



Understanding and Managing Industrial Transitions

Workshop “Fourth Industrial Revolution: Challenges and Opportunities for Europe”

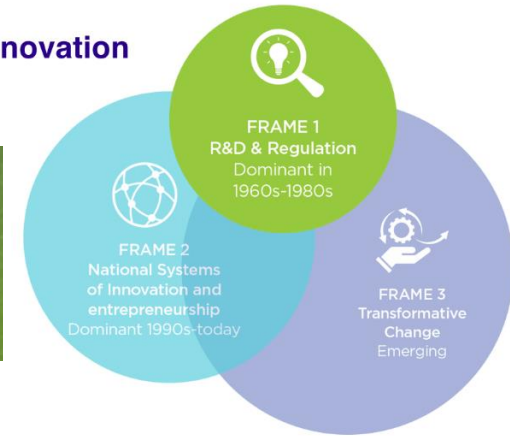
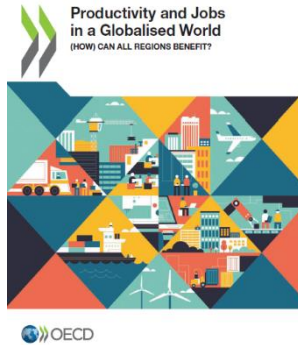
Dimitrios Pontikakis, *Joint Research Centre, European Commission*

8 July 2021

Outline

Reflections on working paper:

- The need for an industrial policy for Europe
 - On the importance of framing and directionality
 - The neglected role of demand
-
- Brief overview of recent JRC work on Industrial Transitions:
 - Smart Specialisation Strategies for Sustainability (S4)
 - Projecting Opportunities for INdustrial Transitions (POINT)



Challenges of lagging regions

- Industrial decline and mass emigration
- Structural change: low-productivity agriculture/tourism
- Weak tradable sectors; Investment barriers
- Lacking scale-efficient production and business innovation
- Societal and environmental challenges
- Large infrastructure gaps

- *Deep productive transformations*, esp. in energy and transport systems, and digitalisation
- Resurgence of interest in *industrial policy* – no longer a taboo
- Emergence of new framework of thinking: *transformative innovation policy*
- *European Green Deal and EU Recovery Fund (>1 tn EUR for Green and Digital Transitions)*

Pressing need to develop knowledge-intensive production capabilities

→ *Problem*: no framework available for full-blown industrial policy!

need to re-discover planning capabilities

Saturn V: world's most powerful rocket

- Dependent on massive network (est. 400,000 people*)
- Network disbanded since early 1970s
- Humanity has **since lost** heavy-launch capability
- No point using old 'blueprint' – world moved on

Industrial transitions

- Lost capability for long-term, large-scale social action
- Climate emergency: Non-negotiable deadlines, Massive coordination task
- No point reviving 20th cent. industrial policies - world moved on

[*https://www.theguardian.com/science/2009/jul/02/apollo-11-back-up-team](https://www.theguardian.com/science/2009/jul/02/apollo-11-back-up-team)



how to understand transformative change

- Evol. economics: e.g. Dosi (1984); Perez (2002)
- Literature on system innovation (OECD, 2015)
- Not the same as "*innovation system*"!
- **Production (variation) / Consumption (selection)** at centre
- science and technology one (of many) vectors
- **Directionalities** of central importance
- Outcomes ~ **macro-level organisational innovation**

Builds on:

- Socio-technical transition experiences (large body of knowledge in NL)
- Multi-level perspective (Frank Geels / Johan Schot)

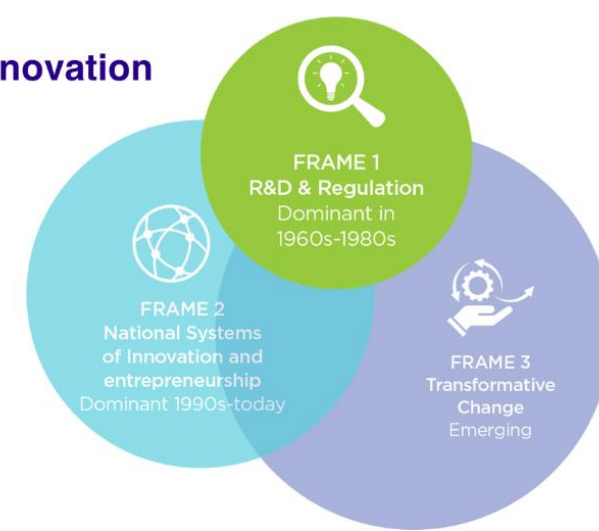
See links below::

OECD [System Innovation Synthesis Report](http://www.tipconsortium.net/)

<http://www.tipconsortium.net/>

<https://www.sciencedirect.com/science/article/pii/S0048733302000628>

The 3 Frames of Innovation



SYSTEM INNOVATION:
SYNTHESIS REPORT



European
Commission

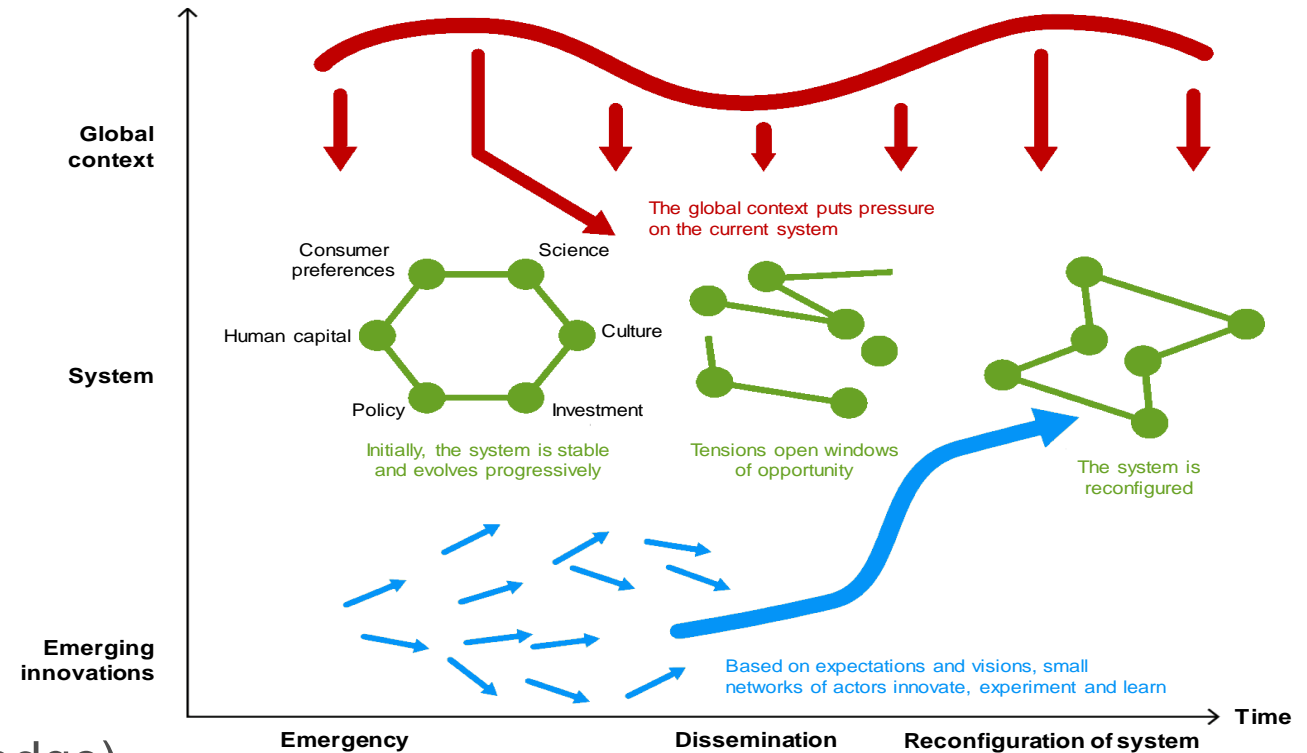
Framing - what's inside and outside the system

Old framing

- Science and technology centred
- Operated at lower level (e.g. firm or organisational level)
- Objective: innovation-driven growth

New framing

- Producer and consumer centred (incl. knowledge)
- Operates at multiple-levels
- Objective: system re-configuration to meet new purpose(s) [system-level innovation with directionality]



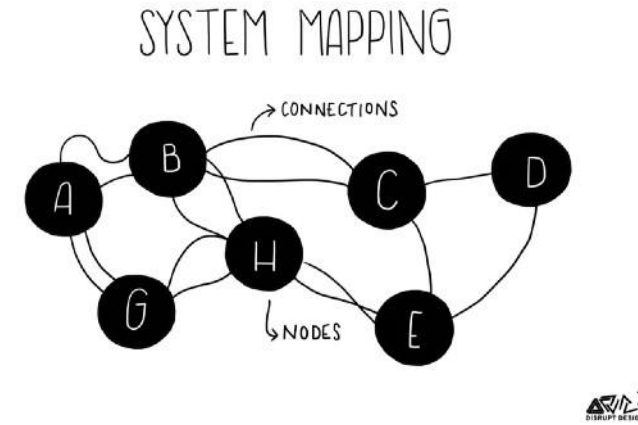
Source: Adapted from Geels (2006) by Marinelli, Fernandez and Pontikakis (2021)

Framing – what's inside and outside the system

- Framing reveals **structure**
- Structure can reveal **points of leverage**
- Framing reveals **perspective**
- Perspective allows **projections**
- Changing perspectives can alter the **goal** of a system



Directionalities based on societal values require a broad system framing



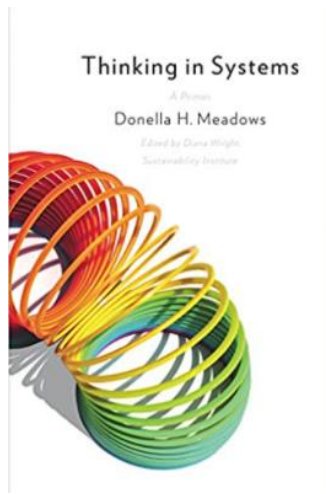
Example: You need to examine a system under a broad framing to appreciate new (or newly relevant) interconnections:

Green: EVs are complementary investments to renewables which are complementary to energy storage, which are complementary to smart grids etc...

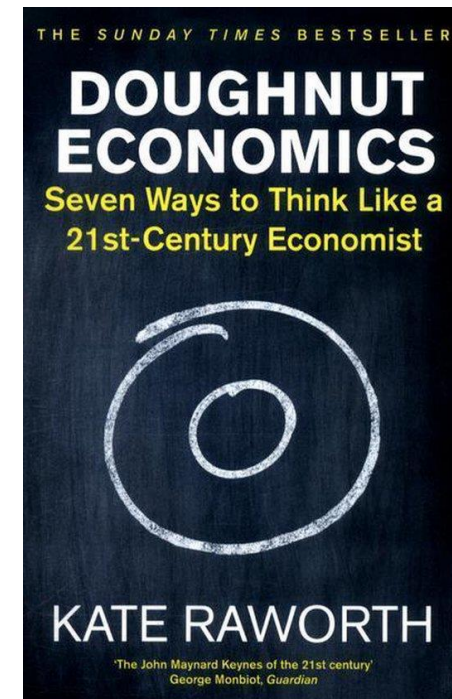
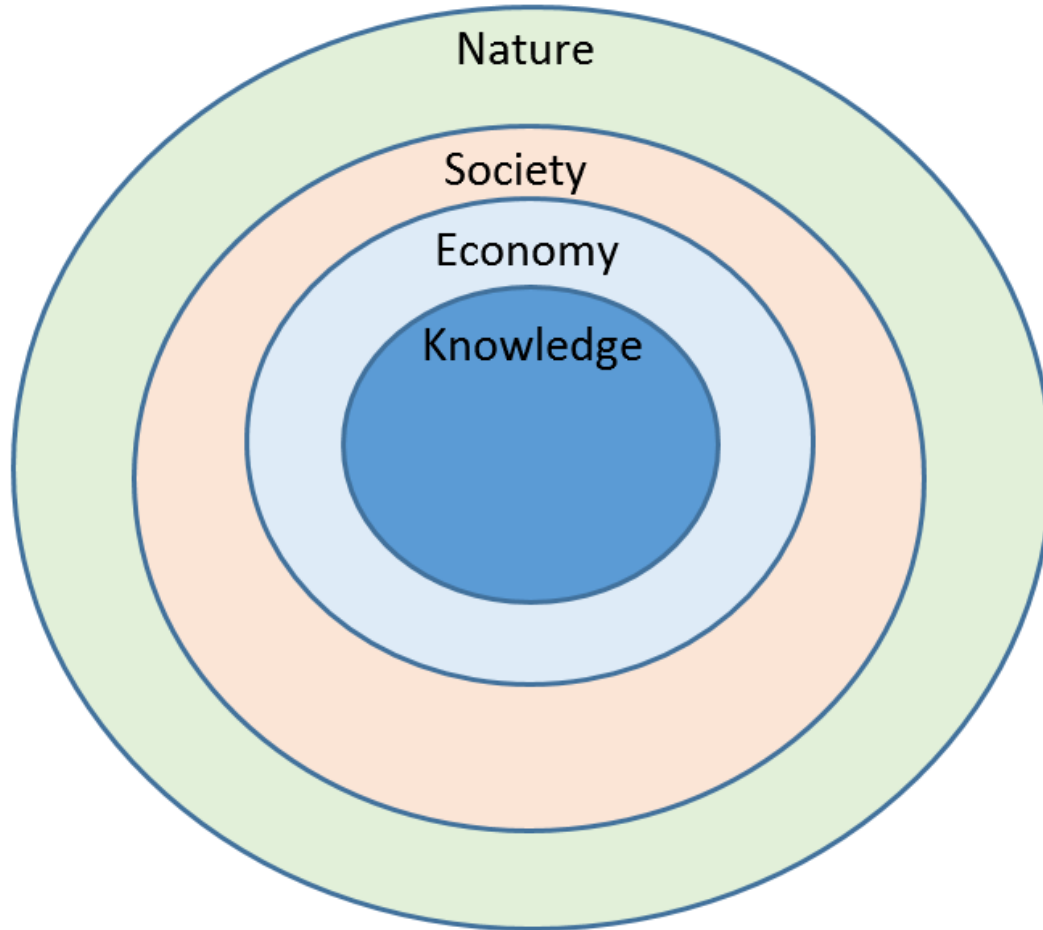
Digital: ICT investments are complementary to advanced manufacturing which is complementary to investments in sensors and data, which are complementary to digital marketing, which is complementary to soft skills etc...



In interconnected nodes, by influencing one node of the system, you can influence others too



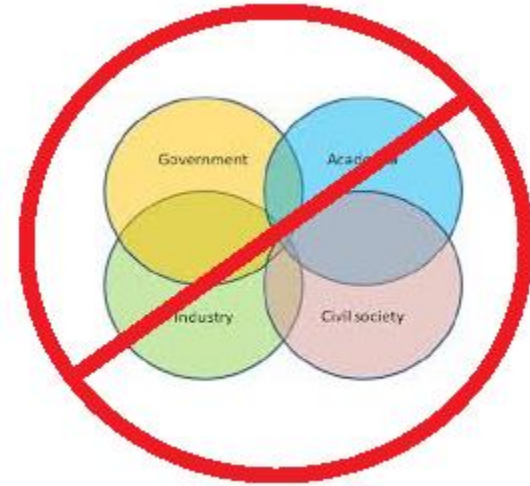
Framing - “Doughnut economics”



Source: Inspired from a different donut in Raworth (2017), which omits knowledge

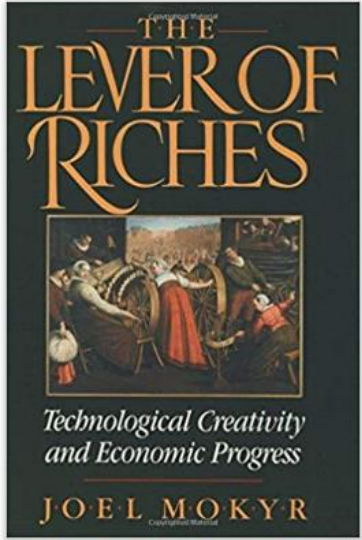
Framing – why the “quadruple helix” is not helpful

- A q-h assigns unconditional pre-eminence to **universities**, **businesses** and **government** and shoves all other stakeholders to a residual **civil society** category. In reality we do not know what actors are important given a particular system.
- A q-h framing, can mislead us into accepting **a false equivalence** between helices, and can blind us to underlying structure.
- E.g. users of technology, financiers, regulators, professional associations, trade unions, educators, consumers or workers may also deserve equal or greater attention.
- Consumers, users and workers can be crucial to system transformation. Ironically, they don't even fall under the dictionary definition for civil society.



The correct framing will vary from system to system and has to be discovered through examination (e.g. a review)

Framing – focus on parts of the system that *can be changed*



Economic history of (radical) macro-inventions: “... *do not seem to obey obvious laws, do not necessarily respond to incentives, and defy most attempts to relate them to exogenous economic variables.*” (Mokyr, 1992, p.13)”

Linear model of innovation still popular because of enduring confusion of (measurable) risk with (unmeasurable) uncertainty.

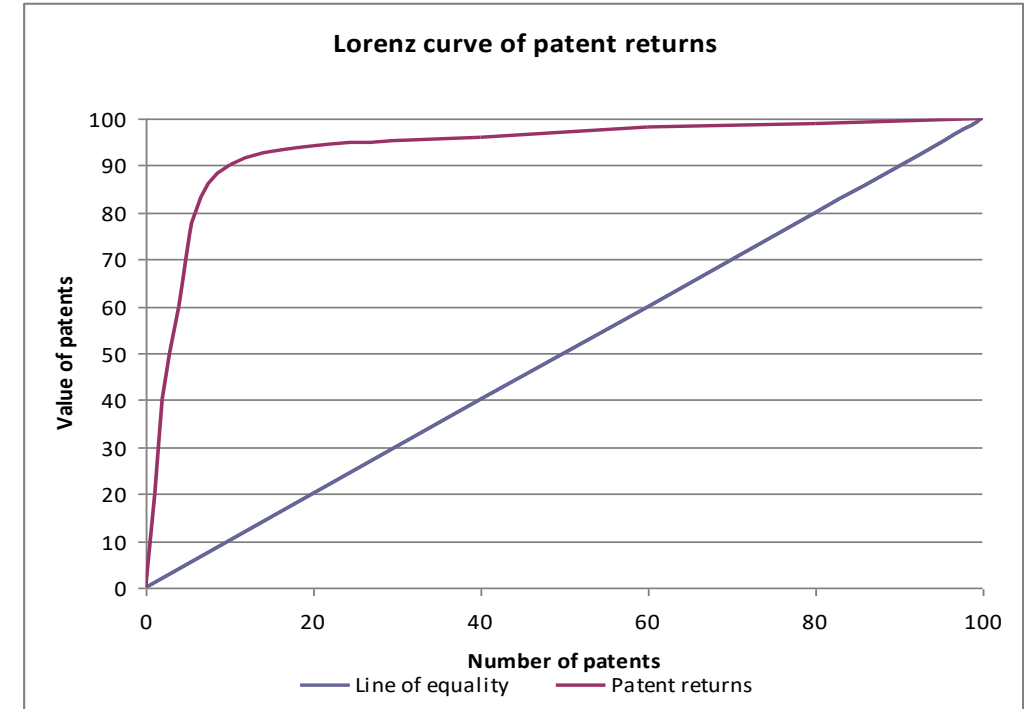
- S&T alone cannot guarantee solutions to time-critical problems
 - Direct interference in **science systems** especially counterproductive (undermines human capital, reduces resilience)
 - Challenges too important to leave to chance



Timely solutions to societal challenges will additionally require *system-reconfigurations* and changes in *consumer/user practice* (with mostly existing technologies)

Distribution of the returns to R&D is fat-tailed

In fat-tailed distributions success in the past is unrelated to the future.

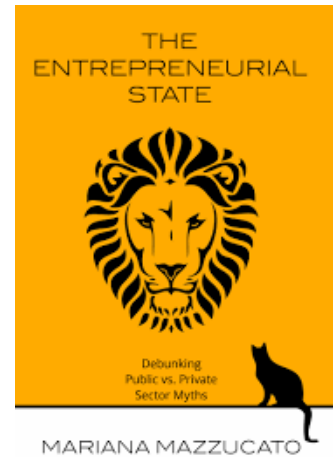
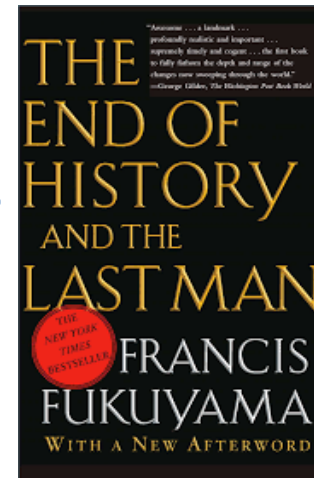


Silverberg, G., Verspagen, B. (2007), “The size distribution of innovations revisited: An application of extreme value statistics to citation and value measures of patent significance”, *Journal of Econometrics*, Volume 139, No. 2, pp. 318-339

Scherer, F. M., Harhoff, D. (2000), “Technology policy for a world of skew-distributed outcomes”, *Research Policy*, Volume 29, No. 4-5, pp. 559-566.

Directionalities – the need for positive, ambitious, shared visions

- Tragedy of the commons: Self-interested individuals do not always produce socially desirable outcomes
- Signalling-through-the price-mechanism is the greatest coordination technology we have, yet it cannot deliver social visions.
- As “new industrial policies” increasingly acknowledge, it cannot on its own even deliver material prosperity.
- Our minds constantly think about the future; in the absence of positive visions, other visions may fill the void.
- Current juncture presents unique opportunities for transitions that deliver widely shared benefits; opportunities however will morph into threats if not firmly grasped and acted upon **on time**.



Optimistic and shared visions are necessary to provide long term certainty and foster non-priced coordination. Bonus: Long term certainty encourages high ambition.

Video credit: Adam Curtis (2004), The Power of Nightmares, BBC. <https://thoughtmaybe.com/the-power-of-nightmares/>

Directionalities – both objectives and constraints

- Each directionality is an **objective**.

e.g. to make our societies environmentally sustainable

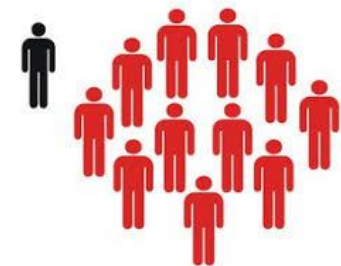
- Multiple directionalities introduce **constraints**

e.g. The European Green Deal: *to make our societies more environmentally sustainable and at the same time more prosperous while making them fairer*

- Key role of government to favour paths that **combine directionalities**
- In the absence of government orchestration **trade-offs will occur**

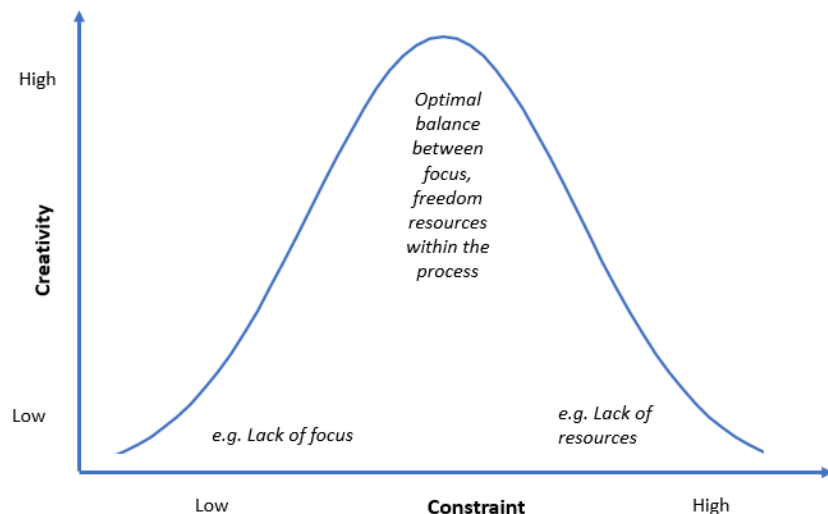


Each directionality is both an objective and *inter alia* a constraint

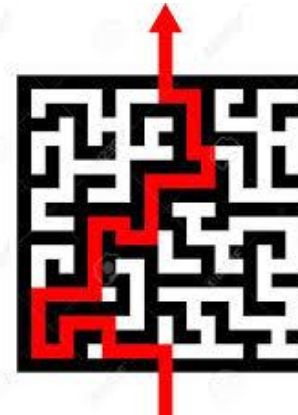


Directionalities – why *directionality constraints* can be useful

- An unusually ambitious vision *excludes most conventional* paths
- Discarding paths incompatible with the vision *focuses attention* to fewer paths
- Discourages ‘linear’ notions of progress – solution may be *old technology* used in new ways (examples abound in wartime)
- Can lead to system-level innovation



<https://www.open.edu/openlearn/history-the-arts/visual-art/constraints-creativity>



Example: Space-X Starship -- Vision: Colonise Mars

Prerequisite: ~10x cost reduction

Constraint-dependent solution:

- Design world's largest capacity rocket and make it re-usable to reduce costs;
- Use steel instead of carbon fibre to bring costs down;
- Cost is low enough to permit large-scale manufacturing (build *hundreds per year*) which reduces costs further.

Largely based on existing technologies (with the exception of the fuel-engine combination), some of them, like steel hull and full-flow staged combustion, were tested or used (but abandoned) in the 1950s.

Directionalities - always focus on strengths?

Focusing on strengths and accentuating comparative advantage *may* of course be appropriate.

But many relevant forms of industrial change and capability accumulation are unrelated to it.

Crucially, some modes dictate *moving away* from comparative advantage, not towards it.

Source: [Pontikakis et al. \(2021\)](#)

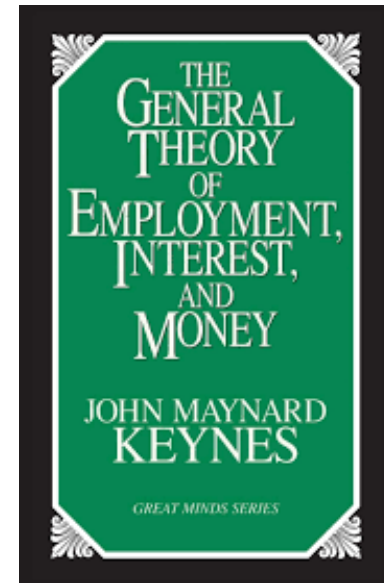
Mode of industrial change	Description	Comparative advantage
Development (de novo)	Develop new capabilities and productive capacities	Created
Modernisation	Technology-driven upgrading, prompting associated structural change, usually within existing paradigms	Unaffected
Renewal / Restructuring	Entrepreneurial and technological upgrading in response to industrial decline, not necessarily within existing paradigms (incl. transition in response to paradigm shifts)	Unaffected
Branching	Diversification into related economic activities	Weakened
Specialisation	Growth and/or concentration of existing economic sectors, accompanied by greater reliance on trade outside the territory (incl. offshoring within GVCs)	Strengthened
Upgrading	Upgrading position within value chains, shifting to higher value activities/tasks.	Unaffected
Deepening	Development of related sectors locally by favouring local input sourcing and linkages	Strengthened
Servitisation	Lateral shift towards services building on territory's industrial experience (sometimes in response to manufacturing decline).	Weakened

Demand – crucially important yet neglected

- Using only supply-side policies is like trying to cut with a single-blade scissor
- Keynes (1936) comprehensively refuted Say's Law: Supply *follows* demand. The other way round happens only exceptionally and cannot be predicted/controlled
- History of invention shows clear patterns of demand-led direction (Schmookler, 1966)

 **If demand precedes supply, studying patterns of current and foreseeable demand can reveal opportunities for industrial development and transition**

e.g. next-to inevitable household investments in sustainable energy and mobility. Who will produce these goods and services?



Demand – first national, then intl. markets

- National (or regional) demand needs offer opportunities for developing new comparative advantages
- Even in open economies a large portion of domestic demand is served by domestic producers.
- E.g. we don't import most of our energy, construction materials, or transport services!
- Yet they require massive private and public investments.
- The transition to sustainability requires policies for “nationally-relevant production capabilities”.
- Can be a stepstone, through innovation, to developing internationally relevant production capabilities

Table 9. Public support for production and innovation capabilities

<i>...business sector is predominantly characterised by...</i>	A. Basic or no production capabilities	B. Nationally relevant production capabilities	C. Internationally relevant production capabilities	D. World class production capabilities
(Stars denote intensity of policy attention / need for public support)				
III. New-to-the-world innovation capabilities (shifting global frontier)	N/A ("High tech fantasies")	**	* * *	* * *
II. New-to-the-market innovation capabilities (edge vs current competitors)	*	* * *	* *	N/A (no additionality)
I. New-to-the-firm or new-to-the-territory innovation capabilities (local problem solving)	* * *	*	N/A (no additionality)	N/A (no additionality)

Source: Own elaboration

Source: [Pontikakis et al. \(2020\)](#)

Demand – steering, confluence and sequencing

How?

- Use public procurement strategically

and also:

- Steer household and business consumption and investments
- Harness foreseeable future consumer expenditures for industrial *development*
- Protecting domestic industry from import competition (NOT applicable, except for possibility of EU-perimeter tariffs on strategic sectors)
- Stimulate demand (Keynesian “demand management” only applicable in the context of economic stabilisation)

Example 1:

Nudge consumers towards sustainable goods or regulate consumption (e.g. prohibit combustion cars)

Example 2:

Armed with knowledge of likely future consumption patterns (e.g. towards sustainable mobility, green buildings), support the development of domestic production capabilities but *do so before subsidising green buildings or electric vehicles.*

Example 3:

“Build-back better/different” while stimulating insufficient aggregate demand (in a crisis)

Smart Specialisation Strategies for Sustainability (S4)

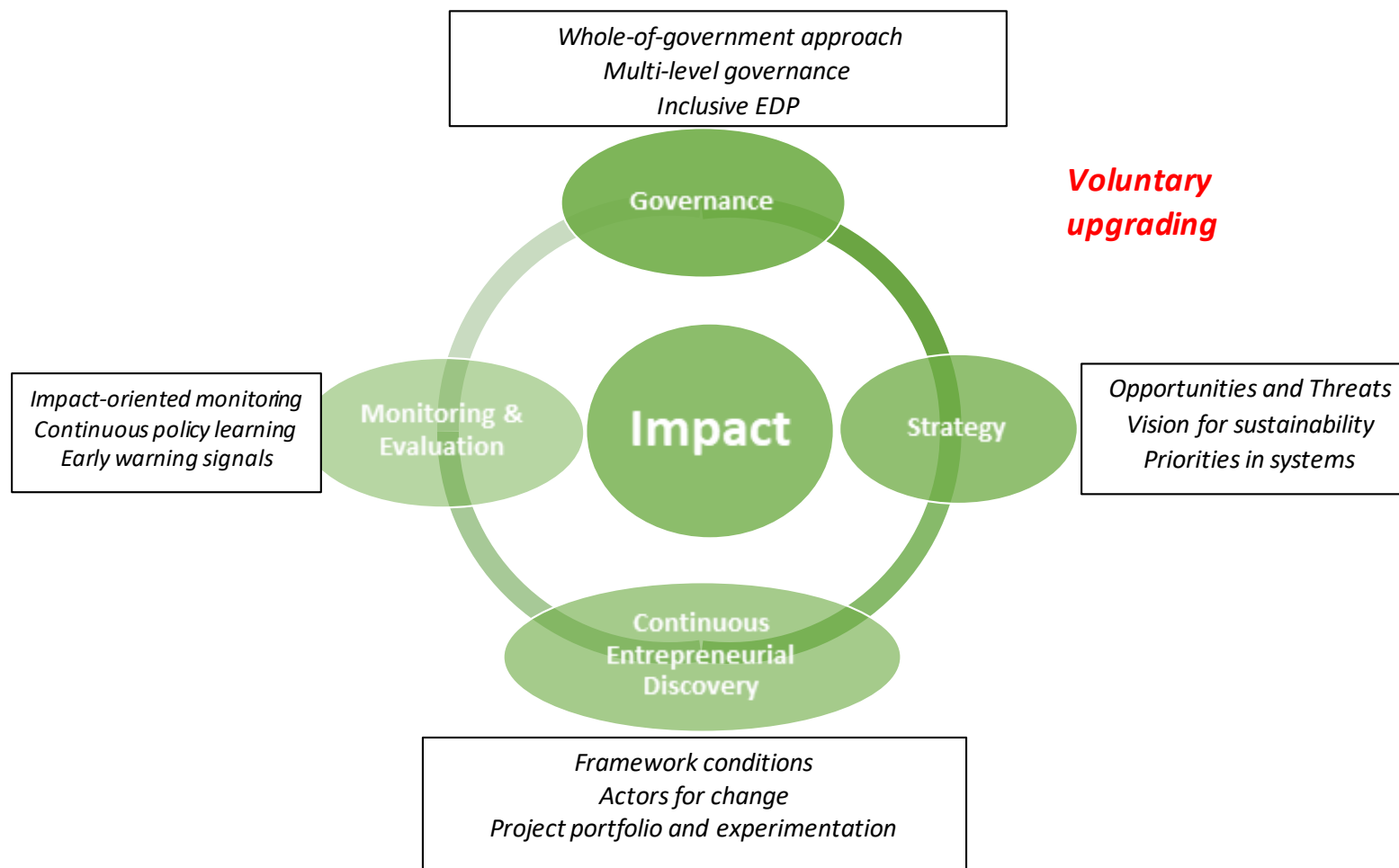
S4: Why upgrade smart specialisation?

No legal obligation to change existing smart specialisation strategies. Not replace the obligation to comply with Enabling Conditions. **It is a voluntary approach!**

Why then upgrading?

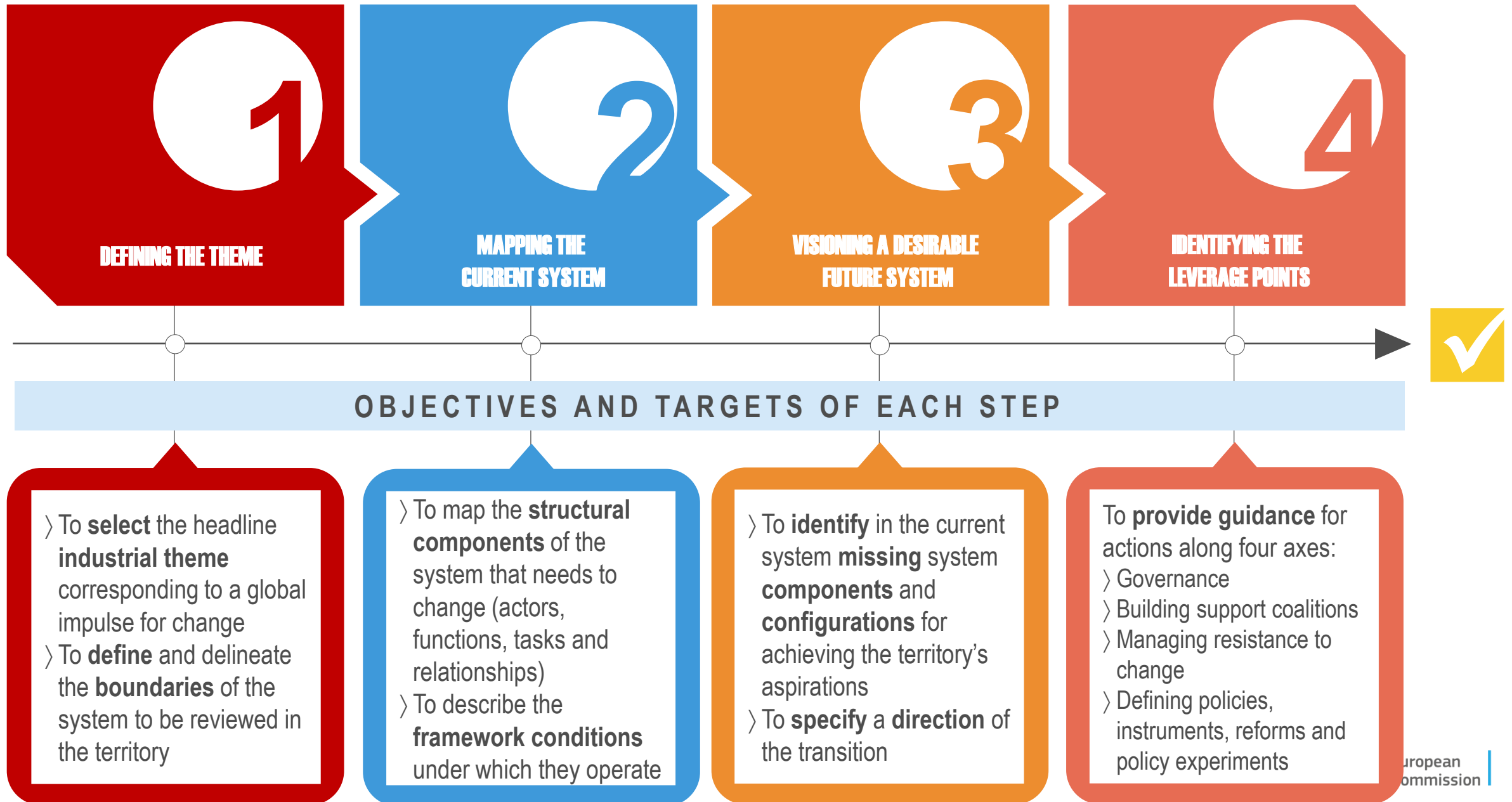
1. We have **a new EU policy agenda**, a political lead on positioning our firms and jobs in the new resilient, green and digital economy; tilt the market-led green and digital transitions;
2. We need to take this **historical EU and national investment** to reset, *transform* our economies and society to be sustainable, resilient and competitive in the new economy;
3. We have to ensure **synergies** for the highest rate of return on our investment: synergies between policy strategies, synergies between funding sources; synergies between instruments.
4. We have to building on our experience on smart specialisation over the last 10 years, and **learn and improve** on academic insights.
5. We have to ensure **no one is left behind** in the delivery of the European Green Deal, creating a Europe for all.

Four building blocks of S4

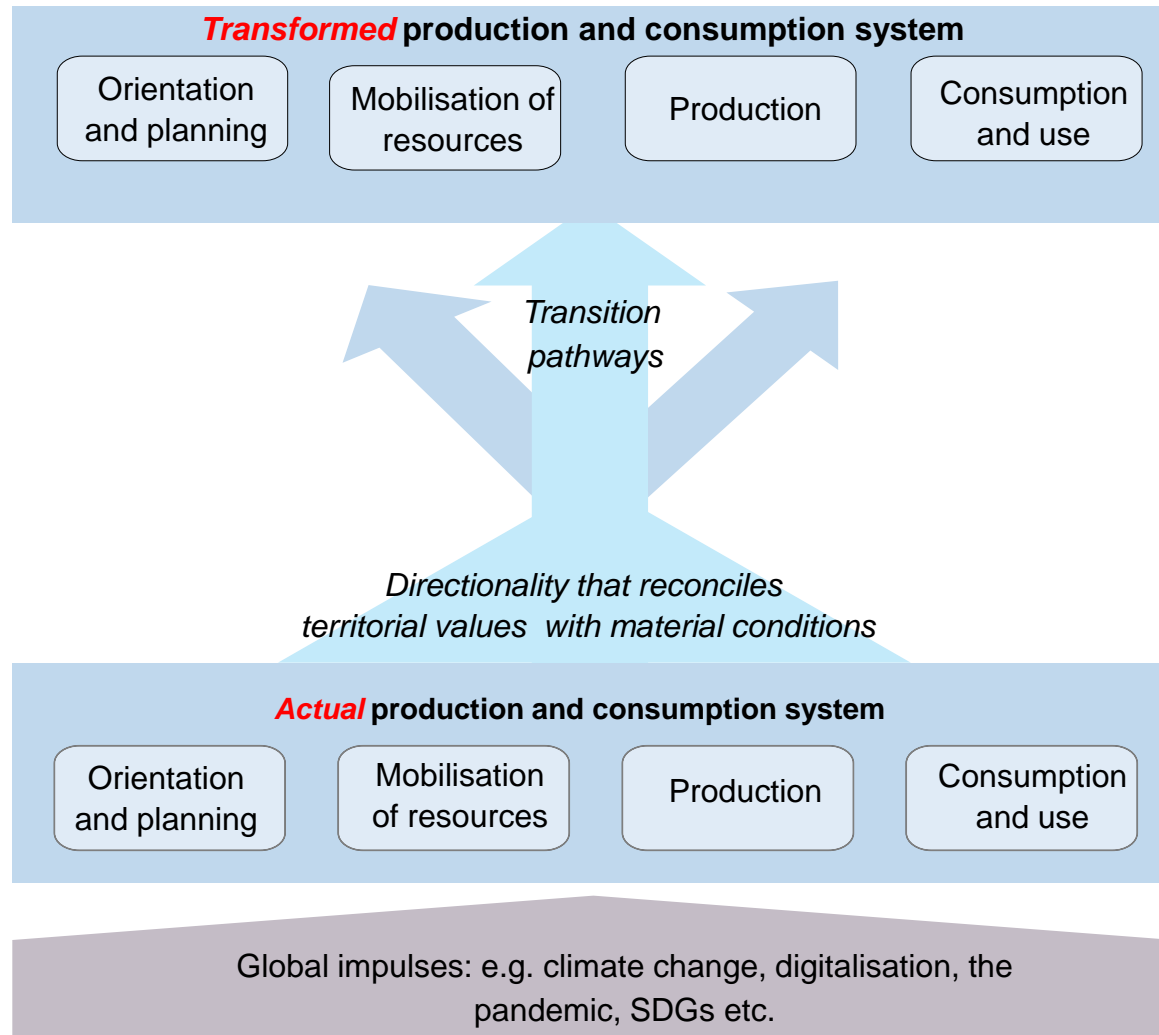


Projecting Opportunities for INdustrial Transitions (POINT): Experience from Pilot Reviews

STEPS OF THE REVIEWS

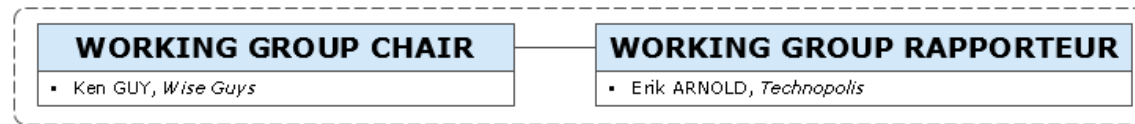


a functional approach to system transformation



- Functional perspective: focus evidence gathering and analysis only on **key functions** of industrial systems
- Functional perspective makes broad framing of transformative innovation **analytically manageable**

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Regional authorities

- Andalucía (Spain)
- Western Macedonia (Greece)
- All regions (Romania)

- Catalonia [own resources] (Spain)

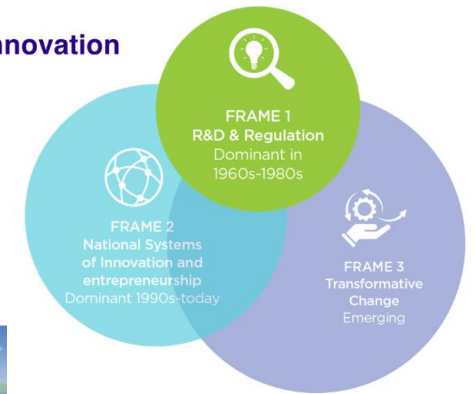
National authorities

- Ministry of Development (Greece)
- Council of Ministers (Bulgaria)
- Ministry of Economy, Energy and Business Environment, and other ministries with inputs in S3 (Romania)

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The 3 Frames of Innovation



MULTIPLE IMPACTS

JRC TECHNICAL REPORT

Projecting Opportunities for Industrial Transitions (POINT)

Concepts, rationales and methodological guidelines for territorial reviews of industrial transition

Fontakaki, Dimitris
Fernandez, Tatiana
Janssen, Matthijs
Guy, Ken
Marques Santos, Anaëlle
Boden, Mark
Moncada-Paternò-Castello, Pietro

2020

JRC SCIENCE FOR POLICY REPORT

POINT Review of Industrial Transition of Bulgaria

Harmonising digitalisation to link and strengthen the ICT and mechatronics sectors

2021

JRC SCIENCE FOR POLICY REPORT

POINT Review of Industrial Transition of Greece

Renewables, Batteries and their Applications in Mobility, Agriculture, Shipping and Defence

2021

JRC SCIENCE FOR POLICY REPORT

FORTHCOMING

2021

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FORTHCOMING

2021



A European Green Deal

Striving to be the first climate-neutral continent

- + RRF / JTF/ JTTP (GR)
- + ROP (BG)
- + Energy Strategy S4 (AND)

[POINT METHODOLOGY
DOWNLOAD](#)

[BG DOWNLOAD](#)

[GR - DOWNLOAD](#)

<https://s3platform.jrc.ec.europa.eu/industrial-transition>



Horizontal lessons across reviews

- Importance of domestic **demand** for industrial development – many unexploited opportunities for profitable **sequencing** of policies (e.g. precede demand-side subsidies for energy efficiency, RES and EVs with support for business investment and skills to enter emerging GVCs).
- **Synergies** between research and innovation, broader business support, skills, infrastructures, thematic policies (health, energy, ...) etc. **can be identified with a POINT review.**
- **Massive coordination task within government** requires a “**whole-of-government**” **approach**, focused on national(/regional) goals (e.g. National “Missions”, smart working parties, shared agendas, etc.)

Evidence to upgrade to S4

1. System-level evidence is unavailable, yet extremely valuable.

POINT reviews can make a contribution. Evidence and promising pathways to upgrade to S4 and align with the European Green Deal, the Just Transition Fund, the Recovery and Resilience Facility.

2. Evidence can change perspectives.

A broad, systemic framing is necessary to find policy levers for transformation:
Pedagogical role of reviews and other evidence about the socio-technical system

3. Evidence is not enough. New framework for transformative stakeholder coordination is necessary.

POINT reviews only a beginning. Not enough to change policies. Need to work directly with stakeholders and build support coalitions (through e.g. truly transformative Entrepreneurial Discovery workshops)

Thank you!

No wind is favourable to the one who does not know to which port to sail.

Lucius Annaeus Seneca (c. 4 BC – AD 65)

<https://s3platform.jrc.ec.europa.eu/industrial-transition>



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