Howe Sound Pulp & Paper

“A Good News Story”

Presentation to
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Continuing Studies and Executive Education

ElderU

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Part 4

Natural Cycles

and what we can
learn by studying them

The Four “Spheres”

The Four “Spheres”

Scientists classify the living and non-living material of the earth into four spheres:

- The *lithosphere* includes the entire crust of the earth. “Litho” is the Greek word for stone.
- The *hydrosphere* includes all of the water of the earth. “Hydro” is the Greek word for water.
- The *atmosphere* is the air around us. “Atmo” is the Greek word for air.
- The *biosphere* is composed of the living organisms. “Bio” is the Greek word for life.

The four “Spheres”

- Changes to spheres can be natural (earthquake) or human caused (air pollution), and changes in one sphere often result in changes in another.

- Changes can be local (a flood may spread only a few miles) or widespread (the change in ocean currents from an El Niño event can change the weather across a continent).

- The four spheres work together to create our environment and sustain life on earth. Within the environment are the smaller systems called *ecosystems*.

The Biogeochemical Cycles

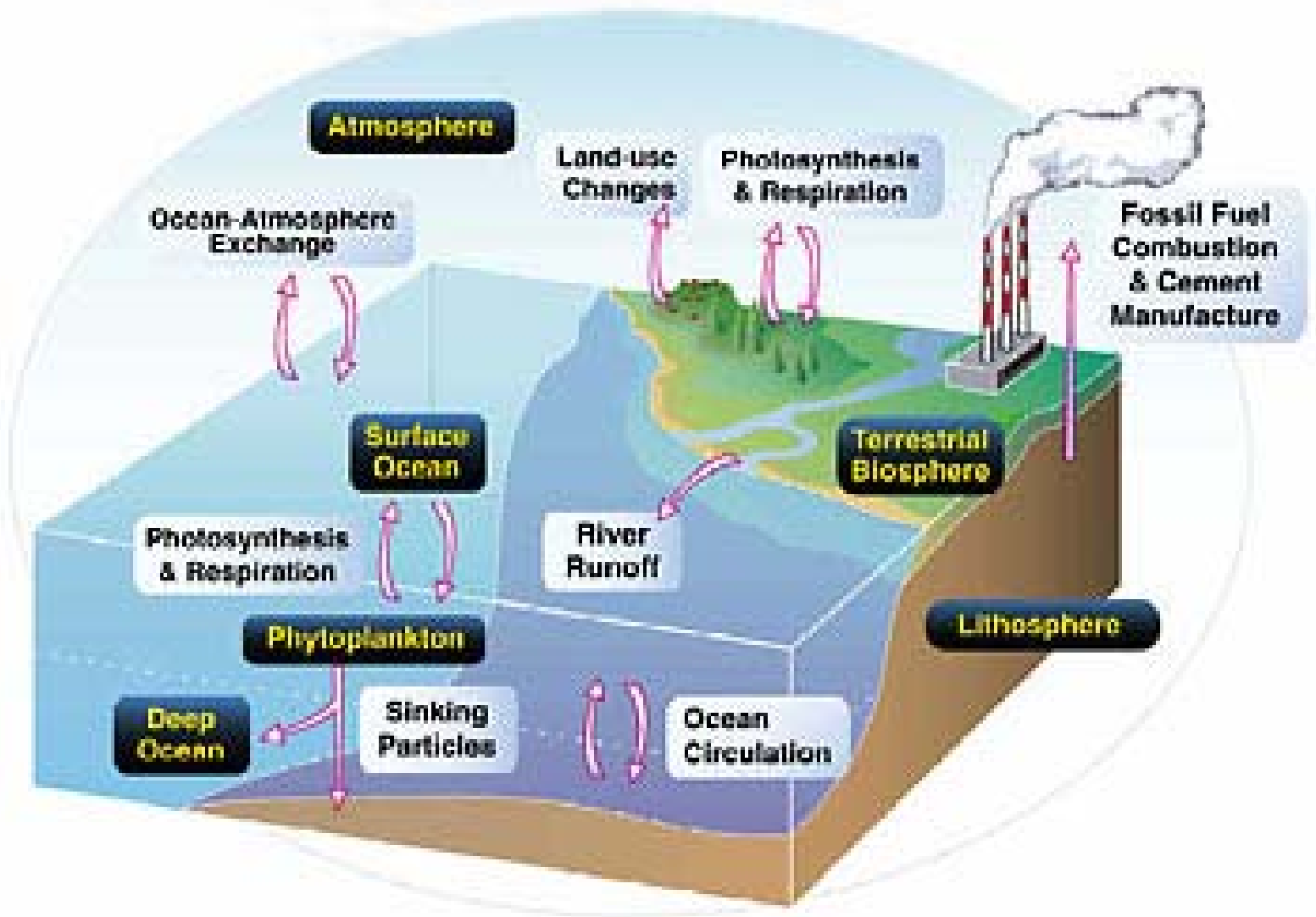
- Oxygen
- Carbon
- Sulphur
- Phosphorous
- Hydrologic
- Rock

- (Energy)

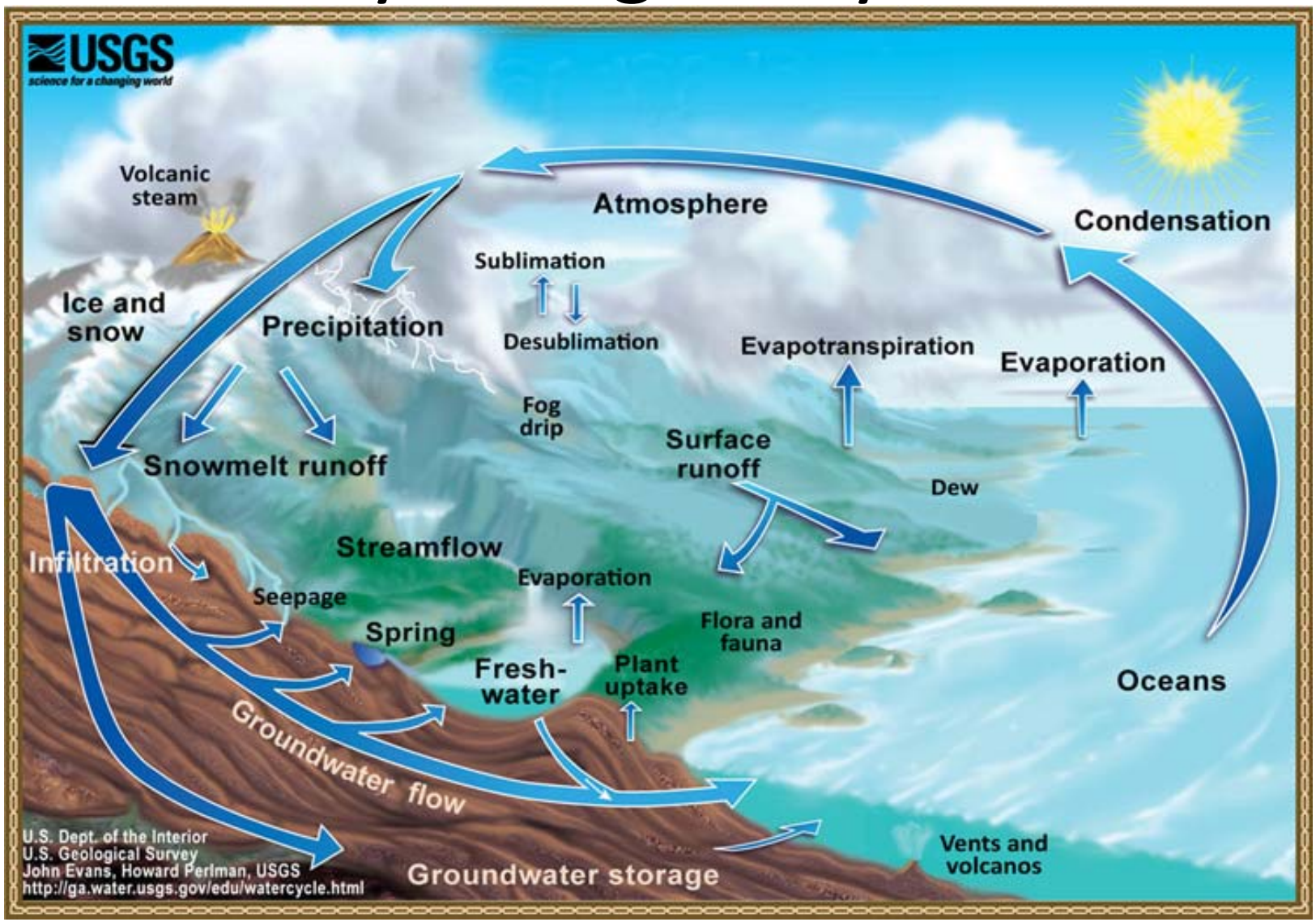
"a pathway by which a chemical substance moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth.

A cycle is a series of changes which come back to the starting point and which can be repeated.

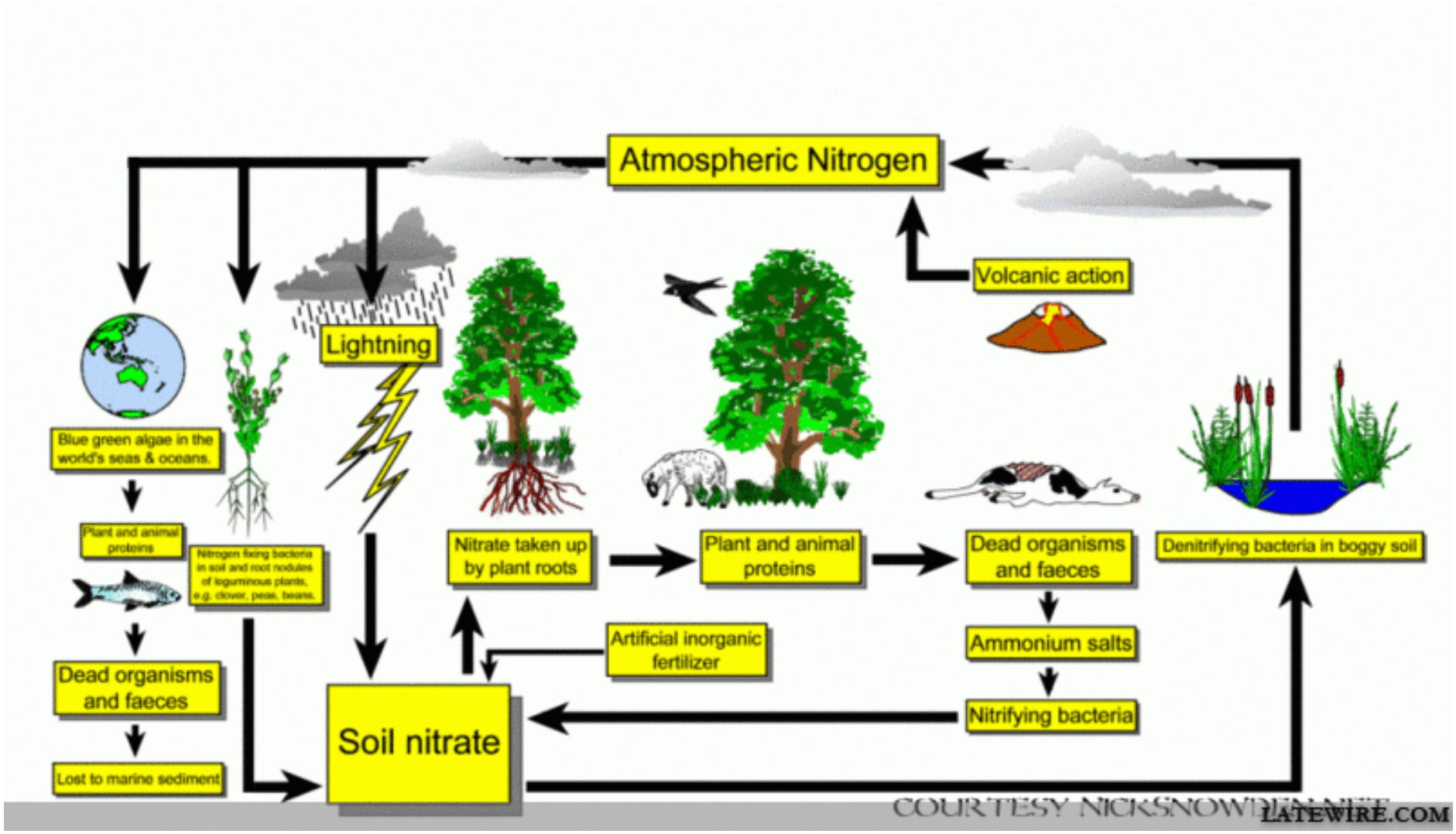
Global Carbon Cycle



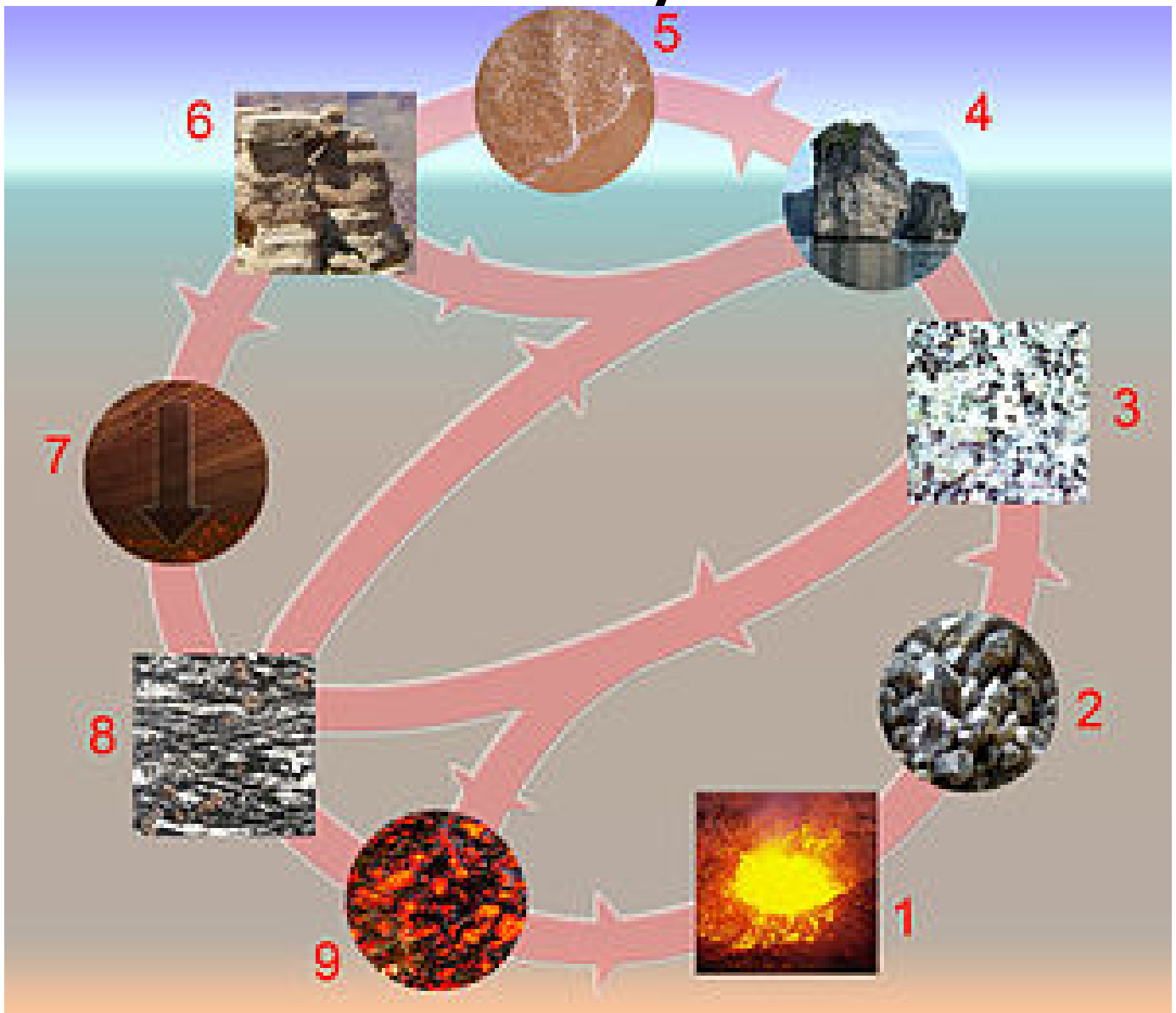
Hydrological cycle



Global Nitrogen Cycle



Rock Cycle



The Technosphere

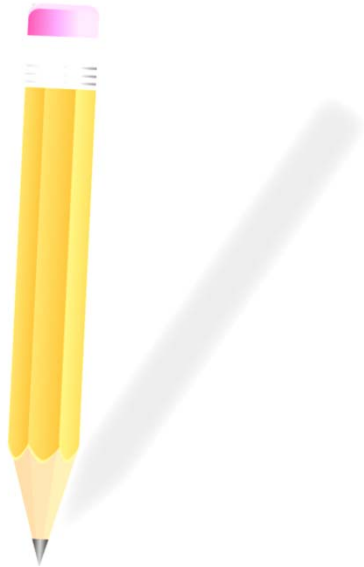
The Technosphere

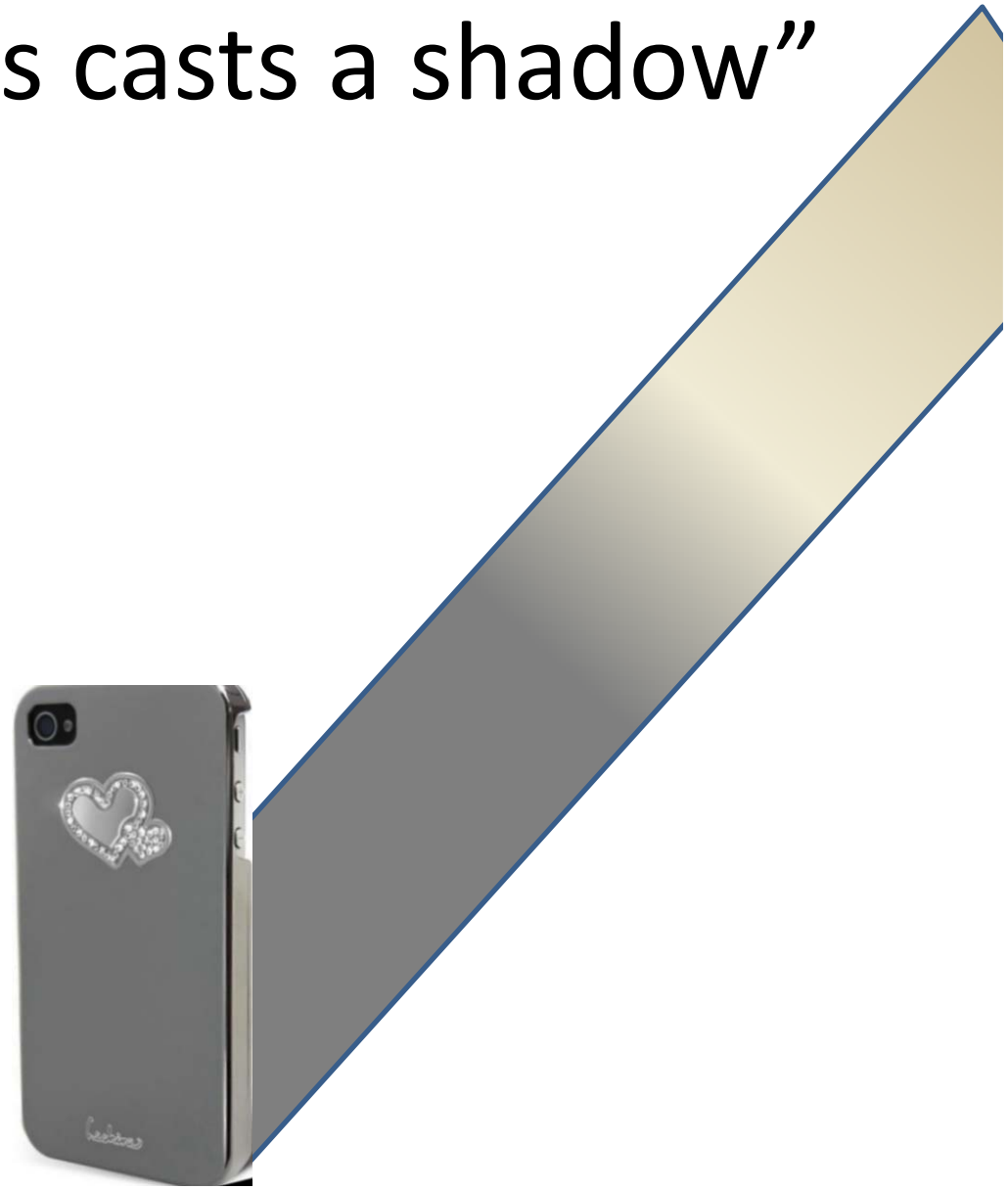
- The *technosphere* refers to the elements of our world altered by human activity.

- The technological evolution occurs on a time scale orders of magnitude faster than biological evolution.

- Increasingly there is conflict between the *technosphere* and the *four natural spheres.*

“Every products casts a shadow”





Technosphere Issues revealed by LCA

- On average, only 6% of resources taken from the environment end up as products.

  The other **94% is waste** Lowe, Warren, Moran, 1999
- Is it really waste, or is it a by-product that can be used elsewhere?
- In most LCA's the impacts associated with energy use form the largest damage categories

Industrial Ecology (IE)

- Industrial Ecology is the study of material and energy flows through industrial systems
- The name comes from the idea that we should use the analogy of natural systems as an aid in understanding how to design more sustainable industrial systems
- The discipline has sometimes been dubbed “the science of sustainability”
- It can be applied at various levels: company, industrial park, national/global cycles

Industrial Ecology

- A system that *"would maximize the economical use of waste materials and of products at the ends of their lives as inputs to other processes and industries."* *Frosch 1992*
- Combines knowledge gained from toxicology, Life Cycle Assessment, Environmental Design, material reuse and recycling and other tools
- By understanding the more complete picture we can try to better identify opportunities for improvements or synergies

Industrial Ecology Analogies

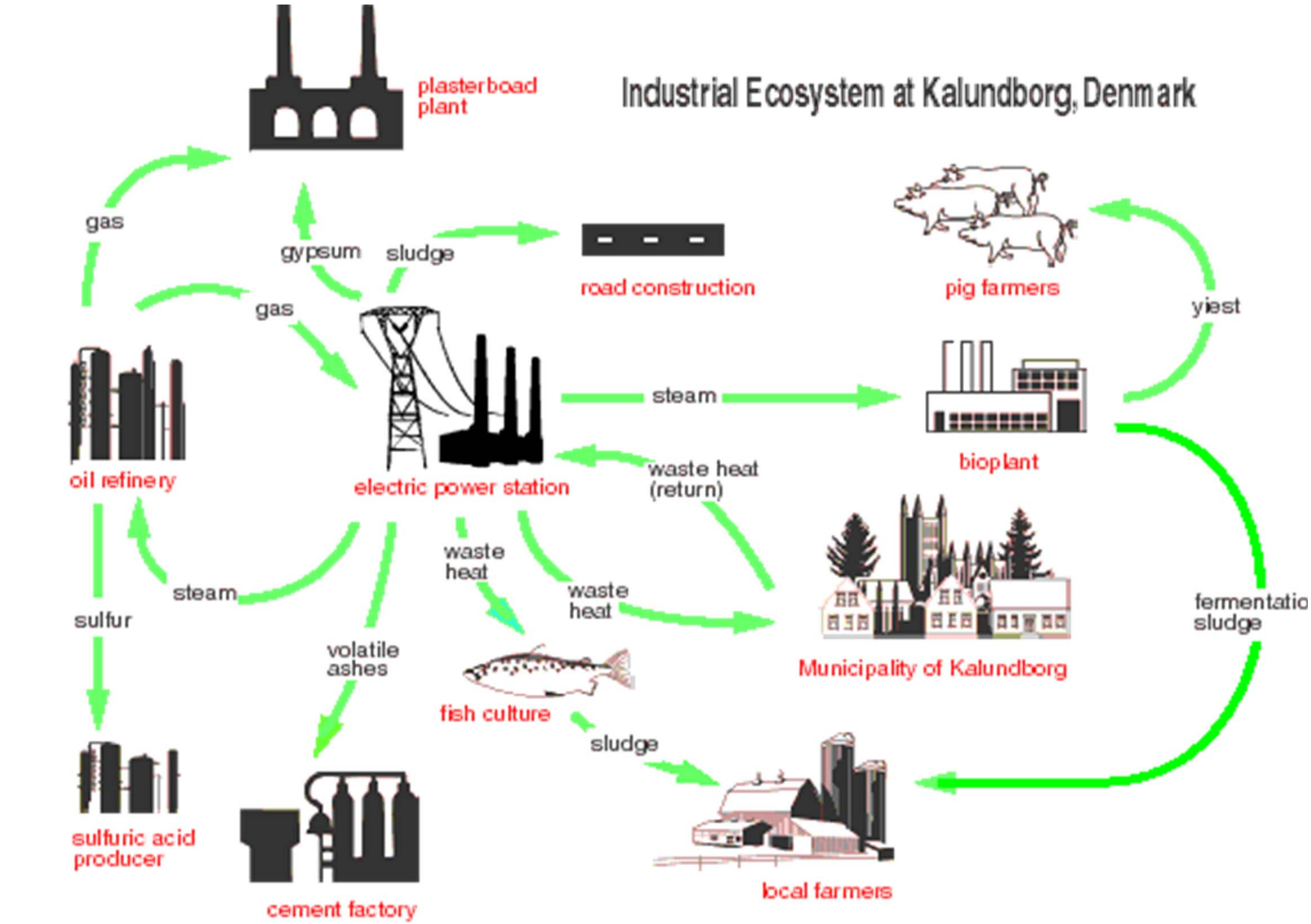
Biosphere	Technosphere
Environment	Market
Organism	Company
Natural Product	Industrial Product
Natural Selection	Competition
Ecosystem	Eco-Industrial Park
Ecological Niche	Market Niche
Anabolism / Catabolism	Manufacturing / Waste Management
Mutation and Selection	Design for Environment
Succession	Economic Growth
Adaptation	Innovation
Food Web	Product Life Cycle

Industrial Ecology Analogies

- It is important to note that the analogy only holds for the material flows in the technosphere, there are contradictions too:

- Rate of change: biosphere slow/technosphere is rapid by its very nature

- Nature has ways to stabilise her systems, in the technosphere this could cause ethical or moral issues


Industrial Ecosystem at Kalundborg, Denmark
plasterboad plant
gas
gypsum
sludge
road construction
pig farmers
yiest
gas
steam
oil refinery
electric power station
waste heat (return)
bioplant
steam
waste heat
waste heat
fermentatio sludge
sulfur
volatile ashes
Municipality of Kalundborg
fish culture
sludge
sulfuric acid producer
cement factory
local farmers

Kalundborg Industrial Park, Denmark

- Industries exchange wastes
- Companies made agreements 70s – 90s
- Asnaes – Coal-fired power plant
- Statoil – Oil Refinery
- Gyproc – plasterboard company
- Novo Nordisk – biotechnology company

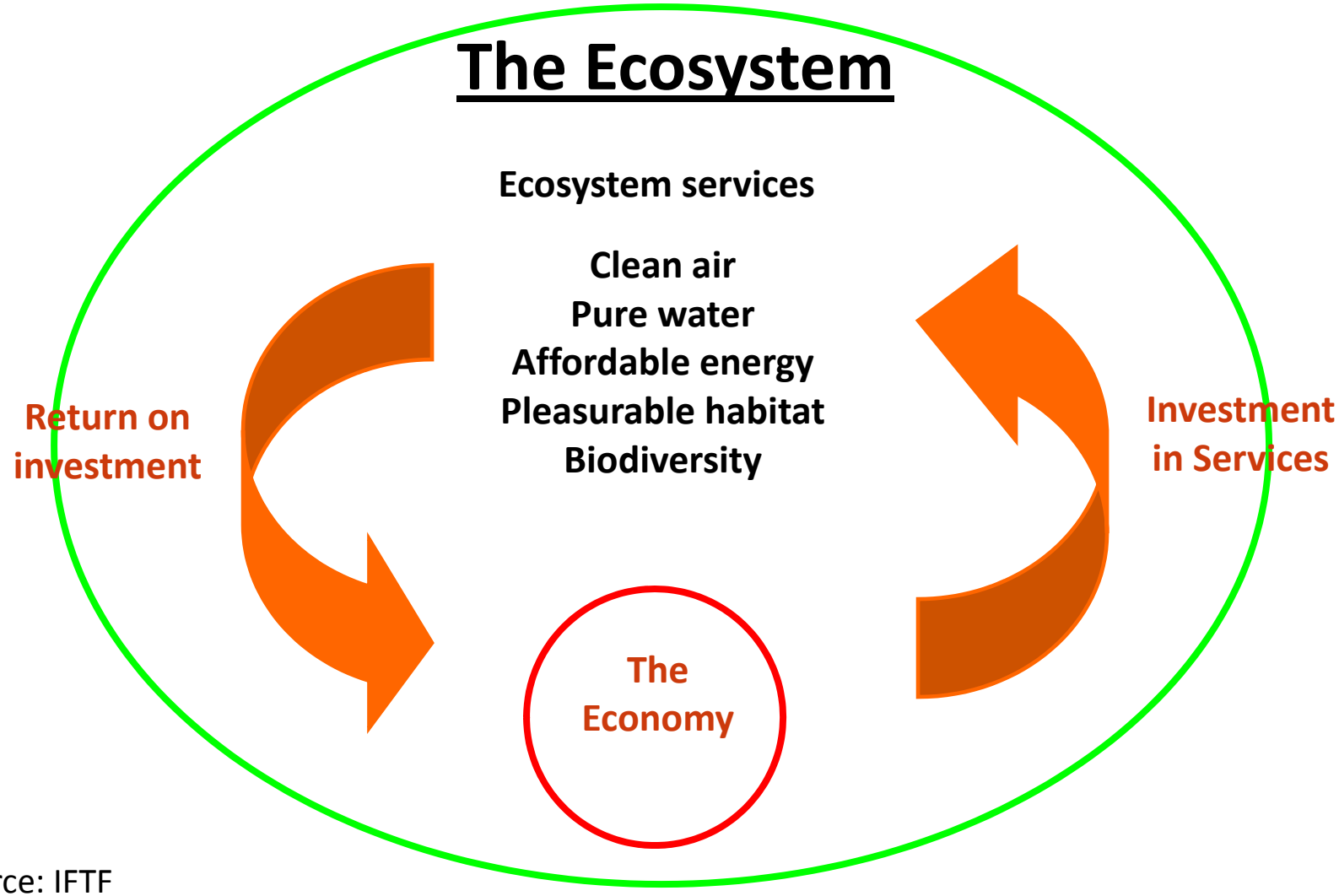
The Forest Products Industry

Role of forests in the cycles

- Forests regulate:
  - Carbon – sequester Carbon, albedo effect
  - Hydrologic – run-off/flood control, quality
  - Nutrients – P, S, N
  - Rock – landscape stabilisation

  - And many more…

The Sustainable Development Ecosystem



Source: IFTF

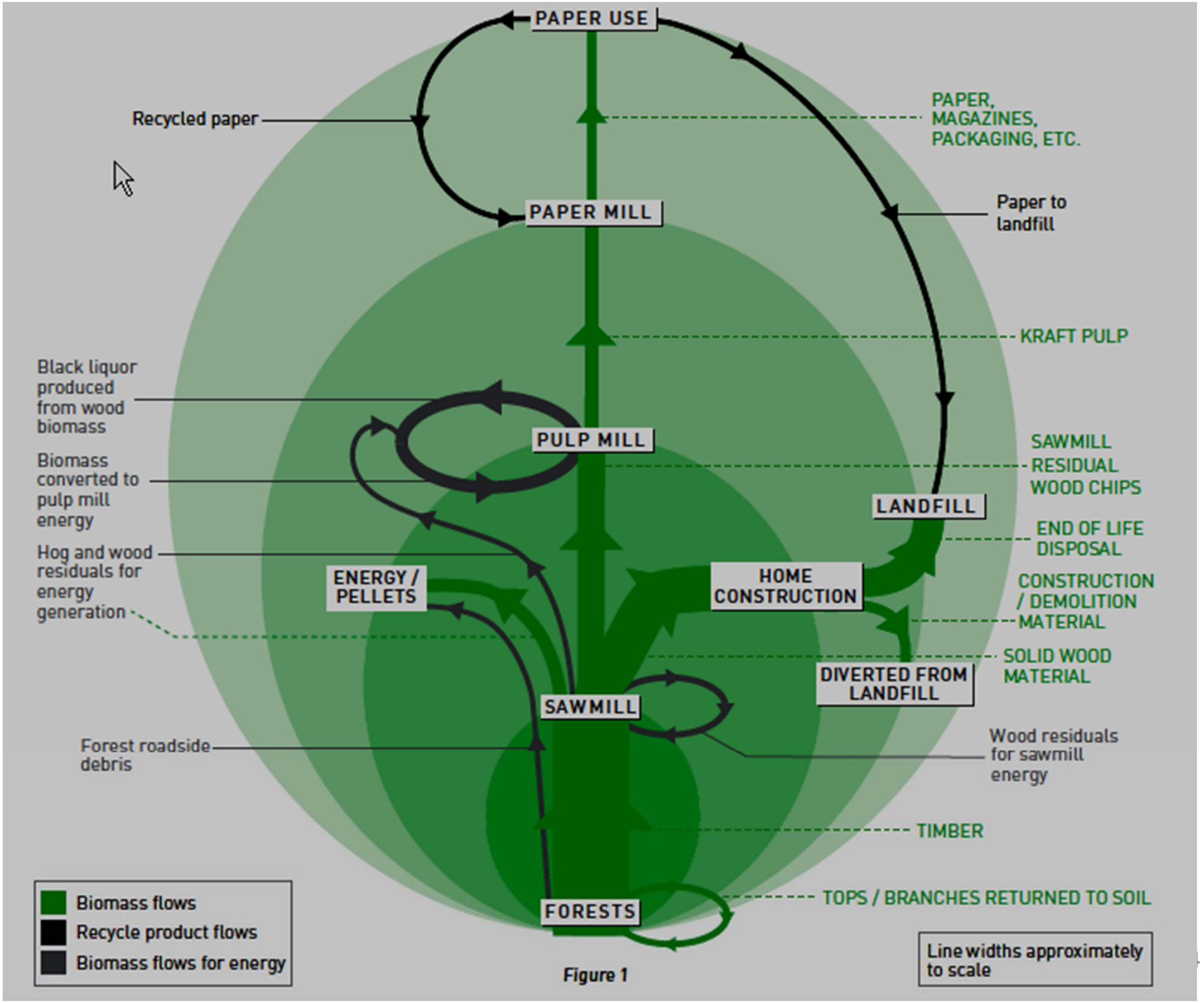
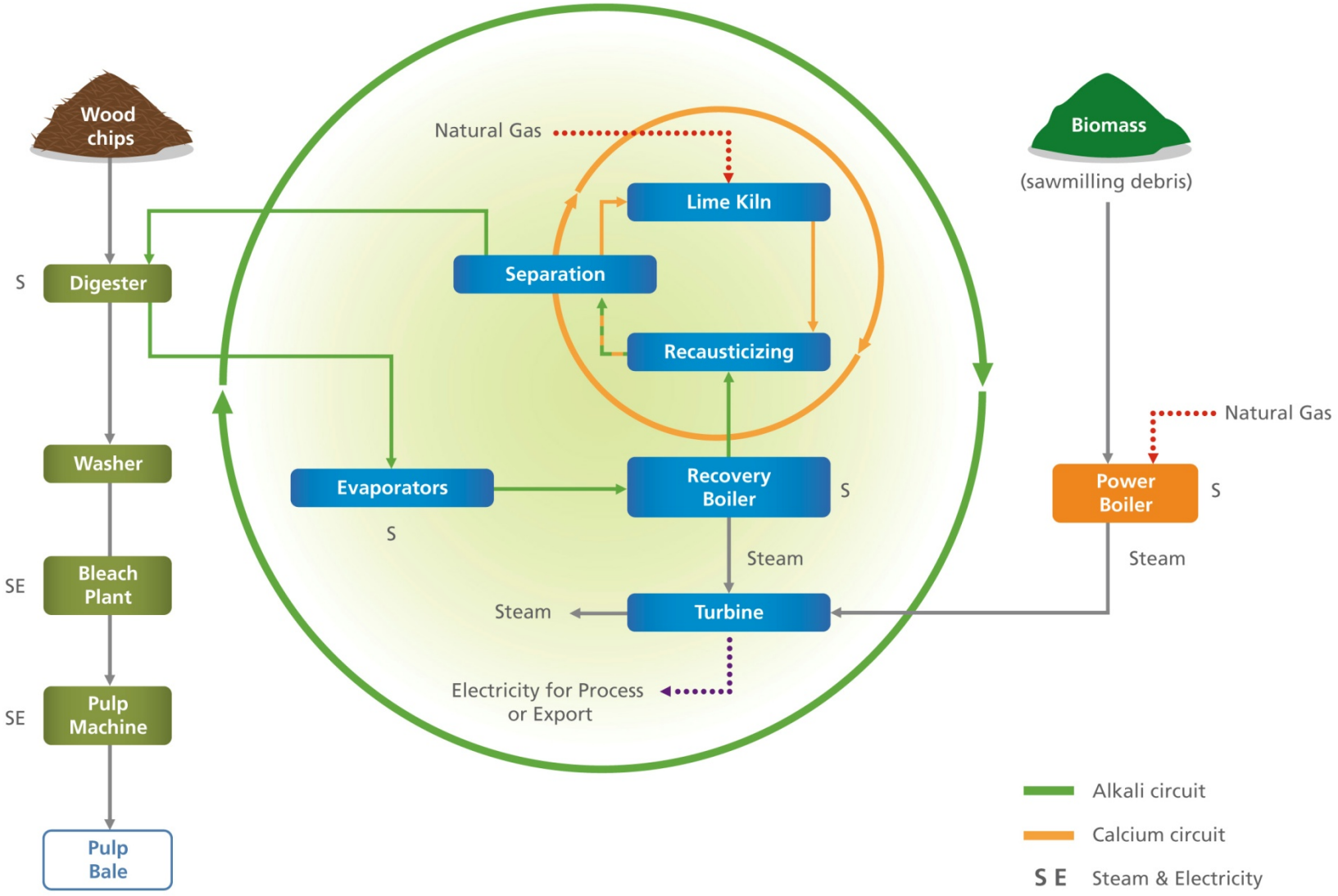

PAPER USE
Recycled paper
PAPER, MAGAZINES, PACKAGING, ETC.
PAPER MILL
Paper to landfill
KRAFT PULP
Black liquor produced from wood biomass
PULP MILL
Biomass converted to pulp mill energy
SAWMILL RESIDUAL WOOD CHIPS
LANDFILL
END OF LIFE DISPOSAL
Hog and wood residuals for energy generation
ENERGY / PELLETS
HOME CONSTRUCTION
CONSTRUCTION / DEMOLITION MATERIAL
SOLID WOOD MATERIAL
DIVERTED FROM LANDFILL
SAWMILL
Forest roadside debris
Wood residuals for sawmill energy
TIMBER
FORESTS
TOPS / BRANCHES RETURNED TO SOIL
Biomass flows
Recycle product flows
Biomass flows for energy
Line widths approximately to scale

Figure 1

Kraft pulping cycle



The forest products cycle

- Unlike many industries, our industry does reuse and recycle, so we clearly exhibit Type II characteristics
- But we also re-grow, relying on photosynthesis, so we exhibit a key Type III characteristic too
- A key weakness today is the low recovery rate for construction wood at the end of its life

Industrial Ecology

- In a special edition of the Journal of Industrial Ecology, Reid Lifset at the school of Forestry and Environmental studies at Yale wrote:
- *"..good research on the industrial ecology of forest products, although not done using the rubric of industrial ecology, has been done using its tools and orientation. Much as when Monsieur Jourdain in Molieres' Le Bourgeois Gentilhomme discovers he has been speaking prose all his life, we now realise that they have been doing industrial ecology all along."*

•JIE, Vol 1, No. 3, Summer 1997

Thank you for your attention!

Carbon neutrality

- Forests are very effective at pumping carbon (in the form of CO2) out of the atmosphere and storing it in trees, wood and soil.
- Think of trees as “carbon pumps”
- Over the lifetime of a tree, carbon is first removed from the biosphere then returned as it dies and decays. But it is always carbon from the biogenic pool. Hence international agreements differentiate it from carbon released from the fossil resources – ie gas, oil

Carbon balance for daily newspaper