CO_2, energy and material balance of waste treatment options

Experts seminar: Optimal recovery of material and energy resources: The cases of the rest fraction of municipal waste and sewage sludge

Seville (Spain)

16-17 June 2010

Presentation of RDC Environment

Main features

- Created in 1992
- Based in Brussels
- Staff : 21
- Innovative studies, no routine
- Work in EU, Belgium, France (ADEME, MEEDDAT, EC, Veolia, Saint-Gobain, Tetra Pak, EMPAC, Nestlé Waters, Danone, Carrefour, Alcatel…)

Presentation of RDC Environment

Activities

- Life Cycle Assessment (LCA)

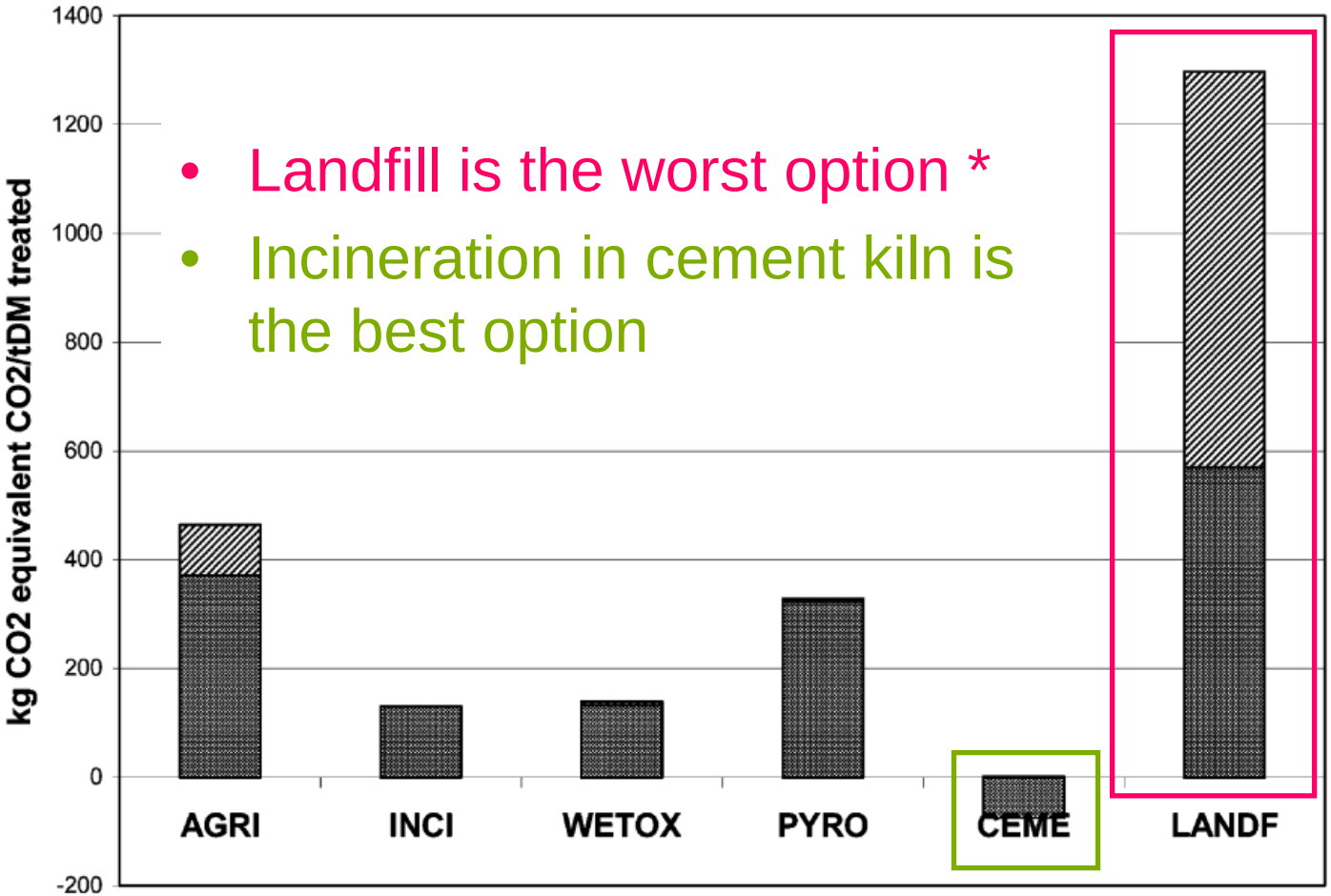
  Since 1990 : among LCA pionneers in Europe

- Cost Benefit Analysis (CBA)
- Strategic waste management
- Site consulting : EIA, Environnemental audit

Energy and CO_2 balance (of sewage sludge treatment)

- Opposite results in general
  - Energy recovery often has a positive, yet variable effect. It depends on :
    - the efficiency of energy recovery and
    - the energy consumption for preparation (e.g. drying)
  - CO_2 balance of energy recovery is always negative
    - The CO_2 intensity of energy recovery is higher than the energy intensity of substituted energy production, mainly because of low efficiency
- For sewage sludge, even energy balance is negative

CO_2 balance of sewage sludge treatment



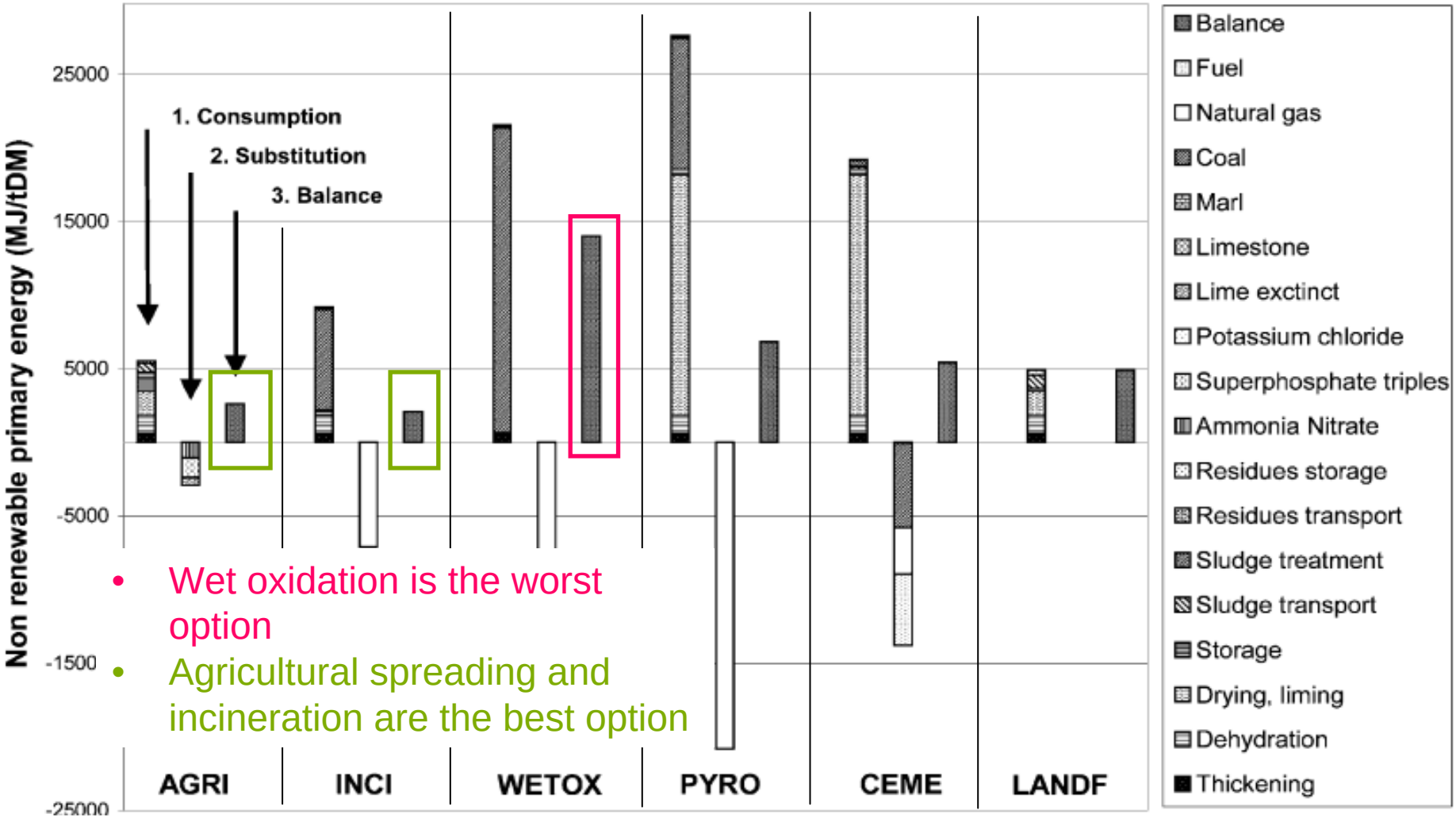
- Landfill is the worst option *
- Incineration in cement kiln is the best option

* If organic matter fully degrades

* If schlamm is substituted

From G. Houillon et al. (2005)

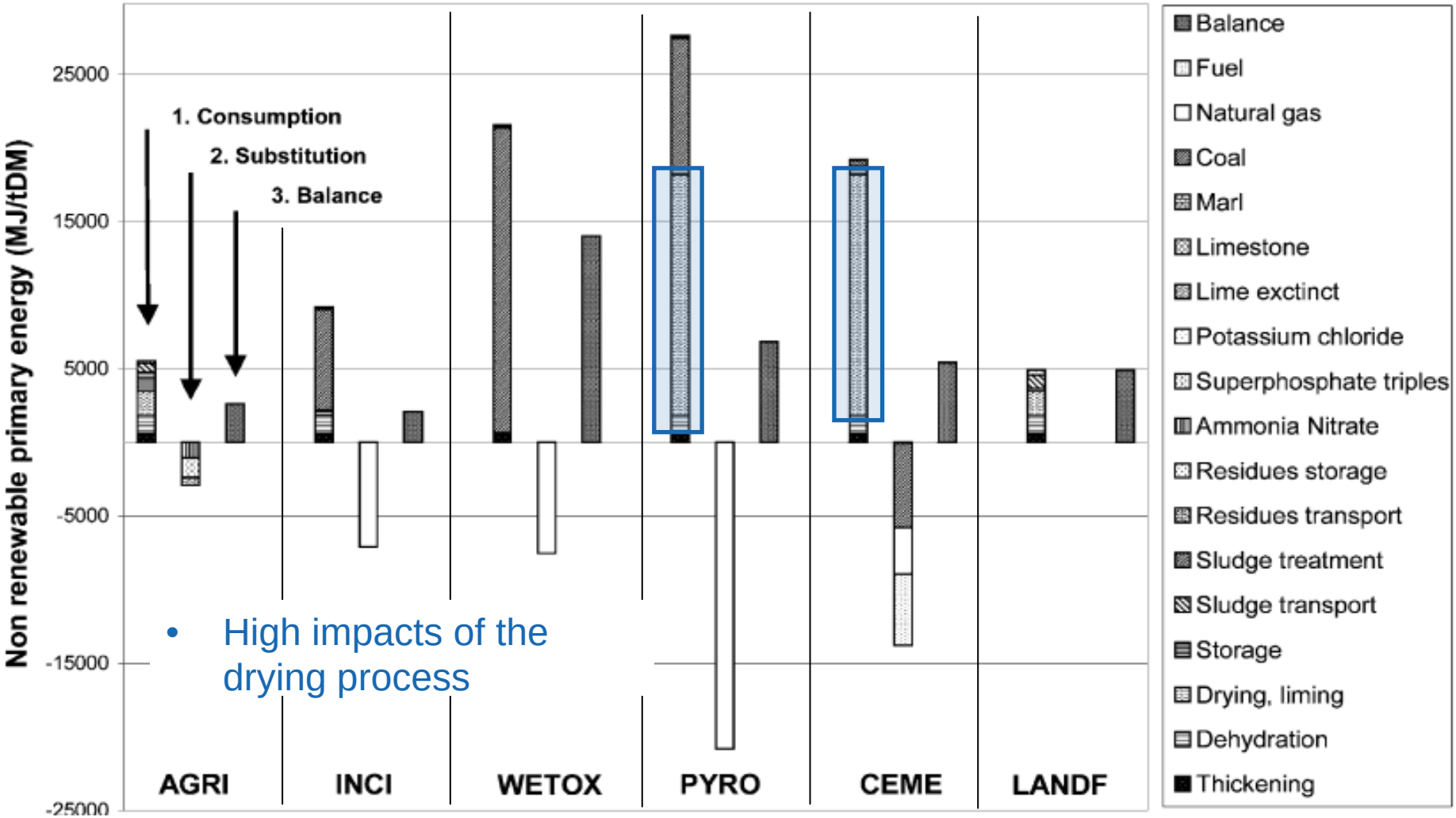
Energy balance of sewage sludge treatment



- Wet oxidation is the worst option
- Agricultural spreading and incineration are the best option

From G. Houillon et al. (2005)

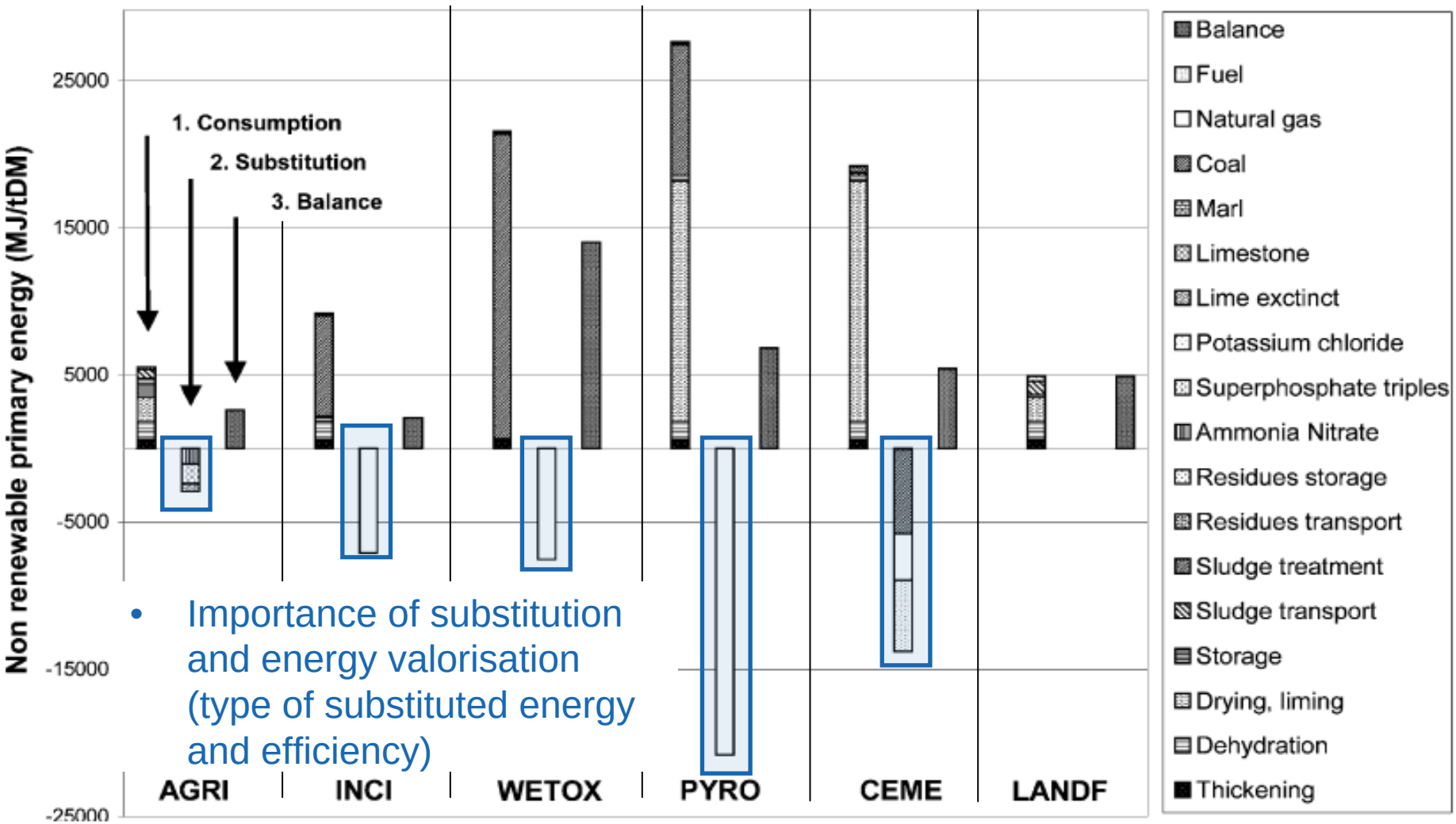
Energy balance of sewage sludge treatment



- High impacts of the drying process

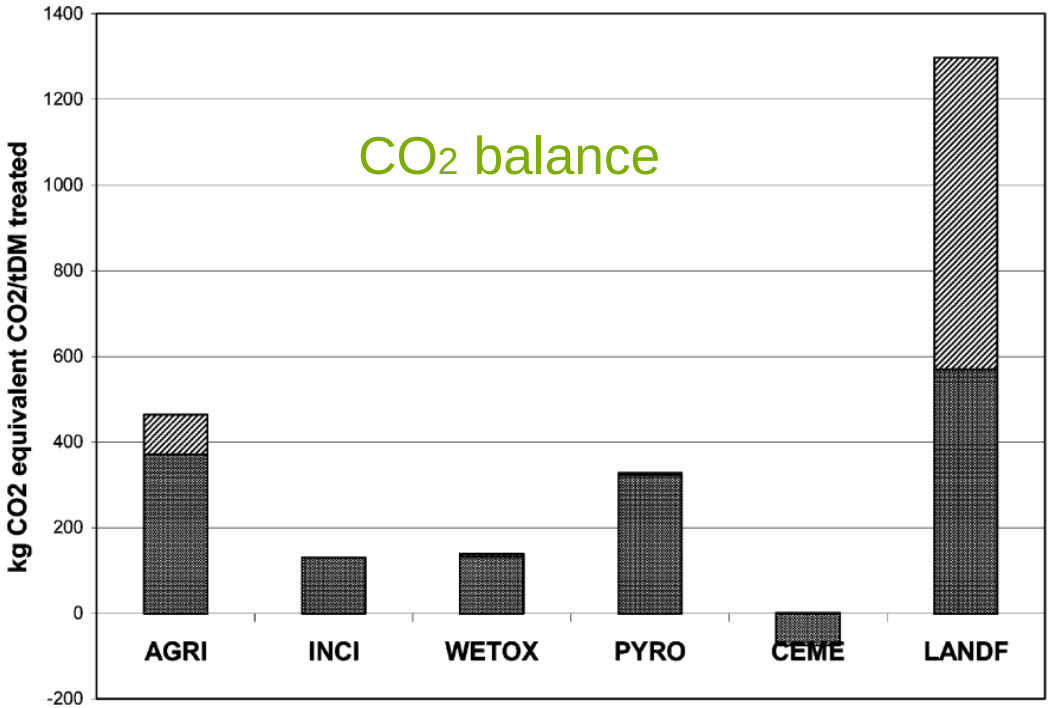
From G. Houillon et al. (2005)

Energy balance of sewage sludge treatment

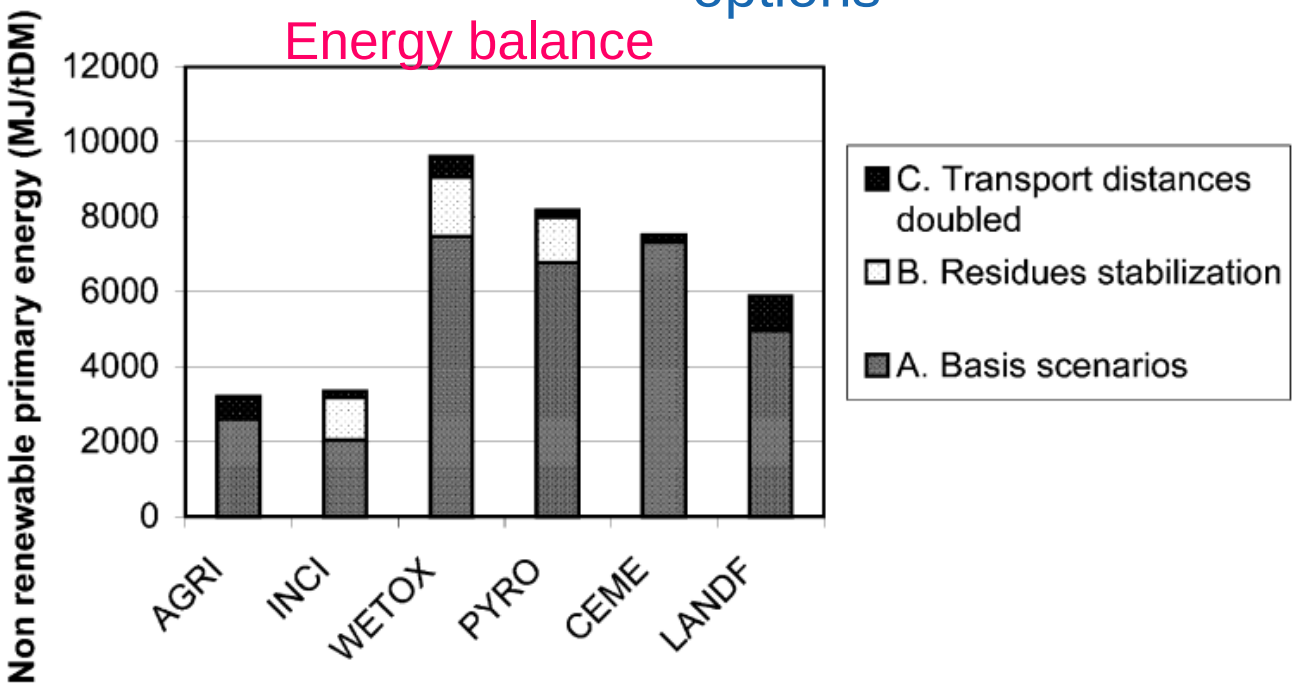


- Importance of substitution and energy valorisation (type of substituted energy and efficiency)

From G. Houillon et al. (2005)



- Conclusions of the study
  - Based on the energy and CO_2 balance it is difficult to conclude on the global impact of the six treatment processes
  - INCI and AGRI seems to be the best options



rdc CO_2, energy and

Energy and CO_2 balance of sewage sludge treatment

- Conclusions :
  - Optimisation route
    - Agricultural spreading :
      - Fertiliser substitution is not sufficient to achieve a positive primary energy balance
      - Necessary to add a digestion process of sludge before spreading
    - Drying process (to reduce its high energy demand)
    - Energy recovery : Combined heat and power

From G. Houillon et al. (2005)

Energy and CO_2 balance of sewage sludge treatment

- Conclusions :
  - High sensitivity of the results to modelling assumptions
    - Type of substituted product :
      - Energy :
        - heat and/or power
        - Fuel or coal consumption
      - Fertilizer
      - Organic matter
    - Risk of ineffective substitution is high for
      - Pyrolysis (PYRO)
      - Co-incineration in cement kilns (CEME)
      - Wet oxidation (WETOX)
    - and low for :
      - Fluidised bed incineration (INCI)

From G. Houillon et al. (2005)

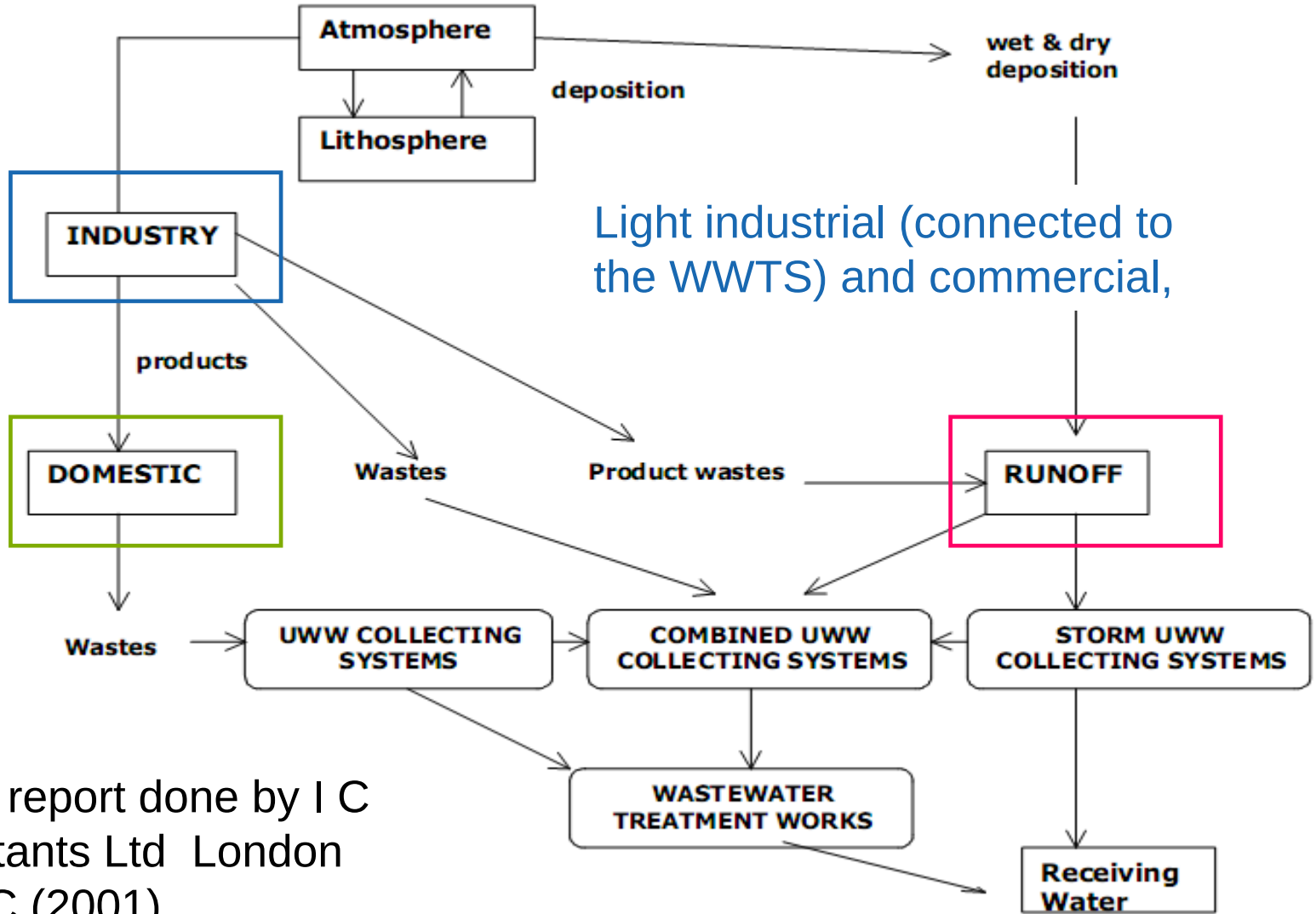
From a literature study done by RDC-Environment for ADEME (2004)

Energy and CO_2 balance of sewage sludge treatment

- Conclusions : Key issues :
  - Pollutants in sludge
    - Types :
      - Potentially toxic elements including Cd, Cr III and Cr VI, Cu, Hg, Ni, Pb and Zn,
      - Organic pollutants including PAHs, PCBs, dioxins (PCDD) and furans (PCDF).
    - Source : human activities
    - Could prevent some treatment process e.g. agricultural spreading

Energy and CO_2 balance of sewage sludge treatment

- Key issues : Sources of pollutants in sludge



From a report done by I C Consultants Ltd London from EC (2001)

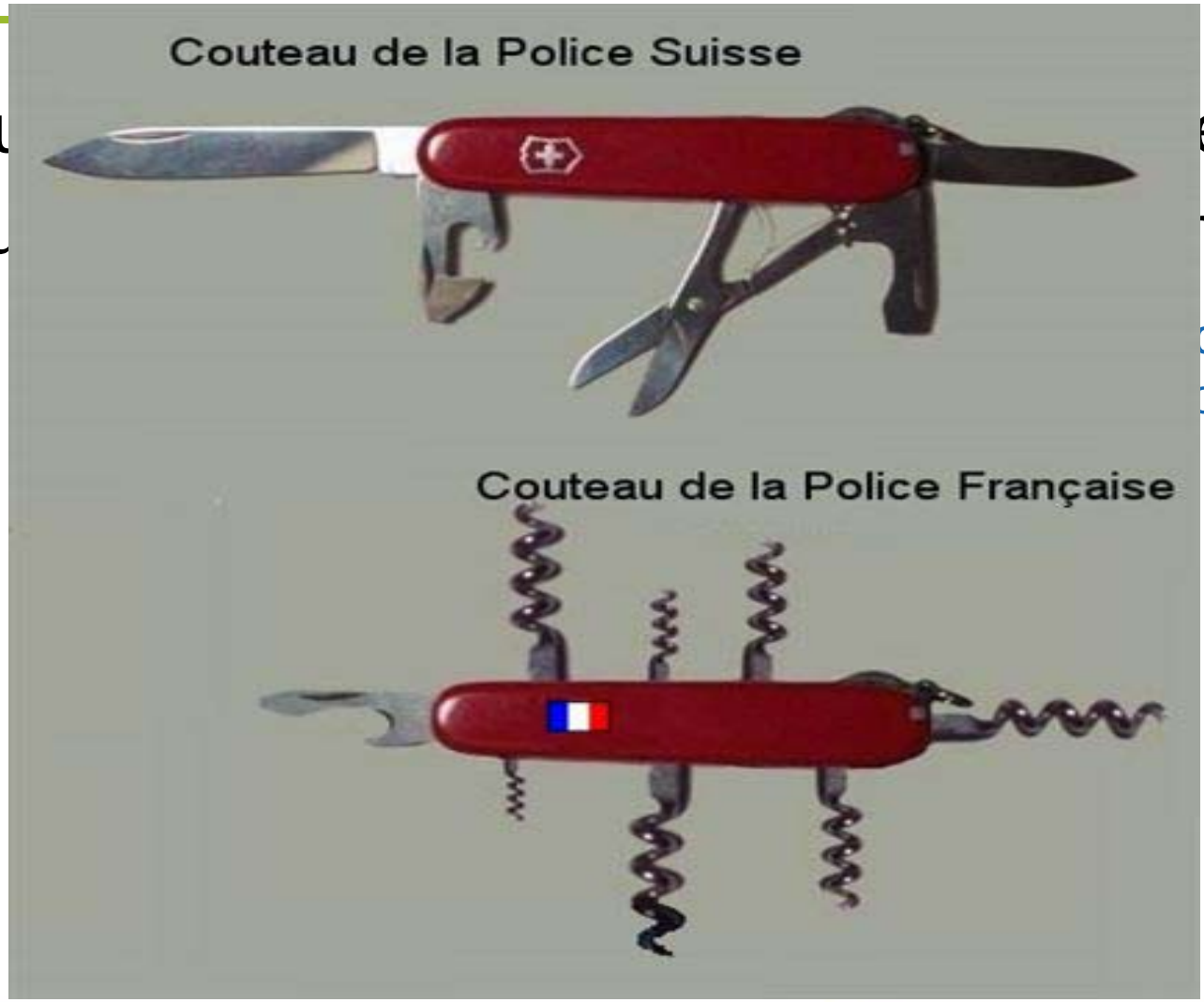
Energy and CO_2 balance of sewage sludge treatment

- General conclusions : current LCA limits
  - Does not properly take into account toxicity aspects of sludge application on land related to :
    - Organic micro-pollutants
    - Heavy metals
  - Omits other agronomic benefits of sludge valorisation e.g. improvement of soil quality (➔ less water needed, less pesticides, better fertilizer storage…)

From a literature study done by RDC-Environment for ADEME (2004)

Sewage sludge

- No u ent
- Solu ns



Sources

Life cycle assessment of processes for the treatment of wastewater urban sludge: energy and global warming analysis ,G. Houillon and O. Jolliet - Journal of Cleaner Production 13 (2005) 287–299

RDC study done for ADEME (2004) “Bilan des connaissances ACV sur les enjeux environnementaux de la gestion des déchets organiques”

Thank you for your attention!

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Life Cycle Assessment,
Waste Management,
Impact Assessment