Re-Imagining Economic Growth through the Lens of Resilience

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Preparing for future transformations: policy design for resilient societies, economies, and ecosystems

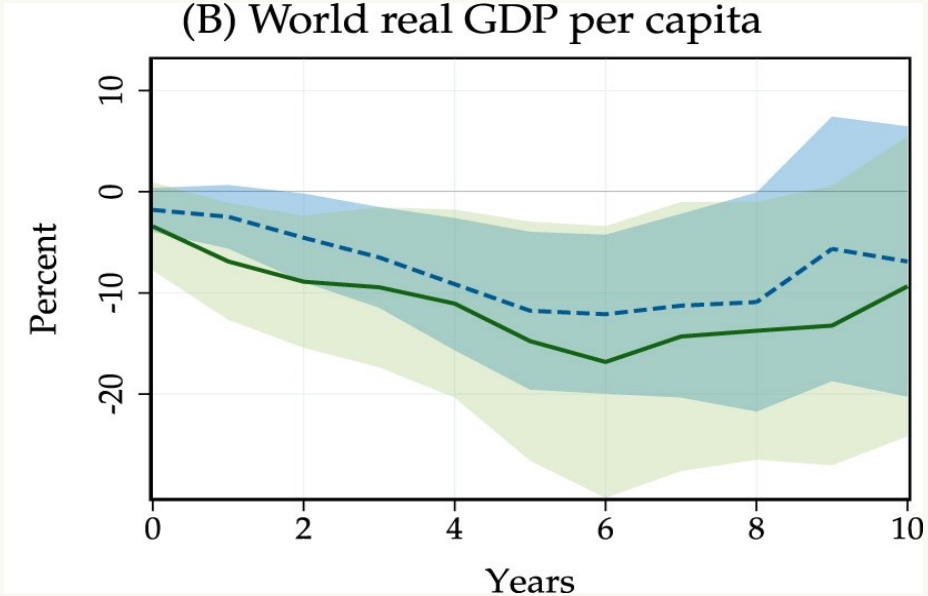
Rabat, November 4th, 2026

The development challenge has changed

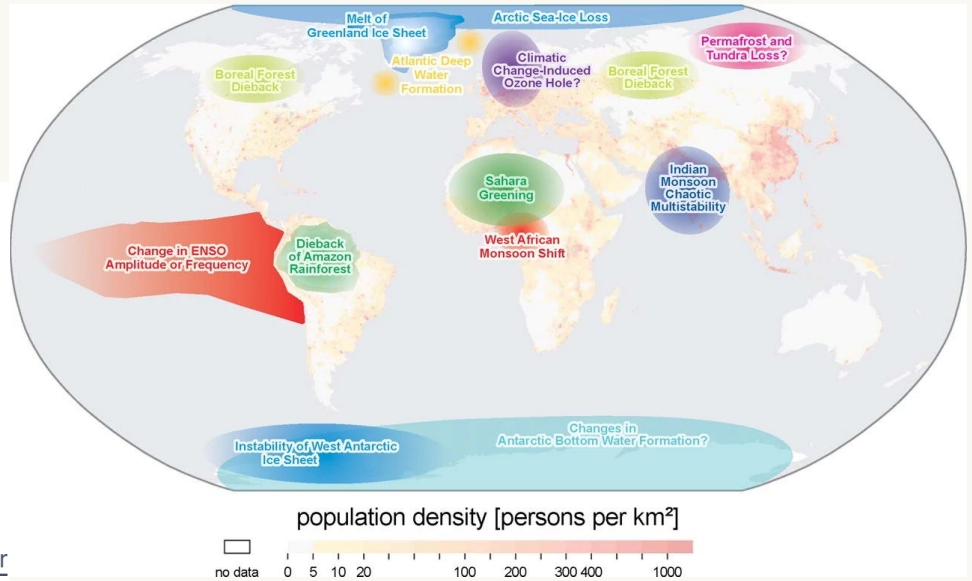
- **Long-term trends**: climate change, AI, demography, biodiversity loss and geopolitical fragmentation
- In particular, **climate change** impacts are getting bigger and are very persistent, damaging socioeconomic systems across multiple dimensions (GDP growth, inequality, health), further reducing development capacity
- In this context, the objective of development cannot simply be to maximize GDP growth, but to sustain **inclusive and sustainable development** under persistent uncertainty and structural change
- Development strategies must address poverty traps and the new climate-induced development traps, particularly in a high-impact low-income low-resilience context like **Africa**

Climate change: a systemic development threat

- A one degree increase in global temperature has **very large and persistent impacts** on economic activity (Bilal and Kanzig, 2026, QJE), possibly triggering **structural transformations**
- Most impact studies rely on historical data and relationships. These need **not** hold under **unprecedented warming**
- Additionally, **tipping points** introduce **nonlinearity, cascade dynamics and irreversibility**. Overall, in presence of deep uncertainty, policies need to follow the precautionary principle



Source: Bilal and Kanzig (2026), QJE



Source: Steffen et al. (2018), PNAS

Climate tipping points – too risky to bet against

nature

The growing threat of abrupt and irreversible climate changes must compel political and economic action on emissions.

By Timothy M. Lenton ✉, Johan Rockström, Owen Gaffney, Stefan Rahmstorf, Katherine Richardson, Will Steffen & Hans Joachim Schellnhuber

Africa: a climate–development vulnerability loop

Climate shocks — More exposed to climate hazards; high baseline temperatures; climate-sensitive agriculture; unequal impacts.

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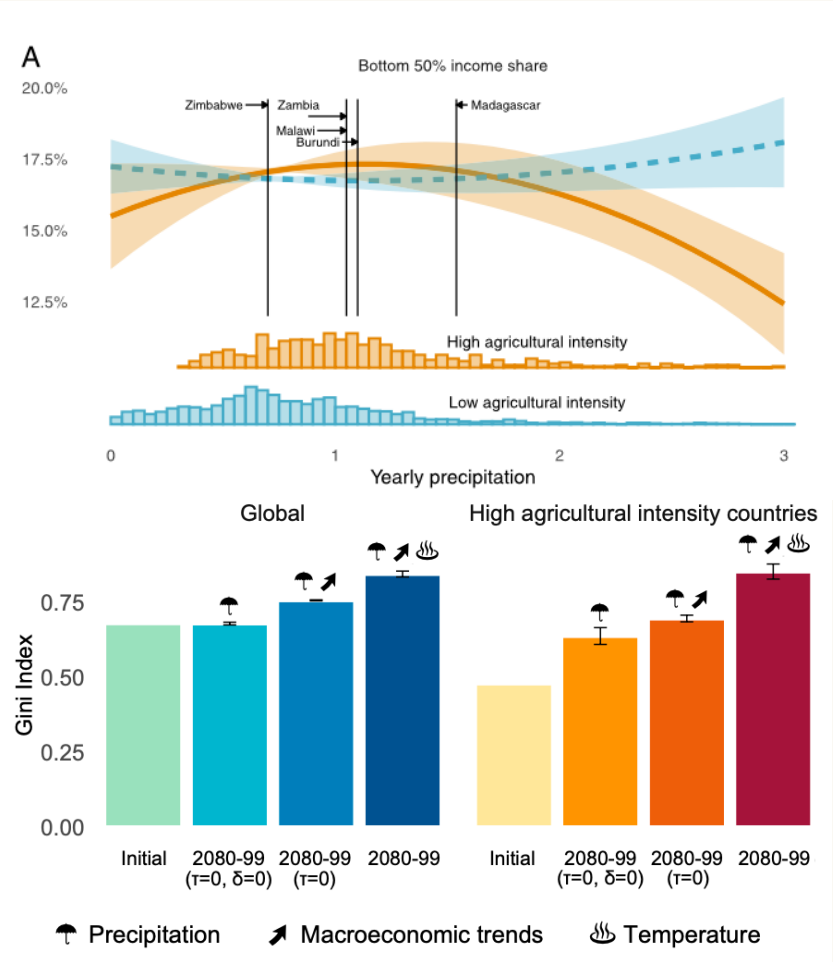
Lower capabilities — Persistent losses in income, investment, productive capabilities and fiscal space.

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Adaptation gap — Limited social protection, technology and innovation; insufficient domestic and international adaptation finance.

↓

Greater exposure — Higher exposure and sensitivity to subsequent shocks, reinforcing development traps.



Source: Palagi et al. (2022), PNAS

What makes a growth trajectory resilient?

ABSORB

Limit losses and safeguard core functions

- Income support and social protection
- Insurance and emergency finance
- Protect jobs, assets and public services

ADAPT

Adjust practices to changing conditions

- Climate-resilient farming and infrastructure
- Technology adoption and diffusion
- Learning and adaptability, flexible behaviour and institutions

TRANSFORM

Change structures that reproduce vulnerability

- Diversify climate-sensitive production (redundancy)
- Build domestic green and innovation capabilities
- Upgrade institutions (polycentric governance) and create good jobs
- Attention to feedbacks and slow-moving variables (social cohesion, environmental feedbacks)

- **Resilience is an endogenous property of the growth model—not only a stock of buffers.**
- **Adopting a resilience growth perspective means changing the horizon of interest: abandon the short run, the priority must be not to lose the possibility to cope with high-end future**
- **Policies oriented towards transformation of the economy – not productivity gains per se - are the key**

Operationalizing resilience: what, who, how?

WHAT | Outcomes

- Growth & production: GDP, investment, productivity, jobs.
- Inclusion: poverty, inequality, wages and job quality.
- Human well-being: health, education, food security.
- Sustainability: natural capital, land use and exposure to future risks.

WHO | Distribution

- Households: income groups, rural vs. urban, vulnerable groups.
- Workers: agriculture, formal and informal employment.
- Firms: size, technology and sector.
- Places: regions with different exposure and adaptive capacity.

HOW | Capacities & policies

- Absorb: safety nets and social protection, insurance, emergency fiscal support.
- Adapt: resilient farming, infrastructure, skills and technology adoption.
- Transform: diversification, domestic innovation and industrial policy.
- Enable: strengthen institutional capacity, domestic redistribution policy and pressure for higher international climate finance.

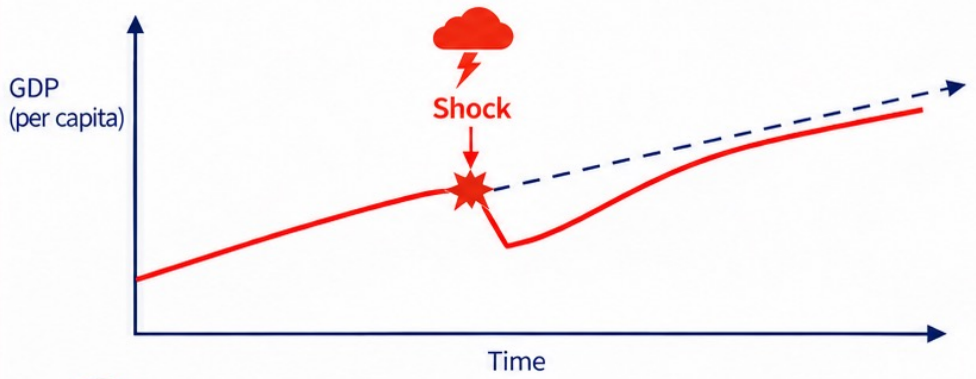
Outcomes can also be drivers of resilience themselves: lower inequality, better health and stronger capabilities can generate virtuous cycles of investment, adaptation and growth.

Two views of resilience and growth

From bouncing back to transforming under climate change

Conventional view

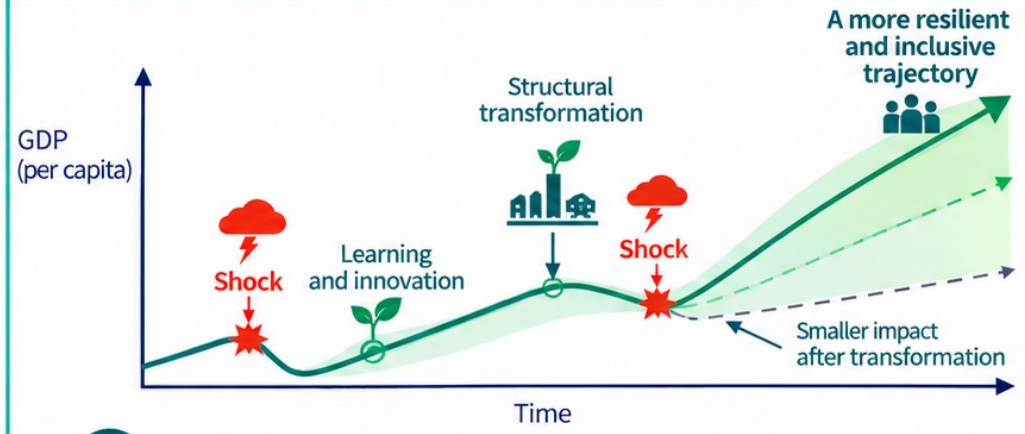
Resilience as recovery to the previous path



- Return to equilibrium
- Temporary deviation from trend
- Adaptation as an optimal adjustment
- Focus on restoring pre-shock conditions

Complexity-based view

Resilience as adaptation and transformation



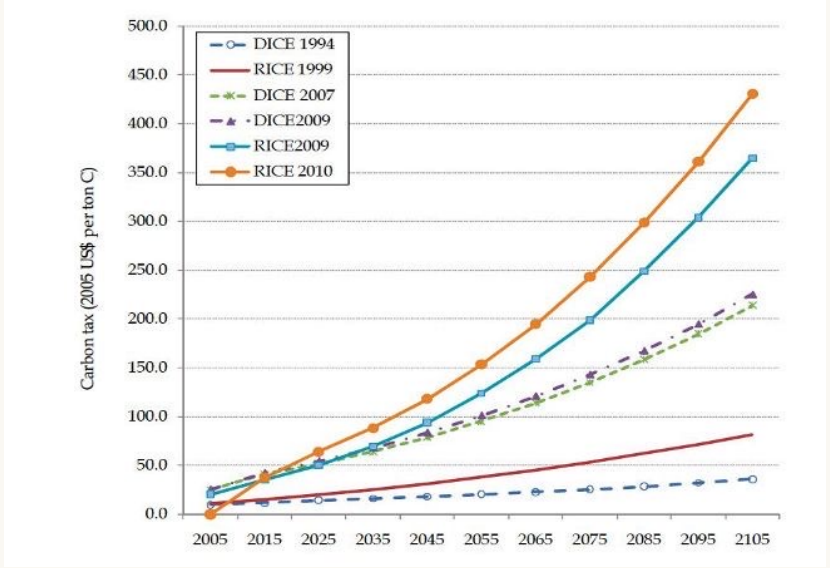
- Continuous adaptation under uncertainty
- Structural transformation
- Heterogeneity and interactions matter
- Feedbacks, nonlinearities and learning
- Goal: sustain inclusion, capabilities and well-being

Why conventional approaches struggle

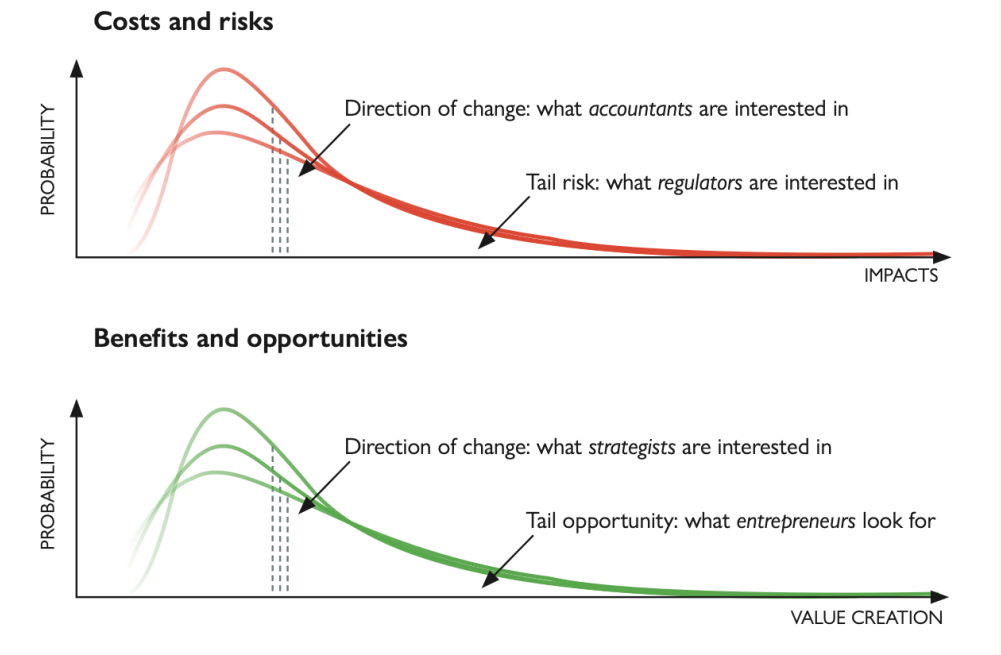
Heterogeneity & interactions	• Representative agents conceal uneven climate exposure and adaptive capacity across households, firms, sectors and regions. • Aggregation misses transmission through production networks, labour markets and income distribution.
Equilibrium & path dependence	• Convergence to a baseline underplays persistent losses of capital, skills, productivity and fiscal space. • Feedbacks, development traps and tipping points can change the growth trajectory itself.
Expectations & adaptation	• Perfect foresight and optimizing responses are difficult to reconcile with deep uncertainty and limited information. • Learning, bounded rationality and institutional or financing constraints shape adaptation over time.
Climate damages & transformation	• Narrow damage functions omit indirect, non-market and cross-sector effects and may understate persistence. • If shocks appear small and temporary, models undervalue preventive investment and structural transformation.

The problem with cost–benefit analyses

- **Cost–benefit analysis** (CBA) rests on contested assumptions (e.g., intertemporal preferences and the valuation of uncertain future damages).
- **Unknown and potentially unknowable damages**: persistent losses, cascading effects, tipping points and irreversible changes challenge reliable damage estimation.
- Given such tail risks, CBA **underestimates costs**.
- It also **underestimates tail benefits** that might arise from transition-driven **innovation**, technological change and diffusion.
- **Adaptation** should not be reduced to a single optimal investment choice.
- Key guiding principle: **no CBA, shift to a risk-opportunity decision tool**



Source: Nordhaus (2010), PNAS.



Source: Grubb et al. (2021). EEIST Report.

Complexity toolkit: key advantages

Heterogeneity

Interacting households, firms, sectors and institutions. Key to represent inequality, financial market dynamics

Endogenous change

Innovation, diffusion and structural transformation

Co-evolution

Joint evolution of economy, society and environment – key for operationalizing resilience

Adaptive behaviour

Learning under deep uncertainty and bounded rationality

Nonlinear feedbacks

Amplification, persistence and possible regime shifts. Able to capture **positive and negative tipping points**

Policy laboratories

Evaluate policy mixes and consequences on economic performance, inequality and environment

Five complementary policy objectives in Africa

01	**Reduce vulnerability**	Climate-smart agriculture (e.g., drought-resistant crops, efficient irrigation, agrivoltaics), economic diversification away from climate-sensitive sectors, and investment in long-term adaptive capacity (e.g., seawalls and dikes, mangroves along the coast, sponge cities/green roofs/permeable pavements for flood and sea-level rise protection, resilient transport infrastructure, early-warning systems).
02	**Build back better**	Use post-event reconstruction to upgrade assets (e.g. renewable energy), interrupting the vulnerability cycle, and fostering positive hysteresis effects. Particularly relevant under recurrent shocks, when rebuilding existing vulnerabilities risks perpetuating future losses.
03	**Develop domestic capabilities**	Innovation in strategic sectors, mission-oriented policies (e.g. towards infrastructure, industry, and agriculture), domestic value chains and good jobs (Rodrik 2016). The importance of the manufacturing industry. High multipliers and job creation potential (Batini et al. 2022; Cappa et al. 2024; WB 2025).
04	**Secure social inclusion**	Address inequality, education, and unequal access to adaptation (e.g., affordable cooling, social protection for climate-vulnerable households). Lower inequality is associated with more sustained growth (Berg et al. 2018), via widespread human capital, social cohesion and collective action, and private buffers enable risk management to contain adverse impacts of climate change – virtuous cycle.
05	**Mobilize cooperation & finance**	International financing, redistribution from high-income countries to African countries (e.g., via taxation of high-net-worth individuals), and creation of institutions supporting climate investments (Global Justice Report, 2026), similar to UN tax convention process, G20 initiatives led by South Africa, such as the International Panel on Inequality.

Towards a context-aware policy laboratory for African economies

Key model features

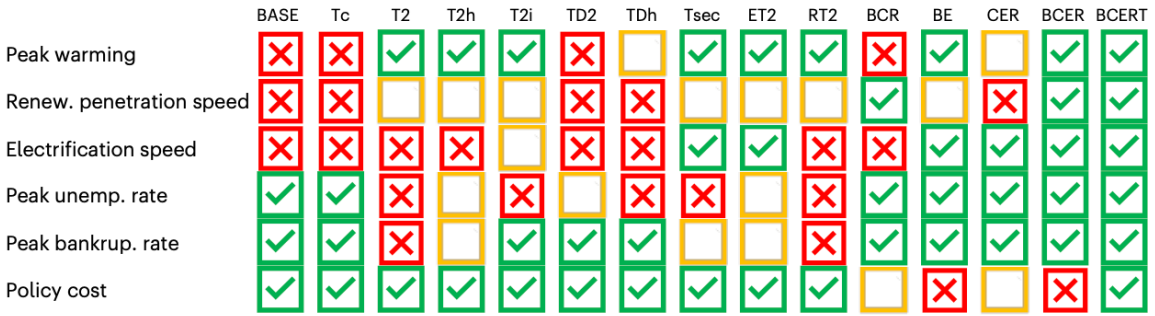
- Climate box and climate shocks propagation
- Genuine heterogeneity: firms, households, banks and public sector
- Explicit finance-real economy linkages
- Realistic endogenous innovation and technology processes
- Key role of land use and natural capital

Compare pathways

- Modelling of resilience: not only recovery, but also absorption, adaptation and structural transformation
- Recovery in terms not only of GDP, but assessed in a multidimensional way (e.g., inequality, natural capital).
- Compare alternative climate and development policies: no one-size-fits-all

Evaluate outcomes

- GDP and jobs
- Structural change
- Inequality and well-being
- Capability accumulation
- Future exposure scenarios



Article
https://doi.org/10.1038/s41893-025-01683-w

Policies for rapid decarbonization with steady economic transition and employment creation

Claudia Wieners [1], Francesco Lamperti [2,3,4] ✉, Giovanni Dosi [2] & Andrea Roventini [2,5]

nature sustainability

Ongoing projects on complexity and socioeconomic transformations

EEIST

- Complexity science for the energy transition
- Going beyond cost-benefit, towards risk-opportunity framework
- Dedicated communities of practices in key countries: e.g., Brazil, China and India
- ~€300k

FIND

- Complexity science for studying innovation and socioeconomic dynamics related to negative emissions technologies
- Developing tailored ABM-IAMs
- Mapping the industry and studying adoption and diffusion dynamics
- ~€1.3 million

TAILS

- Negative and positive socioeconomic hysteresis given by climate and transition shocks
- Tail risks and opportunities exploiting an ensemble of complexity-based models
- ~€600k

Other related projects in our research group:

- **CAAM**: complexity-based models to guide climate adaptation among Mozambican farmers (~€300k)
- **SCI-PET** and **TRACE**: two projects addressing the unequal contributions to global warming, heterogeneous impacts of climate change and climate policy (~€1 million each)
- **ECHOESS**: development of integrated, multi-scale framework, including cascading effects and resilience (~€300k)

Key messages and next steps

- **Resilient growth shifts the horizon of interest** integrating **absorption**, **adaptation** and **transformation.**
- Its objectives are **multidimensional** and **distributional**: from short-term GDP growth obsession to **sustainable and inclusive development.**
- More is different… and complex! **Complexity approach** offers a reliable framework to study interactions, cascading effects, structural change and nonlinearities into resilient-growth models.
- **Agent-based models** represent the key toolbox to model continuously evolving socioeconomic systems under climate change. They are **policy friendly**: flexible laboratories for ex-ante analysis of alternative policy mixes and ex-post evaluation of both micro and macro outcomes.
- **Next step:** build a **context-sensitive modeling framework** that accounts for the specificities of **African economies** and operationalizes resilient growth and concrete policy interventions with measurable outcomes.

Appendix

Label	Policy instrument	Description
	Carbon tax	
Tc	Constant carbon tax[a]	Sufficiently high tax to induce full energy transition by 2100
T2	Constant carbon tax[a]	Sufficiently high tax to keep warming below 2 °C
T2h	Constant carbon tax[a]	As T2, with full rebate of revenues on households
T2i	Constant carbon tax[a]	As T2, with full rebate of revenues on firms as R&D subsidy
TD2	Increasing carbon tax	Exponentially increasing tax mirroring 2 °C policy in DICE model
TDh	Increasing carbon tax	As TD2, but with initial value corresponding to Tc
Tsec	Constant carbon tax[a]	Sector-dependent carbon tax: higher for capital goods producers
	Green subsidies	
C	Lump-sum transfer	Subsidy for the construction of green plants in the power sector
R	Lump-sum transfer	Subsidy for green R&D in the power sector
	Command and control	
E	Mandatory regulation	Ban on fossil-fuel use in the capital goods sector
B	Mandatory regulation	Ban on the construction of new fossil-fuel-fired power plants
	Policy mix (examples)	
BE	Mandatory regulation	Ban on new fossil-fuel-fired power plants (B) and on fossil-fuel use in the capital goods sector (E)
CER	Regulation and transfers	Subsidies for green plant construction (C) and green R&D (R) and ban on fossil-fuel use in the capital goods sector (E)
BCER	Regulation and transfers	As CER, also with a ban on new fossil plants (B)
BCERT	Regulation, transfers and tax	As BCER, also with a constant carbon tax (Tc)

Resilience principles for a growth strategy

Diversity & redundancy	Diversify production, supply chains and shock buffers.
Managed connectivity	Limit cascading risks across networks and sectors.
Learning & adaptability	Build innovation and experimentation capabilities.
Participation & polycentric governance	Adapt decisions to heterogeneous local contexts.
Feedbacks & slow variables	Track natural capital, capabilities and cumulative vulnerabilities.