Climate change and energy transitions

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Mainly based on:
Overview

- **Energy: substrate of civilization**
  - Energy transition spearheading sustainable development
  - Two transitions: $\rightarrow$ renewables $\uparrow$ $\rightarrow$ electricity

- **Deep Decarbonization**
  - Energy & climate policies

- **Energy transitions**
  - Thorough $\Leftrightarrow$ Fake
  - Thorough & urgent
Energy: substrate of civilization

Civilization
- Paradigms [social construct, policy, politics]

Substrate
- From dense sources ♦ poor technology to weak sources ♦ strong technology
- Lock-in ♦ existing infrastructure ♦ incumbent interests

ENERGY USES = TECHNOLOGY × ENERGY SOURCES
Energy Civilization: Present → Future

Present

$ rich
$$ richer
$$$$ richest
American Dream

Fossil fuels & Atomic power

Future

Global Sustainability

Transition 2 societal

Renewable Energy

Transition 1 energy

Energy efficiency
Energy for Social Activities & Services

SOCIETY
Gross Domestic Product (wealth) = spending on numerous Activities
GDP = \( \Sigma_{i=1...\Omega} P_i \times A_i \)
Activities occur in various sectors, e.g.
Agriculture ★ Industry ★ Commercial ★ Transport ★ Households
Activities require Energy Services
Light ★ HVAC ★ Drive Power (stationary, mobile) ★ Process Heat

RENEWABLE flows & stocks
[sun, moon, earth, oceans, nature,... ]

ELECTRICITY

Hydrogen

FOSSIL FUELS
[coal, oil & gas deposits]

ATOMIC fission power
[uranium mines]

BIO FUELS
[land, water, light]

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DEEP DECARBONIZATION = Contracting & Converging all countries’ average energy-related CO₂ emissions/person
Blow up the climate gridlock = All countries continuously improve three indicators

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

Prosperity with less fuels
Energy from sun, wind, water, bio

Energy/carbon billing

Budget/tax reform

Matches
- SE4All
- Polluter Pays
- fairness

Rejects emissions trading with offsets

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## Transitions

**Thorough ⇔ Fake**

<table>
<thead>
<tr>
<th>1. Nuclear phase-out + local, public RE initiatives</th>
<th>1. Nuclear as low-carbon + large-scale RE</th>
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</thead>
<tbody>
<tr>
<td><strong>2. Technological innovation:</strong></td>
<td><strong>2. Questionable innovation:</strong> PWR? CCS? biomass combustion? large-scale tidal?</td>
</tr>
<tr>
<td>• energy efficiency</td>
<td></td>
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<tr>
<td>• PV, wind, batteries</td>
<td></td>
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<tr>
<td><strong>3. FIT (Feed-in tariffs): support innovations per RE category</strong></td>
<td><strong>3. Subsidies for nuclear PWR:</strong> UK price guarantee £92.50/MWh during 35 years (not enough!)</td>
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<tr>
<td><strong>4. Superior RE technologies:</strong> mediocre RE sources harvestable, redundant powergen. capacities, regulatory solutions needed, independent public regulators</td>
<td><strong>4. Old power supply model:</strong> capacities on command, Optimal composed systems Marginal cost pricing <strong>Now amended</strong> with payments for capacity</td>
</tr>
<tr>
<td><strong>5. Emulation by all countries:</strong> essential for global solution &amp; sustainable development</td>
<td><strong>5. Emulation by developing countries:</strong> Unlikely, impossible</td>
</tr>
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Transitions: Thorough + Urgent

- **Sustainable Development ↔ Business-as-usual**
  - No general mantras, but practical bolts and nuts
  - Sustainability assessments of technologies, projects, policies

- **Thorough electricity/energy transitions**
  - Rich countries develop & deploy technologies
  - Other countries will emulate techniques & practices

- **Only valid reference = future sustainable energy systems**
  - Renewable energy + efficiency ↔ energy ‘Pantheon’
  - Local natural flows, prosumers first • complemented by centralized renewable plants
  - Kickstart transition, even stranding existing assets
  - Apply ‘polluter pays principle’: incumbents are liable, not the sustainable challengers
  - New electricity economics: most capacities not on command but stochastic and redundant (public interest regulation!)
Acropolis Workshop

Slides in Annex

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Interacting INFRA ☯ SUPER structures

- Dynamic history of mankind
- Energy & Technology are intertwined
- Histories are evolutionary & revolutionary, with inertia, lock-in, leapfrogging, ...
- Interests reign human actions
  - Incumbents ⇔ Innovators
- Paradigms sum-up visions and positions
  - Obsolete (deceiving) ⇔ Vanguard (promising)
- Actions on the floor = actual change, transition
4 money flows (2 positive – 2 negative)

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<tr>
<th></th>
<th>&quot;Climate Goods&quot;</th>
<th>&quot;Climate Bads&quot;</th>
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<tbody>
<tr>
<td>Levies, charges, taxes</td>
<td>B1-</td>
<td>B2+</td>
</tr>
<tr>
<td>Subsidies, support, feed-in tariffs</td>
<td>B3+</td>
<td>B4-</td>
</tr>
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</table>

‘Climate tax revenues’ = (B2 + B3) – (B1+B4)
Wealth Intensity of Persons: prices $x$ activities by whom?

\[
\text{Wealth Intensity} = \frac{\text{\$ GDP}}{\text{Person}} = \sum_A \frac{P_A \times \text{Activity}_A}{\text{Person}}
\]  (3)

Energy Intensity of Wealth: budget shares $x$ efficiency

\[
\text{Energy Intensity} = \frac{\text{kWh energy}}{\text{\$ GDP}} = \sum_A \frac{P_A \times \text{Activity}_A}{\text{\$ GDP}} \times \frac{\text{kWh energy}}{P_A \times \text{Activity}_A}
\]  (4)

CO₂ emissions Intensity of Energy: energy mixes

\[
\text{CO₂ Intensity} = \frac{\text{CO₂ emissions}}{\text{kWh energy}} = \sum_E \frac{\text{kWh type}_E}{\text{kWh energy}} \times \frac{\text{CO₂ emissions}}{\text{kWh type}_E}
\]  (5)
• Magritte Group (March 19, 2014) recommends:
  - Preference for ‘mature renewables in the regular market’
  - Priority to the utilization of existing competitive power capacity rather than subsidizing new constructions
  - Restore the ETS as a flagship climate and energy policy

• EU (April 9, 2014) New Energy State Aid Guidelines
  - Refrain the German Energiewende
  - Payments for UK coal power capacity
  - Subsidize planned EDF EPR at UK Hinkley Point (€115/MWh during 35 years)

• Nuclear discourse molds fake reality
  - IAEA & IPCC option low-carbon (↔ renewables)
  - No real sustainability assessment
Self-governance in global climate policy

195 Countries / UNFCCC Parties
With ‘common but differentiated responsibilities and respective capabilities’

- Highly diverse
- Sovereign

3. TRANSFERS
   finance
   technology
   governance

4. PARTICIPATION & COMPLIANCE

5. PLEDGE & REVIEW

6. Binding yearly COMMITMENTS on measured indicators

7. MRV
   Monitor
   Report
   Verify

2. SPEARHEAD POLICY:
   eliminate energy-related CO2 emissions

1. URGENCY to protect

Atmosphere & Climate

Ultimate global COMMONS

Deterioration Destruction IRREVERSIBLE