Science and innovation policies for green transitions

9 November 2021
Science and Innovation in the Green Transition: The context

The IEA’s net-zero scenario (IEA, 2021) shows that half of the global reductions in CO2 emissions through 2050 will have to come from technologies that are currently at the demonstration or prototype phase.

Reaching net zero by 2050 requires both reducing the cost of already available technologies so that they can be deployed quickly and developing new breakthrough technologies that are not on the market yet.
Technological change is key to reducing the costs of emission reduction policies

Declining renewable energy costs since 2010

Note: The grey band crossing the entire chart represents the fossil fuel-fired power generation cost range.
Source: IRENA Renewable Cost Database.
A wide range of new technologies is required, e.g. to decarbonise industry

Role of various technologies in emission reductions in the Dutch manufacturing sector, 2015-50

Key questions

• Are we moving fast enough?
• What policies are being used across countries?
• What can policy do to accelerate low-carbon innovation?
Are we moving fast enough?
The pace of low-carbon innovation has slowed down...

Share of climate mitigation patents in total patents, 1978-2019

... and green start-up funding has not kept pace

Global Venture Capital investment in green start-ups

Source: OECD, based on Crunchbase and Dealroom data.
Why? Weak climate policies...

Climate policy stringency in OECD countries, 1990-2020

Source: OECD Environmental Policy Stringency indicator (2021)

Carbon pricing in 44 OECD and G20 countries, 2018

Source: OECD Effective Carbon Rates (2021)
..., low energy prices... (until recently)

**Worldwide low-carbon patent filings and oil prices**

![Graph showing oil price and low-carbon patent intensity](attachment:image.png)

*Source: Based on data from the Global Patent Statistical Database (available through the OECD MicroData Lab) and Oil price data from the World Bank.*
...and insufficient public support for R&D, ...

Low-carbon public R&D expenditures in GDP
OECD countries, 1974-2019

Source: IEA Energy RD&D public expenditures (2021)
..., compared to high support for deployment (at least in renewables)

Public RD&D vs deployment support in renewable energy 2018 (bn USD)

Source: IEA (RD&D); IRENA (deployment)
What policies are being used across countries?
Today, we’re launching a new policy portal

• The **STIP Compass net zero portal** is a collaboration between the EC, IEA and OECD: https://stip.oecd.org/stip/net-zero-portal

• It presents information on STI policies that explicitly support the transition to net zero, with policy information on ~250 policies from 40 countries and the EU

• It semantically links to other data resources, including publications and statistics
Main features

- The portal has the same features as the main STIP Compass site (https://stip.oecd.org)
  - Interactive dashboards
  - Country pages
  - Linked publications and statistics
- Built on a philosophy of open data re-use
- Each policy initiative has its own fiche containing information on its funding, use of policy instruments, and the groups targeted, among other metadata
- The portal uses this metadata to facilitate search and to summarise policy landscapes through dashboards
The portal probably has less than half the STI policies currently in use that target net zero, with some countries better covered than others.

We will continue to gather data through the STIP Compass monitoring tool and the IEA’s PAMS.
... by budget range and funding body
Estimated annual budgets (1)

€5-20M is the main range of annual budgets
Estimated annual budgets (2)

- Set of measures for **hydrogen** R&D launched in 2020
- 4 programmes planned to **last for 6+ years**
- Investment in **business** R&D and demonstration
- **Package of grants** for multiple technologies
### by type of policy instrument

<table>
<thead>
<tr>
<th>Policy Instrument</th>
<th>Budget Range</th>
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<tr>
<td>Centres of excellence grants</td>
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<tr>
<td>Creation or reform of governance structure or public body</td>
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<td>Debt guarantees and risk sharing schemes</td>
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<td>Dedicated support to research infrastructures</td>
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<td>Equity financing</td>
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<td>Formal consultation of stakeholders or experts</td>
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<td>Grants for business R&amp;D and innovation</td>
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<td>Horizontal STI coordination bodies</td>
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<td>Information services and access to datasets</td>
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<td>Innovation vouchers</td>
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<td>Institutional funding for public research</td>
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<td>Loans and credits for innovation in firms</td>
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<td>Networking and collaborative platforms</td>
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<td>Policy intelligence (e.g. evaluations, benchmarking and forecasts)</td>
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<td>Procurement programmes for R&amp;D and innovation</td>
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<td>Project grants for public research</td>
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<td>Public awareness campaigns and other outreach activities</td>
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<td>Science and innovation challenges, prizes and awards</td>
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<td>Science and technology regulation</td>
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<td>Standards and certification for technology development and adoption</td>
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<td>Strategies, agendas and plans</td>
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<tr>
<td>Tax or social contributions relief for firms investing in R&amp;D and innovation</td>
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<tr>
<td>Technology extension and business advisory services</td>
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- **59 business grants**
- **78 project grants for public research**
- **79 strategies / plans**
... or by the groups targeted

<table>
<thead>
<tr>
<th>Economic actors (individuals)</th>
<th>Less than 1M</th>
<th>1M-5M</th>
<th>5M-20M</th>
<th>20M-50M</th>
<th>50M-100M</th>
<th>100M-500M</th>
<th>More than 500M</th>
<th>Unknown</th>
<th>Not applicable</th>
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<tbody>
<tr>
<td>Firms by age</td>
<td></td>
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<td>19</td>
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<td>13</td>
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<td>Firms by size</td>
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<td>Governmental entities</td>
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<td>Intermediaries</td>
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<td>9</td>
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<tr>
<td>Research and education orgs</td>
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<td>33</td>
<td>11</td>
<td>11</td>
<td>13</td>
<td>8</td>
<td>40</td>
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<tr>
<td>Researchers, students and teachers</td>
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<td>Social groups especially emphasised</td>
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Digging deeper: the nature of R&D investments

• 9 countries and EU give importance to **CCU/S** and 4 countries are proceeding with **CCU/S-exclusive programmes**.  

• Some countries encourage **academia-industry collaboration in batteries and hydrogen** to provoke R&D breakthroughs that meet social demands.

• The number of **hydrogen**-related initiatives shows a rapid increase in the last 2 years
  
  • Establishing partnership between different stakeholders (academia-industry / different sectors)
  
  • Strategy making
  
  • International joint R&D investment for the energy transition
The portal links policy data to statistics, publications and the IEA’s databases.
What can policy do?
Encouraging innovation directly, ...

- **Re-balancing** STI policies
  - Balance between **support for breakthrough technologies, e.g. through mission-oriented policies, and the diffusion of existing technologies** – recognising different levels of technology maturity
  - Balance between **direct and indirect** (horizontal) support instruments
  - Increase support for **demonstration projects** – currently typically too small compared to typical project needs
  - Target low-carbon technologies & enabling technologies (e.g. digital/bioeconomy)
  - Leverage scare public R&D funds through the use of **blended finance** tools

- **Strengthening** international cooperation and technology transfer
  - Cooperation in particular at R&D and demonstration phase
  - Technology transfer to diffuse technologies as widely as possible.
... including through digital technology policies: Sustainability of networks, smart cities and the IoT

- **Boosting the transition to future proof technologies** for environmental sustainability
  - Fibre as a “green technology” (e.g. 85% more energy efficient)
  - Increase use of “Green bonds” to finance fibre deployment

- **5G and AI systems:**
  - Optimising network management and reducing energy consumption
  - On the other hand: Data traffic and compute demand increase

- **Promoting smart cities and devices** (IoT)
  - Smart buildings and cities, street sensors and connected transport, smart electricity grids, precision agriculture, the Internet of “Trees” to monitor deforestation, etc.

- **Net Zero commitments** by communication operators
- Scope for international cooperation for “green” digital policies
... and the OECD Recommendation on Broadband Connectivity, as well as ...

- The Recommendation underscores how **the environmental sustainability of networks is paramount.**
  - It recommends to “**minimise negative environmental impacts of communication networks**” by:
    1) **promoting smart and sustainable networks** and devices
    2) **encouraging operators to report on the environmental effects of networks** (both positive and negative).

- The **G20 Guidelines for Financing and Fostering High-Quality Broadband Connectivity for a Digital World**, developed with the support of the OECD, recommend countries:
  - to encourage cross-sectoral collaboration to “**minimise costs, disruption, and environmental impacts**” of network deployment.
... biotechnology and the bioeconomy, ...
... where we find strong emphasis on supply-side policy measures, with too little policy action on the demand side, ...

<table>
<thead>
<tr>
<th>Feedstock/Technology push</th>
<th>Market pull</th>
<th>Push and pull</th>
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<tbody>
<tr>
<td>Local access to feedstocks</td>
<td>Mandates and targets</td>
<td>Metrics, definitions, terminology</td>
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<tr>
<td>International access to feedstocks</td>
<td>Public procurement</td>
<td>Skills and education</td>
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<tr>
<td>R&amp;D subsidy</td>
<td>Standards</td>
<td>Regional clusters</td>
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<tr>
<td>Pilot and demonstrator support</td>
<td>Labels, certification</td>
<td>Public acceptance, raising awareness</td>
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<tr>
<td>Flagship financial support</td>
<td>Fossil carbon taxes and incentives</td>
<td>Governance and regulation</td>
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<tr>
<td>Tax incentives for industrial R&amp;D</td>
<td>Removing fossil fuel subsidies</td>
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<td>Technology clusters</td>
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<td>SME and start-up support</td>
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... and by providing the right framework conditions

- Provide clear indication on direction of change
  - Carbon pricing
  - Reduce policy uncertainty

- Foster demand for low-carbon technologies
  - Product standardisation (e.g. sockets for EVs, hydrogen origin)
  - Regulation (e.g. emissions standards, recycled content, bio-based products)

- Fund public infrastructure
  - e.g. EV charging stations, carbon and hydrogen pipelines, 5G.

- Support entrepreneurs and start-ups, not only established firms
  - Preserve competition, contestability of markets and openness

- Support workers, whose skills need to be updated
  - Focus on people, improve training and access to labour markets