Climate change: an issue of study and action

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Overview lecture

1. **Factors shaping climate and energy policy**
2. **Sustainable Development: Our Common Future**
3. **Sun-Earth energy balance**
4. **Analytical frames of planet-people interactions**
   - **Metabolism (material balances)**
   - **Causal sequence VDPSI@R**
   - **Decomposition of emission sources**
5. **Evaluation of the frames**

FACTORS shaping climate and energy policy

IDEAS
Myths
Symbols
Images
Narratives
Discourses
Ideology
Paradigms
…
INFLUENCE
LEGITIMACY

INTERESTS
Positions
Power
Knowledge
Property
Capital
Income
…
MONEY

ACTORS

Citizens, Activists, NGOs
Energy, Industrial Companies
Employers, Employees, Trade Unions
EU Commission, Parliament, Council
EU Member States, Cities
Financial Institutes, Exchanges
International Organisations
Scientists, Consultants, …
…
on one finite planet, surrounded
by one vulnerable atmosphere

INSTITUTIONS
Habits
Norms
Rules
Laws
Institutes
…
POLITY

INFRASTRUCTURES
Buildings
Transport
Production
Commerce
Recreation
…
ASSETS

SUBSTRATE

Energy ⌘ Technology

TRANSFORMATIONS

UN World Commission on Environment and Development
Brundtland et al. 1987
Our Common Future (OCF)

- Sustainable Development (SD)
  - NOT vague, abstract, remote idol, worshipped to futility in neoliberal discourse
  - YES concrete, hands-on, radical paradigm in OCF-SD
    - Clear goals & constraints (limits)
    - Specific action programs are political-societal constructs
- Operationalize Sustainable Development
  - NOT by glossy brochures, events, selfevaluations
  - YES by comprehensive sustainability assessments of policies, technologies, projects, programs, actions, …
    - Identify criteria (= attributes to own, results to obtain)
    - OCF provides normative frame (the stem) + assessment adds constructed specificity (branches)

Goal + Substance of Sustainable Development

GOAL statement towards Sustainable Development

quotes from Our Common Future (WCED, 1987)

***Humanity* has the *ability* to *make* development sustainable – to ensure that it meets the needs of the present generations without compromising the ability of future generations to meet their own needs (p.8)**

Growth control (limitations, p.43):

- **Demographic developments in harmony with the changing productive potential of the ecosystem (p.44; p.55-57)**
- **Consumption standards that are within the bounds of the ecological possible and to which all can reasonably aspire (p.44)**

Redistribution (overriding priority to the essential needs of the world's poor, p.43):

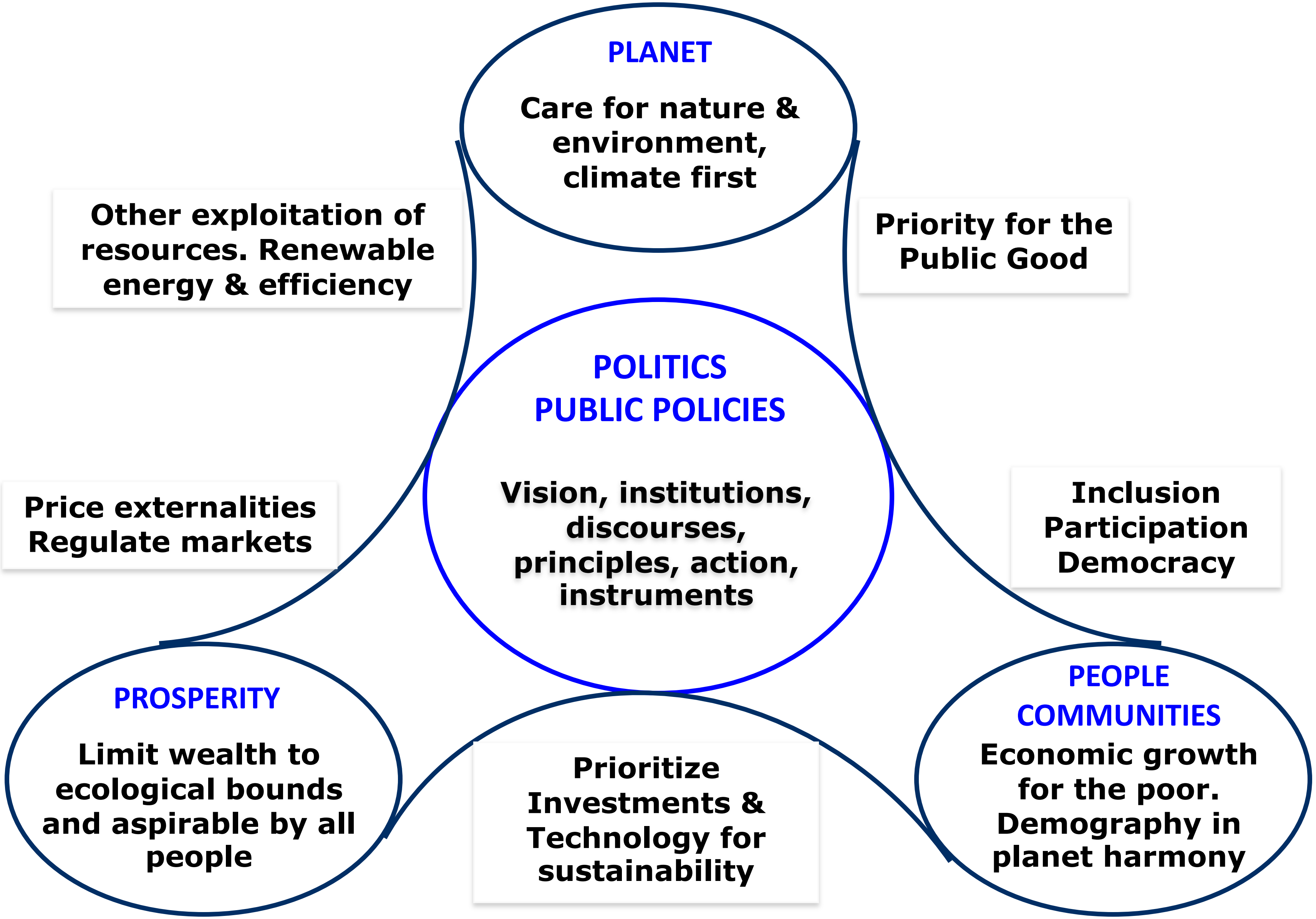
- **Many problems arise from inequalities in access to resources (p.48)**
- **Economic and social justice within and amongst nations (p.49)**
- **Economic growth for the alleviation of poverty (p.51)**

Processes of change in Political, Economic, Social, Ecological systems (p.9, 46, 65)

In case:

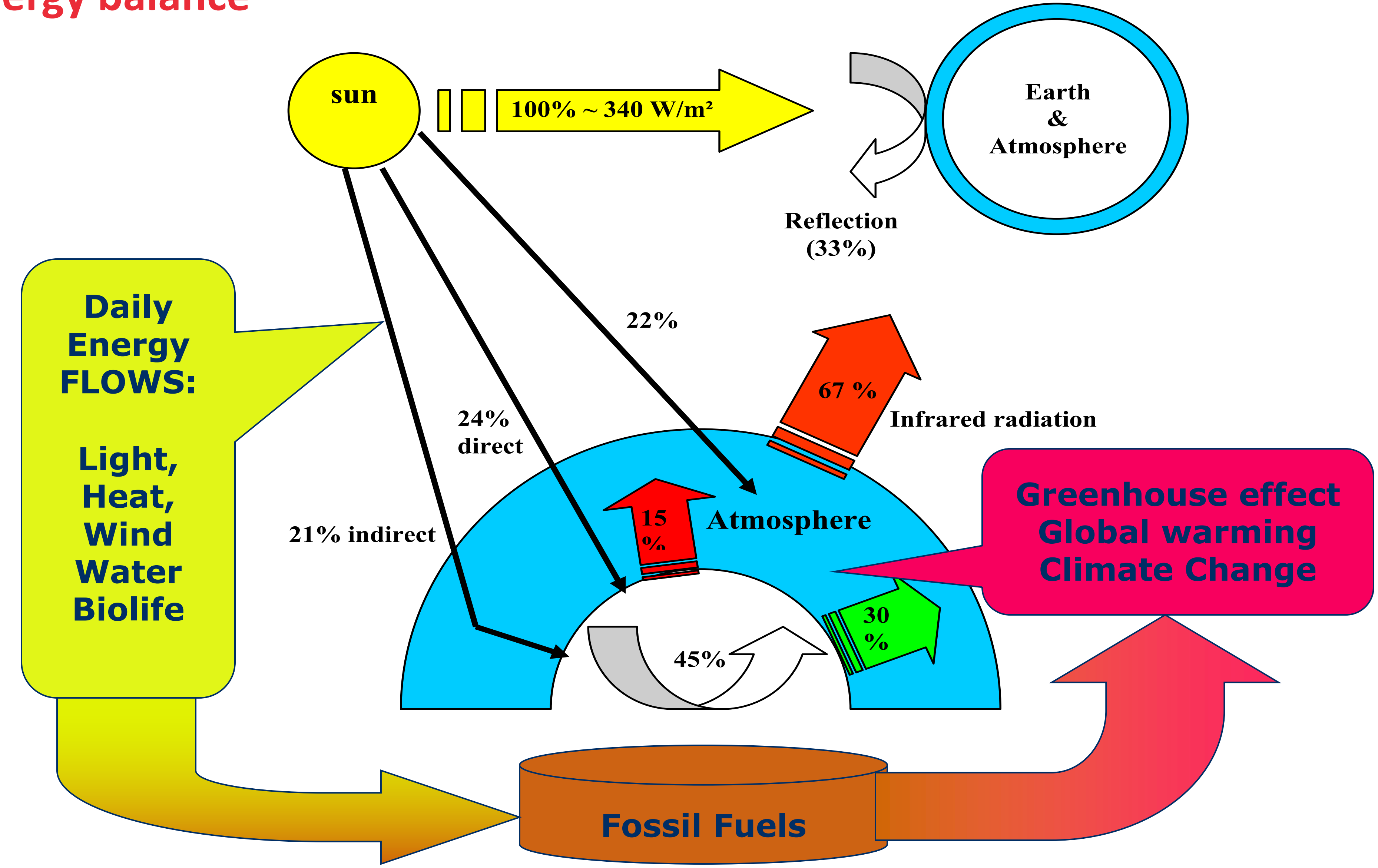
- **Exploitation of resources**
- **Direction of investments**
- **Orientation of technological development**
- **Institutional change; the real world of interlocked economic and ecological systems will not change; the policies and institutions concerned must (p.9)**

Sustainable development holds 4 main dimensions. Politics stays central, moulding vision, institutions, discourses; guarding principles; spurring action

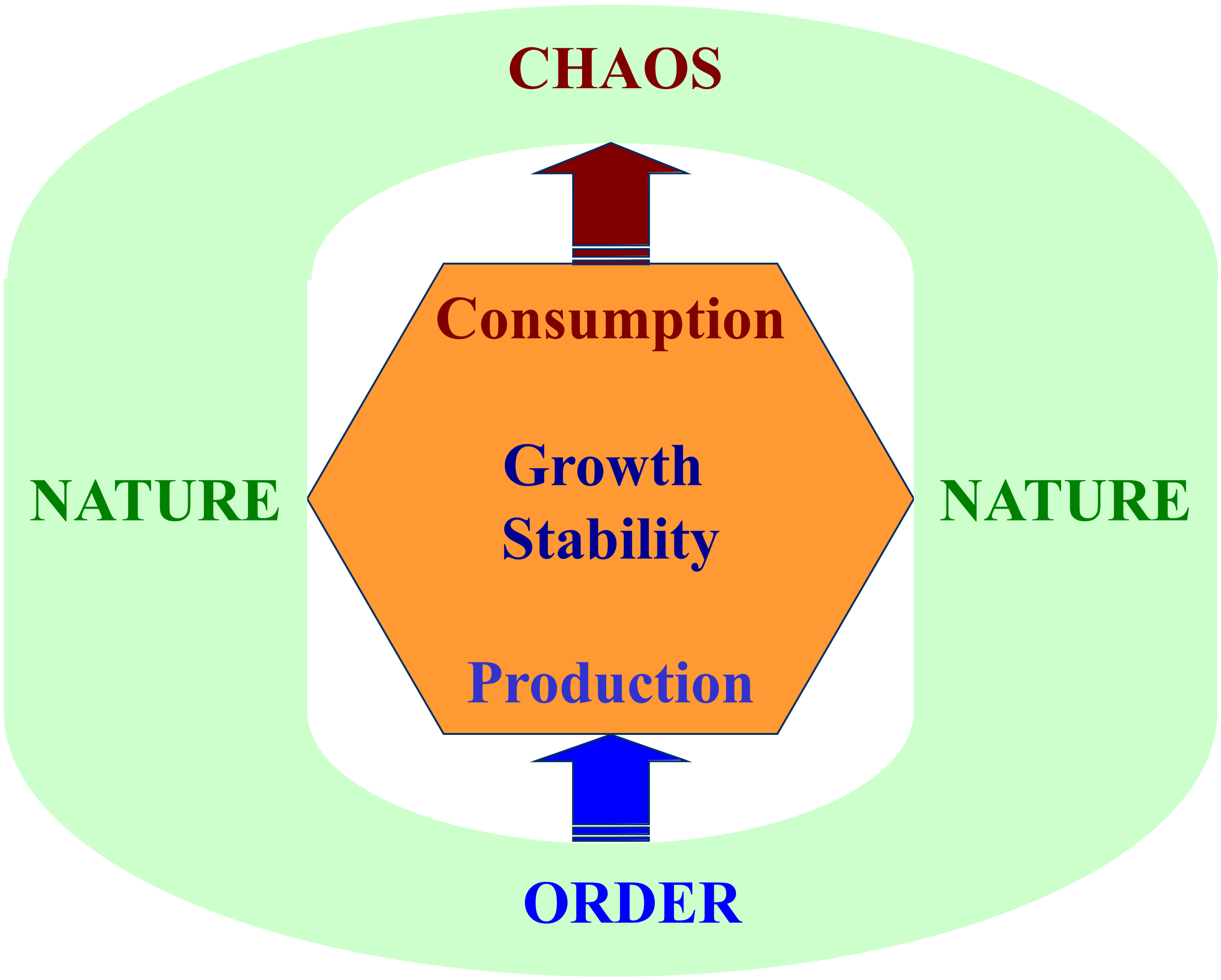


University of Antwerp
IMDO | Institute of Environment and Sustainable Development

Sun-Earth energy balance



Fysics of life: metabolism
nature-society interactions



Observed phenomena obey two main physical laws of thermodynamics

- **Conservation of energy/mass**
  For example combustion of fossil fuels 'IN = OUT'
  1 kg petrol (C-H molecules) + 11 kg air (N_2–O_2 mixture) = 12 kg flue gasses
  > Greenhouse gases: CO_2 , N_2O, CH_4 , F-gases, H_2O vapor
  > Pollution: NOx, Particulate Matter (PM10, PM2.5), PAHs (Poly Aromatic Hydrocarbons), PICs (Products Incomplete Combustion), …

- **Available energy used (by conversion & transfer) to obtain energy services, increases entropy [nett chaos overall (= system + environment)]**

  Heat flows from High to Low Temperature

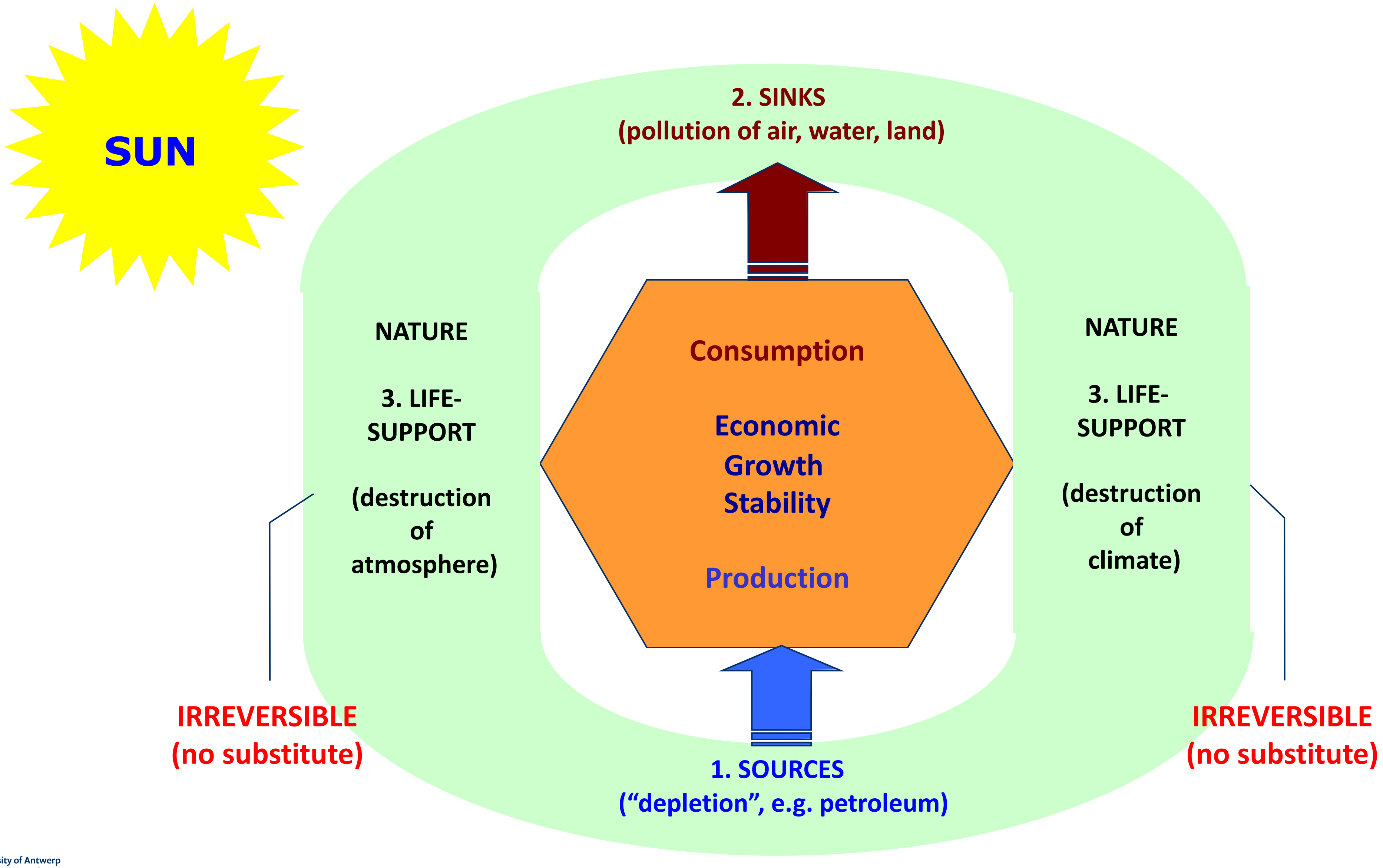
  Pressures settle (currents from High to Low Pressure)

  Mixtures blend spontaneously

  …

'*Irreversibility*' doom-day alarmism
⬄ energy system cycles are repetitive, adding fresh available energy supplies from outside (the system's environment).
Electricity generation from natural currents (wind, light, water) is benign harvesting, keeping doom away.
'*Irrevocability*' is proper term for decreasing availability, because substitution is possible

Economy ⌘ Environment-Nature [important role for energy]



V-DPSI@R framework

D-P-S-I causal sequence

V a l u e s

Driving Forces		Pressures	State	Impacts
Macro economic structure	Sectors: - transport - energy - industry - agriculture - tourism	GHG emissions Land use Waste Effluents Radiation	ppm GHG In the atmosphere	Biodiversity Well-being Health Environmental functions & services

Mitigation-Abatement of drivers & pressures

Private sphere: households, businesses, …

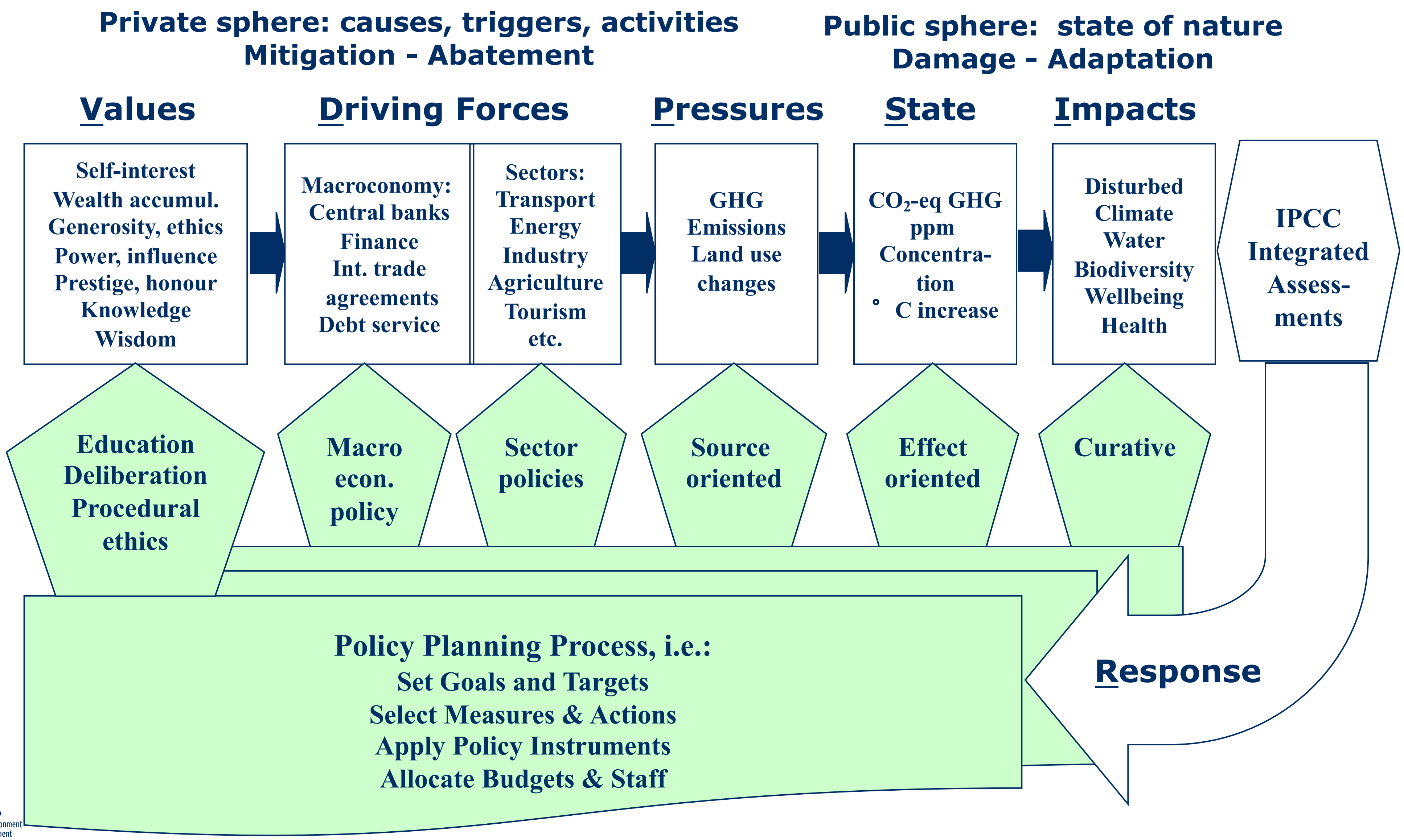
Self-interest prevails

Damages & Adaptation to impacts

Public domain: commons, public goods

Politics must prevail

VDPSI@R framework addressing climate change. Causal sequence Values ➔ Driving Forces ➔ Pressures ➔ State ➔ Impacts @Response, structured as a Policy Planning Process addressing all components of the causal sequence.



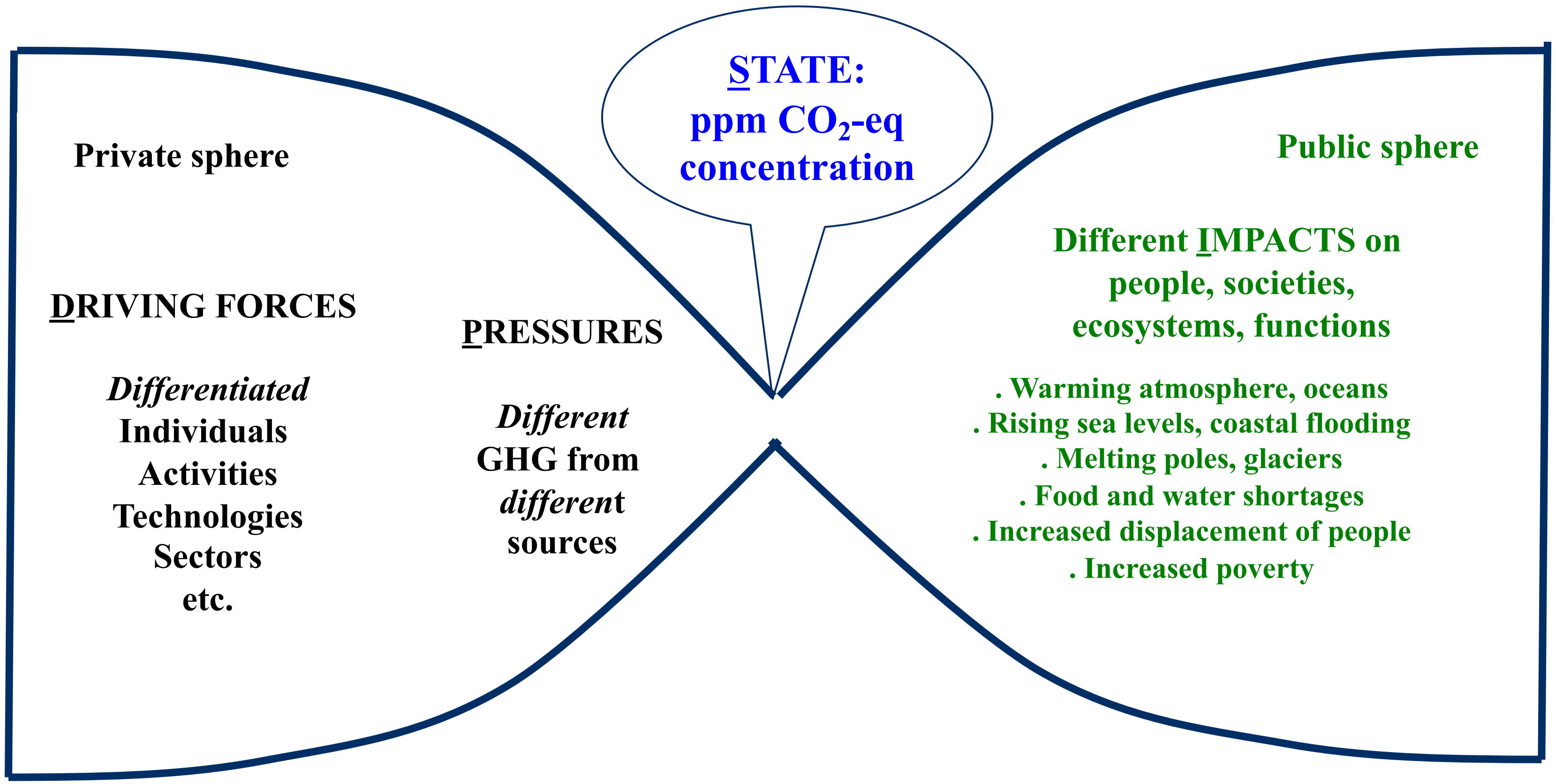
Climate change DPSI *hourglass* format

Every emitted ton CO_2-eq same weight in global CO_2-eq concentration

However,

not a valid argument for uniform treatment of diverse driving forces, diverse pressures and diverse impacts

e.g. not a foundation for the ‘Global Uniform Carbon Price’ discourse



Present energy use causes emissions, waste, risks, …

1. People

≈ 7.8 billion (2020)

2. Welfare

≈ trillion $US
75.64 (2016)
87.50* (2018)

3. Fossil fuels
≈ 11.5 billion toe (2017)
coal, oil, gas

Gaseous litter
≈ 36 billion tons CO_2 (2016)
+ SO_2, NO, NO_2, PICs, PAHs
+ Particulate Matter (2.5; 10)
etc.

4. Nuclear fuel
< 2% of final energy use

Eternal waste problems
Accidents, Catastrophes
Spreading Atomic Weapons

Decomposition of energy-related CO_2 emissions: Ehrlich-Holdren / Kaya Identity

CO_2 emissions	=	People capita	*	Affluence. € GDP	*	Energy intensity	*	CO_2 intensity
Gigaton	=	Gigacap	*	€/cap	*	kWh/€	*	CO_2/kWh

- **Mainly Political are:**

People ~ demography, migration, culture, traditions

Affluence ~ growth, trade, technology, distribution, …

Self-interest [hold and aim for more]

- **Mainly Technical are:**

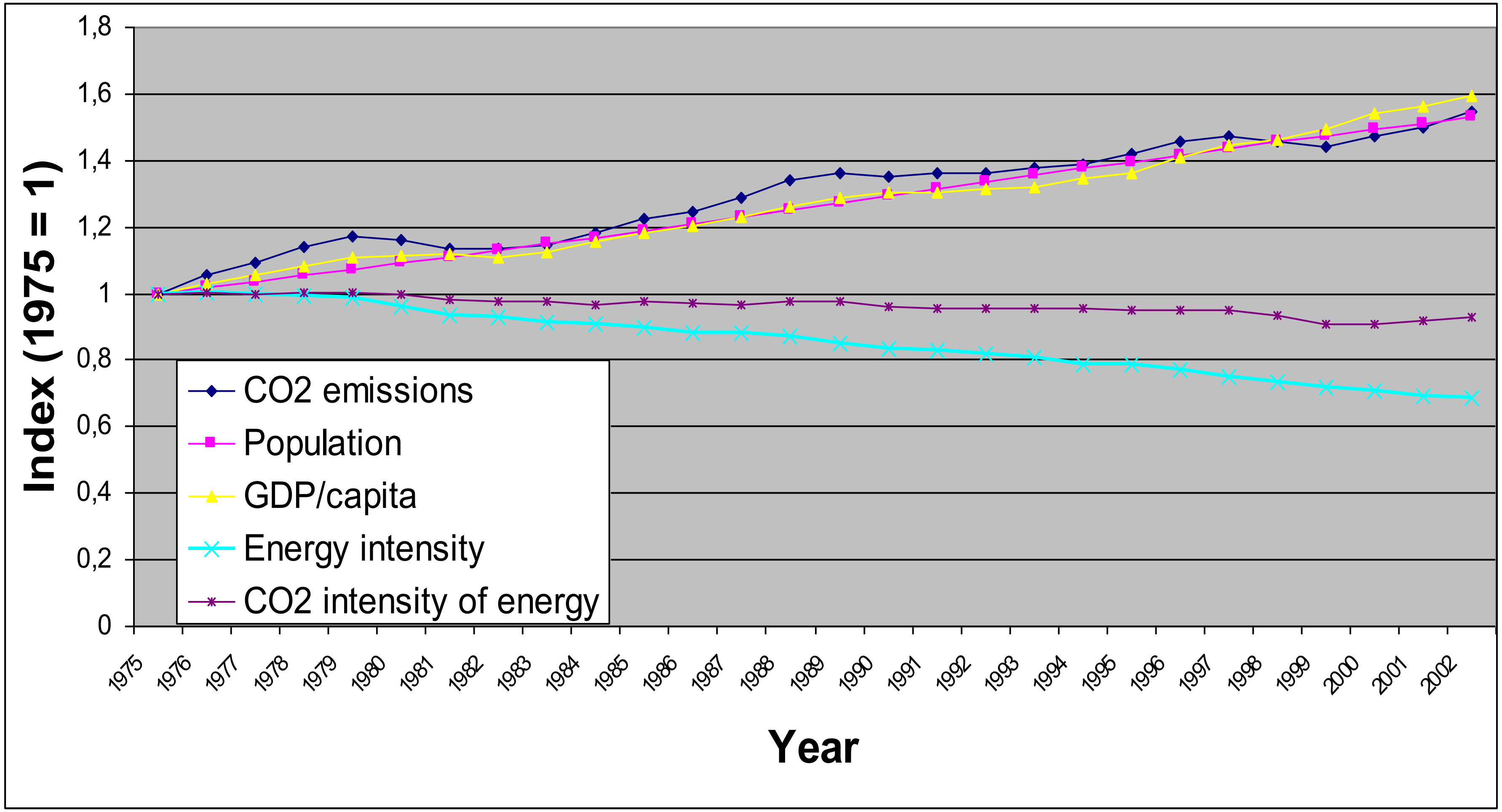
Energy intensity = Structure (activity/€) * Efficiency (kWh/activity)

Conservation means changing structure, i.e. type and amount of activities.

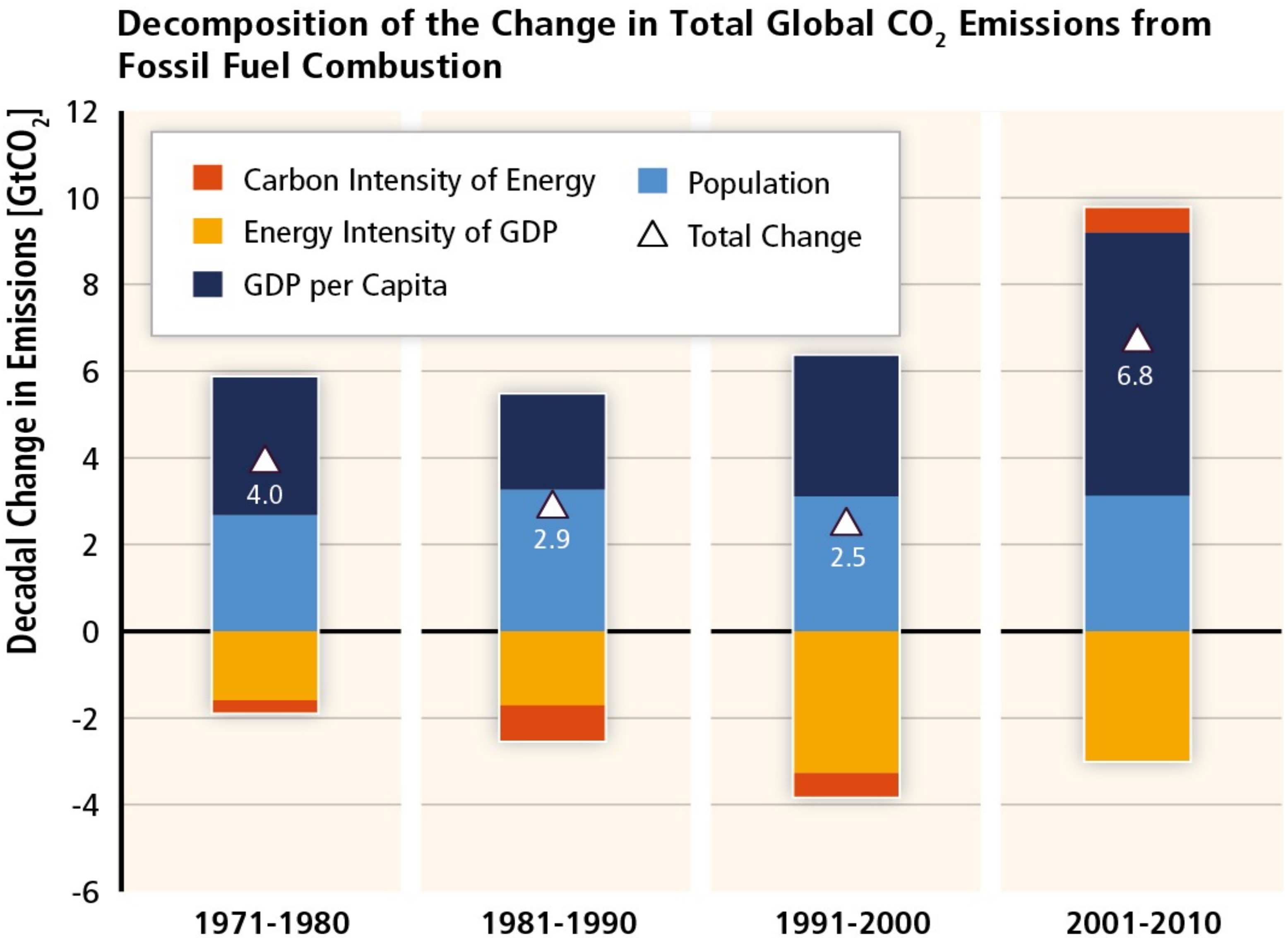
Measuring Efficiency of activities is difficult; aggregate efficiency is spurious.

CO_2 intensity: highly dependent on type of energy used, in case: fossil fuels ⇔ Low/zero carbon energy (renewable, atomic power)

CO_2 Emissions & 4 composing factors (period 1975-2002; based on IPCC AR4 2007 data)



IPCC AR5 WG3 (2014): GHG emissions rise with growth in GDP and population; long-standing trend of decarbonisation of energy reversed.



Decompose deeper to detailed facts on activities, people, energy types, …

$$\frac{CO_2 \text{ emissions}}{\text{Person}} = \frac{\$ \text{ GDP}}{\text{Person}} \times \frac{\text{kWh energy}}{\$ \text{ GDP}} \times \frac{CO_2 \text{ emissions}}{\text{kWh energy}}$$

Wealth Intensity of Peoples

$$\text{Wealth Intensity} = \frac{\$ \text{ GDP}}{\text{Person}} = \sum_A \frac{P_A \text{ x Activity}_A}{\text{Person}} \qquad (3)$$

Energy Intensity of Wealth

$$\text{Energy Intensity} = \frac{\text{kWh energy}}{\$ \text{ GDP}} = \sum_A \frac{P_A \text{ x Activity}_A}{\$ \text{ GDP}} \text{ x } \frac{\text{kWh energy}}{P_A \text{ x Activity}_A} \qquad (4)$$

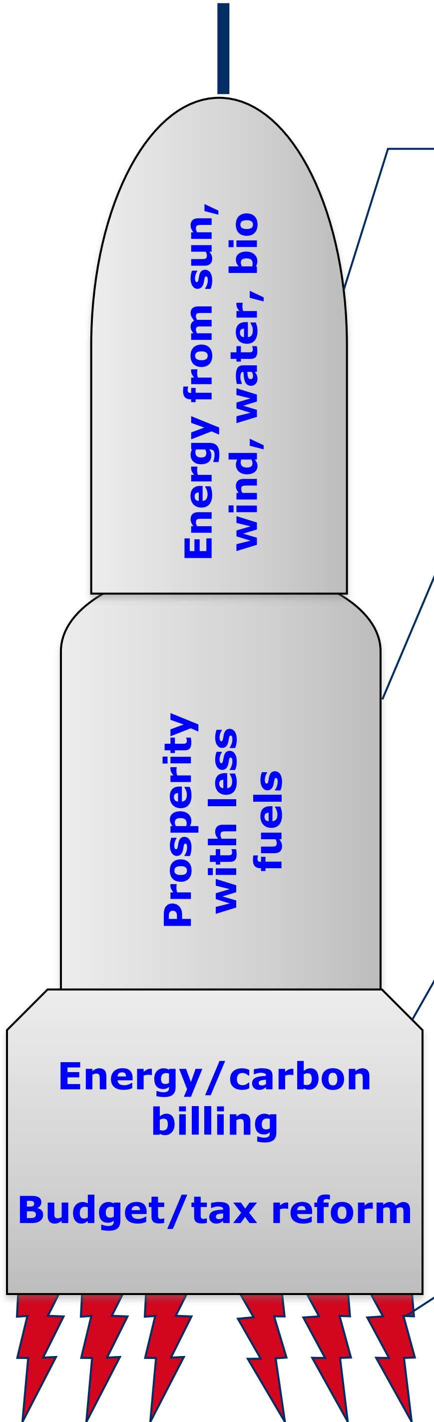
CO_2 emissions Intensity: energy mix x intensity

$$CO_2 \text{ Intensity} = \frac{CO_2 \text{ emissions}}{\text{kWh energy}} = \sum_E \frac{\text{kWh type}_E}{\text{kWh energy}} \text{ x } \frac{CO_2 \text{ emissions}}{\text{kWh type}_E} \qquad (5)$$

Decomposition

Blow up the climate gridlock
=
All countries continuously improve three indicators:
Increase share of RE
Decrease fuel intensity
Progressing budget reform

Matches
☑ **SE4All (UN)**
☑ **Polluter Pays**
☑ **Fairness**
☑ **SDG**



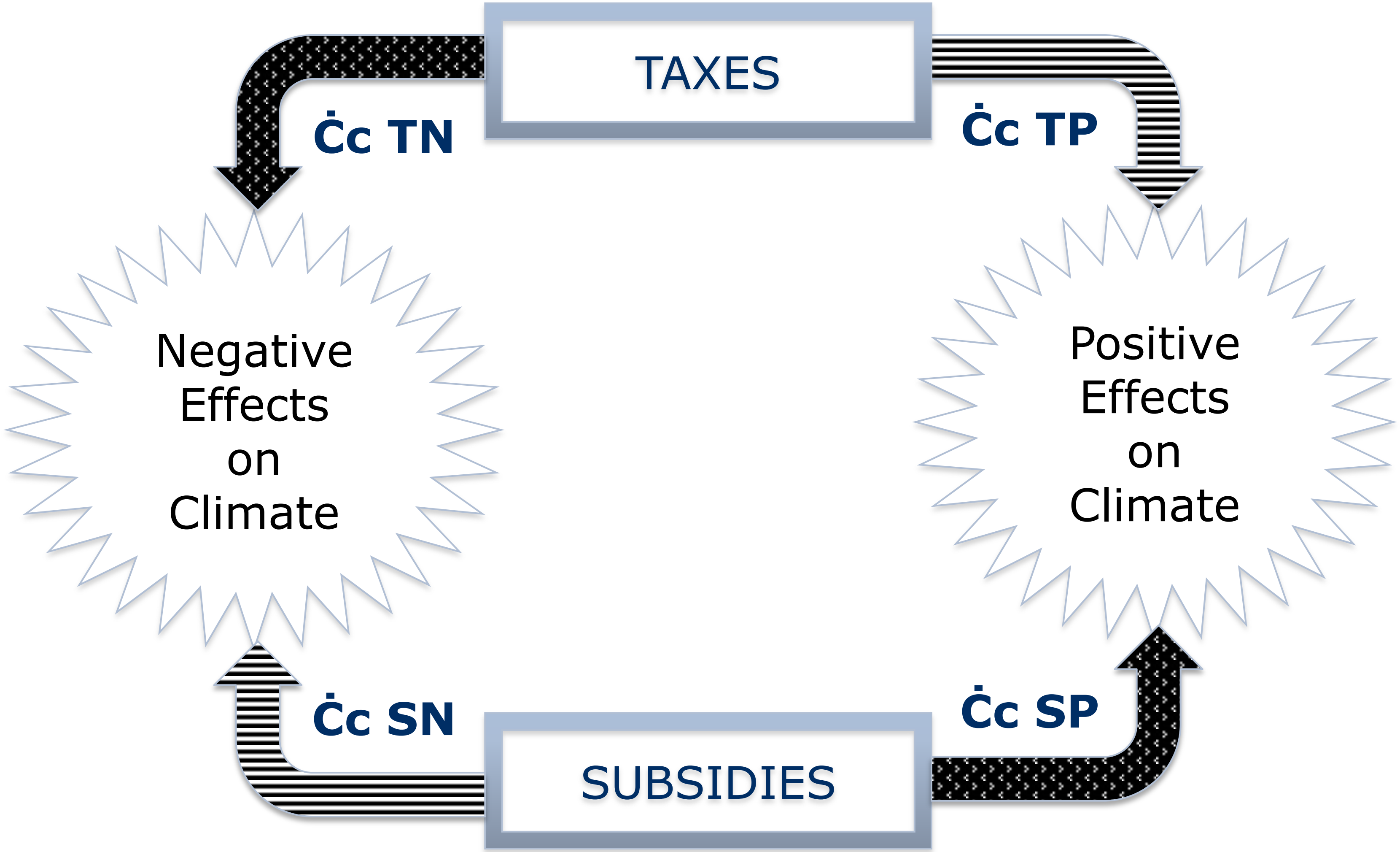
The only sustainable low-carbon option, when for all people affordable

Lean energy systems are affordable by all

Dosed price pressures, adjusted to diverse conditions
New activities, practices
New infrastructures

Necessary thrust

Metrics of country performance in applying financial incentivizing instruments {Ċc = currency of a country}



Ċc Addition: { TN + SP } – { TP + SN }
Ratio = Ċc Addition / Ċc Public budget

Evaluation of the frames

- **Metabolism (material balances)**
  Conceptual interesting: combines depletion & pollution & degradation of nature by human activities
  A foundation of 'ecological economics'
  Yes comprehensive, No practical models

- **VDPSI@R**
  Conceptual strong: connects human values (V), activities (DP) with nature & environment (SI) and the policy range (@R)
  Practical frame to describe & analyse various environmental issues & policies – also Climate Change
  ! Non-linear causalities
  ! Respect full diversity of components

- **Decomposition**
  Conceptually straightforward (identity formula)
  Used to analyse past energy-related CO_2 emissions of countries, e.g. IPCC, AR5, WG3, Ch.5
  ! Absent in UNFCCC COP deliberations
  ! Interdepence among components; OK as cross-section (short-term); not OK for long-term (beyond 5 years) extrapolations.