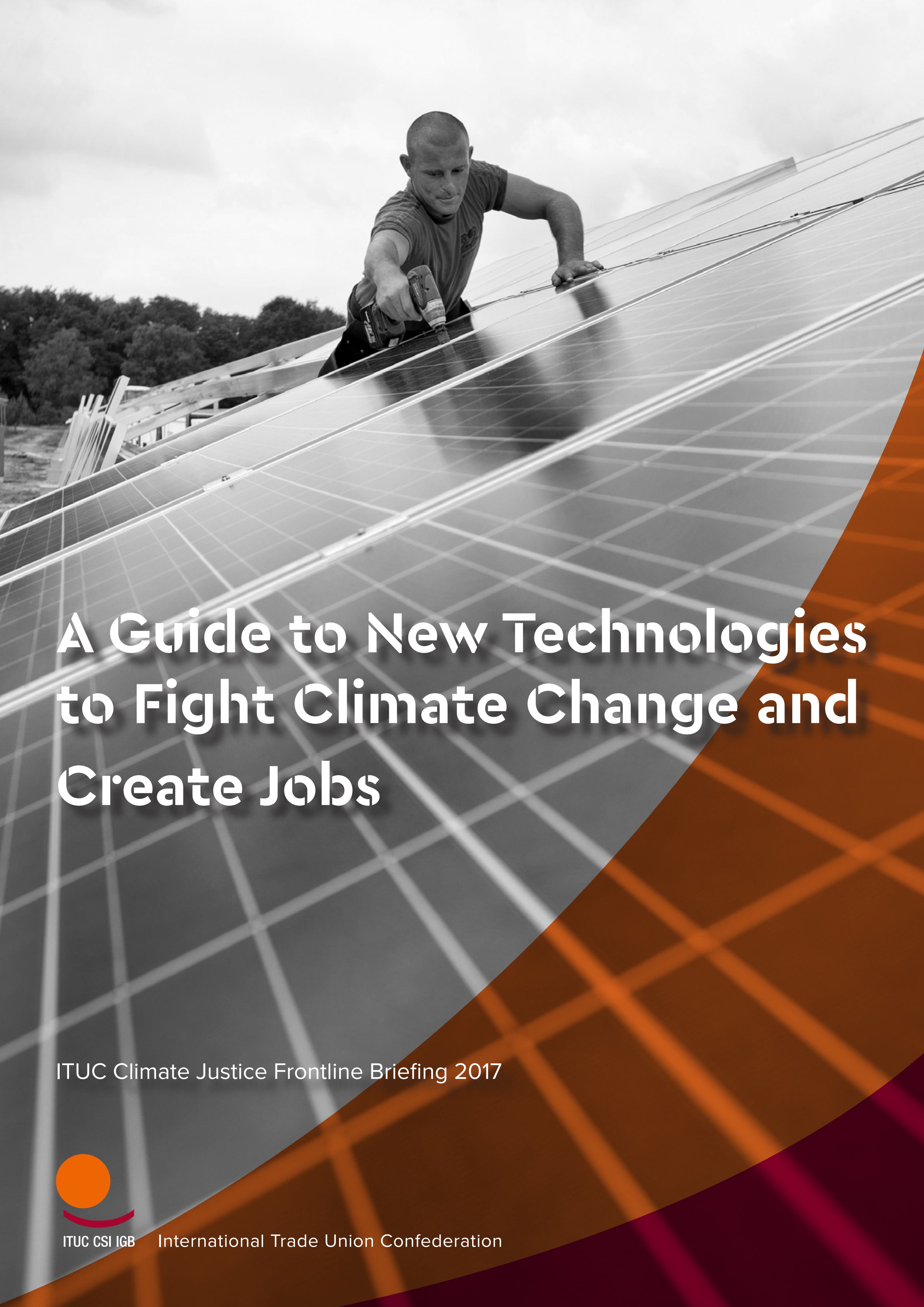

A Guide to New Technologies to Fight Climate Change and Create Jobs

ITUC Climate Justice Frontline Briefing 2017

ITUC CSI IGB International Trade Union Confederation

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1. Introduction
The climate imperative

Despite the Paris Climate Agreement, there's still a huge "emissions gap" between nations' pledges to reduce CO2 emissions and what's required to stay well below a 2°C degree or greater temperature increase that would herald irrevocable climate change[1].

The further effort required has been estimated at 12-17 gigatonnes of CO2 equivalent emissions per year. For reference, 1 gigatonne is the equivalent of removing all cars in Europe for one year. Unless humans change course, we can expect global warming of 2.9°C - 3.4°C by the end of this century.

Major innovations will be needed to close this gap in the long run, but much can be done now. If properly supported by companies and governments, known technologies can deliver more than half of the missing emission reductions – 40% through efficiency savings and 35% via renewables[2].

But for new technologies to develop, political commitments and regulations must improve. That's where unions play a critical role. Lack of investment by companies now in a low-carbon pathway can only put jobs at risk. Union leaders must demand to be consulted regarding investment and technological decisions. Social dialogue and collective bargaining are critical tools to ensure jobs and Just Transition in all sectors.

A "Worker's Right to Know" is the organising campaign initiated by the ITUC. Workers have a right to know what their governments are planning to meet the climate challenge and what the Just Transition measures are. Equally, workers have a right to know what their employers are planning, what the impact of the transition is and what the Just Transition guarantees will be. And workers have a right to know where their pension funds are invested with the demand that they are not funding climate or job destruction.

Policy options

Some in civil society have established short-term goals to staying below an average global temperature rise of 2°C. These include:

- Reaching 30% of renewable energy in the world's electricity supply by 2020 (up from 23.7% in 2015);
- Deploying investments to decarbonize buildings and infrastructure;
- Doubling mass-transit use in cities;
- Reaching at least 15% of electric vehicles (EVs) among new car sales; and
- Increasing fuel efficiency and energy use in transport and industry.

Investment in early-stage research for radically innovative technologies is also important.

1 UNEP Emissions Gap Report 2017. Especially note graph on Page 35, emissions reduction potential by sector.
2 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France, Page 31

This report aims to start a discussion concerning the challenge and the technology available in major sectors along with the implications for jobs. Many of the sectors included in this briefing are undergoing very rapid change. We hope affiliates and the Global Union Federations (GUFs) will add their knowledge to this first technology brief and that it begins to build the knowledge and resources necessary for collective bargaining that include climate-related provisions. Emissions saved are costs saved by business, and this resource productivity dividend can be bargained for to the benefit of workers.

Unions demand the right to know. We demand a seat at the table to design and participate in the policies and programs to drive a more equitable and fair workplace and economy.

In the medium term:

If we are to stay below a 2°C rise, the following needs to happen:

- Unabated coal (that is, plants without any carbon capture and storage technology – CCS) must be phased out;
- Emissions from buildings would need to decrease by 85% compared with current trajectories; and
- The share of EVs or fuel-cell electric vehicles in the light-duty road vehicle fleet must reach about 60% and in the heavy-duty vehicles fleet about 40% by 2060.

2. Ensuring climate friendly technology and workers' rights

Unions have a vital interest in ensuring companies lower their environmental footprint and head towards zero emissions. Without such plans, jobs will certainly be lost in the downward spiral of disinvestment.

Here are seven ways to champion climate-friendly technology that also strengthens the rights of working people.

1. Technologies must be comprehensively assessed

Technological progress must come with whole-of-government strategies that involve social partners and combine industrial and innovation policy with climate and other environmental targets. Measures to incentivise the commercialisation of technologies could include CO2 pricing, with revenues allocated to technology funds.

Such strategies must include:

- Thorough social dialogue and collective bargaining designed to support decent work and broader prosperity;
- Social and environmental safeguards;
- Rules on intellectual property rights that prevent the creation of private monopolies; and
- Increased public investment in research and development (R&D), while connecting universities, higher education institutions and independent innovators.

2. Progress requires transparent data

An important step for setting the right goals for each company is good quality data on new technologies' performance, deployment and required investment. This is critical to allowing a democratic debate about each sector's role in reducing emissions.

Inside companies, trade unions have long called for transparency and inclusiveness when embracing technological change.[3] Up-to-date design and monitoring processes must involve worker representatives through collective bargaining agreements.

The introduction of new technologies must be based on:

- Open and universal standards (regulatory, technical and ethical) and best practices;
- Robust risk assessment and management systems, underpinned by the precautionary principle to ensure all new processes and networks are safe, efficient and reliable; and
- Processes that emphasise both productivity and quality of work, accounting for any risk of displacement of workers.

3. Public resources must be properly handled

It is often ambitious government policies that drive technological development. There should be a

3 TUAC, Digitalisation and the digital economy – Trade Union Key Messages, February 2017

careful assessment of current subsidies and public financing of research and projects – in particular those connected to energy-intensive industries. Stricter performance targets along with a carbon price and investment disclosure for industry and investors would act as a driver for companies to commit the necessary investments, in particular in sectors where there are only a few key corporate players[4].

4. Supporting home-grown innovation in developing countries

Technological development cannot become a privilege for companies in wealthy countries. Support must be provided to public institutions in developing countries to identify their needs and support the local production and deployment of the technologies mentioned in this briefing.

5. Don't forget skills

Workers must be offered appropriate training, no matter their age and sector, to ensure they can continue developing their skills. Such measures include a training guarantee for all workers, continuous on-the-job learning, strengthening vocational education and training systems and extending coverage to non-standard jobs.

6. A Just Transition is key

It is important to connect technological innovation with the need to secure a Just Transition for workers and communities. This means being alert to the possibility that technological deployment might lead to job losses, undemocratic decision-making processes and reducing rights at work, and doing everything possible to mitigate these risks.

Key principles of a Just Transition include:

- Research and early assessment of social and employment impacts;
- Social dialogue and democratic consultation of social partners and stakeholders;
- Active labour market policies and regulation, including training and skills development;
- Social protection, including pensions and unemployment income;
- Community renewal and economic diversification plans; and
- Sound investments leading to high-quality, decent jobs.

7. The role of trade unions

Trade unions must play a more active role at the intersection of climate change and technology. This means:

- Holding companies accountable to their commitments to reduce emissions;
- Ensuring collective agreements and worker representation mechanisms include sections on the use of new technologies;
- Participating in advisory councils on innovation and industrial policies and providing an informed and independent stand on how companies can do more on climate change;
- Holding pension funds accountable for sustainable investment to ensure jobs and Just Transition; and
- Delivering on-the-job training and vocational education and training systems, as well as co-designing national competency strategies and promoting the take-up of further training.

4 Public resources play a very substantial role in technology development and innovation. For arguments about the socialising of the cost of innovation whilst privatising the profits see https://marianamazzucato.com/entrepreneurialstate

3. A sector-by-sector guide to reducing the emissions gap

Renewable energy

State of play

Even conservative estimates by the International Energy Agency (IEA) indicate that in order to stay below 2°C, the power sector (the world's largest emitter of carbon dioxide) needs to reach net-zero CO2 emissions in 2060, with 74% of generation from renewables, 15% from nuclear, 7% from fossil fuels equipped with CCS and the remainder from natural gas-fired generation without CCS[5]. Electricity generation in particular remains dominated by fossil fuels, which made up 67% of the sector globally in 2014. However, technological advances and falling costs are prompting the growing use of renewable energy. A dramatic reduction in energy demand and increase in energy efficiency is required. Without that it will be difficult to meet all energy needs with an increase in renewable energy.

Solar photovoltaic (PV)

Global capacity soared from 40 GW in 2010 to 219 GW in 2015, when it accounted for approximately 20% of all newly installed power generation capacity. Utility-scale projects are economically competitive with new fossil-fuel generation, and solar PV is competing without financial support even in regions with abundant fossil fuel resources. Electricity from small-scale distributed PV is already cheaper than power from the grid in several countries, and PV is often the least-expensive option for remote or off-grid regions.

5 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France. Page 273

Fulfilling the Paris Agreement will require:

- **An end to unabated coal-fired power plants** (by 2030 in the EU and the OECD, by 2040 in China and by 2050 in the rest of the world) [6].

- **Electrification of end uses previously powered by fossil fuels (i.e., buildings, transport)[7]:** Final electricity demand from these sectors must shift to 35% by 2060 (from 18% today)[8].

- **Massive deployment of renewable energies, both baseload renewables (hydro-power, geothermal, sustainable biomass), and wind and solar (with higher capacity factors and more stable production like offshore wind[9]).** This will require adjustments to physical infrastructure as well as market design regulation.

- **An active demand side:** "Smart grids" provide timely information about supply and demand.[10] Electrification of mobility and heat allows storage of peaks of electricity in EV batteries and heat in buildings and industry. Electrifying more sectors allows spreading demand peaks, diversification and places to store energy from supply peaks. In a 2°C pathway, demand response in the transport, industry and building sectors, as well as the transformation sector (e.g., large-scale heat pumps or electrolysers or hydrogen production) shifts electricity loads in the order of 320Gw by 2060.[11]

6 Climate Analytics (2016). Implications of the Paris Agreement for Coal Use in the Power Sector, page1
7 IRENA 2017 Adapting markets – page 19
8 Page 274
9 UNEP Emissions Gap Report 2017, page 30-32.
10 IRENA (2017), *REthinking Energy 2017: Accelerating the global energy transformation.* International Renewable Energy Agency, Abu Dhabi, page 78
11 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France.

The choice of ownership and management model for the deployment of advanced meters and the management of metering data is important. This includes granting access to stakeholders in a transparent and non-discriminatory way.[12] The risk of capture by a few providers and the importance of protecting personal and sensitive public sector data is equally vital. It is therefore important to create better data governance regimes and legal rules[13].

- **The deployment of off-grid**, **non-utility scale energy**, is a key solution to provide low-carbon alternatives for people and industries, especially in developing countries, that might reduce or eliminate the need for grids where they don't yet have them. Micro-grids enable high penetration of renewables in the energy-mix, provide higher reliability of electricity supply, and system resilience with lower emissions.[14]

- **Storage:** Global storage capacity needs to rise and start being used for the stability of renewable energy provision. Pumped hydro is the dominant form of storage globally, along with compressed air. [15] IRENA estimates that total available battery storage for electricity will increase from just 0.8 GW in 2014 to 2050 GW in 2030[16]. Battery technologies are moving quickly in terms of performance and costs[17]. In 2017, battery costs are already low enough to make battery storage cost competitive for commercial electricity users who want to avoid paying peak prices.[18]

- **Transmission infrastructure:** When generation grows at the consumer end of the distribution grid, there are implications for the transmission and distribution network (managing not fully predictable power flows, potential grid congestion, voltage variability). Interconnections need to be improved with neighbouring power markets.[19] Over time this might lead to the need to transform high-voltage electricity networks. According to the IEA, a large-scale expansion of high-voltage transmission infrastructure is a key enabler of power system transformation. High-voltage direct current (HVDC) – presently accounting for 250 GW, the combined total generation of France and Italy – along with interconnection capacity, is expected to expand by one-third before 2020. This capacity will need to increase substantially to stay below 2°C.

- **Reducing "line losses" of energy during transmission, locating more differentiated, renewable technologies closer to the points of consumption and diversity of power sources and making population centres less vulnerable to blackouts, resource price shocks and pollution.**

- **Policy support for technological innovation:** Onshore wind and solar PV, for example, demonstrated the impact of targeted policy support for technological innovation, delivering substantial cost reductions and rapid investment growth over the last decade. A predictable policy framework, giving greater revenue certainty and addressing the infrastructure gaps so that renewables can better integrate into the grid are important pieces of technology development and deployment. The policy setting must include innovative mechanisms to support renewable energy in developing countries and emerging economies. Governments and financial institutions need to align elements including: targets, funding and incentives for R&D; grant and loan guarantees for pilot projects and commercialisation; and subsidies for deployment and use.

12 IRENA 2017 Adapting markets – page 128
13 (See in depth recommendations from unions on this topic in the Declaration) TUAC, digitalisation and the digital economy, TRADE UNION Key Messages - February 2017
14 World Business Council for Sustainable Development, 2016: "*Business Case for Low-Carbon Microgrids*" provides case studies from Kenya, Myanmar, India, Hong Kong and the US.
15 IRENA (2017), *REthinking Energy 2017: Accelerating the global energy transformation.* International Renewable Energy Agency, Abu Dhabi, Page 77
16 IRENA (2017), *REthinking Energy 2017: Accelerating the global energy transformation.* International Renewable Energy Agency, Abu Dhabi, page 77
17 http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/battery-storage-the-next-disruptive-technology-in-the-power-sector
18 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France. Page 298
19 IRENA (2017), *REthinking Energy 2017: Accelerating the global energy transformation.* International Renewable Energy Agency, Abu Dhabi, page 40

DID YOU KNOW?

Alternating current (AC) has been the preferred global platform for electrical transmission to homes and businesses for the past 100 years. However, HVAC transmission has limitations, starting with transmission capacity and loss of voltage over long distances which makes it poorly suited for transmitting , as well as the impossibility of directly connecting two AC power networks to different frequencies[1]. With the rapid growth of variable renewable energies, the growth in access to electricity, the electrification of new services in transport, industry and buildings, and the need to build a smarter grid, new technologies for transmitting power over long distances and between power systems are expected to grow far beyond their current levels of deployment.[2]

1 See http://www.elp.com/articles/powergrid_international/print/volume--21/issue-12/features/the-rise-of-hvdc-and-promise-of-supergrids.htlm
2 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France. Page 301

Energy-intensive industry

State of play

The industrial sector accounted for 36% of final energy consumption in 2014[20]. However, despite the need to decarbonise, more carbon-intensive capacity in industry is being installed, raising the risk of stranded assets and costly retrofits[21].

Fulfilling the Paris Agreement will require:

- **Energy and material-efficiency measures:** Together with deployment of Best Available Technologies (BATs), such measures could deliver around half of the additional emissions reductions needed from industry before 2030.[22] These technologies are already available. The key is to design and implement incentives and regulations that favour these over obsolete, less efficient processes. The rest of the sectorial emissions' gap depends on processes that are not yet commercially available and require additional research and investment. Realising substantial CO2 emission reductions in the industry sector requires ambition and solid knowledge from public authorities on energy performance and company results. Industry bodies cannot be the only source of information for regulators.

- **The right policy framework for a rapid deployment of the BAT and energy efficient processes:** Increasing recycling rates for steel, aluminium and plastics would significantly reduce the energy and emission intensity of production, so they should also be prioritised in terms of policy regulations.

Iron and steel

State of play

The iron and steel subsector consumes 23% of heavy industry's final energy demand, and is the sector's largest CO2 emitter. To decarbonise heavy industry sectors, a shift to innovative low-carbon technologies, product substitutions, circular production routes, and possible industrial scale deployment of CCS will be needed. Targeted R&D efforts are necessary to accelerate the availability of these options[23].

Fulfilling the Paris Agreement will require:

- **Increased and improved production of secondary steel from scrap in electric arc furnaces (EAF)[24]:** This must be pursued and expanded. Limitations exist, however, including availability of scrap. New processes, such as innovative direct reduced iron (DRI) and smelting reduction technologies, will be important here.[25]

20 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France. Page 76
21 UNEP Emissions Gap Report 2017, page 32
22 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 35
23 Climate Action Tracker, 2017 Decarbonisation Series. "*Manufacturing a Low-Carbon Society: How can we reduce emissions from cement and steel?*"
24 Industry's Electrification and Role in the Future Electricity System A Strategic Innovation Agenda, page 40
25 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 76

- **Clear policy signals to this industry on the need to invest more in the research and development of low-carbon options:** The current subsidies or free quotas, for example, tend to delay the implementation of best-available technologies and do not give a price signal to those investing in the future.

DID YOU KNOW?

Direct-reduced iron (DRI) involves the reduction of iron ores in their solid state at temperatures well below the metal's melting point. Direct reduction makes it possible to use alternatives to metallurgical coke as reducing agents, including hydrogen. After the direct reduction, the reduced iron is in a solid state and for further processing it needs to be melted – typically in an electric arc furnace (EAF).

There are a number of ongoing projects involving the use of hydrogen as the main reducing agent in primary steel production (injection into the blast furnace or direct reduction process). So far, however, practical experiences are limited. The HYBRIT project in Sweden aims to replace the blast furnaces with an alternative process, using hydrogen produced from "carbon-neutral" electricity, to reduce iron ore. After an initial feasibility study, the aim is to scale up to pilot plant trials in the period 2018-2024 with the ambition to move on to demonstration plant trials in the period 2025-2035[1].

1 Industry's Electrification and Role in the Future Electricity System A Strategic Innovation Agenda, page 41

Chemicals and petrochemicals

State of play

Chemicals and petrochemicals consume 28% of the total global final energy consumption and are the third-largest CO2 emitter in the industry sector.

Fulfilling the Paris Agreement will require:

- **Better technologies in reactor designs** with best-practice heat integration and energy recovery;
- **Design of new catalysts** to increase yield and selectivity of desired products;
- **Research on bio-based production processes[26]; and**
- **An increase in post-consumer waste plastic collection rates**, recycling yield rates and the extent to which recycled polymers displace virgin resin consumption[27].

DID YOU KNOW?

Bio-based routes to both primary chemicals and downstream chemical products present promising avenues for decarbonisation. Biomass-based production processes can produce ethylene from lignin, starches and sugars[1] and biomass-based ammonia[2] and methanol[3], exist mainly at pilot scale.

1 IEA-ETSAP and IRENA, 2013, Technology-Policy Brief I13
2 Pratham Arora et al, Multi-objective optimization of biomass based ammonia production - Potential and perspective in different countries, Journal of Cleaner Production 148 (2017) 363-374
3 IEA-ETSAP and IRENA© Technology Brief I08 – January 2013

Cement

State of play

Cement makes up 7% of total final energy use from industry but due to the high level of process-related emissions, its share of emissions is much higher: 27% in 2014[28]. In addition to emitting CO2 as an energy consumer, cement generates in the chemical conversion leading to the production of clinker, a component of cement, in which limestone is converted to lime.

26 Brown et al, (2012) Reducing CO2 emissions from heavy industry: a review of technologies and considerations for policy makers, Grantham Institute for Climate Change Briefing paper No 7,Imperial College London.
27 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France, Page 80
28 Climate Action Tracker, 2017 Decarbonisation Series. "*Manufacturing a Low-Carbon Society: How can we reduce emissions from cement and steel?*"

Fulfilling the Paris Agreement will require:

- **Reducing process-related emissions** (described above); and
- **Developing new, low-carbon cement processes**[29].

DID YOU KNOW?

Clinker substitution in cement manufacturing directly reduces the thermal energy and associated process carbon emissions for the same amount and quality of final cement produced. At a European level, it is estimated that the clinker-to-cement ratio can be reduced to 70%, resulting in a further CO2 saving of 4% overall[1] These technologies are commercial. See for example, Dalmia Cement India low emissions blended cement.[2]

1 CEMBUREAU (2017) The role of cement in a low carbon future. http://lowcarboneconomy.cembureau.eu/index.php?page=clinker-substitution
2 http://www.oecd.org/environment/cc/g20-climate/collapsecontents/Just-Transition-Centre-report-just-transition.pdf - page 15

Aluminium

State of play

The aluminium subsector is the fourth-largest CO2 emitter from industry, with 3% of the sector's total direct CO2 emissions in 2014.

Fulfilling the Paris Agreement will require:

- **Aluminium recycling:** The impressive energy savings here should make it the prioritised route for policy makers' drive on this sector's emission reductions, putting in place stronger measures for collection and recycling of scrap.
- **R&D focused on alternative production routes**, particularly those that address the process of CO2 emissions from primary smelting, such as inert anodes.

DID YOU KNOW?

Production of recycled aluminium involves refining and remelting scrap. Aluminium recycling conserves energy and other natural resources. It requires up to 95% less energy to recycle aluminium than to produce primary metal and thereby avoids corresponding emissions, including greenhouse gases.1

1 http://recycling.world-aluminium.org/review/sustainability/

DID YOU KNOW?

Inert anodes for primary aluminium production could reduce process emissions from the primary aluminium smelting process by replacing carbon-based anodes with anodes made from alternative materials. Carbon anodes produce CO2 as they degrade; inert anodes produce pure oxygen. This technology is being tested by RUSAL, but it has not been commercially deployed or demonstrated at large scale. The use of inert anodes could curb CO2 emissions by as much as 1.65 tCO2 per tonne of aluminium compared to a typical smelter. This technology is at the demonstration phase.[1]

1 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France, Page 201

29 https://phys.org/news/2015-09-technique-cement-carbon-neutral.html

DID YOU KNOW?

Carbon Capture and Use (CCU) has often been identified as an alternative route for captured CO2 to geological storage, being particularly attractive to sectors that are unlikely to undertake storage.

CO2 can be used as a source of carbon in the production of petrochemicals in place of hydrocarbon chains from fossil fuels. It can be converted to various chemicals, including polymers and carbonates, through reaction with other molecules or chemicals. These processes generally require significant amounts of energy to break the bonds of the otherwise stable CO2 and therefore rely on abundant cheap renewable energy to keep life-cycle emissions low. Therefore, R&D is being conducted around the world to find technologies that efficiently use CO2.

A number of processes can convert CO2 into transport fuels, most commonly through the production of methanol or syngas. As with all CO2 conversion to chemicals, the process requires a substantial energy input, usually from renewable electricity, and the CO2 is eventually released to the atmosphere when the fuel is combusted. These technologies, so far, are not low emission .[1]

1 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France, Page 388

Buildings

State of play

Nearly one-fifth of global greenhouse gas emissions come from the building sector. Under current policies, energy consumption in buildings is set to rise by 1% per year.[30] Average energy consumption per person in the global buildings sector remains practically unchanged since 1990.[31] Current developments are not on track to limit global temperature increases to 2°C, let alone 1.5°C. Nearly two-thirds of countries still do not have any building energy codes in place. A similar share of energy-consuming equipment in buildings globally is not covered by mandatory energy efficiency policies.[32]

The construction industry has a vital role to play in meeting national and global climate targets by supporting production in other sectors including electricity generation, the construction and maintenance of more efficient buildings and of new transportation infrastructure, as well as ensuring adequate and affordable housing.

Net zero initiatives will require the work of a variety of trades people including masons, boiler makers, pipefitters, insulators, electrical workers, glaziers, heating, ventilation and air conditioning (HVAC), linesmen, iron workers and other construction trades.[33]

Fulfilling the Paris Agreement will require:

- **Massive efficiency gains** using the Best Available Technologies.
- **Rapid deployment of high-efficiency lighting, cooling and appliances** could save the equivalent of nearly three-quarters of today's global electricity demand between now and 2030[34].
- **Avoiding inefficient buildings:** With most of the 2060 buildings to be built in the next 30 years, immediate steps must be taken to avoid lock-in of inefficient buildings.[35] Building-envelope measures such as "cool roofs" and exterior shading, and building design, such as placement of windows, building orientation and use of natural ventilation, can drastically reduce the need for space cooling, while also contributing to reduced heat island effects in urban areas. [36]

30 Carbon Action Tracker (2016) Constructing the future: Will the building sector use its decarbonisation tools?

31 Carbon Action Tracker (2016) Constructing the future: Will the building sector use its decarbonisation tools?
32 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France, 94
33 Colombia Institute 2017 Jobs for Tomorrow: Canada's Building Trades and Net Zero Emissions
34 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 9
35 UNEP Emissions Gap Report 2017, page 30
36 IEA (23013) Technology Roadmap, Energy Efficient Building Envelopes

- **Building codes should reflect climate goals.** The battleground for the standards which will be used in the next 10-15 years for new buildings, notably in developing countries, as well as the rate of renovation, in particular in OECD countries, will define the capacity of this sector to make its contribution to the 2°C goal. The transformation in buildings might also need policy makers to start thinking about groupings of buildings rather than a single unit, so that a critical mass of buildings can be put together as a means for satisfying renewable energy generation and integrated technology solutions. Some buildings might not have sufficient space for certain equipment; others might not have the appropriate roof. Ensuring good working conditions and labour standards are respected as well as green building standards and certification programs are robust underpin sustainable construction practices. The World Green Building Council has called for all buildings to be net zero by 2050 through new construction and deep renovation and retrofitting. [37]
- **Electrifying the heating supply:** Heat remains largely fossil fuel-based, making this a good step forward.
- **Deploying energy efficiency standards for appliances**, e.g., lighting.
- **Policymakers understanding the barriers behind the non-deployment of zero-carbon technologies** when they are already available.

37 World Green Building Council 2017; "From Thousands to Billions – Coordinated Action Towards 100% Net Zero Carbon Buildings by 2050"

DID YOU KNOW?

A significant proportion of systems for space and water heating demand in buildings globally uses inefficient oil and gas boiler (e.g., less than 70% and 80% for typical conventional boilers) or electric resistance technology (less than 100% when storage and distribution losses are included). Condensing boilers would minimally improve equipment performance, whereas shifts to high-efficiency equipment, such as electric heat pumps, would achieve energy performance from 250% to 400% or higher for space heating, and 200% to 300% or greater for water heating. [1]

1 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 130

DID YOU KNOW?

The Passivehaus standard is one of the most ambitious building energy certification schemes. This standard encourages very low-energy buildings from a heating and cooling perspective, with low thermal losses and optimised thermal gains. The Passivehaus standard has been adapted to different climate zones worldwide and further developed with the common target that annual final energy use for heating and cooling – not exceeding 15 kilowatt hour (kWh) per m2 per year. This target represents a reduction of up to 90 per cent in energy demand for heating and cooling for most existing buildings. The global floor area of Passivehauses has grown from 10 million m2 in 2010 to 46 million m2 in 2016, with the most activity occurring in Europe. Presently, the price premium for new Passivehauses in several countries is comparable to standard construction costs. Since 2010, in Brussels (Belgium) all new public buildings are mandated to be built to the Passivehaus standard, and as of January 2015 it is a mandatory requirement for all new buildings and major retrofits[1].

1 UNEP (2016) Emissions Gap report

Transport

State of play

The transport sector produces 7.0 GtCO2eq of direct GHG emissions per year (23% of total energy-related CO2 emissions).[38] CO2 emissions from transport could increase 60% by 2050, and if no additional measures are taken, CO2 emissions from global freight alone could increase by 160%.[39] More than a half of the additional effort required by the transport sector to stay within 2°C trajectory can be achieved through known technologies and processes ("avoid, shift and improve"[40]).

Fulfilling the Paris Agreement will require

- **Transforming the nature and structure of transport demand.**
- **Major improvements in efficiency.**
- **Transitioning as quickly as possible to electrification:** The IEA estimates that electricity should become the largest energy carrier for transport by 2060 if we were to stay below 2°C.[41] Some long-distance transport modes – in particular aviation, heavy duty road transport and shipping – present major challenges in this regard.
- **Reversing the expected shift towards private passenger transport** as a consequence of raising incomes in emerging economies and developing countries[42].
- **Investments in urban transit infrastructure, including rapid transit tracks, subway tunnels and dedicated bus lanes[43].**

DID YOU KNOW?

The International Maritime Organization's energy efficiency design index (EEDI) requires most new ships to be 10% more efficient beginning 2015, 20% more efficient by 2020 and 30% more efficient from 2025. If implemented according to this time schedule, the ICCT projects that up to 263 million tonnes (Mt) of CO2 will be reduced annually by 2030[1]. While important, IEA and UNCTAD have concluded that this commitment is roughly aligned with the average efficiency trend in the industry for the past 15 years. In its current format, the implementation of EEDI would therefore not be driving emission reductions below business as usual. [2]

1 http://www.theicct.org/sites/default/files/publications/ICCTpolicyupdate15_EEDI_final.pdf
2 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 88

- **Major changes to trucking:** Systemic improvements and rapid exploitation of energy efficiency potential will be needed (e.g., in supply chains, logistics, routing in the case of freight). In the long term, decarbonisation will require major investments in infrastructure for alternative energy carriers. In addition to hydrogen, electric road systems on highly frequented roads are also being developed and are in demonstration phase.[44]
- **Greater regulation of long-distance transport modes** (i.e., international shipping and aviation): These are the most difficult modes to decarbonise and need to urgently replace fossil-derived high-energy density liquid fuels. Despite this urgency, they are still under-regulated.[45]

38 IPCC, FAR (2014) Transport chapter. Page 603
39 OECD/ITF (2017), ITF Transport Outlook 2017, OECD Publishing, Paris. Page 13
40 OECD/ITF (2017), ITF Transport Outlook 2017, OECD Publishing, Paris. Page 14
41 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 9
42 OECD/ITF (2017), *ITF Transport Outlook 2017*, OECD Publishing, Paris., page 53-54
43 See details of the International Transport Federation (ITF) Our Public Transport Campaign

44 www.eesc.europa.eu/resources/docs/electric-road-systems.ppt
45 UNEP Emissions Gap Report 2017, page 32-33

- **Embracing different forms mobility.** The various elements of the "autonomous and connected vehicles, electrification and sharing" (ACES) paradigm are beginning to penetrate mobility markets, particularly major cities[46]. The extent to which these changes contribute to making the transport sector less energy intensive is still to be seen, but certainly opportunities exist for this trend to substantially modify the sector. The model of car-ownership, and the overall integration of transport modes, for example, might be soon changed. Mobility as a Service (MaaS), for example, is receiving increasing attention. MaaS could offer an alternative to owning one's own car, allowing access to a variety of transport modes such as public transport, car sharing facilities, rental bikes, etc., and therefore reduce car use and related emissions. Some MaaS projects have been estimated to save 3.2 tons of CO2 per year and person (based on driving 15,000 km driving per year with a car consuming 0.8 litres of petrol/10km)[47].
- **Using regulations, standards and incentives** to encouraging investment in low-carbon modes (rail, public transport), and improvements in vehicle and fuel efficiency – including tightening average emission per km standards.

DID YOU KNOW?

Power-to-X refers to the possibility to convert surplus electricity, typically during periods where renewable energy generation exceeds load, to other energy carriers: power-to-ammonia, power to hydrogen, power to syngas, etc. The limited availability of low-cost renewable electricity constraints its development.[1]

1 https://en.wikipedia.org/wiki/Power-to-X#cite_note-acatech-2016-1

46 IEA (2017) Energy Technology Perspectives 2017, Catalysing Energy Technology Transformations. Paris, France Page 216
47 http://www.climate-kic.org/projects/mobility-service-business-case-ec2b/

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