
The dream of a clean environment for all.
Gatze Lettinga

A major challenge for the present generations is to attain the Millennium Development Goals (MDG).

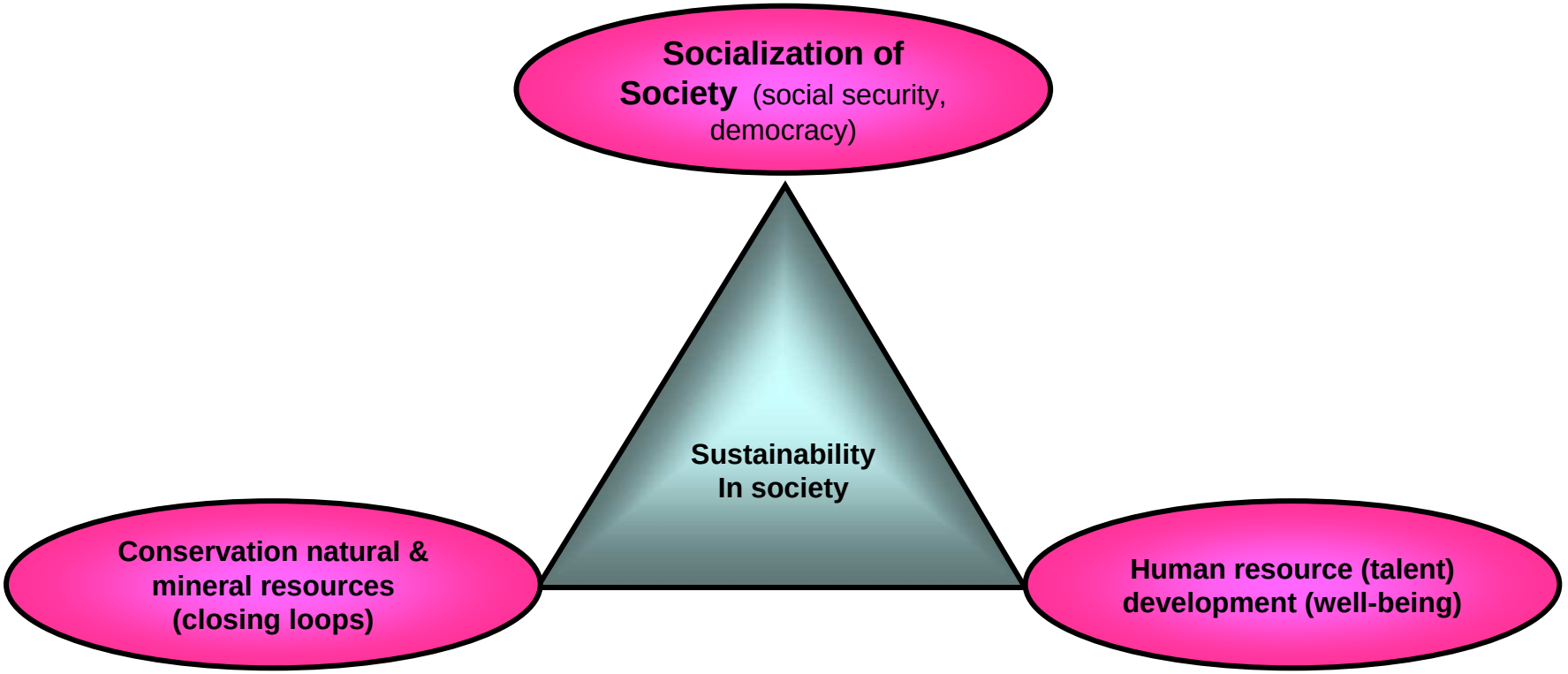
Millennium Water Goals 2000. The Hague 2000

- By 2015; reduce by one-half the proportion of people without access to hygienic sanitation facilities
- By 2015 to reduce by one-half the proportion of people without sustainable access to adequate quantities of affordable and safe water
  (UN Millennium Goal, Johannesburg, 2002)
- By 2025 to provide water, sanitation, and hygiene for all

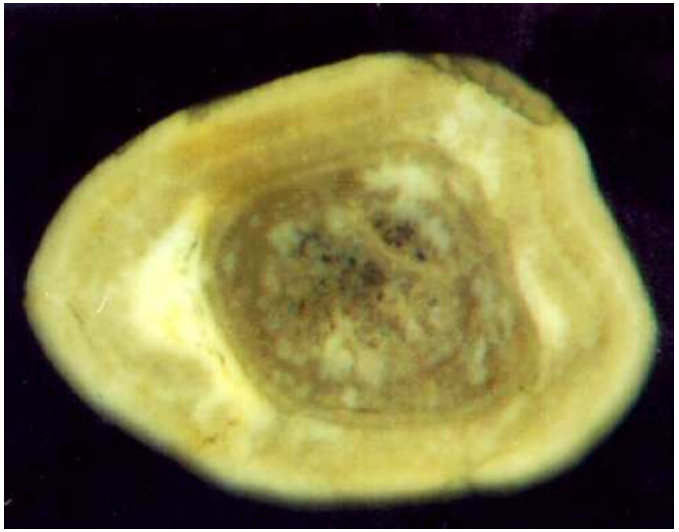
Sustainable Development

What does it mean?

There exists a lot of confusing!


Socialization of Society (social security, democracy)
Sustainability In society
Conservation natural & mineral resources (closing loops)
Human resource (talent) development (well-being)

Cannery



Protein fed

Brewery 1

Brewery 2

There exist 54 definitions for the notion Sustainable Development

(Rogers, Jalal, Boyd, “An Introduction to sustainable Development”).

The vast majority of the 54 sustainability definitions is directed to own specific domains or to self-interest,
hardly to the common interest of citizens.

Brundtland Commission

World Commision on Environment & Develoment

(was asked in 1983 by the General Assembly of the UN to formulate 'a global agenda for change')

'Our Common Future'

1987

Interpretations of Brundtland

Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future.

The satisfaction of human needs and aspirations is the major objective of sustainable development.

Brundtland's view about poverty

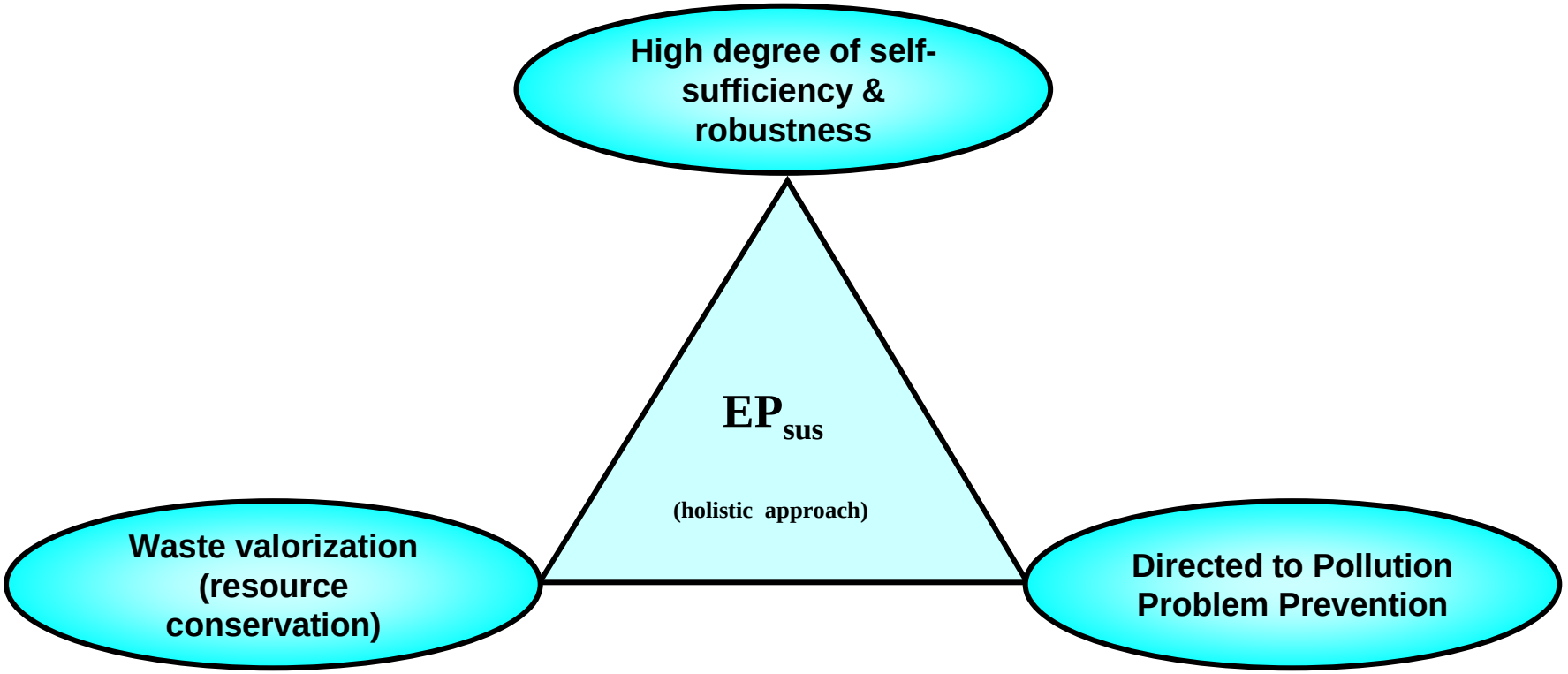
A world in which poverty and inequity are endemic will always be prone to ecological and other crises.

Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life.

Brundtland opinion about the ‘need’ of economical growth in the prosperous world.

Living standards that go beyond the basic minimum are sustainable only if consumption standards everywhere regard for long-term sustainability.

What means sustainability in environmental protection?


High degree of self-sufficiency & robustness
EP sus
(holistic approach)
Waste valorization (resource conservation)
Directed to Pollution Problem Prevention

Do we (i.e. our world leaders) really want to attain the MDG's ??

Appropriate instruments to force development towards sustainability are available for most of the vital sectors in society *(environmental protection, food production, energy generation)*

They lie in the promotion of:

a) **Problem Prevention,**
b) **Self-sufficiency,**
c) **Application of the sustainable technologies/concepts.**

Brundtland: Humanity has the ability to make development sustainable

Application of Anaerobic Digestion processes as the core method in:

1. **Environmental protection,**
   (residue valorization)

2. **Generation renewable energy,**

3. **Urban agriculture .**

For waste-valorization apply:

The BioMin$_{nat}$- treatment concept

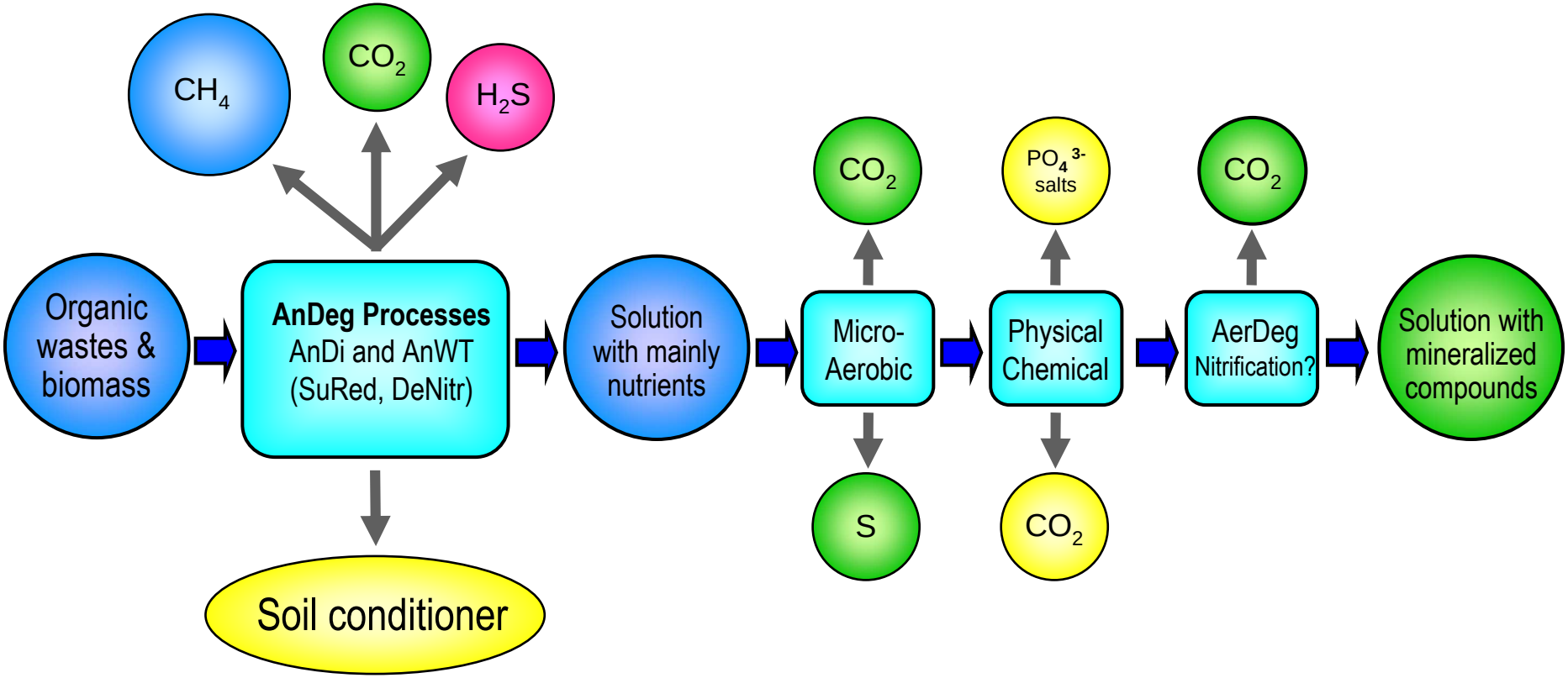
(Natural Biological Mineralization route),

combined with:

- proper waste(water) collection,

- complementary physical-chemical methods

Natural Biological Mineralization (**BioMin$_{nat}$**)



AnDegr-processes
the core method in BioMin$_{nat}$

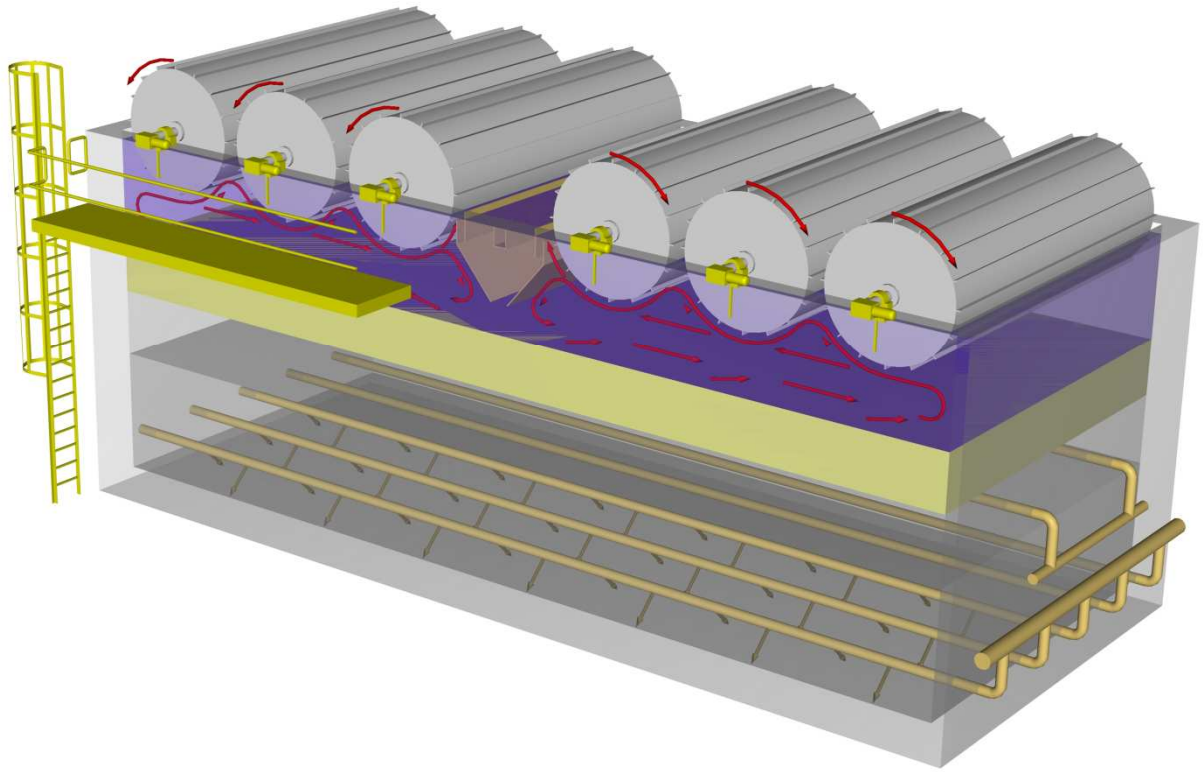
- Stabilizing biodegradable organic matter (without input fossil energy),
- Generating energy carriers: **CH_4** ! *(possibly **H_2** or even electricity?)*
- Making available of fertilizers (nutrients) and biological sulphur (i.e. indirect energy production/saving).
- Producing valuable organic soil conditioners

Microaerobic Treatment ($Ae_{micro}WT$) -systems.

As the first post-treatment step following AnWT

1. Conversion of reduced S-compounds into elementary sulfur.
   (use of the oxidative part of the **S_{biol}-cycle**)
2. Degradation of remaining, easily biodegradable organic pollutants,
3. Oxidation of reduced inorganic compounds (e.g. Fe^{II}),
4. Removal of colloidal matter (+ dispersed pathogenic organisms).

An impression of a UASB-A_{plus} –reactor, here equipped with a biorotor system



Microaerobic Treatment ($Ae_{micro}WT$) -systems.

As a preliminary-treatment step in front of a high rate AnWT-system

1. Coagulation/precipitation of colloidal matter and possibly small pat of soluble pollutants.

2. Partial removal of dispersed pathogenic organisms.

(like in the A-step in so-called A/B process (Böhnke Germany)

Positive impacts of Decentralized Applications of the $BioMin_{nat}$- treatment concept

- Maximum of **valorisation** of residues,

- Decentralized Sanitation & Resource Recovery (**DESAR**)practices (*closing of water and substance-loops, minimization transport, stimulation development urban agriculture*),

- More **self-sufficiency**,

- **Pollution prevention** tackle in EP,

- Significant **cost-reductions**.

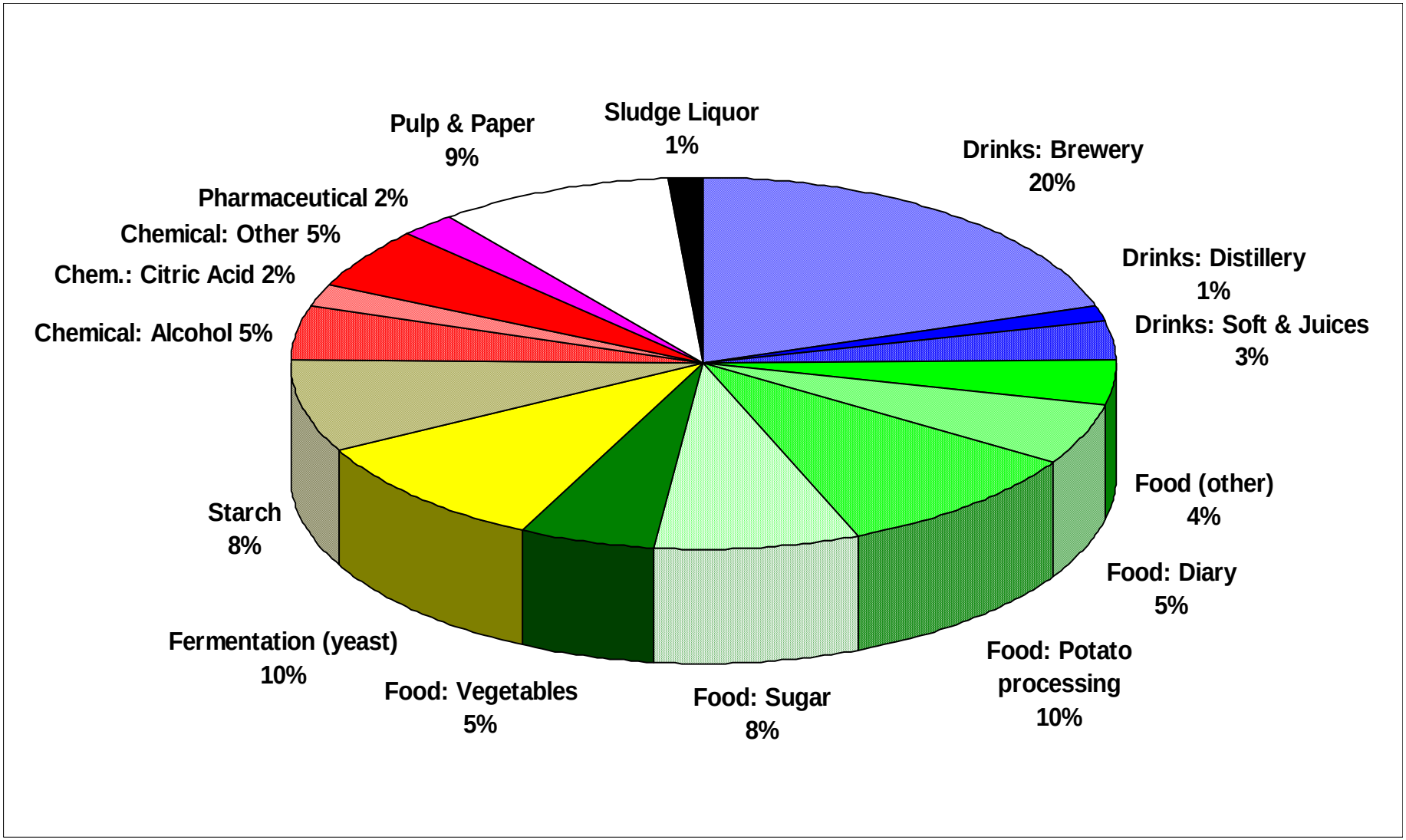
Waste Valorization

Integrate Environmental Protection with Food Production (agricultural practices) and Energy Saving and Production !

AnWT combined with complementary BioMin$_{nat}$ –methods already are a ‘grown-up DESAR-technology’ in the industrial sector for a large variety of wastewaters in an increasing number of countries.

It leads increasingly to closing water and substance loops.

Types of industries using AnWT



Like in the industrial sector, we also need $DESAR_3$ (ECOSAN) in the PuSan-sector in order to:

- Prevent health risk and environmental pollution (limit use of clean water),
- Reduce investment, operational and maintenance costs,
- Reduce vulnerability in EP, improve self-sufficiency (community participation)
- Strengthen Resource Recovery and Reuse

Implementation of sustainable ‘decentralized BioMin$_{nat}$ – concepts in the PuSan-sector worldwide, particularly in developing countries.

BUT HOW TO ACHIEVE THAT?

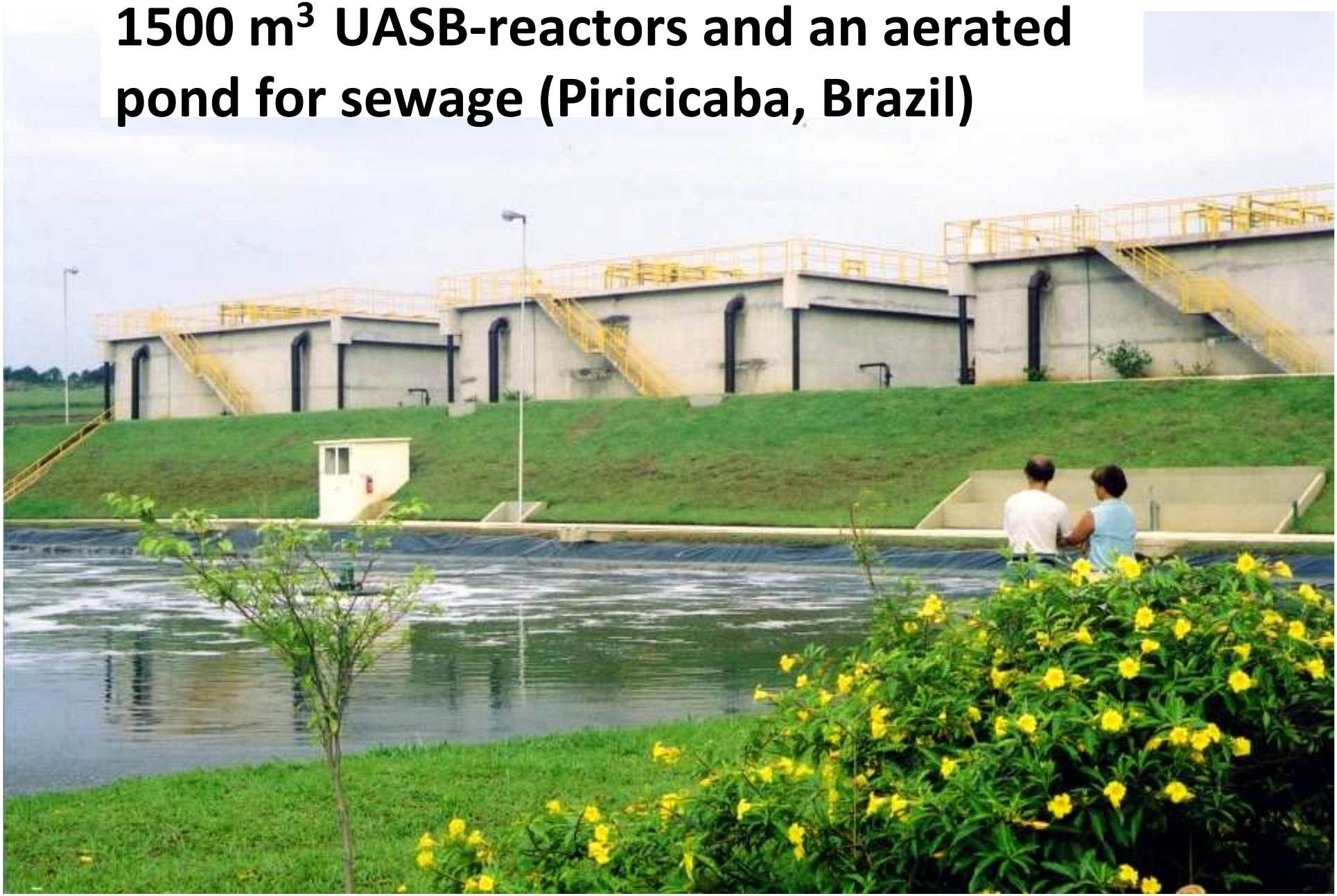
Why is the PuSan-sector so behind, so reluctant??

Developing countries take the lead!

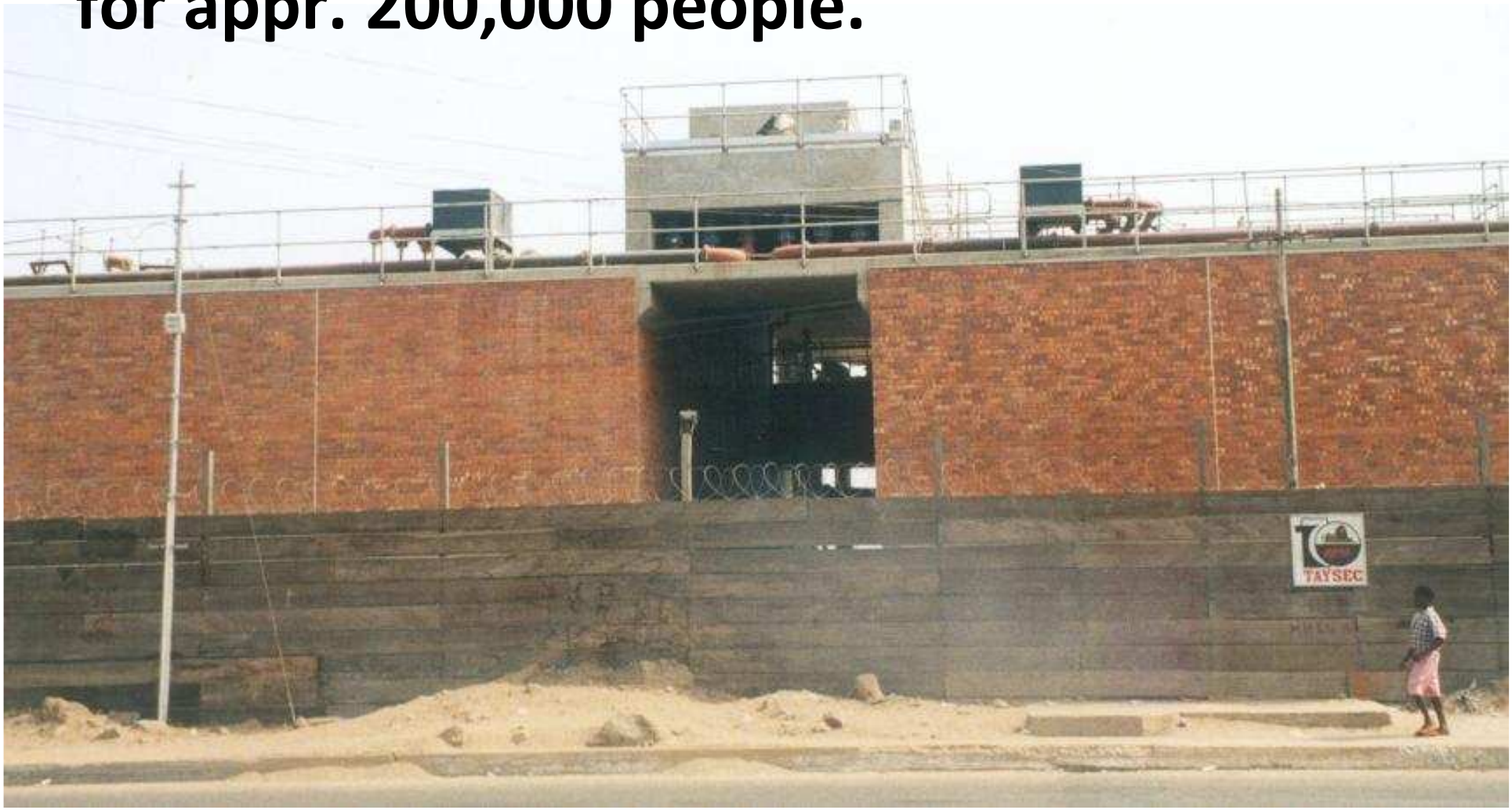
India, Brazil, Mexico, ….

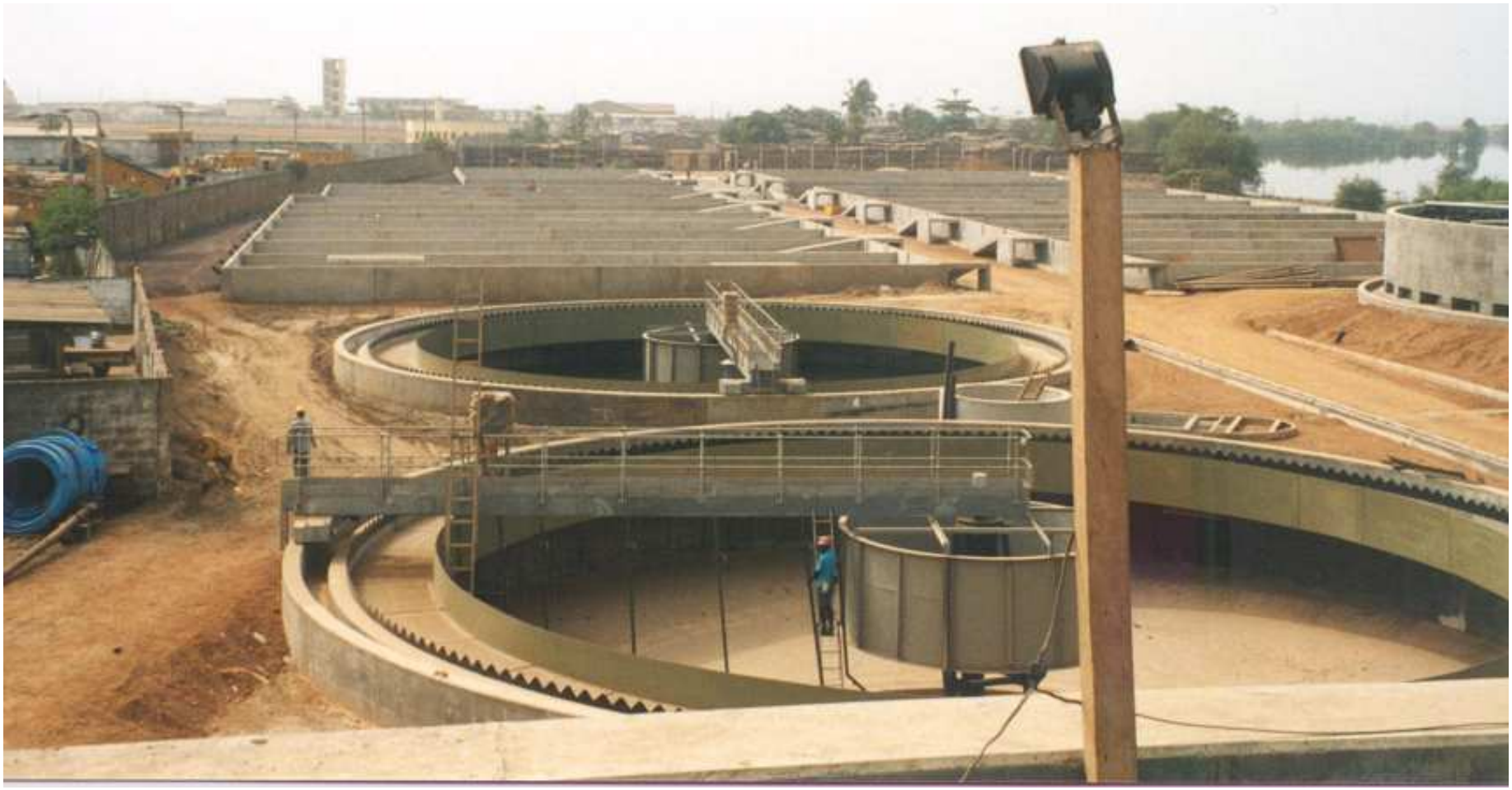
Full scale UASB-installation Kanpur India

1500 m^3 UASB-reactors and an aerated pond for sewage (Piricicaba, Brazil)



6000 m^3 UASB-installation in Accra (Ghana) for appr. 200,000 people.





Implementation DESAR$_3$-concept in PuSan in the industrialized world.

It needs prolonged periods of time, because:

1. Huge investment have been made in the past (and are still going on), viz. in:

- High water consuming toilets,
- Expensive - non-sustainable - waste(water) transport systems,
-Conventional waste(water) treatment,

2. Secondary factors like:

- Little emphasis put so far on waste-valorization,
- Lack of infra-structure of the sustainable alternatives,
- reuse of recovered by-products is difficult.

Great advantages of AnWT compared to AeWT:

- Resource producing (energy, fertilizers, soil conditioners) instead of demanding,
- No excess sludge disposal problems,
- Simple, cheap and robust technology,
- Can handle very high organic loading rates,
- No external power supply required,
- Viable anaerobic sludge can be preserved for years, i.e suitable for campaign industries.

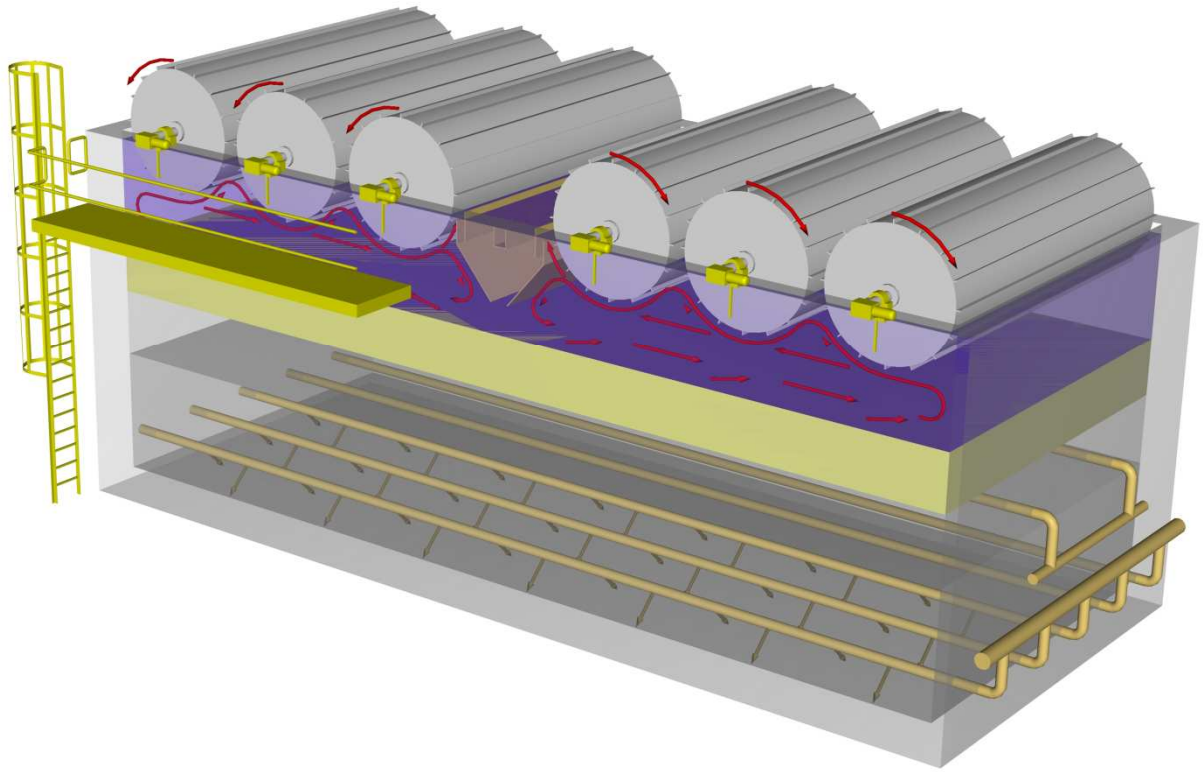
The first possible transition in existing CENSA-settings likely can be found in:

Substitution of conventional AeWT-systems
by modern BioMin$_{nat}$-systems,
starting with high-rate ANWT-systems *(especially at sewage temperatures > 18 °C).*

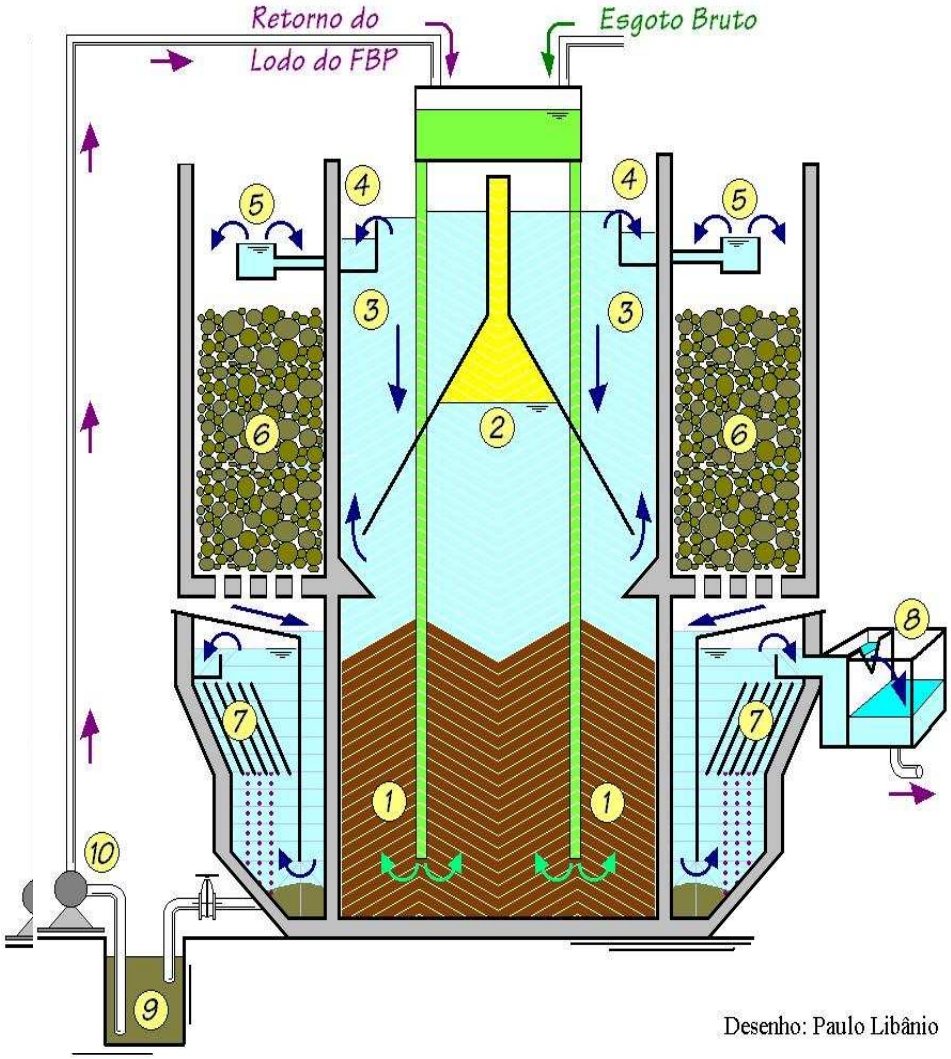
Big potentials for UASB + Ae_{micro}WT post-treatment at temperatures > 18°C

(UASB-A_{plus} – reactor system)

An impression of a UASB-A_{plus} –reactor, here equipped with a biorotor system



Integrated anaerobic treatment – post treatment, Brasil



Desenho: Paulo Libânio

Optimization resource recovery from ‘residues’ (wastes and wastewaters):

-Reduce the amount of wastewaters,

- Increase the amount of slurries and solid wastes.

Modern AnWT will lose importance in favor for (modern) AnDi-processes.

An ideal solution in urban public sanitation and energy supply:

‘The Greenhouse Village’

(Noor van Andel, Jon Kristinsson, Adriaan Mels)

A multidisciplinary approach in PuSan and Energy supply:

sanitary-, chemical- and civil engineers,
biotechnologists, (bio)chemists, microbiologists,
irrigation experts and agronomists,
economists and sociologists,
architects, household scientist,
health care specialists,
common citizens.

What is Greenhouse Village?

Greenhouse for:

- collection of heat (using innovative highly efficient heat exchanger)
- production of e.g. food crops and clean water

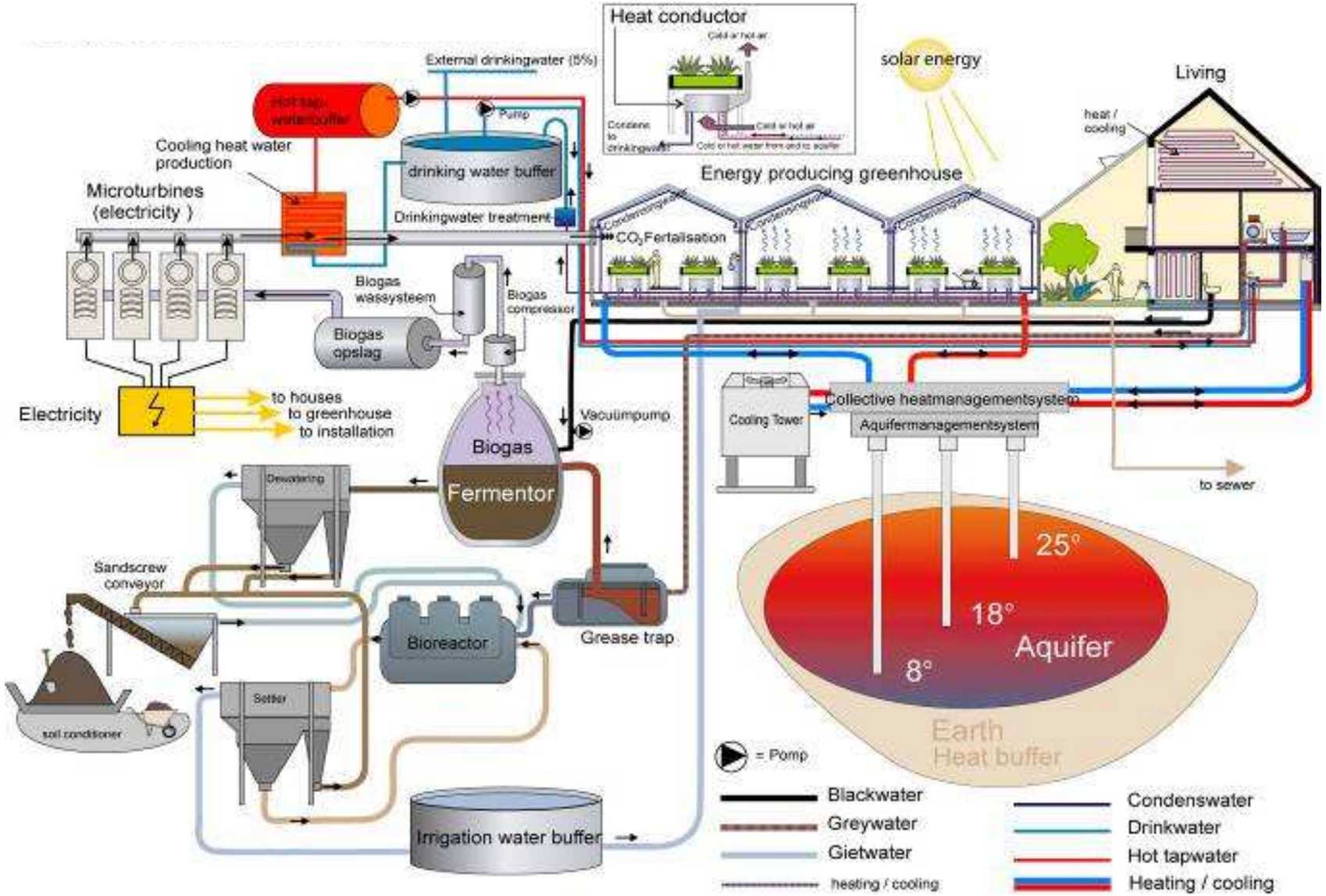
Aquifer technology for :

- storage of warm/cool water for heating /cooling houses and greenhouse

Decentralized NBMS-based wastewater treatment for:

- production energy (biogas/electricity),
- production CO_2, fertilizers and compost

Technical scheme of Greenhouse



The interest in moving to DESAR$_3$-application in the PuSan-practice is growing in Europe, especially in:

- New real estate situations (neighbourhoods, hospitals, schools, hotels, apartment buildings etc.),

- In existing situations when private decision making is sufficiently strong for take own measures!

- In existing CENSA-situations when costly renovations have to be made and public authorities take the 'risks' to move in a new concept (paradigm).....

- Situations where most EP-measures still need to be taken.

Production of renewable energy from biomass (wastes and energy crops).

The nowadays hype!

Production of renewable energy from biomass (wastes and energy crops).

- **Gaseous** energy carriers, power supply for all citizens!

- **Solid** energy carriers, power supply for all citizens.

- **Liquid** energy carriers, for road, air and water transport.

Anaerobic digestion systems are superior systems for production of

renewable energy (biogas!) from wet types of biomass.

Energy conversion from energy crops.

- ***Alcohol production from Sugarcane:***
  - ***38 % net energy.***

- ***Methane production from sugar cane:***
  - ***60 % net energy + compost!!***

Environmental Protection tackle in PuSan sector

Centralized (transport based) Sanitation Practices (CENSA) *are dominant nowadays, but they become expensive, vulnerable and non-sustainable at too large scale*.

Decentralized Sanitation & Resource Recovery Reuse (DESAR$_3$ or EcoSan), optimal centralization, *have the future, but a long way to go.*

Benefits of substitution of AeWT-systems in existing sewage treatment plants by BioMin$_{nat}$-systems :
(although it is not the optimal DESAR$_3$-approach!)

- Lower space requirements,
- Saving of energy,
- Simpler treatment process,
- Much less excess sludge problems,
- Saving in investment and operational costs,
- Applicable at almost any scale,
- Enables the step-wise implementation of DESAR$_3$ in down-town area's,

Step-wise implementation of $DESAR_3$ in down-town area's with sewerage (and off-site treatment).

- Relatively easy implementation of Compact UASB-A_{plus}-systems *(little space requirements, underground constructions possible, no mal-odour, little excess sludge).*

- Existing sewerage still can be used for transport of pre-treated sewage,

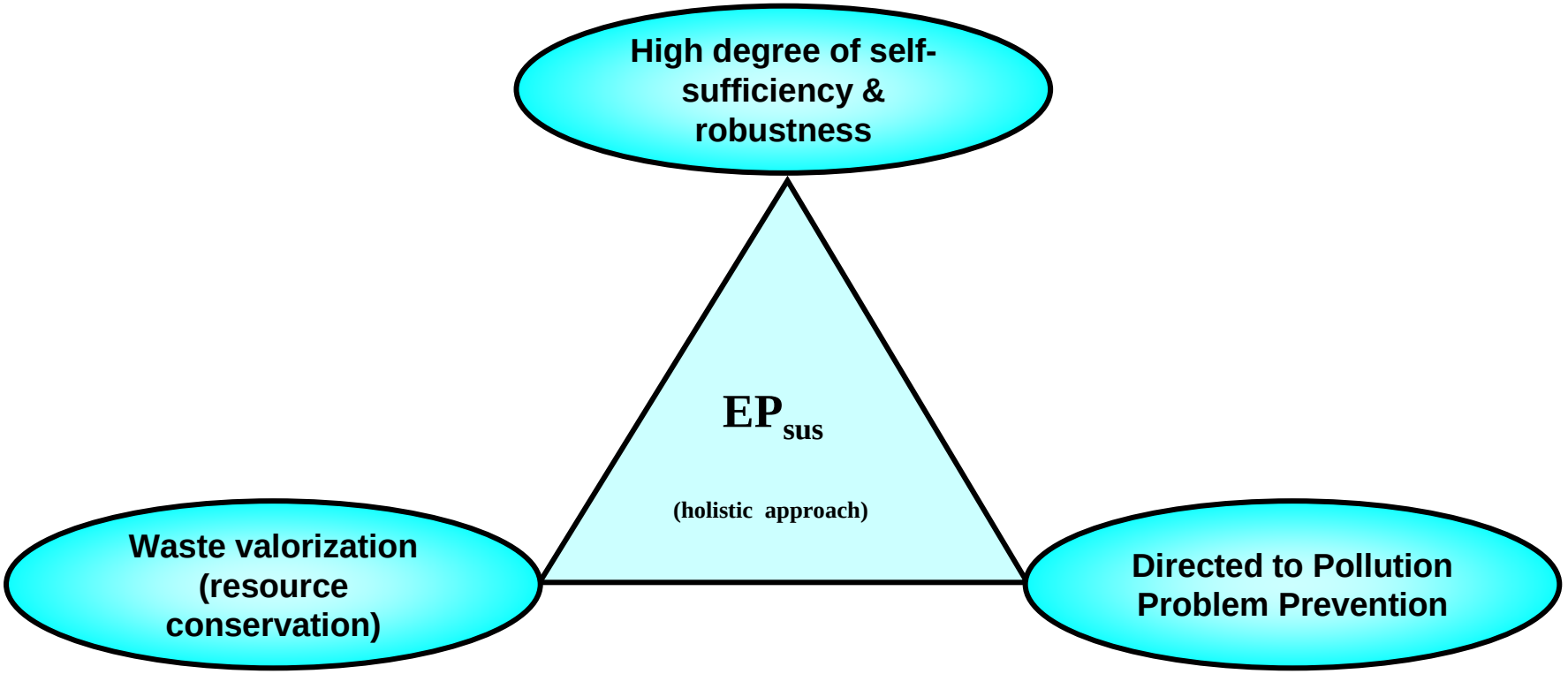
- Considerable savings in existing off-site AeWT-treatment,

- Very attractive for developing countries

Compared to implementation in existing traditional CENSA-situations, $BioMin_{nat}$-systems can be implemented much easier:

- **In big private buildings (hospitals), settlements,**
- **When expensive renovations are needed,**
- **In new real estate situation**

Coming to the conclusions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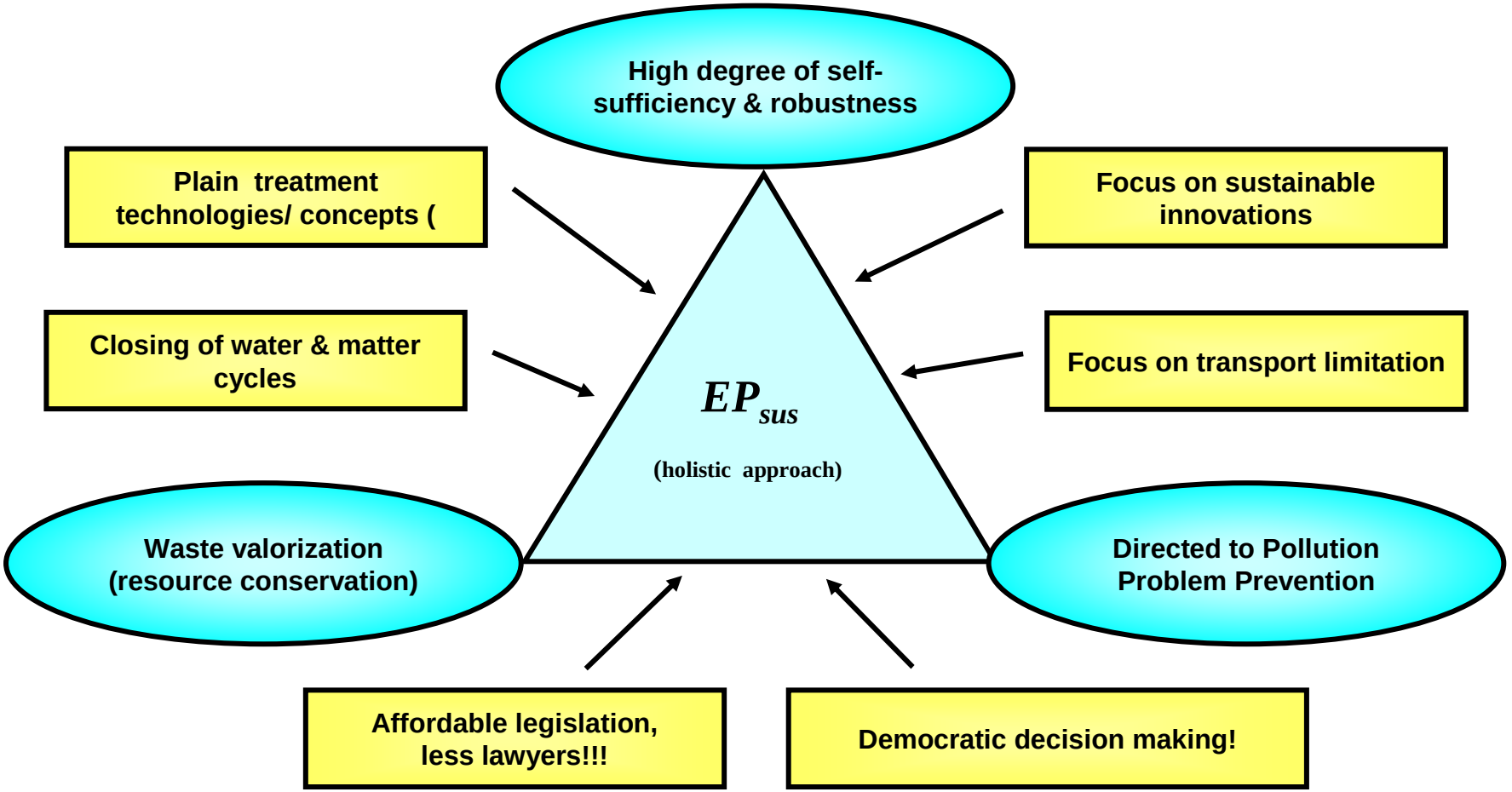

High degree of self-sufficiency & robustness
Plain treatment technologies/ concepts (
Focus on sustainable innovations
Closing of water & matter cycles
Focus on transport limitation
EP_{sus}
(holistic approach)
Waste valorization (resource conservation)
Directed to Pollution Problem Prevention
Affordable legislation, less lawyers!!!
Democratic decision making!

Conclusions

1. **For attaining the MDG's we need conceptual innovations towards some kind of $DESAR_3$ (the required technological tools are available).**

Conclusions

2. In order to make progress towards $DESAR_3$, in the field of PuSan sector we need:

   - an really multidisciplinary (holistic) tackle,

   - a proper decision making, i.e. directed to public well being (democratic decision making).

Conclusions

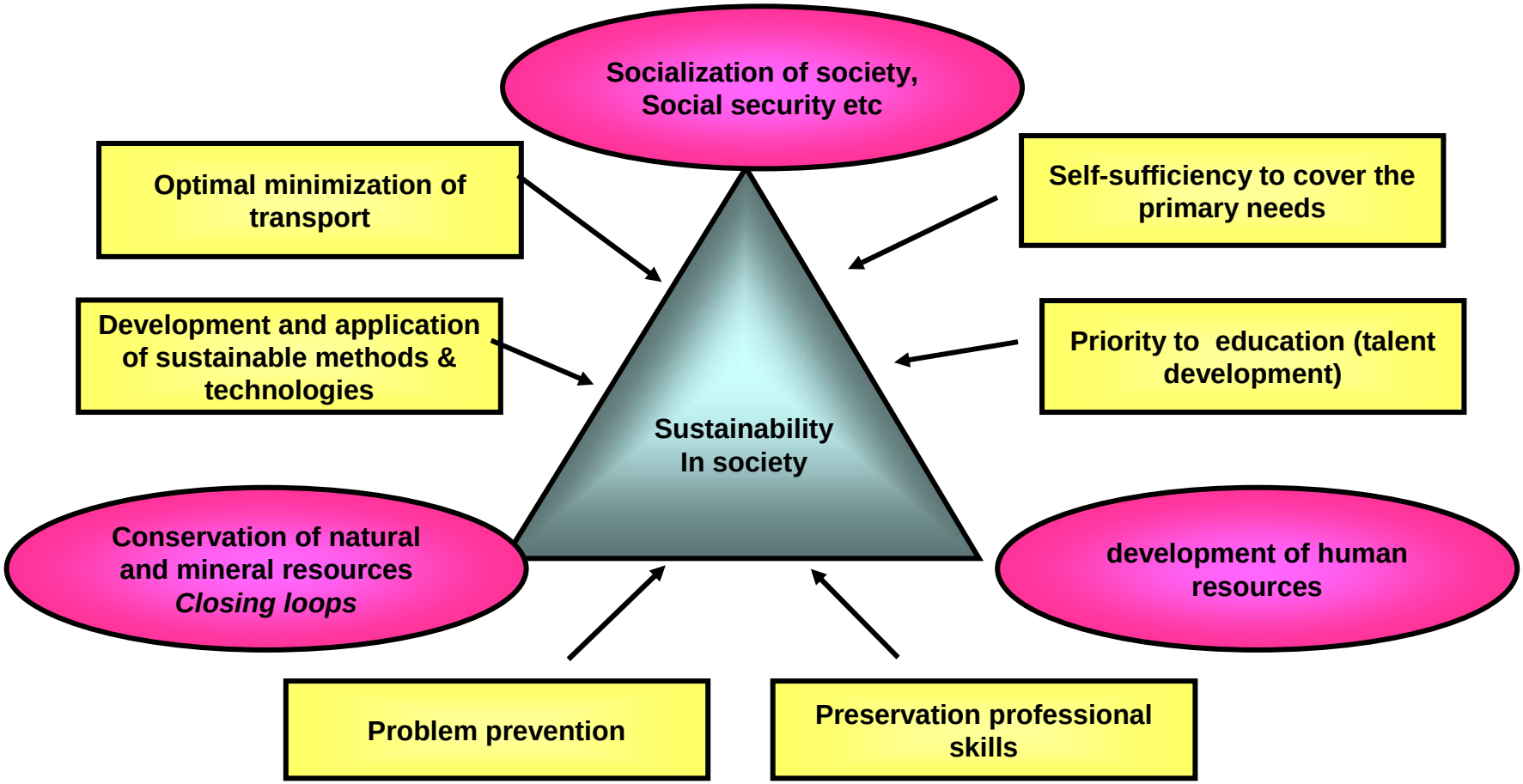
3. **AnDeg-systems and complementary BioMin$_{nat}$ systems in applied decentralized settings for**

   - Environmental Protection,

   - Resource Recovery and Reuse,

   - Renewable Energy generation,

   represent a excellent crowbar to realize the urgently required SUSTAINABILITY IN SOCIETY.


Socialization of society,
Social security etc
Optimal minimization of transport
Self-sufficiency to cover the primary needs
Development and application of sustainable methods & technologies
Priority to education (talent development)
Sustainability
In society
Conservation of natural and mineral resources
Closing loops
development of human resources
Problem prevention
Preservation professional skills


The dream of a clean environment for all
Thank you