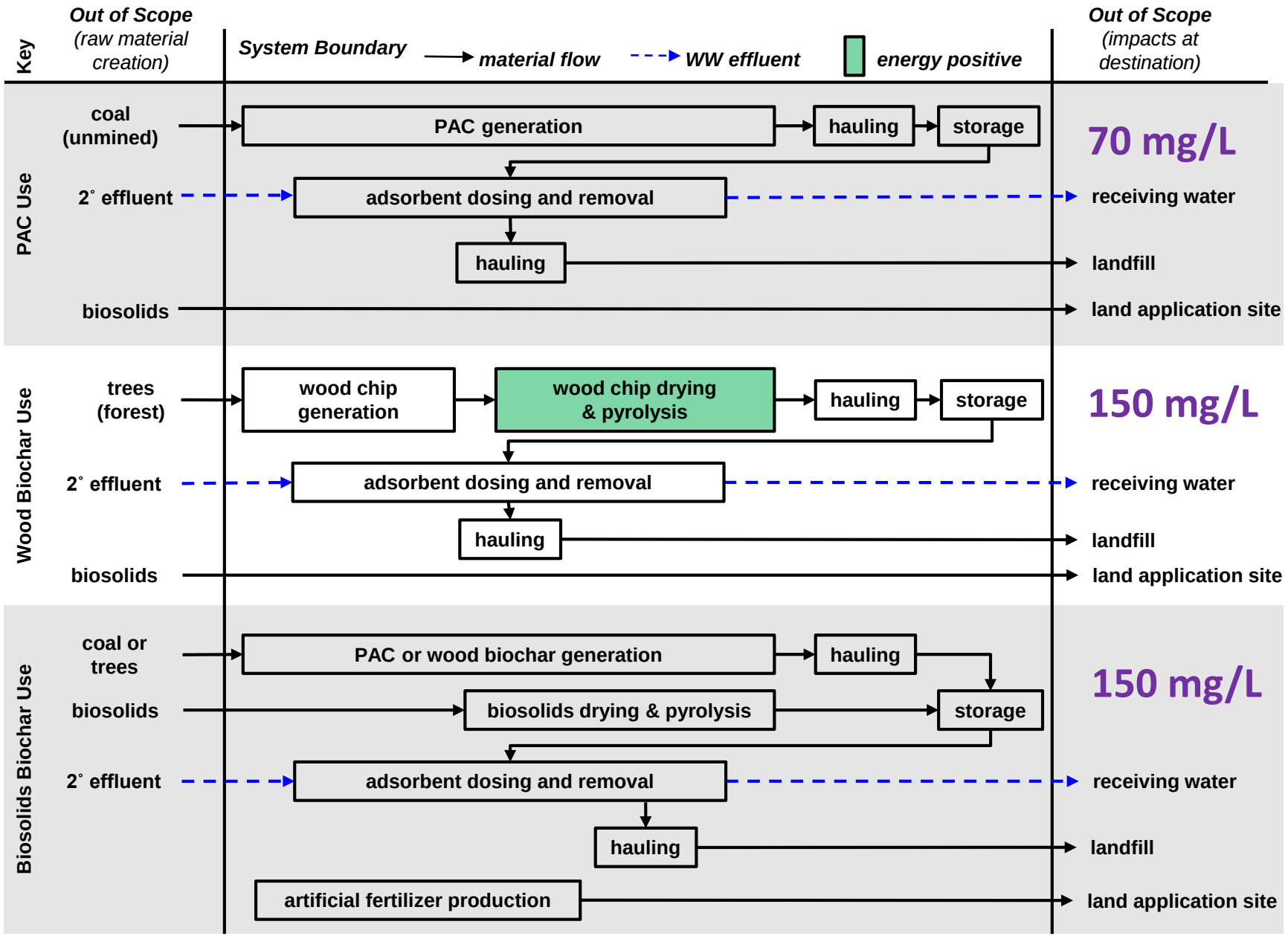


Westerhoff et al. *Environmental Science & Technology,* 2005, 39 (17).

The first step of a life cycle is goal definition and scoping.
This comparative life cycle assessment used TRACI to express environmental impacts in 10 midpoint categories.


goal definition & scoping
impact
75% Removal of SMX from
12.5 MGD of wastewater
inventory
interpretation
Life Cycle Inventory
Life Cycle Stages
Life Cycle Impacts
Life Cycle Impact Assessment
categories
raw materials
energy
unit process #1
unit process #2
unit process #3
unit process #4
unit process #5
air emissions
water emissions
soil emissions
TRACI
Tool for the Reduction and Assessment Of Chemical and Other Environmental Impacts
classify & characterize
respiratory effects (kg PM2.5 eq)
global warming (kg CO2 eq)
smog (kg O3 eq)
ozone depletion (kg CFC-11 eq)
acidification (kg SO2 eq)
carcinogenics (CTUh)
non-carcinogenics (CTUh)
ecotoxicity (CTUe)
eutrophication (kg N eq)
fossil fuel depletion (MJ surplus)

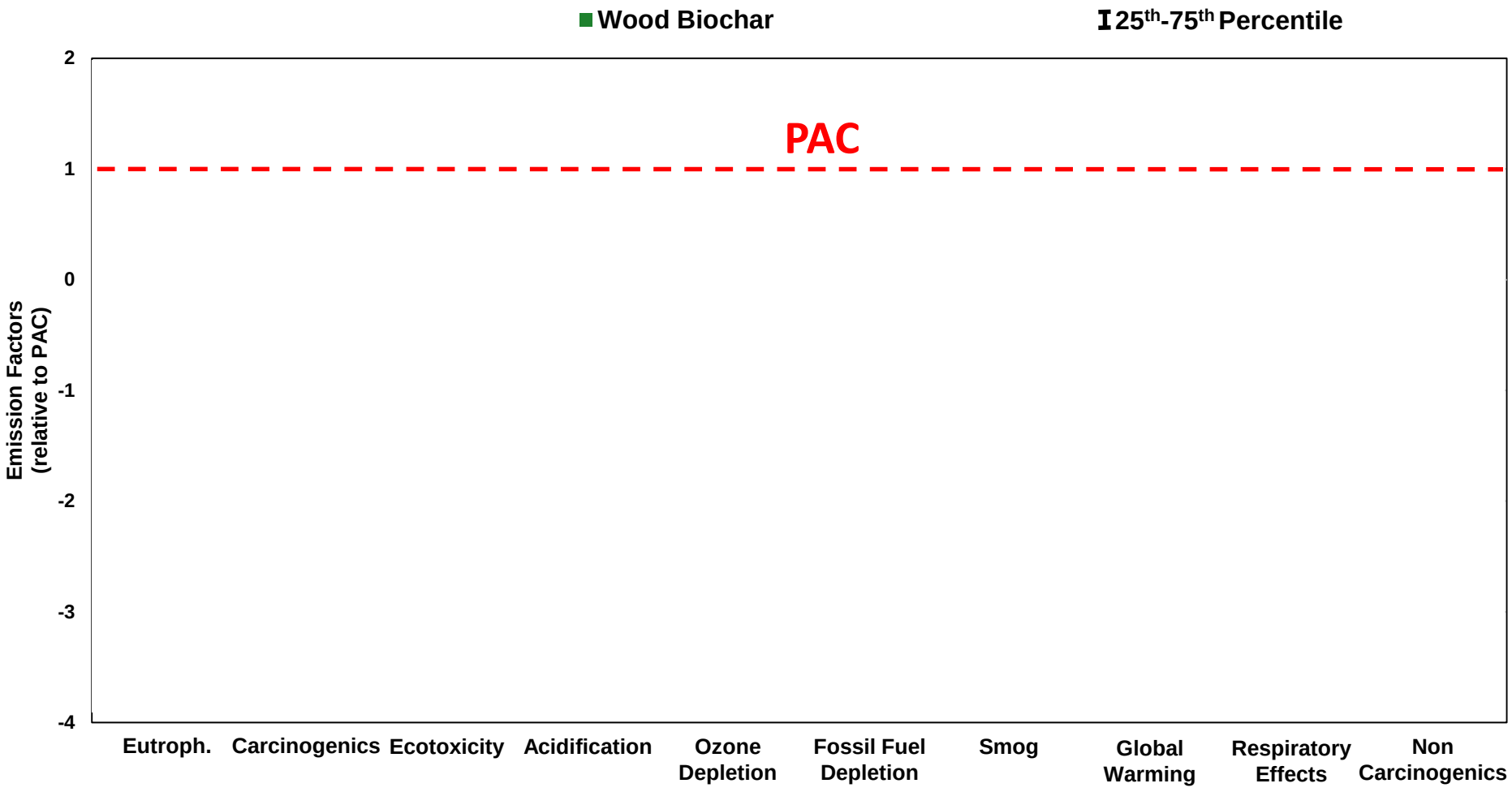
Three adsorbents: PAC, wood biochar, biosolids biochar



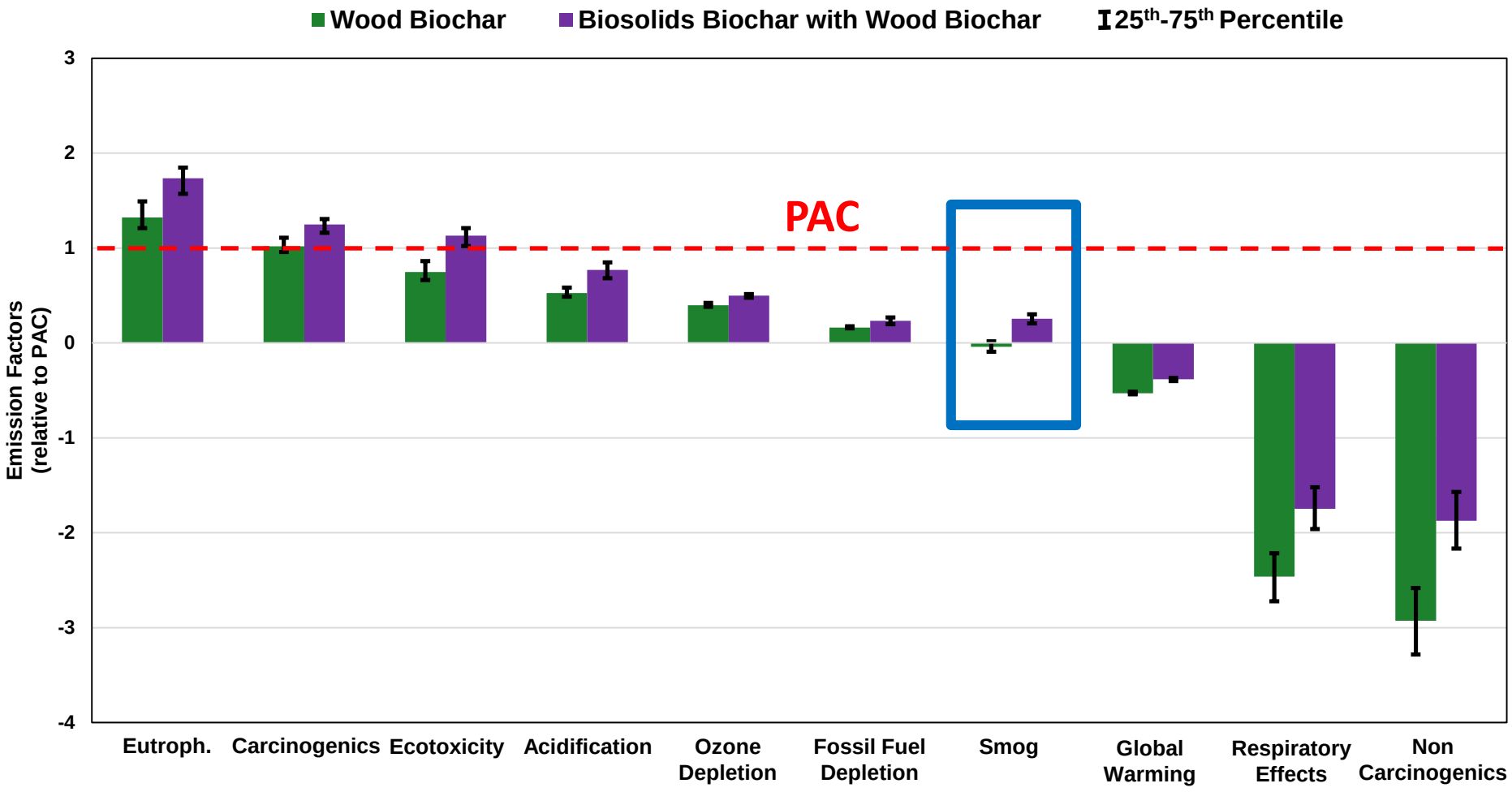
Shimabuku et al. *Water Research,* 2016, 96 (C).

Results are normalized to PAC.

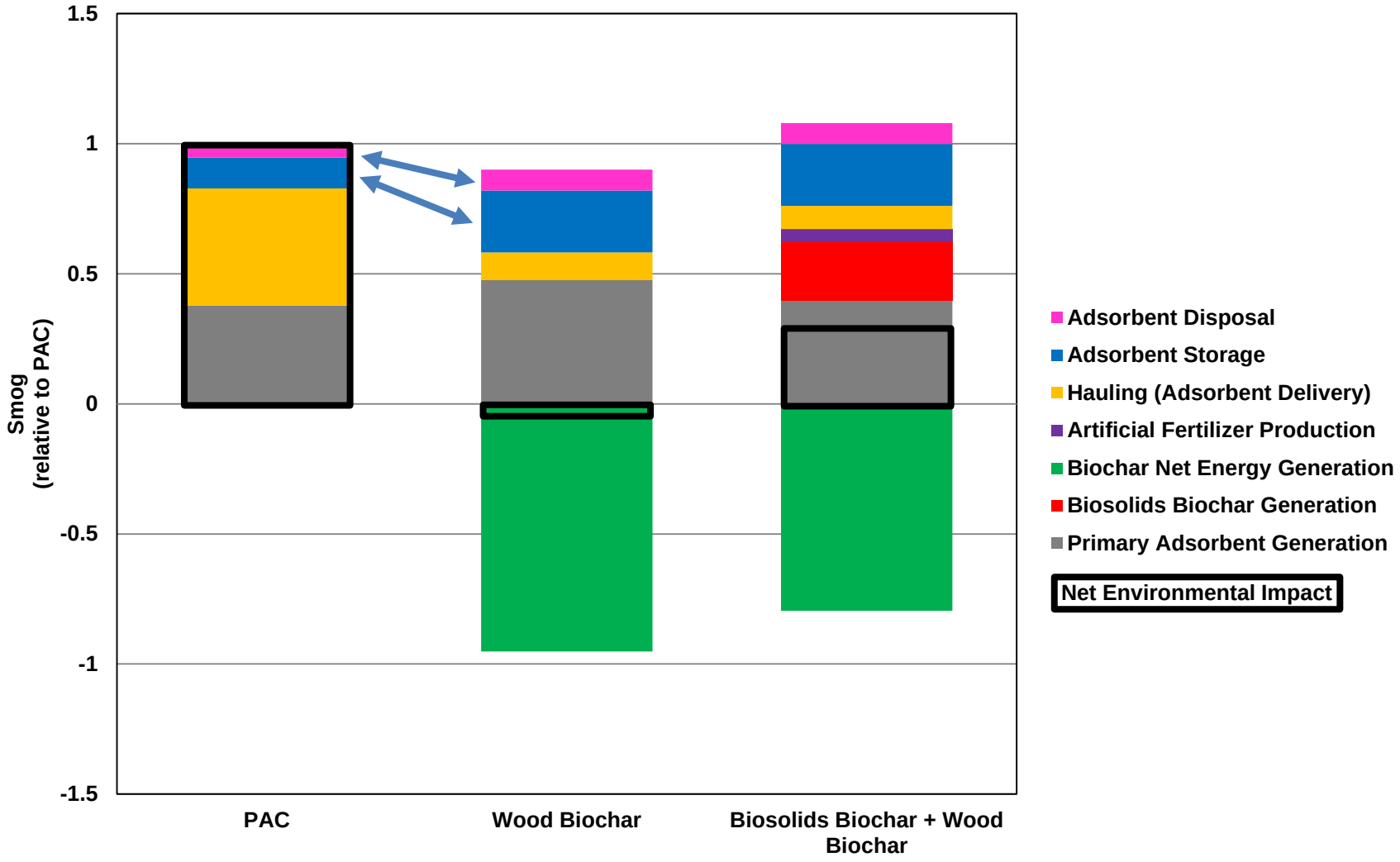
Wood biochar has lower environmental impacts than PAC in 8/10 categories.



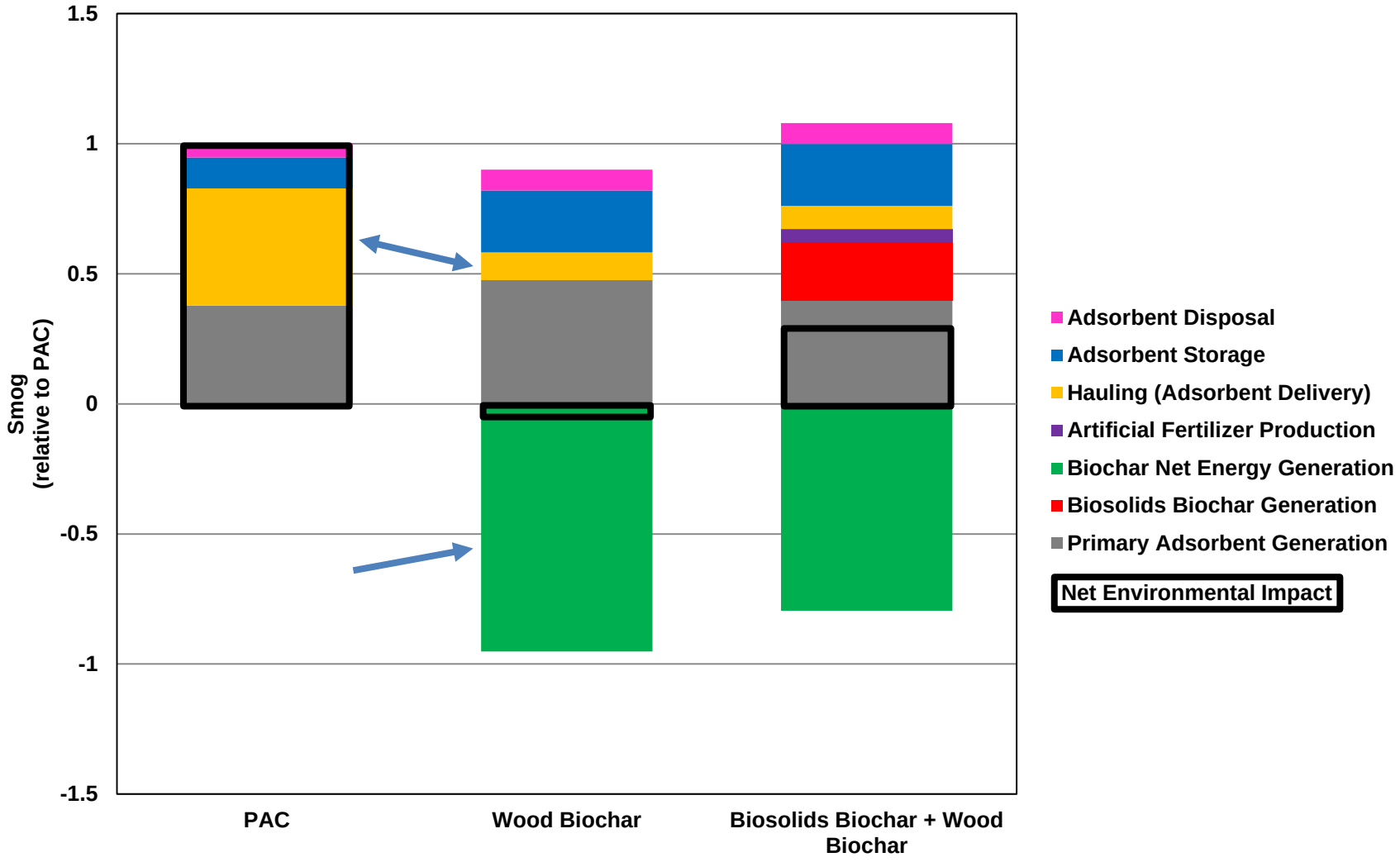
Biosolids biochar is worse than wood biochar in all environmental impact categories.



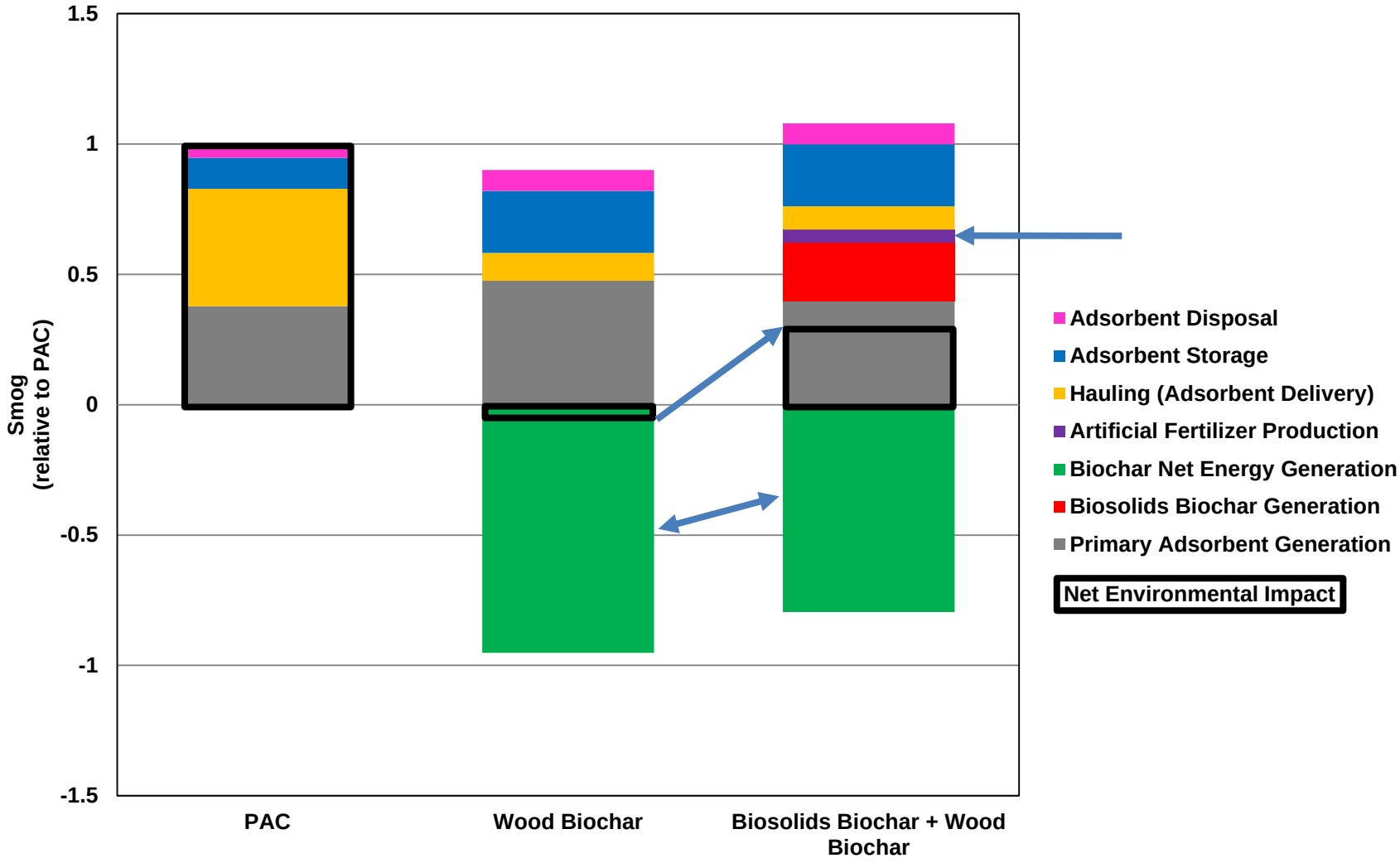
Wood biochar had higher impacts from adsorbent storage and adsorbent disposal.



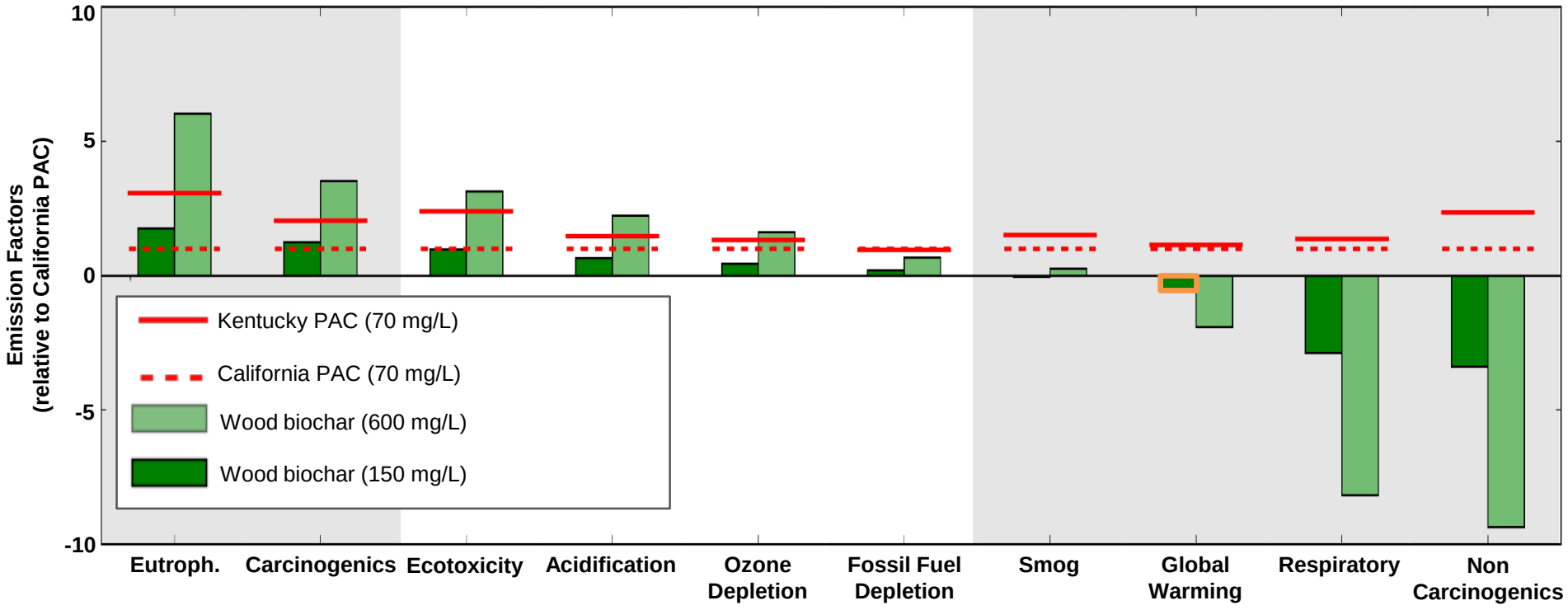
Wood biochar had less impact from delivery and an environmental benefit from pyrolysis energy.



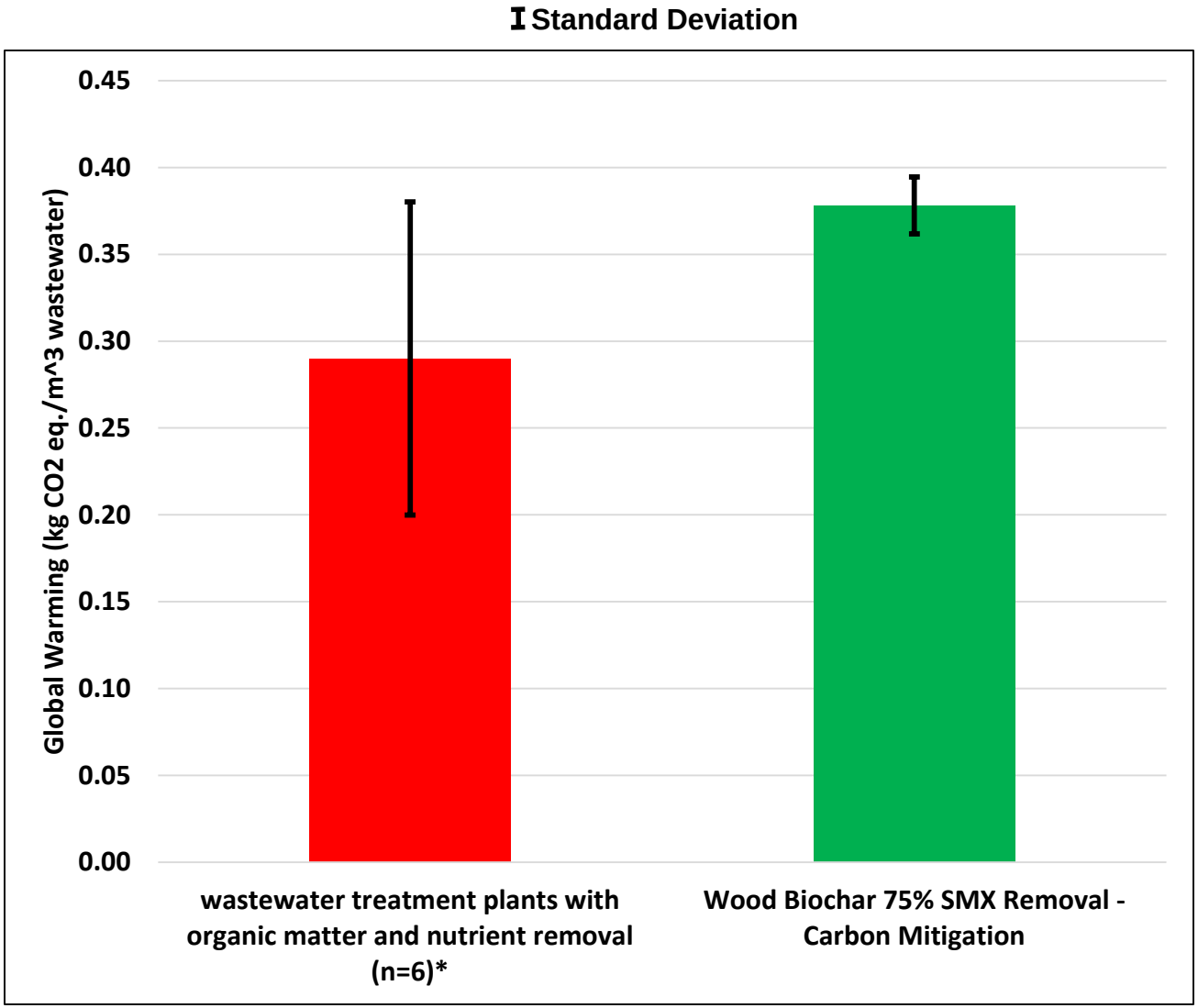
Biosolids biochar had more impact than wood biochar because its generation is energy consuming.



The relative sustainability of wood biochar depends on its adsorption capacity.

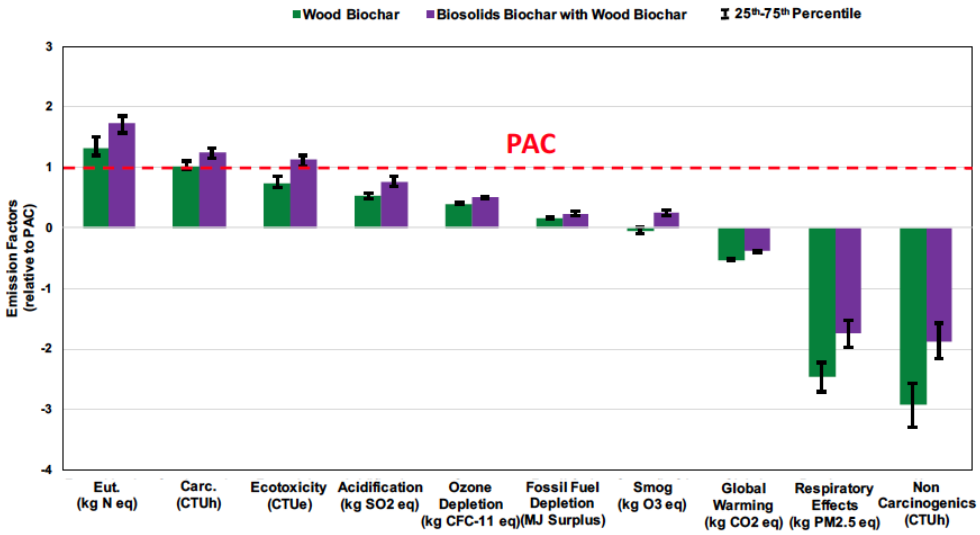


Wood biochar usage is sufficient to offset the global warming impact of an entire wastewater treatment plant.



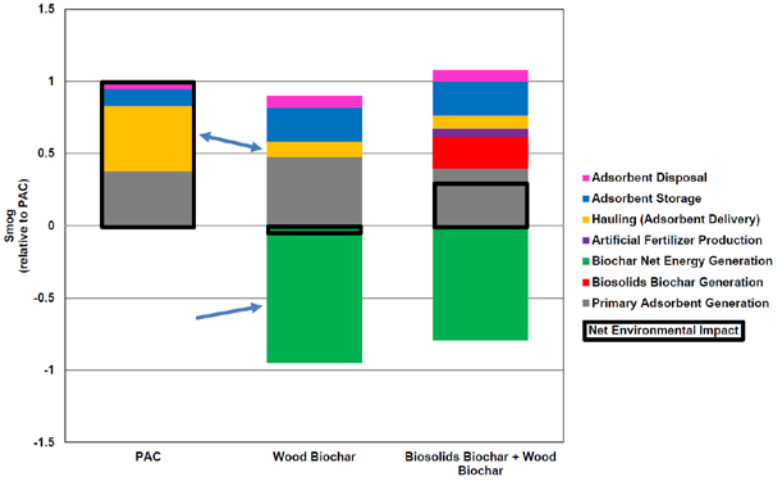
*Rodriguez-Garcia et al. *Water Research,* 2011, 45 (16).

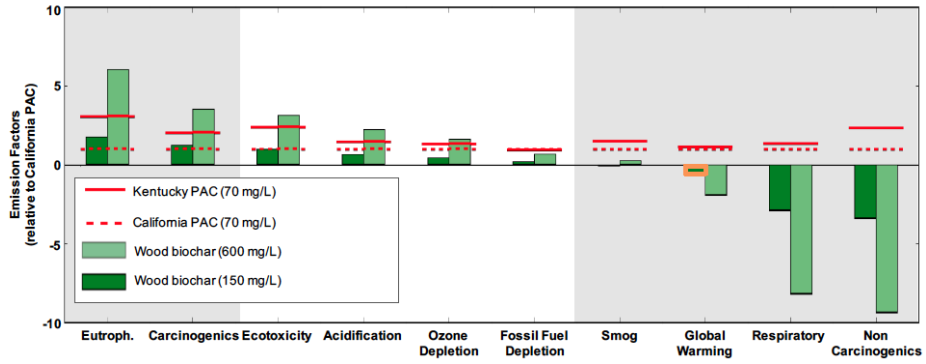
Conclusions



Wood biochar has lower environmental impacts than PAC or biosolids biochar.

The environmental benefit of wood biochar is largely due energy production during pyrolysis.





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