Radical dematerialization and degrowth

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**0. 概览（文章主旨）**

* **核心命题**：巴黎协定所需的深度减排意味着**激进去物质化**（大幅减少资源开采、使用与处置）。作者主张：**激进去物质化与经济增长不相容**；它几乎必然伴随**去增长（degrowth）**。于是关键问题转为：如果增长不可持续，**怎样在无增长或负增长中维持社会可持续与福祉**。
* **政策线索**：为让“不可避免的去增长”更可承受，作者讨论三类政策：**工时分享（work‑sharing）**、**绿色税收（green taxes）**、**公共货币（public money）**。

**1. 引言（为什么把“去物质化”和“去增长”绑在一起）**

* **逻辑链**：减排→要显著**减材（dematerialization）**→规模前所未有且伴随深刻社会/政治/文化变迁→**小概率与经济增长兼容**。资本主义经济在不增长时**易失稳**，而减材政策通常**抑制增长**。因此，若“无增长可被良好管理”，就更容易实施严格的减材/减排政策。
* **要点**：把“增长不可或缺”当作常识，是阻碍强力减材政策的关键心理与政治障碍。

**2. 生态经济学：一种“物质重要（matter matters）”的经济学**

作者用生态经济学（EE）的五个基本洞见，搭好理论与实证骨架：

**(a) 经济过程＝物质转化，由人类与非人类“工作（work）”驱动**

* **热力学视角**（Georgescu‑Roegen）：经济将低熵资源转为产品/服务，同时产生高熵废弃物。
* **增长的能量面**：**有效能投入与产出强相关**；技术进步很大程度上是“更大量、更高效率地把能源转化为**有用功（useful work）**”。
* **EROI**（能量回报率）关键：化石能源的**高EROI**是现代增长的重要“净能量”来源；可再生能源的EROI通常更低，意味着**用可再生支撑同等规模的增长更难**。

**(b) 效率与规模（反弹/耶文斯悖论）**

* 效率提升通常让单位产品更省料/省能，但**价格下降→需求扩大→总量反增**（反弹效应）。
* 在资本主义积累逻辑下，**效率红利被再投资**推动再生产，从而**吞噬节约**。除非**设定总量上限**，否则效率无法带来总量下降。

**(c) 生产要素的互补性（而非完全替代）**

* 资本品本身具有物质性（需要能量与材料生产）。
* 人力与机器、能源彼此**互补**：很多过程存在**最低要素配比**，不能靠“多用一种要素”无限替代其他。
* “用劳动替代能源/材料”虽可能省资源，但会**压低劳动生产率与产出**，与“增长”目标冲突。

**(d) 隐含能/物质（embodied/“Emergy”与生态足迹）**

* 服务并不“飘在天上”——服务人员的衣食住行、教育交通的能物投入也**体现在服务里**。
* 发展出\*\*物质足迹（Material Footprint, MF）\*\*等消费端核算：追溯进口品链条背后的材料和能量。

**(e) 外部性＝成功的转嫁成本**

* 不把污染/生态破坏计入价格，不是“市场的小失误”，而是**逐利下的系统性成本转嫁**。
* 若全面“内部化”历史与当下的生态成本，**增长可能从一开始就难以成立**；这也解释了强碳税等为何遭遇既得利益的抵制。

**节要**：EE框架下，**增长与物质/能源投入强耦合**；效率与替代在“增长机器”里往往被“总量扩张”抵消。

**3. 为什么“去物质化”与经济增长不大可能相容**

* **全球证据**：1980年以来，**全球材料开采总量超过翻番**；单位产值的材料强度略降，但**总量仍大涨**。
* **“峰值物质（peak stuff）”的误读**：在一些发达经济体，**国内材料消费（DMC）停滞不等于总需求下降，因为进口制成品中隐含材料**被统计遗漏。看\*\*物质足迹（MF）\*\*时，**MF仍随GDP同步上升**。
* **跨国计量**：GDP每增长1%，**物质足迹约增0.6%**；碳排与GDP亦呈0.5–0.7%的弹性关系。**强耦合仍在**。
* **结论**：**增长→更多材料使用**；反向亦然：**少用材料**通常意味着**更慢的经济**。

**4. 去物质化为何会放慢经济**

四条机制：

1. **效率→利润→再投资扩张**：若无总量上限，效率省下的材料会被**增长吞没**。
2. **以工代料**（例：**大修旧楼**而非重建）：能**增就业、减物料**，但**拉低劳动生产率与盈利**，抑制增长。
   * **能源转型**：风光等**低EROI**→**净能盈余下降**，难以支撑当下体量与2–3%年增速。
3. **延缓商品周转**（自修手机/汽车、延长寿命）：**非市场部门扩大→市场交易缩小**；“2%年增=约35年翻番”的周转速度难维持。
4. **绿色基建“挤出”**：大规模减碳/去物质化投资会**挤出**提升劳动生产率的传统投资，**压低长期增长**。

* **价值与偏好面**：在满足基本需要与公平分配的前提下，人们可能接受**更朴素的高关系性福祉**（少物质多关系），从而使“去增长”社会上可行。
* **术语**：**可持续去增长（sustainable degrowth）**=在**产出下降**环境下，**福祉上升/稳住**。

**5. 走向“可持续去增长”的三类政策**

**A. 工时分享（Work‑sharing）**

* 减少个人工作时长但**不减收入**，以此**平摊就业**、共享生产率红利为**闲暇/生活时间**，而不是为资本利润。
* 实证与模型：**缩时工作**有助于**就业、减排、提升幸福感**；是**零增长稳定路径**的关键条件之一。
* 限制与配套：若“多出来的时间”被用在**高物耗休闲**，会**反弹**；需配**绿色税**抑制高耗消费。

**B. 绿色税收（Green taxes）**

* 税负从“好东西”（劳动）转向“坏东西”（资源消耗/污染）。
* 需覆盖**进口隐含碳/材料**。
* **累退性问题**：穷人收入中能源占比高；对策：**以税返税**或**替代低收入群体的个税**，保证**总体税负不上升**、分配不恶化。
* 与去增长的关系：**足够严格的绿税会抑制经济**，所以必须与**工时分享等社会政策**配套，承接“低增长/无增长”的后果。

**C. 公共货币（Public money）**

* 现行系统中，**商业银行放贷创造货币**并附带利息，形成**增长压力**。公共货币主张由**国家直接发钞**用于**公共目的**（如**基本收入**或**绿色补贴**），回收**铸币税**，弱化对**私人债务驱动扩张**的依赖。
* 更广泛的制度议题：若实行这些“改革”，经济将**大异于当代资本主义**（劳动雇佣减少、银行去中介化、资源能源使用被严格限额），并需要**重大权力结构变化**。

**配套的分配与制度问题**

* **不增长时的不平等**：理论上资本回报率>增长率会推高不平等；但**慢增长也可能压低资本回报**，辅以**累进税/遗产税/最高收入上限**可控不平等。
* **全球发展难题**：历史上**没有“无工业化的发展”**；而工业化伴随**资源使用增加**。若所有国家都追求“体面的人类发展指数”，即便在较低资源强度路径下，也可能**越过地球边界**。这构成一种“**不可能三角**”：若**绿色增长不可行**、而**无增长的发展又不可行**，则**传统发展概念**需重估——转向**可持续满足“基本需要”的福祉定义**。

**6. 结论（直面“政治上难、生态上必要”的张力）**

* **主结论**：深度**脱碳与去物质化**与**经济增长不相容**；推行严格的脱碳/去物质化**将抑制增长**。因此应当研究并筹划\*\*“无增长的管理之道”\*\*。
* **集体行动困境**：在国家间竞争格局下，**各自追逐增长**以保经济/军事实力，**合成结果反而走向生态灾难**。
* **现实提醒**：两百年技术进步靠的是**高能高材**、向新边疆扩张；**和平收缩**并非资本主义的强项。
* **学术伦理**：科学家不应只说“政治上可接受”的话，而应坚持“生态上必要”的真相。

**0. Big picture**

* **Thesis**: Meeting Paris targets implies **radical dematerialization**. Such dematerialization is **incompatible with economic growth**; it will likely come with **degrowth**. The key question becomes how to maintain **social sustainability and wellbeing without growth**.
* **Policy preview**: Three levers to make “inevitable degrowth” socially sustainable: **work‑sharing**, **green taxes**, and **public money**.

**1. Introduction**

* **Logic**: Deep emissions cuts → deep **reduction in material throughput** → unlikely to co‑exist with growth. Since capitalist economies tend to be **unstable without growth**, strict dematerialization policies are politically hard **because** they slow growth. If **no‑growth can be managed**, strict material demand reduction becomes more feasible.

**2. Ecological Economics: “An economics where matter matters”**

Five building blocks:

**(a) The economy as material transformation driven by work**

* Thermodynamic view: converting low‑entropy resources into goods/services produces high‑entropy wastes.
* **Useful work** explains much of “technological progress”: it’s about **using more energy more efficiently**.
* **EROI matters**: fossil fuels’ high EROI underwrote modern growth; **lower‑EROI renewables** make sustaining the same scale of output/growth harder.

**(b) Efficiency and scale (Jevons/rebound)**

* Efficiency lowers unit costs → expands demand → **total use rises** unless a **hard cap** controls scale. In capitalism, efficiency gains are **reinvested**, fuelling expansion that **offsets** savings.

**(c) Complementarity of production factors**

* Capital goods are **material**; labour, capital, and energy are **mutual complements** with **minimum input requirements** for many processes.
* Substituting labour for energy can save resources but **cuts labour productivity and profits**, conflicting with growth targets.

**(d) Embodied energy/materials**

* Services embody upstream energy/materials (feeding, housing, educating workers, mobility).
* Consumption‑based metrics (e.g., **Material Footprint**) trace imported supply chains, revealing the full resource use behind final demand.

**(e) Externalities as cost‑shifting successes**

* Ecological harms are not accidental “market failures” but **systemic cost shifting**. Full internalization (including historical debts) would likely **erase the basis for growth**, explaining resistance to strong carbon/resource taxation.

**UpShot**: In EE, **growth is tightly coupled** to energy and material throughputs; efficiency/substitution, within a growth regime, tend to be **overwhelmed by scale effects**.

**3. Why dematerialization is unlikely to be compatible with growth**

* **Global data**: Since 1980, **material extraction more than doubled**; modest intensity gains did **not** prevent total growth in use.
* **“Peak stuff” caveat**: Flat **DMC** in some rich countries reflects **offshoring**; **Material Footprint** (including embodied materials in imports) still **rises with GDP**.
* **Cross‑country elasticities**: Roughly **+0.6% MF per +1% GDP**; carbon shows similar 0.5–0.7 elasticities.
* **Conclusion**: **More GDP → more materials**; conversely, **less material use → slower GDP**.

**4. Why dematerialization would slow the economy**

Four channels:

1. **Efficiency → profit → reinvestment**: savings fuel expansion unless a **hard cap** exists.
2. **Labour‑for‑materials** moves (e.g., **retrofits** over rebuilds) **save materials, create jobs** but **lower labour productivity/profits**; renewables’ **lower EROI** lowers net energy surplus, making 2–3% growth hard to sustain.
3. **Slower turnover** (repair, longer product lifetimes) expands **non‑market** activity while **shrinking market throughput**, inconsistent with compounding growth.
4. **Crowding out**: massive green/dematerialization investments can **crowd out** productivity‑boosting investments, dampening long‑run growth.

* **Values & preferences**: With needs secured and fair distribution, people may embrace **relational wellbeing** over material throughput. This underpins **sustainable degrowth**—**rising or safeguarded wellbeing with declining output**.

**5. Policies for sustainable degrowth**

**A. Work‑sharing**

* Shorter working hours **without income loss** to share jobs and **convert productivity gains into free time**. Evidence/modeling suggests **higher employment, lower emissions, higher wellbeing**; it stabilizes a **zero‑growth** macro path. Needs **green taxes** to avoid rebound via resource‑intensive leisure.

**B. Green taxes**

* Shift taxation from **labour (a “good”)** to **resource use/pollution (a “bad”)**; include **embodied** carbon/materials in imports. Address **regressivity** by recycling revenues to **reduce/replace low‑income income taxes**. From a degrowth view, **sufficiently strict** green taxes will **slow the economy**, hence the need for social policies like work‑sharing.

**C. Public money**

* Today’s **bank‑created, interest‑bearing money** imposes a **growth imperative**. **Sovereign issuance** for public purposes (e.g., **basic income**, **green subsidies**) could reduce reliance on private debt expansion, reclaim **seigniorage**, and steer demand.
* Together with stronger redistribution (progressive/wealth/estate taxes, **maximum income**), these policies imply an economy **unlike contemporary capitalism**, and require **significant power shifts**.

**Development & the global constraint**

* Historically, **no development without industrialization**, and industrialization **raises resource use**. Even at lower resource intensities, **universalizing decent living standards risks overshooting planetary boundaries**. Hence an “**impossibility theorem**” under conventional definitions; solution: **re‑define wellbeing in materially sustainable terms** (secure **basic needs**).

**6. Conclusion**

* **Bottom line**: Deep **decarbonization/dematerialization** are **incompatible** with growth; strong policies will **curb growth**—so we must design for **managing without growth**.
* **Collective action trap**: Nation‑state competition drives a **race for growth**, risking **ruin for all**.
* **Sobering note**: Past technological feats were **resource/energy‑intensive** expansions; **peaceful contraction** is not capitalism’s forte.
* **Scholarly stance**: Science should state the **ecological necessity**, even if it is **politically inconvenient**.