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CRTE
CENTRE DE RESSOURCES DES TECHNOLOGIES POUR L'ENVIRONNEMENT

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Emergy to assess abiotic depletion in LCA

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Overview CRP Henri Tudor

(**R**esearch & **D**evelopment & **I**nnovation)

Staff: ~ 450 Located on 3 sites: ± 9,000 m2

- R&D
- Technological Expertise & Consultancy
- Innovation Networks and Platforms
- High-level Training
- Masters in cooperation with universities
- Science based Business Incubation
- Doctoral Research (PhD)

Four Technology Groups:

- Information and Communication Technologies, Information Society Technologies (±49%)
- Materials and Industrial Technologies (±28%)
- Environmental Technologies (±13%)
- Health Care Technologies (±10%)

Overview CRTE

- The « **Resource Centre for Environmental Technologies** » (CRTE): a common structure of the Public Research Centre (CRP) Henri Tudor and the Ministry of Environment

- created in 1997, located in Esch-sur-Alzette

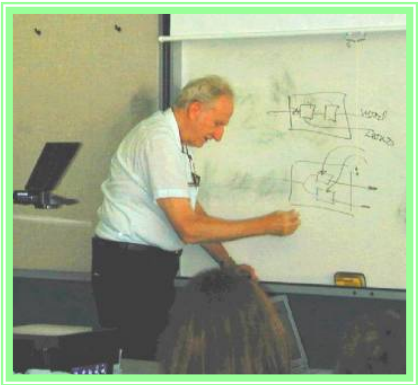
LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Environnement

- Multidisciplinary team of **~ 40 collaborators**:
  chemistry,
  biochemistry,
  physics,
  geo-statistics,
  geography, civil, mechanical,
  environmental
  engineering,...

Emergy Theory

Emergy theory has been introduced by D.M. Scienceman and H.T. Odum

Odum and coworkers have applied emergy analysis to several ecological and economic systems, finding the emergy and transformity values.



DEFINITION:

Solar emergy (seJ): *The available solar energy used up, directly and indirectly, to make a service or a product (Odum, 1996); also referred to as the "energy memory" (Scienceman, 1997)*

Solar transformity (seJ/J): *the solar emergy required to make one joule of a service or product*

Since Ecological input are estimated to be twice as valuable as the global national product (Costanza et al., 1997, "The value of the world's ecosystem services and natural capital"), ignoring them in analysis may lead to underestimation of the real cost of product .

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Emergy in LCA: added value

LCA:

PROS

- It accounts for emissions of pollutants
- It is supported by comprehensive and complete database
- it goes beyond the process boundary (« cradle to grave » analysis)

CONS

- It does not account for ecological inputs (which can be important for e.g. water depletion)
- Accounting of labor and services using mixed approaches (IO and hybrid)
- It is Human oriented (Human point of view is applied in evaluation step)

Emergy analysis:

PROS

- It provides account for all type of inputs, including labor and service
- It provides values expressed in the same common unit (seJ)
- It accounts for contribution of ecological inputs (sun, tide, wind, etc..)

CONS

- It does not provide any information about emissions
- It lacks of details of some process phase (i.e. « cradle and grave » phase of process)
- It does not rely on comprehensive database, as for LCA processes
- It lacks of transparency of data

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Emergy in LCA: added value

LCA:

PROS

- Pollutants emissions
- Comprehensive database
- Cradle to grave perspective

CONS

- Difficult to include service and labor in the same dataset
- Not account for ecological input
- Difficulties in evaluate water depletion
- Human oriented

Emergy analysis:

PROS

- Includes service and labor using the same unit (seJ)
- Includes natural input
- Eco-centric point of view

CONS

- Does not include emissions
- Lack of comprehensive database
- Lack of process detail

Emergy in LCA: "CEmD"

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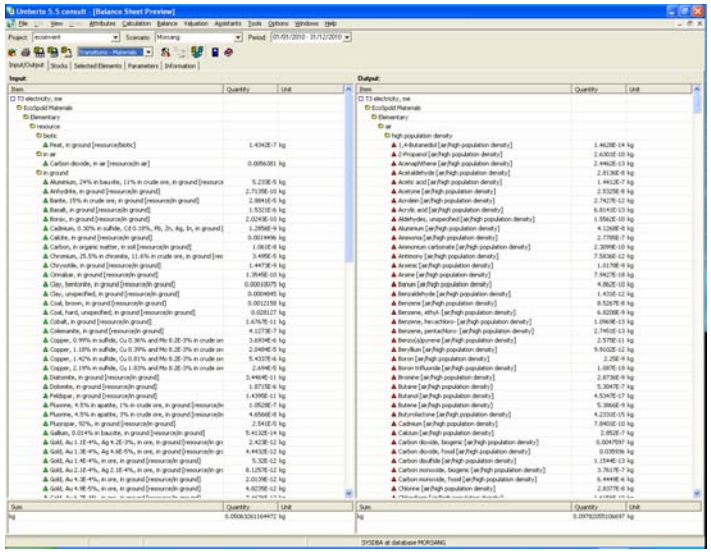
1) Life-cycle inventory database



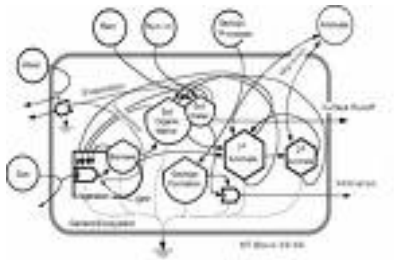
2) Aggregate resources in categories

Land occupation

Water

Classes of minerals

3) Calculate transformity values (τ) for each category



4) Em (seJ) = τ (seJ/unit) * Resource (unit)

ΣEm = « CEmD: Cumulative Emergy Demand »

An indicator for resource depletion (seJ)

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HELICA PhD Project

This work is part of the PhD project **HELICA: Hybrid Emergy and Life Cycle Assessment of potable water supply**

Helica is contributing to the project **EVALEAU: Evaluation of economic and Environmental performance of potabilization process**

Partners:

INSA Toulouse – LISBP (Prof. Ligia Barna)

Public Research Centre Henri Tudor / CRTE (Dr. Enrico Benetto)

SUEZ Environnement - CIRSEE

LERNA – Institut National de la Recherche Agronomique

Scientific Commitee:

Dr. Andreas CIROTH (LCA field)

Prof. Sergio ULGIATI and Dr. Paolo VASSALLO (Emergy field)

Dr. V. LAHOUSSINE TURCAUD and Dr. Luc ZWANK (water field)

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Thank you

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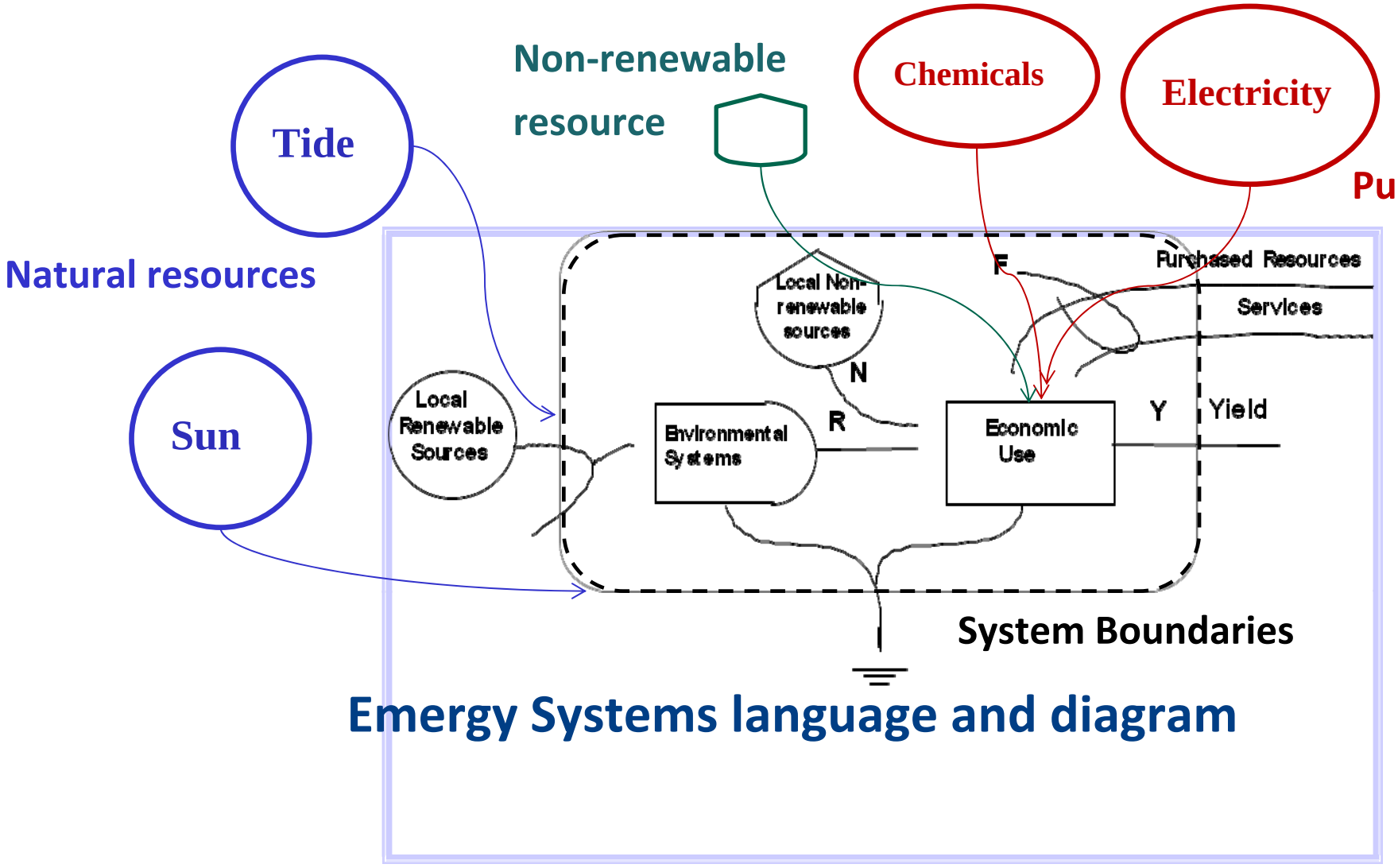
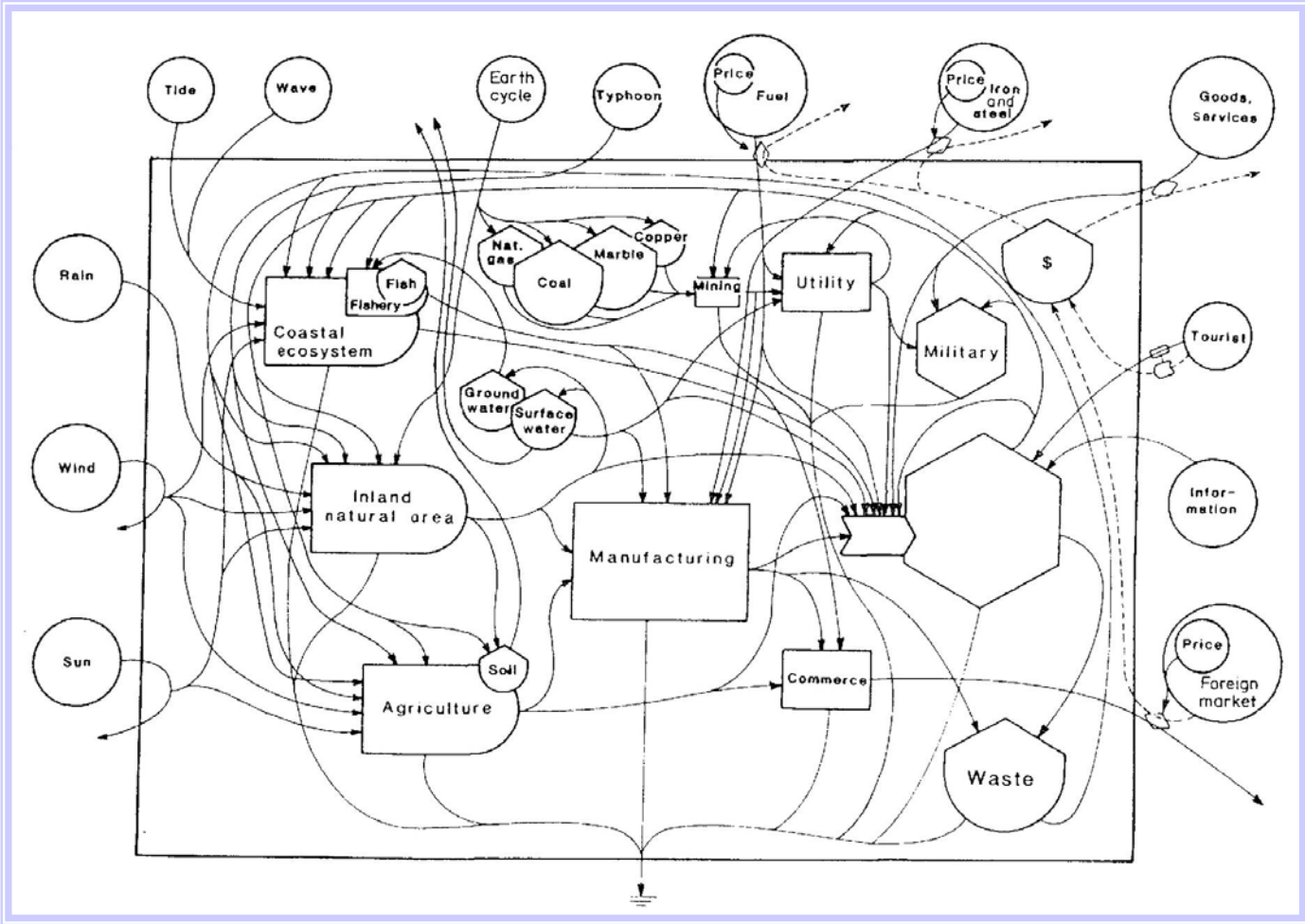
Emergy Theory (2)



Emergy Systems language and diagram

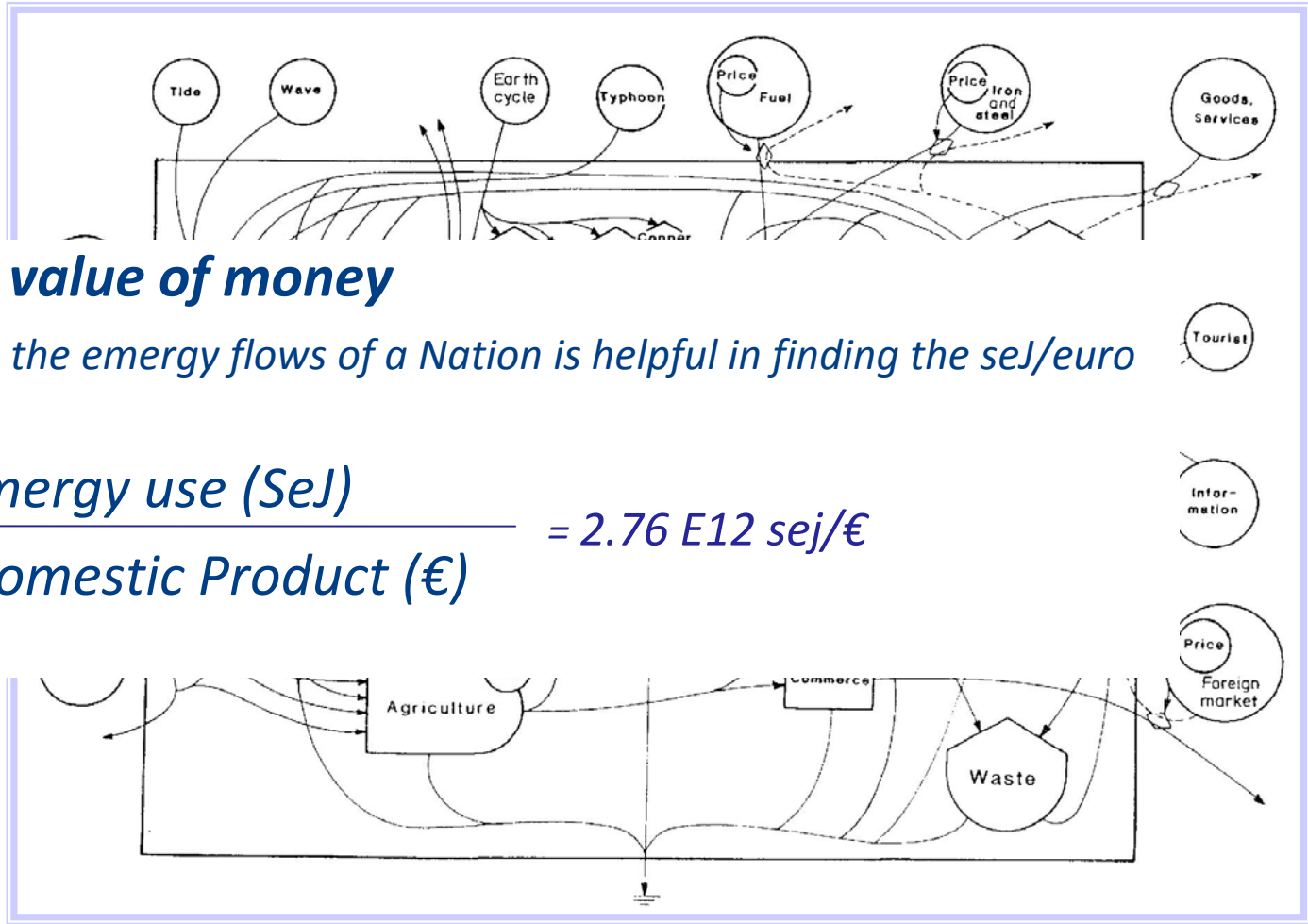
Emergy Theory (3)

Emergy of a nation



Emergy Theory (4)

Emergy of a nation



Emergy value of money

Evaluating the emergy flows of a Nation is helpful in finding the seJ/euro value:

$$\frac{\textit{Total emergy use (SeJ)}}{\textit{Gross Domestic Product (€)}} = 2.76\ E12\ sej/€$$