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SCHOOL OF ECONOMICS

Responsible Consumption and Production

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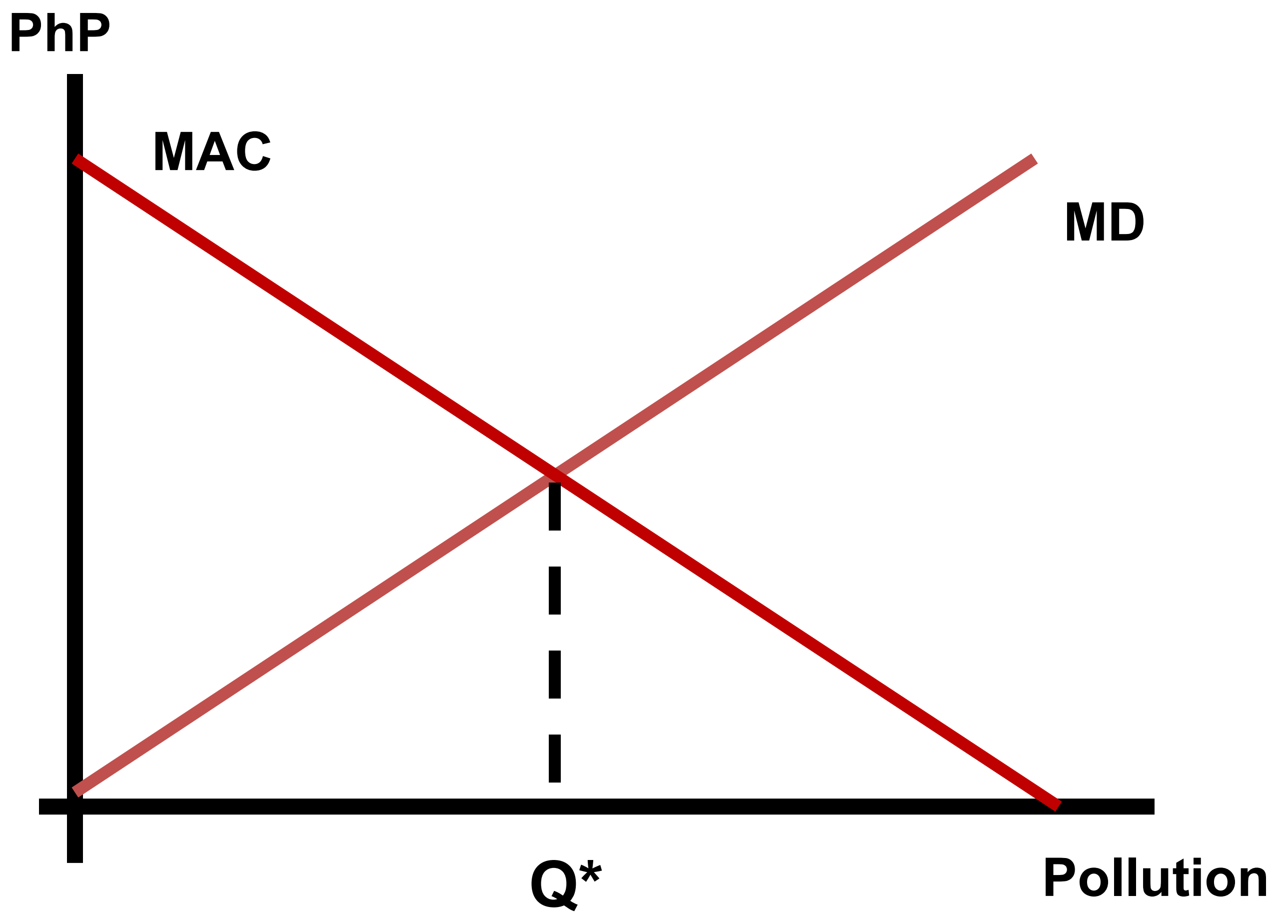
Crucial Question in Environmental Economics

TRUE OR FALSE?

The optimal amount of pollution is zero.

Optimal Pollution



Key take-away: Responsible consumption and production

Decision rule:

- **If PV of benefits – PV of costs $\geq$ 0**
- **Positive present values (PV) for the economy means that it will increase welfare.**

1987 Philippine Constitution

"The maintenance of peace and order, the protection of life, liberty, and property, and promotion of the general welfare are essential [to secure] the blessings of democracy."

Sustainable Development:

Secure to ourselves and our posterity the blessings of democracy under the rule of law.

SD: History of thought

- 1980 – World Conservation Strategy (WCS)
- 1983 – UN's Brundtland Commission
- 1987 – Barbier's Venn diagram of three intersecting circles for biological, economic, and social systems
- 1987 - *Our Common Future* by the World Commission on Environment and Development (WCED: the Brundtland Commission)
  – successfully ensconced sustainability in the development arena!

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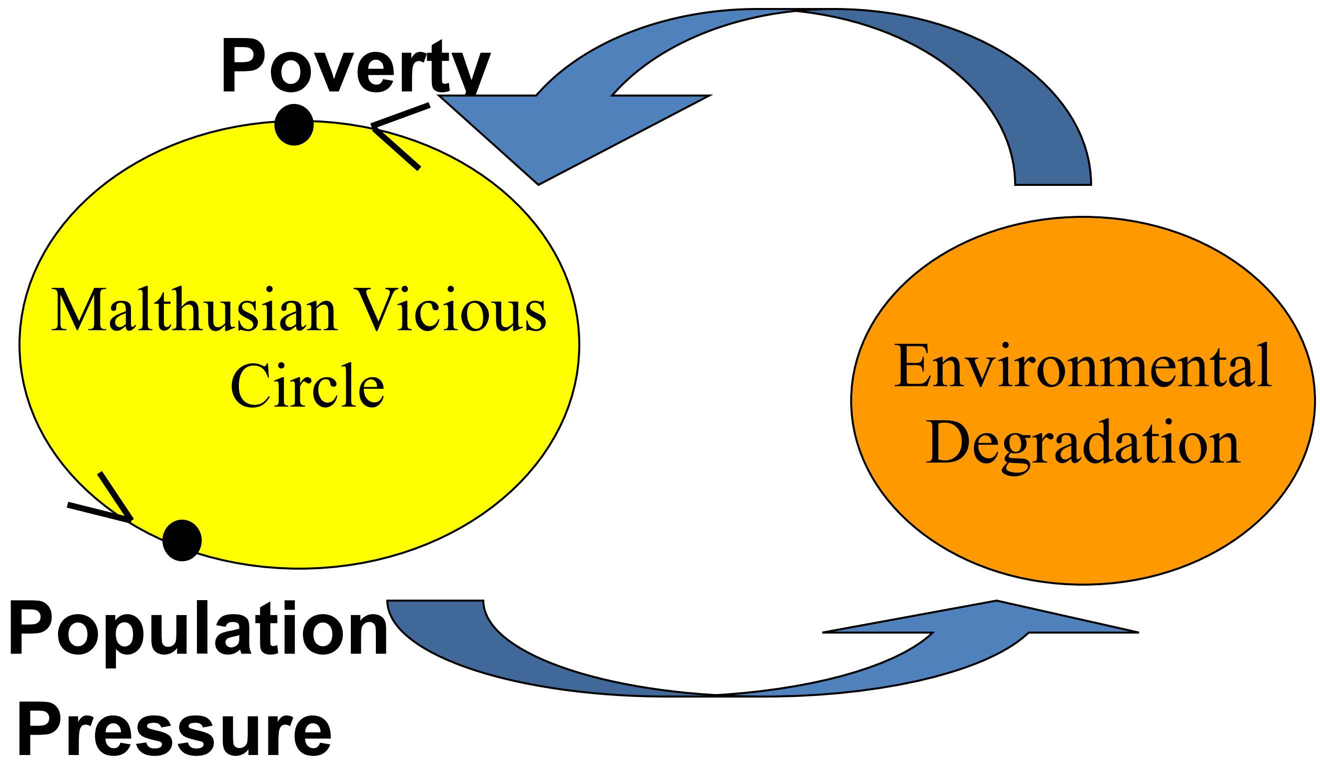
Popular versions of sustainable development

Kitchen Sink Sustainability

- As the king of Austria said to Mozart, "There are just too many notes!"
- Non-operational w/o specific metrics.
- But metrics are likely to be inconsistent (Quiggin)
- Left w/ ad hoc weights at best and mission impossible at worst.

Brundtland Vicious Circle



Negative sustainability: Arrow/Dasgupta approach

Nobel synthesis which only produced the principal of negative sustainability (don't let total savings be less than zero).

$$p_N \dot{K}_N \geq 0$$

prohibits any level of depletion of natural capital such as trees, water, or fish

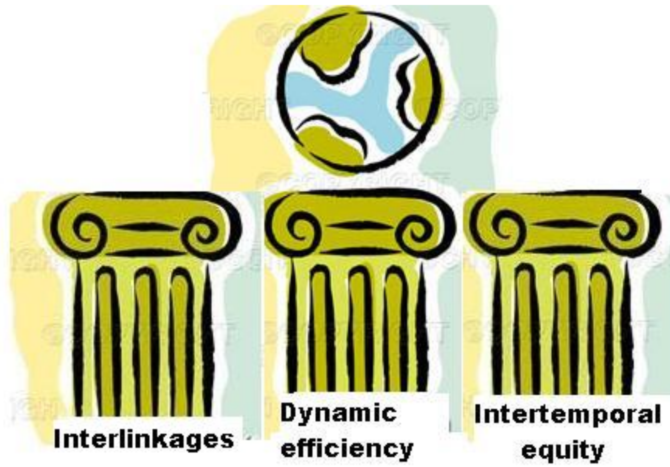
$\dot{C} \geq$ requires

$$p_M \dot{K}_M + p_N \dot{K}_N \geq 0$$

requires the summed value of produced and natural capital to remain constant or increase over time

Needed: positive sustainability principles

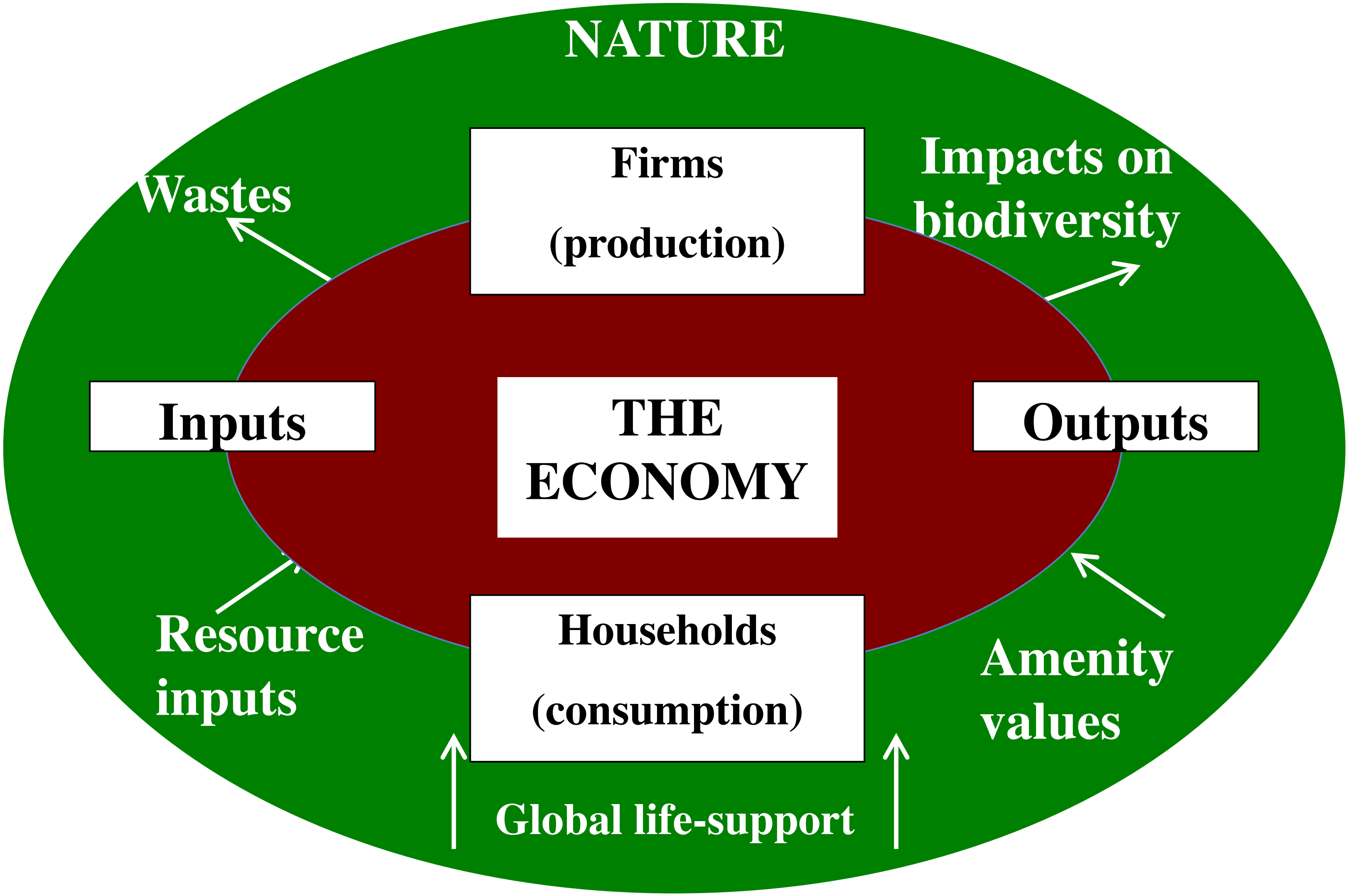
Towards a positive theory of sustainable growth



Three Pillars of Sustainability

1) Interlinkages, especially between natural resource systems, the environment and the economy;
2) Dynamic efficiency: Promote (maximize) the general welfare.
3) Intertemporal equity, which is increasingly represented as non-discrimination against the future.

It's the environomy!



Resource Augmented Economic Development

Single Objective:

To Improve well being (WELFARE)

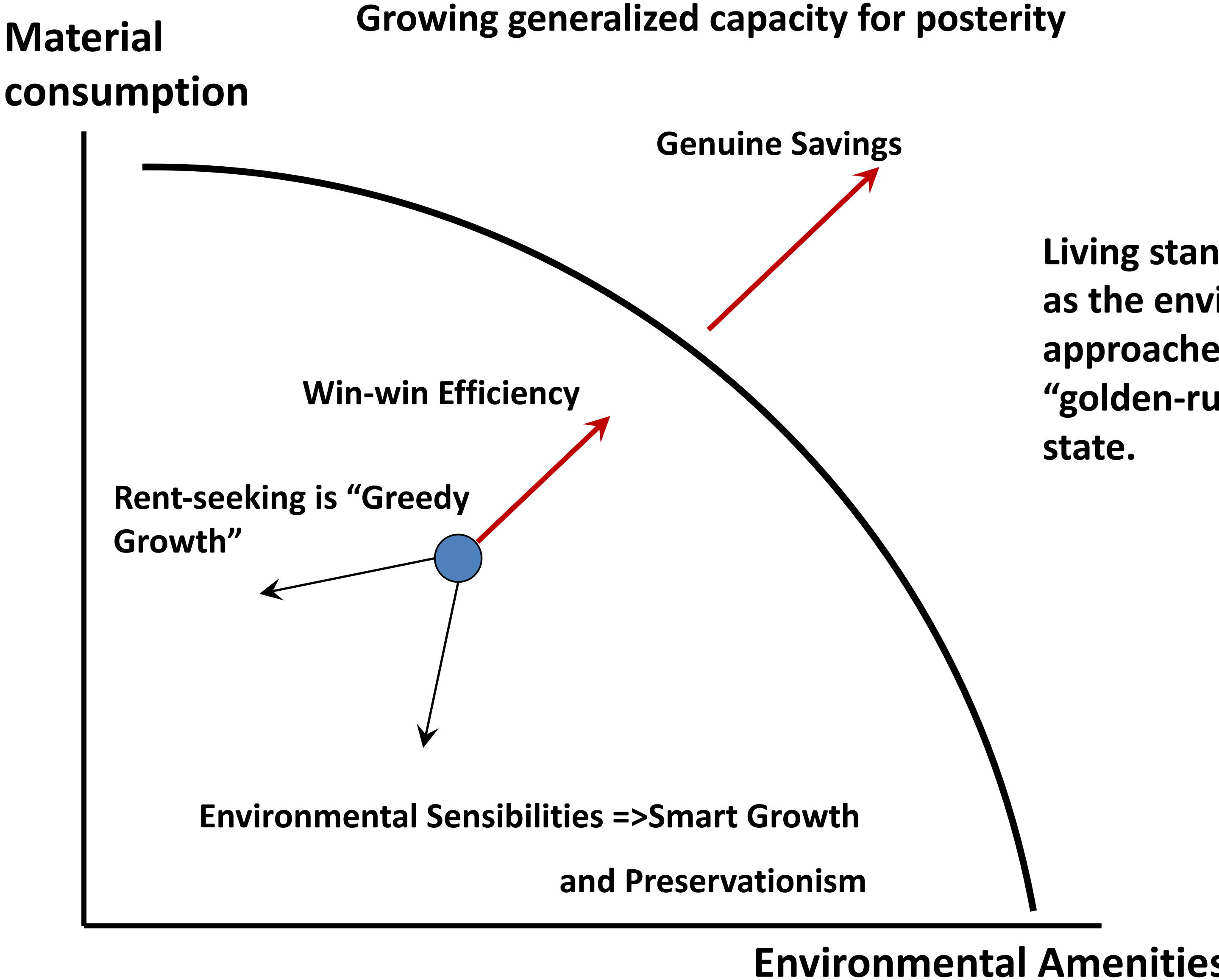
Alternative: Positive Sustainability

- Hotelling and Ramsey conditions determines optimal management of the country's aggregate produced and natural capital.

- This implies:
  - Optimal drawdown of non-renewable resources
  - Optimal drawdown or accumulation of renewable resources
  - Optimal accumulation of produced capital
  - Presence of externalities calls for corrective prices to bring us closer to optimal outcomes

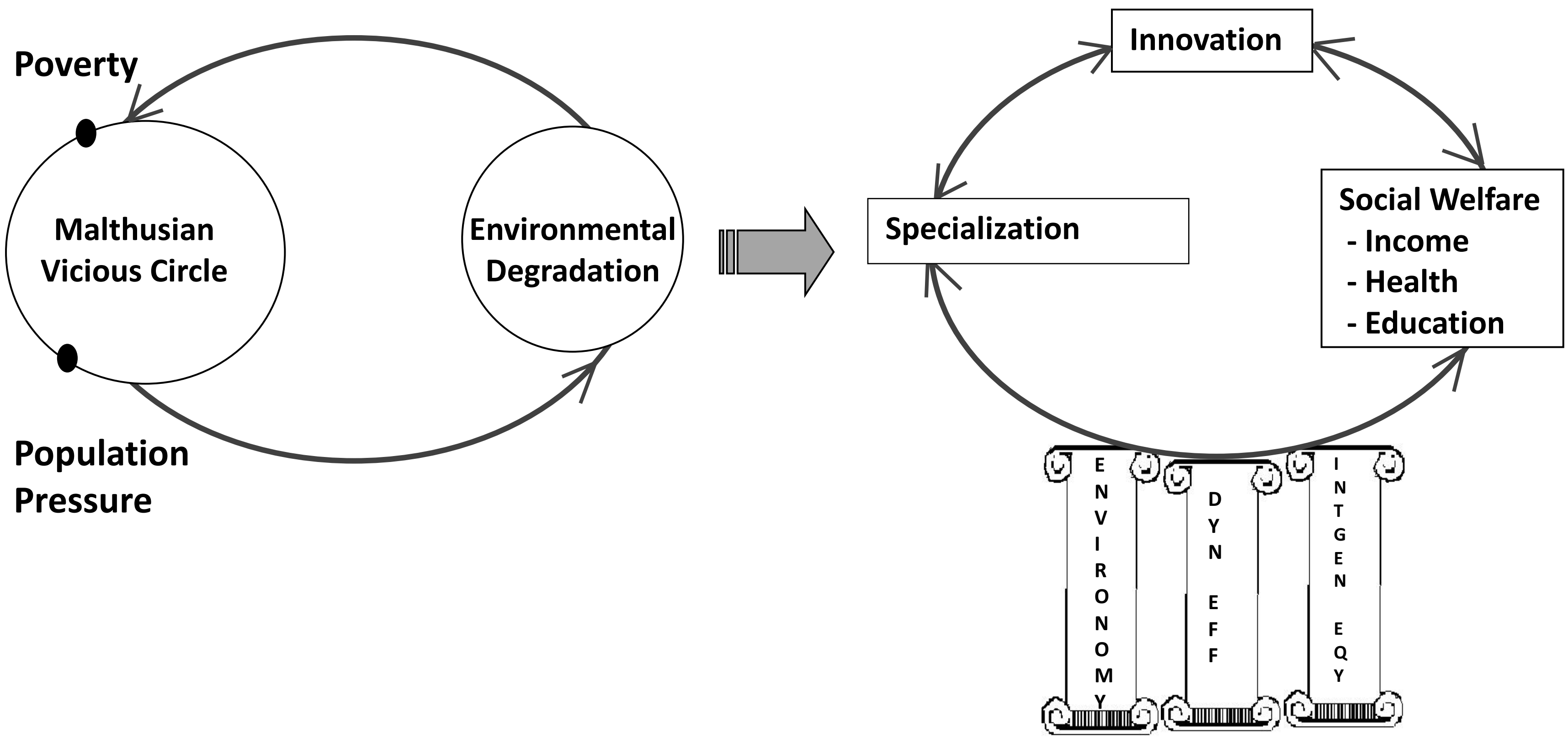
Positive Sustainability

Growing generalized capacity for posterity



Living standards, rise as the environomy approaches a "golden-rule" steady state.

Unsustainable and Sustainable Development



Sustainability Science

- *Sustainability Science*: transdisciplinary research organization focused on specific resource management and policy questions
- Instead of acting like we have the answers, should be *solving* for
  - Efficient water use, including optimal drawdown/build-up of aquifer; watershed conservation
  - Optimal generation profile of fuels for electricity
  - Among others

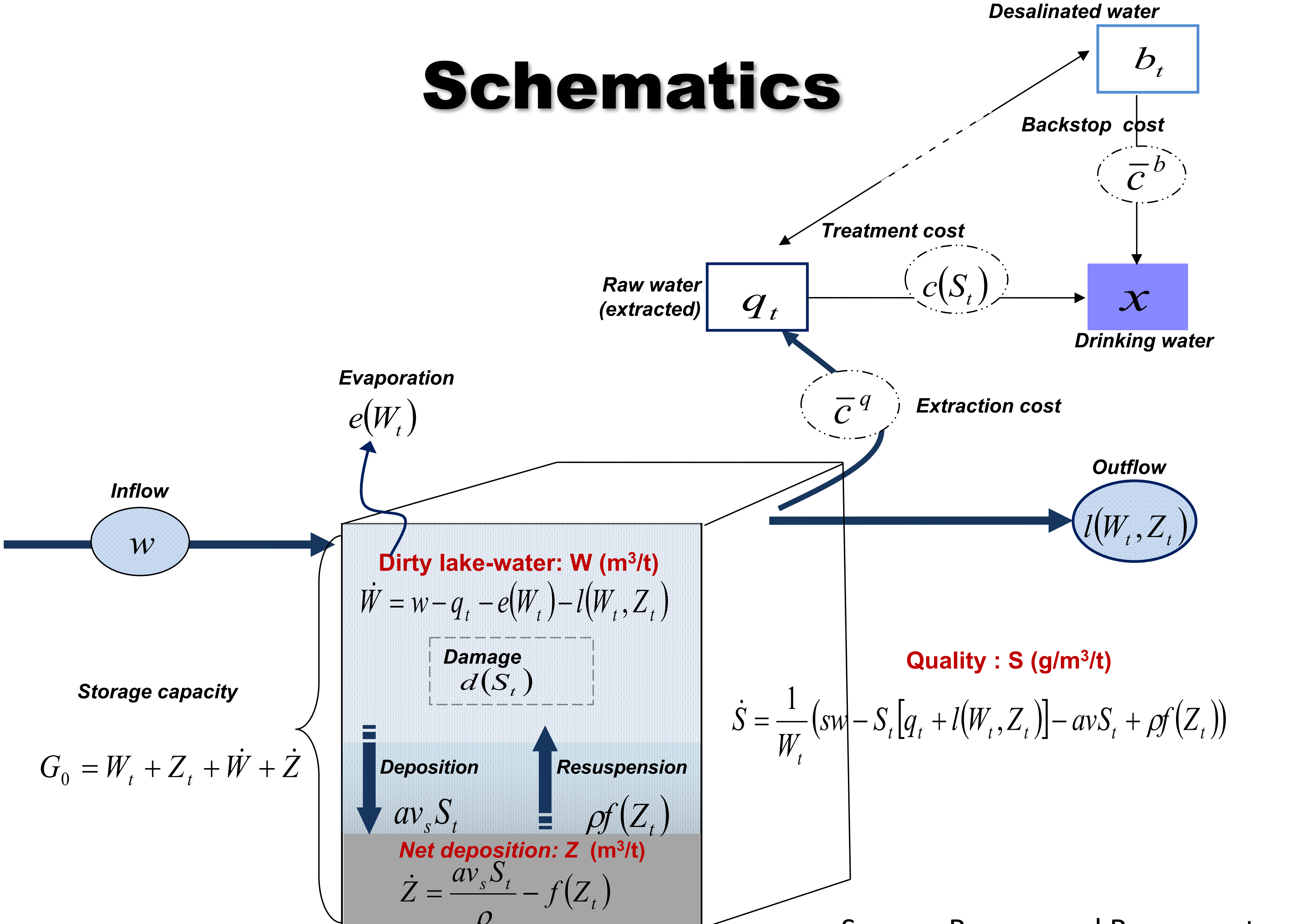
Sustainability Science

Sustainability represents an injunction to extend policy analysis to encompass both system interdependence and intergenerational equity.

- Take a systems approach to development and growth and that promotes appropriate savings and investment for the benefit of future generations.
- Does not require throwing out the policy science that has evolved over the last quarter millenium.

Example 1: In Manila, water production is unable to meet quantity demanded at current prices.

Schematics



Source: Ravago and Roumasset

Lake-water Model

Water manager faces the problem of maximizing the net social surplus (consumer benefit minus the producer extraction and treatment cost and less the damage cost).

$$\underset{q_t, b_t}{Max} \sum_{t=0}^{\infty} \left[\left(\frac{1}{1+r} \right)^t (\text{net benefits})_t \right]$$

Subject to the constraints of:

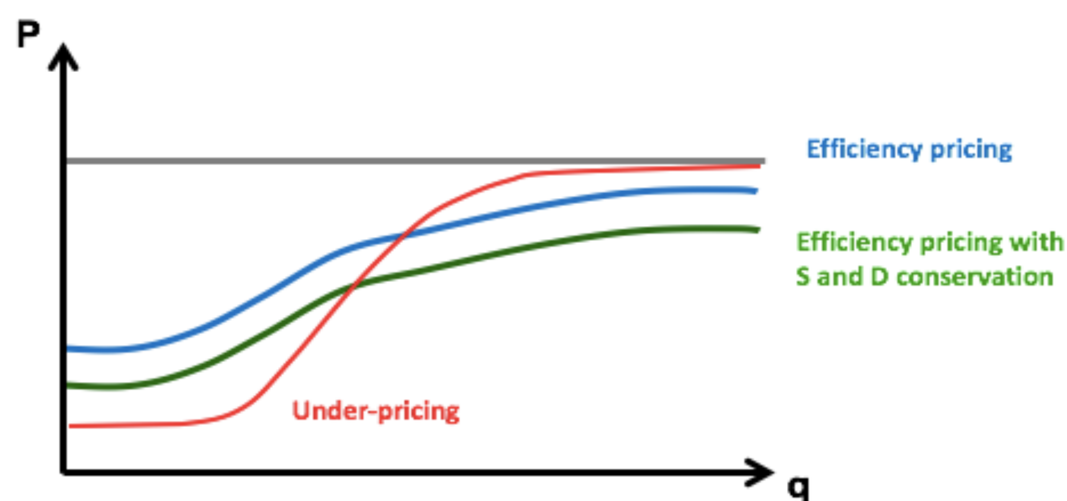
quantity, quality, and storage capacity

Source: Ravago and Roumasset

Efficiency price

- P = MOC:
  - marginal benefit, i.e. price = marginal opportunity cost of lake-water
- MOC = extraction + treatment cost + marginal user cost (MUC).
- P = c + MUC

Under-pricing water artificially increases water scarcity.



Benefits of efficiency pricing

Demand side conservation

Block pricing – implementation of efficiency pricing

- **Efficiency pricing is warranted for sustainable use of lake-water.**
- **Delays the eventual use of expensive backstop technology.**
- **Lowers the treatment cost in transition to steady state.**
- **Lowers the scarcity value of water.**

Supply-side conservation

- **Integrated watershed management**
- **Dredging**
- **Urban – better sanitation, improve sewage facilities, flood management**

Policy implications

- Inform policy decisions when to build and how long to use treatment facilities
- Inform policy decision with regards to the timing of building desalination plants

Ex. 2. Electricity Generation Investment Requirements

- We consider how much additional capacity is indicated, given the existing capacities in place, including committed capacities scheduled for completion by 2025.
- Preliminary results: Existing gas-fired generation-capacity displaces some of the coal-fired generation that would have otherwise been indicated.

Source: Jandoc, Ravago, Roumasset, Espinoza

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ENERGY POLICY AND DEVELOPMENT PROGRAM (EPDP)

Investment Requirements

Visayas (as of 2017)

- Electricity demand is projected to increase to 2,710.1 MW MW by 2025
- dependable capacity for coal is 1,483.33 MW
- diesel has 452.48 MW, and
- excess load of 774.89 MW needs to be satisfied by either building new coal plants or new CCGT plants

- Then we net the projected demand by all other technologies assuming:
  - Solar and Wind doubles its 2017 committed capacity
  - Biomass increase by 50% of its 2017 committed capacity any expansion of hydro and geothermal is just sufficient to maintain current capacities

Use Profile and Costs
Visayas

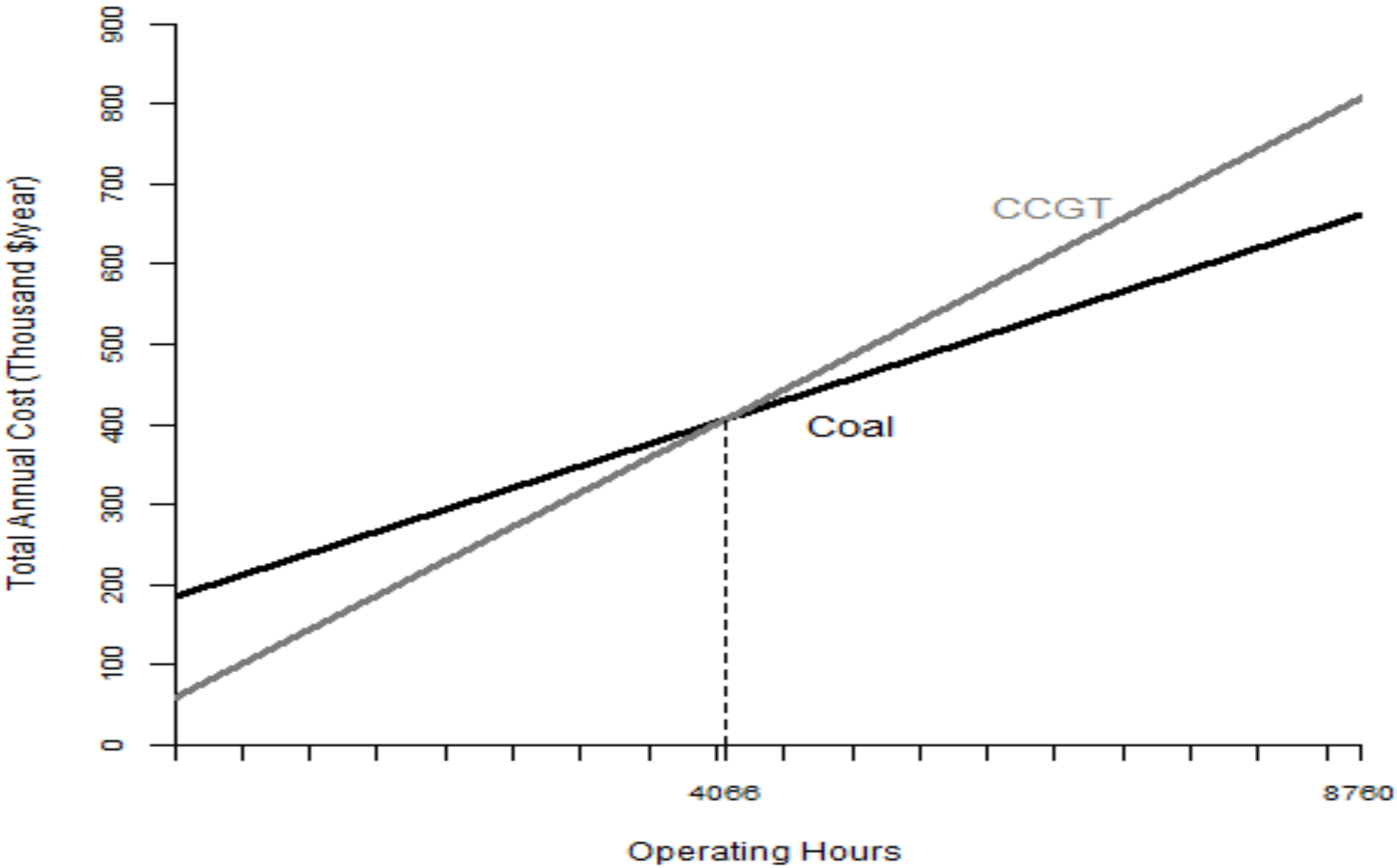
Cost for Visayas Grid **with pollution costs** given existing gas-fueled and diesel-fueled plants, 2025

Generation Technology	Total Cost (Billion $)								Percent of Total Cost
	Fixed	Variable Unit Cost			Pollution Cost			Total	
		L	M	H	L	M	H		
Coal	0.017	0.103	0.204	0.126	0.058	0.114	0.071	**0.693**	73%
CCGT	0.042	0.017	0.095	0.086	0.000	0.001	0.001	**0.242**	25%
Diesel	0.000		0.001	0.016		0.000	0.001	**0.018**	2%
Total	0.059	0.121	0.299	0.228	0.058	0.115	0.073	**0.954**	100%

Note: L – Low load cluster, M – Medium load cluster, H – High load cluster. Fixed cost for existing capacity only include Fixed O&M cost and does not include overnight construction costs (annualized capital costs). Fixed cost for new investments include both Fixed O&M and overnight construction costs. Variable unit cost is fuel cost plus variable O&M costs.

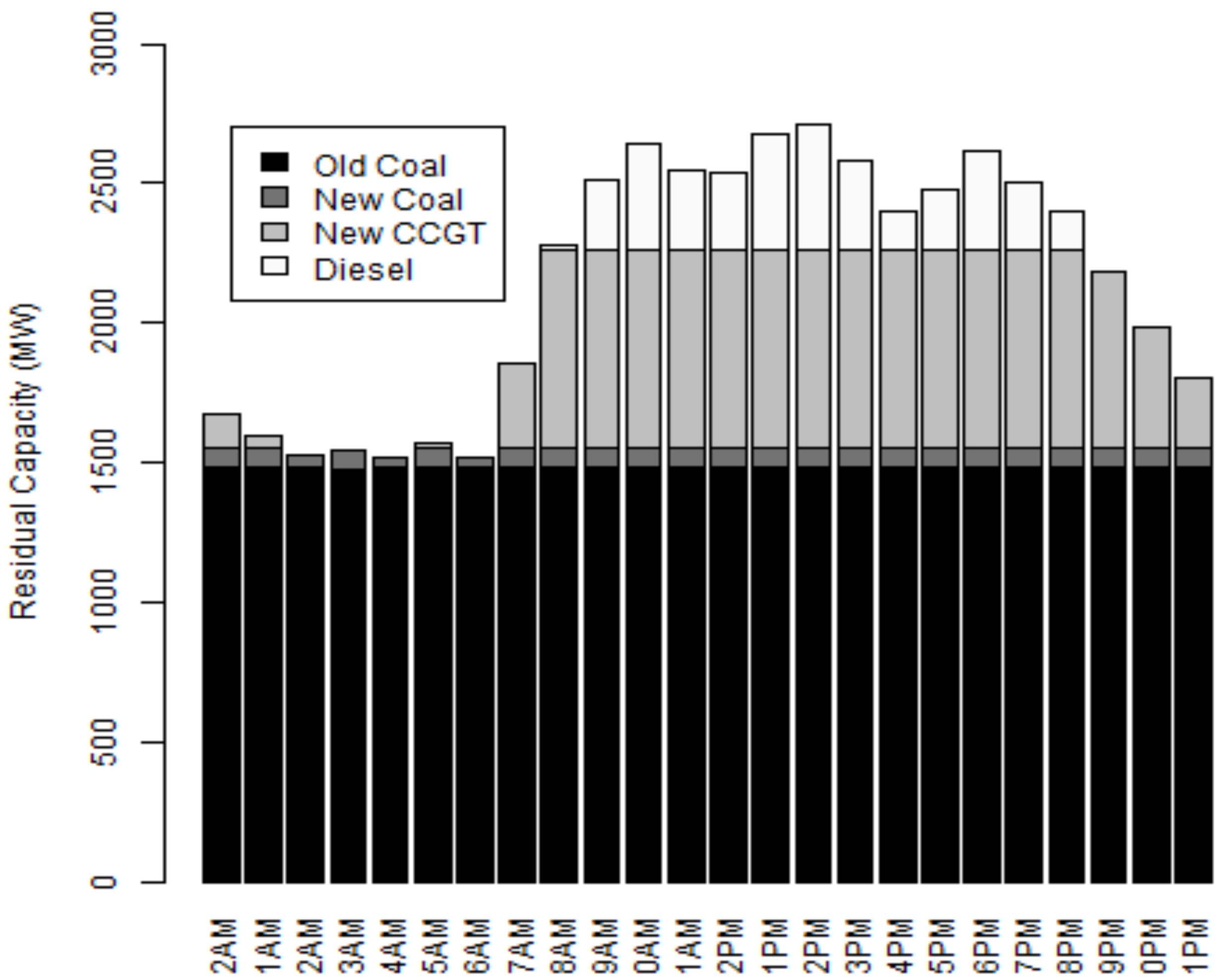
Source: Jandoc, Ravago, Roumasset, Espinoza

Visayas Grid : Least Cost Generating Mix for Residual Capacity with pollution costs



Screening analysis shows the least-cost mix of generation types when the system is being designed from scratch.

2025 Visayas generation profile for hourly peaks with pollution cost given existing coal-fueled and diesel-fueled plants + new coal and gas



Source: Jandoc, Ravago, Roumasset, Espinoza

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Results

- Our analysis of the Visayas grid suggests that the small excess demand by 2025 can be served by existing and committed generation assets should be mostly satisfied by CCGT due to the variability of excess load and the substantially lower pollution cost of natural gas compared to coal.
- Only when the Visayas grid is considered completely separate from Luzon is a small amount of addition investment warranted for new coal-fired plants.

Source: Jandoc, Ravago, Roumasset, Espinoza

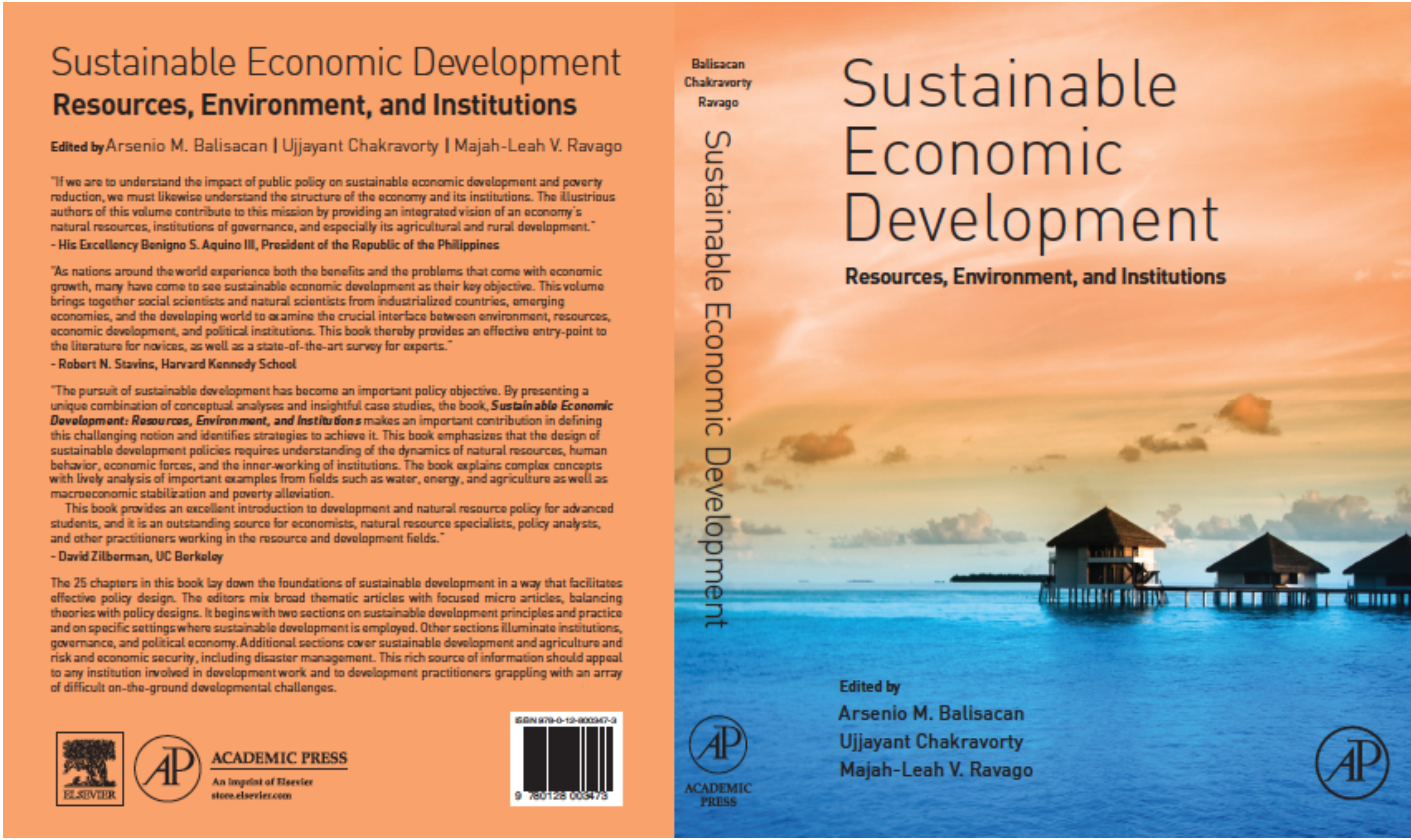
Conclusions

- **Vicious to virtuous cycle : incorporates the principles of sustainable growth and development.**
- **A systems approach that takes into account the *environomy*, combined with dynamic efficiency and intergenerational equity will promote meaningful sustainable development.**

POLICY LESSON:
GET THE PRICE RIGHT !!!

Pearce equation

$$P = MB = MC + MUC + MEC = MOC$$



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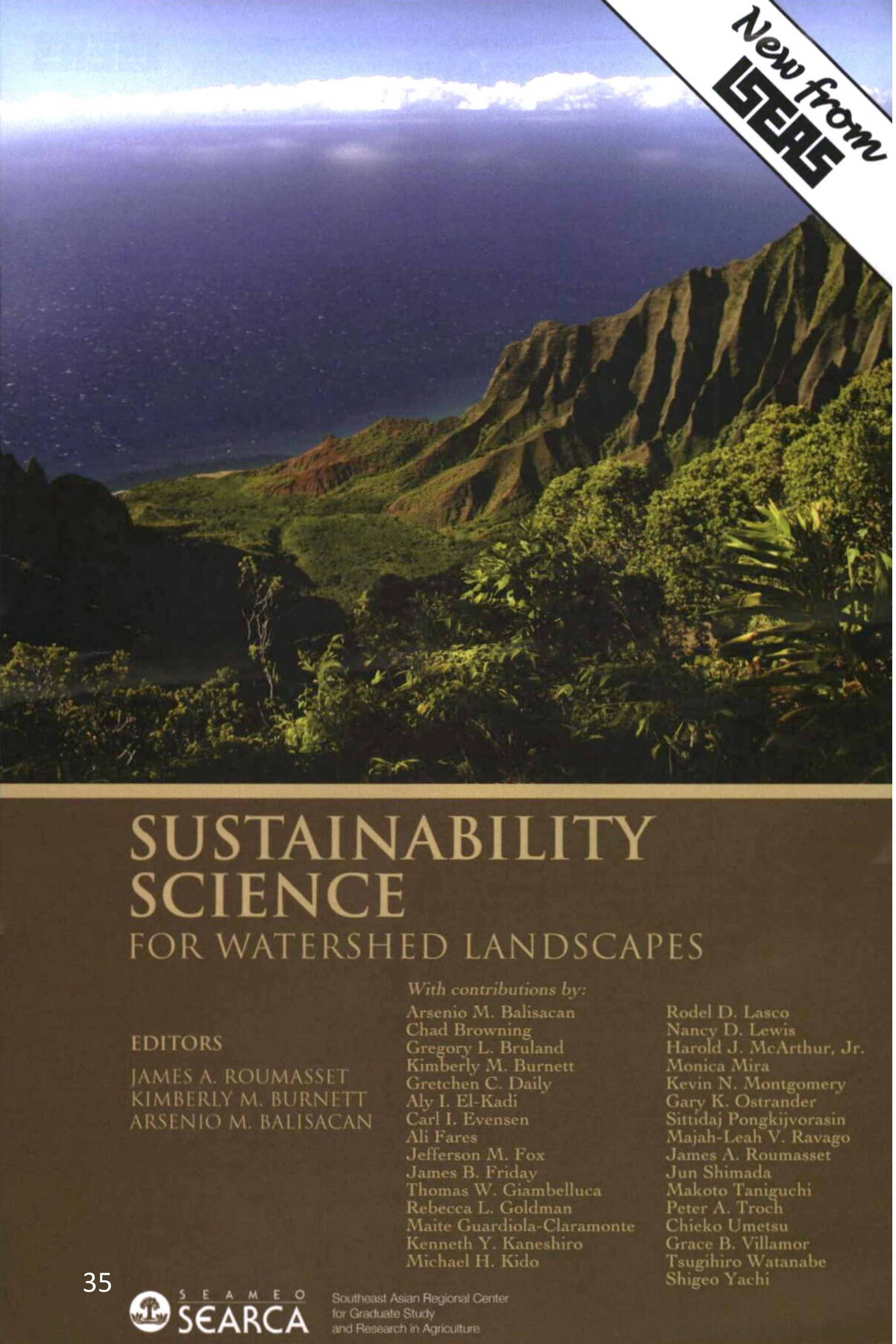

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