

An aerial photograph of a large airport terminal and tarmac. The terminal is a long, multi-story building with a central tower. Numerous aircraft are parked at gates and on the tarmac. The surrounding area includes roads, parking lots, and green spaces.

Determining Airport Sustainability on an Energy Basis

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Society
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Content

- What is an airport?
- What is sustainable development?
- Emergy theory
- Results and evaluation
- A change in design
- Conclusion
- Q&A

Business district

What is an airport?

Runways and terminal

and terminal

MRO

Golf course

Residential area

What is an airport?

“A whole within which technical, economical, environmental, and social systems interact with each other”

“Airport design is the need to develop the capability to identify the salient forces acting upon the system, and to trace out their implications for its performance”

[de Neufville and Odoni]

What is sustainable development?

- Sustainable development is the development that meets the needs of the present without compromising the needs of the future? [*WCED*]
- A socio-ecological process characterized by ideal-seeking behaviour? [*Ackoff & Emery*]
- Regeneration, Substitutability, Assimilation, Avoiding irreversibility? [*OECD*]

Emergy theory

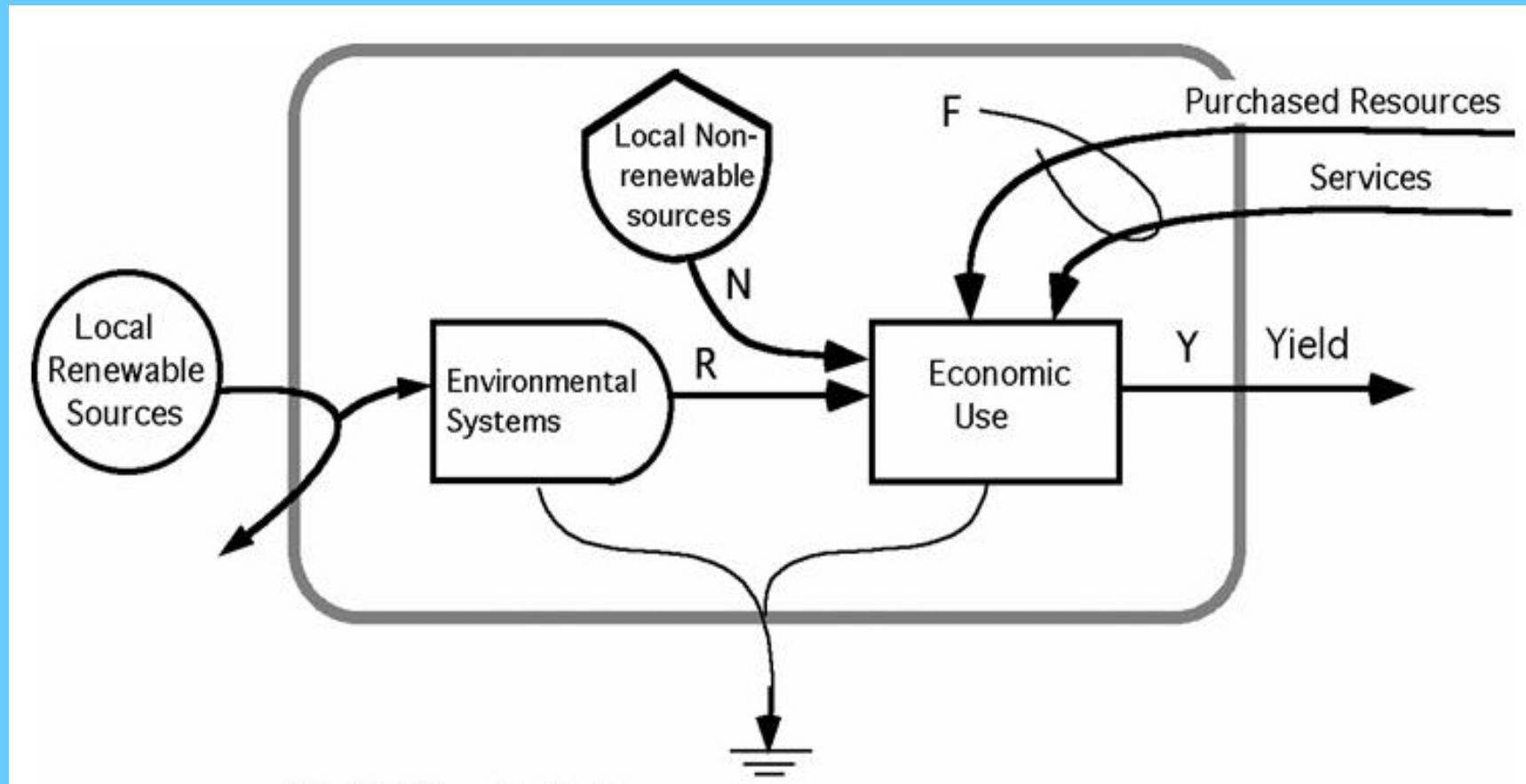
1 Joule = 1 Joule?

“Emergy is the available energy of one kind previously used up directly and indirectly to make a service or product”
Its unit is the emjoule [*Odum*]

Emergy theory

Transformity:
 $E_m = \tau \cdot E_x$

Emergy theory



Emergy theory

Performance Indices:

- Φ - The percentage renewable resources
- EYR - The emergy yield ratio
- ELR – The environmental loading ratio
- ρ – The empower density
- SA – The renewable support area
- ESI – The emergy sustainability index

Results and evaluation

- The airport uses only 14% renewable resources
- Energy Yield Ratio = 1.2
- Environmental Loading Ratio = 6

Results and evaluation

- Empower density of the system:
 $1.9E15 \text{ seJ/m}^2\text{*year}$
- Renewable support area = 275 km²
- Emergy Sustainability Index = 0.2

A change in design

Less electricity, more sustainable...?



A change in design

Effect of the application:

- Energy required for lighting decreases 50%
- Total airport energy budget decreases 1.5%
- System sustainability increases 0.08%

Conclusion

- Although airports produce a small net yield to the next bigger system, they do so at a high environmental cost
- Airports are consumer processes that are not sustainable in the long run
- Airports can be made more sustainable. The example points to a financial and economical win-win



Thank you for your attention!