

# Future climate and energy policy - a Strategy for long-term EU greenhouse gas emissions reductions

Fields marked with \* are mandatory.

## Introduction

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Climate change is happening and without further global action to mitigate it, temperatures will rise within this century well beyond a 2°Celsius compared to pre-industrial times. This will have major impacts on our economies and societies. In order to prevent this, 178 global partners cooperating under the United Nations Framework Convention on Climate Change (UNFCCC) have ratified the Paris Agreement that calls upon all countries to keep global temperature increase to well below 2°C, and to pursue efforts to limit the increase to 1.5°C above pre-industrial levels. Parties to the Paris Agreement are to communicate by 2020 their long-term low greenhouse gas emission development strategies.

In March, the European Council invited the Commission to present a proposal for a strategy for long-term EU greenhouse gas emissions reductions in accordance with the Paris Agreement, taking into account the national plans. The European Parliament made a similar request.

The EU is on track to achieve its [2020 targets](#) and is currently putting in place policies to reduce greenhouse gas emissions by at least 40% in 2030 and achieve high level of ambition in energy efficiency and renewable energy (the so called energy and climate framework for 2030). The policies, legislative instruments and support programmes from the European budget will put the EU on a trajectory compatible with the Paris Agreement, but further measures are needed for the time after 2030.

The EU has currently an objective in the context of necessary reductions by developed countries as a group, to reduce emissions by 80-95% by 2050 compared to 1990 levels.

Delivering the Paris Agreement will require a worldwide transition towards a global economy that will not further affect the climate in the second half of the century.

To pursue these latter objectives, the EU's long term strategy should put forward a vision for the mid-century and how the European Union can help protect the planet, defend its people and empower its economy. The EU's new long term strategy should describe economy-wide pathways with various options for decarbonisation and their implications on technology choices and socioeconomic factors.

The strategy will reflect on a long-term vision of a modern European economy working for all Europeans. Studies and stakeholder input will contribute to the formulation of this vision and help explain the choices to be made. The strategy should reflect on the essential opportunities and challenges stemming from the

long-term decarbonisation and clean energy transition of the EU:

- modernising the economy;
- improving citizens' quality of life;
- ensuring fair transition and tackling social challenges;
- reindustrialising Europe through digital, circular and low carbon innovation and clean mobility;
- promoting free, fair and sustainable global competition for markets, trade and investments; and
- maintaining the EU's global leadership position on key geostrategic and security issues.

The strategy will analyse cost-efficient scenarios towards decarbonisation in line with the Paris Agreement underpinned by holistic analysis of transition options across all key sectors of the economy. This includes a wide variety of sectors, starting with the central role of energy, buildings, transport and mobility, industrial production and the provision of services, waste, agriculture and land-use, as well as the use of natural resources. It will examine the potential and implications of the deployment of innovative technologies, sectoral integration, and of facilitating alternative choices for consumers. It will examine implications for security of supply, investments, competitiveness and socio-economic factors, such as economic growth and job creation, also considering the impacts on citizens, businesses. Regions that stand to be negatively affected by decarbonisation should be supported making this transition just and socially fair.

The visions and reflections of stakeholders involved from all sectors of the economy and society on how to reach the EU's ambition will be an important input into this process. Therefore, the European Commission is very much interested in your views on a strategy for long-term greenhouse gas emissions reductions for the European Union. Please take a moment to fill in our questionnaire. We welcome contributions from the general public, stakeholders and authorities alike. Your views will help to enrich our assessment of what the EU should do in order to meet its commitment under the Paris Agreement.

## Guidance on the questionnaire

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After a few introductory questions related to your general profile in section 1, the questionnaire has a number of questions in section 2.

To participate in the public consultation you are not obliged to fill in all questions. The different sections include questions on greenhouse gas reductions, the impact of consumers, the economic activity, energy, forests and land use, education and research, financing, meta trends, actors and adaptation to climate change. The final section is technical and more focussed on sectoral stakeholders (industry, transport, agriculture, land use).

Some questions are multiple choice questions. Other questions are open to which you can add if you want your comments. Please keep comments clear and concise because there is a limit on the number of characters you can enter.

If you want to express your views in more detail you can also upload a document with your views and insights.

As the results will be published on the Internet, please read the specific privacy statement attached to this consultation. It informs you about how your personal data and contribution will be dealt with. In the interest of transparency, if you are replying on behalf of an organisation, please register with the register of interest representatives if you have not already done so. Registering commits you to complying with a Code of Conduct. If you do not wish to register, your contribution will be treated and published together with those received from individuals.

## General information about respondents

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\* In what capacity are you completing this questionnaire?

- as an individual in your personal capacity
- in your professional capacity or on behalf of an organisation

\* Please give your name if replying as an individual/private person, otherwise give the name of your organisation:

*Text of 3 to 100 characters will be accepted*

Shell Companies

Email address:

\* For individuals, country of residence; for professionals, headquarters and main country of operations:

Netherlands

\* Type of organisation (please select the answer option that fits best):

- Private enterprise
- Professional consultancy, law firm, self-employed consultant
- Trade, business or professional association
- Non-governmental organisation, platform or network
- Research and academia
- Social partners
- National, regional or local authority (mixed)
- Other

Please indicate the economic sector you are active in (as an individual or as an organisation)

- Agriculture, Hunting and Forestry
- Financial Intermediation
- Fishing
- Real Estate, Renting and Business Activities
- Mining and Quarrying
- Public Administration and Defence;
- Manufacturing
- Education

- Electricity, Gas and Water Supply
- Health and Social Work
- Construction
- Other Community, Social and Personal Services
- Wholesale and Retail Trade:
- Activities of Private Households as Employers
- Hotels and Restaurants
- Extraterritorial Organisations and Bodies
- Transport, Storage and Communications
- Other

\* If other, please specify:

*Text of 3 to 100 characters will be accepted*

Energy Industry

\* If you are a civil society organisation or a public administration, please indicate your main area of focus or your area of competence:

*Text of 3 to 100 characters will be accepted*

n/a

What size does your organisation have?

- Micro or small enterprise (10-49 persons employed)
- Medium-sized enterprise (50 - 249 persons employed)
- Large enterprise (250 or more persons employed)

If your organisation is registered in the Transparency Register, please give your Register ID number:

*20 character(s) maximum*

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If your organisation is not registered, you can [register now](#).

\* Please indicate your preference for the publication of your response on the Commission's website:

- Under the name given: I consent to publication of all information in my contribution and I declare that none of it is subject to copyright restrictions that prevent publication
- Anonymously: I consent to publication of all information in my contribution and I declare that none of it is subject to copyright restrictions that prevent publication
- Not at all — please keep my contribution confidential (it will not be published, but will be used internally within the Commission)

(Please note that regardless the option chosen, your contribution may be subject to a request for access to documents under [Regulation 1049/2001](#) on public access to European Parliament, Council and Commission documents. In this case the request will be assessed against the conditions set out in the Regulation and in accordance with applicable [data protection rules](#).)

## Questions

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### Long term greenhouse gas emissions reductions

To achieve its temperature objectives, the Paris Agreement also includes a long term ambition to achieve a balance between emissions and removals of greenhouse gases by human activities in the second half of this century. Given that addressing climate change is a global challenge requiring all parties of the Paris Agreement to act, what do you think the EU should contribute to achieve the Paris Agreement's objectives:

- Reduce greenhouse gas emissions in the EU by 80% by 2050 compared to 1990 levels
- Reduce greenhouse gas emissions in the EU more, within the range of 80 to 95% by 2050 compared to 1990 levels
- Achieve already a balance between emissions and removals in the EU by 2050

In your opinion, what are the biggest opportunities and challenges

*1000 character(s) maximum*

The EU's strategy should set a trajectory, including targets, to deliver Net Zero Emissions aligned with the Paris Agreement. Meeting the EU's ambition will bring rapid transformations in consumer mindsets, technology deployments and enabling policy mechanisms that present opportunity and challenge alike. There is the potential for a very new energy system to emerge and Europe can play a leading role in this space. Shell is committed to keep pace with the changes in Europe's wider energy system and partner with European governments through this transition. As Europe transforms its energy systems and economies in line with its commitment under the Paris Agreement, such changes must recognize the high interdependency of the global economy, the very high costs involved and that this transition must not occur at the expense of the prosperity of its citizens. Whilst rapid transformations are required, it is important to build and maintain the public support for the energy transition.

## Consumers

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Next to the deployment of available and forthcoming technologies, when looking at the long term, consumer choices also have a key role in achieving the decarbonisation of our economy. Please fill in this section based on your habits if you are an individual or, if you are from an organisation, considering the organisation practice.

In your opinion, where do you expect the largest changes to happen in your daily life in order to meet the climate change challenge?

- Housing
- Mobility
- Food
- Consumer goods and services

### Housing and offices

Energy consumption

To which extent would you support the following options that allow reducing the energy consumption and related CO<sub>2</sub> emissions in buildings?

Improving further the energy performance ( insulation, triple glazing, etc.) of your building?

- Yes, I already have done it
- Yes, as a priority
- Yes, but not as a priority
- No, I rent
- No, too expensive
- No, other reason
- No opinion / I do not know

Installing heating and water boilers that run on renewables?

- Yes, I already have done it
- Yes, as a priority
- Yes, but not as a priority
- No, I rent
- No, too expensive
- No, other reason
- No opinion / I do not know

Installing heating and cooling equipment and use electric appliances with the best energy performance label?

- Yes, I already have done it
- Yes, as a priority
- Yes, but not as a priority
- No, I rent
- No, too expensive
- No, other reason
- No opinion / I do not know

Buying carbon free electricity or generating your own renewable electricity?

- Yes, I already have done it
- Yes, as a priority
- Yes, but not as a priority
- No, I rent
- No, too expensive
- No, other reason
- No opinion / I do not know

Having a smart meter and consuming electricity mostly when prices are low?

- Yes, I already have done it
- Yes, as a priority
- Yes, but not as a priority
- No, for privacy concern

- No, I do not want to change my consumption habits
- No, other reason
- No opinion / I do not know

### Domestic waste

Do you sort your waste (paper, plastics, glass, metal, glass, organic...)?

- Yes
- No
- I do not see the interest

What would make you increase the separation of waste (paper, plastics, glass, metal, glass, organic...)?

- Adapted infrastructure (containers, etc.)
- Awareness campaign
- Financial incentives such as deposit schemes
- Other

Do you think increased recycling and reuse are important to achieve greenhouse gas reductions?

- Yes
- No
- I do not know

### Mobility

To which extent would you support the following options that allow reducing the energy consumption and related CO<sub>2</sub> emissions?

Buying a vehicle that does not run on petrol or diesel (for instance an electric car)?

- Yes
- Yes, but only if not more expensive than conventional petrol or diesel cars
- Yes, but only if sufficient refuelling infrastructure is available
- No

Considering using car sharing services?

- Yes
- Yes, but only if an easy to use and affordable service is in place
- No

For short trips, avoiding private car and rather using public transport?

- Yes
- Yes but only if an accessible and regular service is in place
- No, because they are too slow
- No, because it is too expensive
- No

For short trips, avoiding private car and rather using (electric) bike or other active mobility modes?

- Yes
- Yes, but only if proper bike lanes are in place
- No

For longer distance, avoiding flights or car whenever an alternative is available?

- Yes
- Yes, provided a convenient alternative is in place
- No, too slow
- No, too expensive
- No, other reason

Do you think better urban planning would reduce the use of private cars and reduce congestion in the urban areas?

- Yes
- Yes, if combined with better public transport
- Yes, but difficult to put in place
- No

Do you think using more IT tools such as tele-working or video-conferencing could reduce mobility needs?

- Yes
- Yes, to some extent
- No, as difficult to put in place
- No

## Food

Food production, processing and delivery have an impact on greenhouse gas emissions and natural resources consumption.

Would you consider it important that further awareness raising is undertaken about the impact of various types of food consumption on climate?

- Yes
- No

Would you consider the impact of food on greenhouse gas emissions when buying it?

- Yes
- Yes, if information is available about the carbon intensity of food
- Not if more expensive
- No

Also taking into account the importance to have a balanced diet for health purposes, would you consider changing to a less carbon intensive food diet (e.g. reduce red meat consumption)?

- Yes
- No

- I would require more information before changing my diet

## Consumer goods and services

The products/services you consume and the way they are produced also impact energy consumption and related greenhouse gas emissions.

Do you ever consider the impact on greenhouse gas emissions when buying and consuming a product or services?

- Yes I do so regularly  
 Yes but I often lack the information to do so  
 No, I don't consider this

Would you consider buying products and services from companies that produce their goods and services in a greenhouse gas neutral manner?

- Yes  
 No, if more expensive  
 No, other  
 No opinion / I do not know

## Your work and your economic sector

For both individuals and organisations, details on the economic sector should be provided in Section 1.

## Employment and a socially fair transition

In the coming decades, the transition to a low carbon economy will impact even more how we work and how we produce goods and services. Which statements below correspond in your opinion to the impact of climate change and the low carbon transition in your working environment?

Do you expect your company to create or reduce jobs due to the low-carbon transition?

- Create  
 Reduce  
 No opinion / I do not know

What could affect your job most in the future?

- The low carbon transition  
 Digitalisation  
 Impact of globalisation  
 Socio-economic policies (for instance fiscal policy)  
 Other

\* If other, please specify:

*Text of 3 to 200 characters will be accepted*

All of the aspects listed here will significantly impact energy companies, in particular the low carbon transition and globalization.

Do you think you or the sector you are active in would benefit from training of staff in the context of the energy and low carbon economy transformation?

- Yes
- Yes, to some extent
- No
- No opinion / I do not know

### The impact of the low carbon transition on your sector

Do you consider the low carbon transition as an opportunity or as a challenge for your sector?

- An opportunity
- A challenge
- Both
- None
- No opinion / I do not know

Indicate by how much your sector could reduce greenhouse gas emissions by 2050 compared to today?

- It cannot reduce
- Up to half
- By more than half
- Can decarbonise entirely
- No opinion / I do not know

What would be the preferred route to reduce these emissions in your sector?

- Further electrify
- Use other low carbon fuels, like hydrogen
- Improve to the maximum energy efficiency
- Circular economy, including recycling and re-use
- Development of new products and business concepts
- Other
- No opinion / I do not know

\* If other, please specify:

*Text of 3 to 200 characters will be accepted*

A mix of technical solutions and changes in business models, including all of the options listed above, will be needed to succeed in the energy transition.

Will you (or your sector) invest in new low-carbon technologies?

- Yes, as a priority
- Yes, but not as a priority

- No, it has already invested enough
- No
- No opinion / I do not know

Do you think your sector could be further integrated with others so as to decrease emissions while increasing overall efficiency?

- Yes
- No
- No opinion / I do not know

If your sector can be further integrated to others, please mention how and to which sector(s):

*200 character(s) maximum*

Building on technologies optimizing the chemical formulation of their respective products, EU refineries could advance their integration with petrochemical sites into low-carbon manufacturing centres.

Do you think the low carbon transition will lead the EU economy to:

- Modernise and reinforce its competitiveness
- Modernise, and reinforce its competitiveness, but only if non-EU countries and regions also engage in the transition towards a low carbon economy
- Lose competitiveness
- No opinion / I do not know

Do you think the low carbon transition can help the EU industry modernise and grow?

- Yes
- Yes, but only with public support
- Yes, but only if non-EU countries and regions also engage in the transition towards a low carbon economy
- No
- No opinion / I do not know

How can opportunities and challenges (in particular related to carbon intensive sectors or regions) be addressed? What key economic transformations should the EU pursue to achieve a low carbon and resilient economy?

*1000 character(s) maximum*

We believe Europe has great technical and economic potential to deliver its GHG emissions reduction ambition under the Paris Agreement. It will require concerted political and societal willingness to achieve the level of aspired change. In developing the strategy, we encourage the Commission to allow all emissions reduction technologies to compete at a level playing field. The scale of the energy transition to Net Zero Emissions (NZE) requires all solutions to be explored and innovation to be strongly supported. The effective roll out emission reduction technologies at a scale that allows Europe to achieve NZE will bring with it deep economic transformations, as transport systems, production processes and consumption patterns will need to change. The deployment and scale of low carbon solutions should hence always be equally assessed against their impact on the competitiveness of its industry (jobs), energy poverty and energy supply and adequate mitigating measures should be taken.

## Energy

The energy system today is responsible for ca. 75% of the EU's greenhouse gases emissions and undergoes a rapid transition due to e.g. cost reduction of renewables, improvements of energy-efficiency and rapid development of new technologies (e.g. batteries) driven i.a. by policies put forward by the EU and its Member States. Accelerating this change will play a central role in the transition of our economy towards a carbon-neutral economy.

In the following table listing different energy technologies, please rank each option in the table below from 1 (important) to 5 (not important) on what role you think they will play in the clean energy transition (not all options need to be ranked)?

	1	2	3	4	5
Energy efficiency reducing the need to produce energy	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Renewable energy from wind, solar or hydro	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other forms of renewable energy, like geothermal, wave or tidal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Nuclear energy	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fossil fuels with Carbon Capture and Sequestration	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Solid biomass for heat and electricity production	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advanced Liquid Biofuels	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biogas from agricultural and domestic waste	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electricity storage (e.g. batteries)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hydrogen (produced in a carbon-neutral manner)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E-fuels derived from hydrogen	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What are the biggest opportunities, including for the wider economy? What are the biggest challenges, including as regards public acceptance or the availability of land and natural resources, related to these future developments?

*2000 character(s) maximum*

Technological options for decarbonization of industry exist. Electrification provides significant opportunity in the light industry sector and to a lesser extent in heavy industry. Similarly, efficiency and hydrogen deployment provide medium to high mitigation potential in the industry and their large-scale application should be enabled. Whilst opportunities exist, and we strongly encourage their pursuit, it needs to be recognized that development and deployment of abatement technologies, especially for the heavy industry, are costly and require significant investments and time to come to market. Mechanisms to maintain competitiveness whilst achieving decarbonization require a broad review of available instruments.

Different transport sectors will continue to need different fuels in the energy transition. Shell's Sky scenario shows that a technological, industrial and economically possible route forward includes, by 2050, passenger cars, buses and light/medium freight transport (last mile delivery) will predominantly be battery electric. Heavy duty road transport will start to use hydrogen and battery electric but will also continue to use a low carbon liquid such as advanced biofuels and gas (LNG). Aviation and marine will use low carbon fuels such as advanced biofuels and for aviation power-to-liquids as well. EU transport policies have the opportunity to remove the barriers to market entry of new technologies, creating incentives to implement the different low carbon options, driving behavior and adopting new mobility solutions (autonomous, shared). New business models based on digitization and the shared economy will start to reshape the transport system to deliver even more efficiency through on-demand intermodal mobility services, autonomous last mile micro-transit options etc.

The roll out of emissions reduction technologies and associated infrastructures must continue to guarantee energy security and manage impacts on jobs to maintain public acceptance.

## The role of Forests and Land Use

Today, EU's forests, agriculture and land absorb more CO<sub>2</sub> than they emit, which is referred to as the EU's sink. Forests and agriculture land produce renewable biomass that can be used to substitute other carbon intensive products or to produce bioenergy, which in turn reduce greenhouse gas emissions from fossil fuels and industrial processes. Depending on how this biomass is produced, this can impact the size of the EU's sink, as well impact other services delivered by agriculture and forest land including biodiversity and ecosystem services.

In the context of a long term strategy please rank each land-use activities in the table below from 1 (important) to 5 (not important) to indicate which are acceptable and can be important to reduce greenhouse gas emissions and increase CO<sub>2</sub> absorptions (not all options need to be ranked):

	1	2	3	4	5
Forest as a source for biomass for renewable energy	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest as a source of material for bio-based products	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest as a carbon sink storing CO <sub>2</sub>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Agriculture as a source of feedstock for bio-based materials	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Agriculture as a source for bio-energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
based on food crops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
based on agricultural wastes	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

based on woody biomass (e.g. perennials, woody and herbaceous crops, short rotation coppice)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Protecting and enhancing soil carbon stocks on agricultural land	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What should be the role of the land-use sector in reducing emissions and increasing absorptions emissions? For what purposes should biomass be used most to reduce greenhouse gas emissions? How and which sustainability concerns should be addressed?

*1000 character(s) maximum*

Sustainable biofuels will play an important role in meeting future demand for transport cost-effectively in a low carbon world. They can be used in current technology vehicles and infrastructure and hence their GHG benefits can be delivered immediately. Sustainable biofuels should be judged based on their carbon performance rather than feedstock. For biofuels made from food and feed crops (1G biofuels) if they fully meet the sustainability criteria in the Renewable Energy Directive and can be shown to have low land use change risk.

## Education, research and innovation

Considering the long time frame of the strategy, and the inherent magnitude of the decarbonisation transition, the central role of accelerating research and innovation for facilitating this transition will be crucial.

How best could awareness be raised to create the right attitude and values/ mind-sets?

*at most 3 choice(s)*

- At school through education
- Local and regional campaigning
- National and EU wide campaigning

On which sectors should R&D efforts focus primarily in the coming decade to best support the low carbon transition?

*at most 6 choice(s)*

- Energy
- Industrial processes
- Transport
- IT
- Agriculture
- Other field

On which cross-sectoral domains should R&D efforts focus in the coming decades? Is there a particular need for large scale deployment of certain innovative technologies? Is there a different role for authorities and private sector in support R&D and Innovation?

*1000 character(s) maximum*

Shell strongly welcomes the support that the EU has made available for research and innovation (R&I) through programs such as NER300 and Horizon 2020. R&I is and will remain critical to secure the competitiveness of Europe's economy and the prosperity of its citizens.

A balanced funding of low-carbon innovation should include CCUS, renewable energies and innovative low carbon technologies, including advanced transport fuels, energy storage and demand side response. Shell believes that focus should be maintained on funding projects or technologies that have the largest impact on reducing GHG emissions, job creation and on reducing technology costs over time ('minimum capacity and maturity requirements').

We support public-private partnership (PPP) models in R&I. PPP have the potential to turn science into marketable products and services through an alignment of objectives and collaboration throughout the value chain.

## Financing

In many cases, the low carbon economy and energy transition needs high upfront investments with subsequent reductions in operating and fuel costs. In addition, this transition as well as climate change itself will most likely affect the value of existing investments and assets of companies. Finally, to achieve the transition efficiently, the viability and profitability of investments need to be ensured on the long-term. Most of these investments will have to be funded via private finance.

Will the sector that you are active in require significant additional investment in the context of a transition to a low carbon economy?

- Yes
- No
- No opinion / I do not know

For the sector that you are active in, is there a financing gap for making the transition to a low carbon economy?

- Yes
- No
- No opinion / I do not know

Should public sector be more involved in ensuring adequate financing for the low carbon transition?

- Yes, through direct investment
- Yes, through measures ensuring more low cost finance for sustainable investments
- No because of the risk of prompting inefficient investment leading to stranded assets
- No because of crowding effects on other sectors
- No opinion / I do not know

Would you consider that, in your sector, companies are sufficiently transparent about the financial risks they face due to climate change and the low carbon economy and energy transition?

- Yes
- No
- No opinion / I do not know

## Meta trends

Do you think the following trends are important to reduce greenhouse gas emissions.

Economic transition towards a more circular economy?

- Positive
- Negative
- Neutral

Digitalisation, including robotisation and artificial intelligence?

- Positive
- Negative
- Neutral

Shared economy?

- Positive
- Negative
- Neutral

Further interdependency of sectors across borders through globalisation?

- Positive
- Negative
- Neutral

## Actors

Local authorities such as cities and local communities, as well as other actors such as civil society and the private sector, can play an important role in achieving the energy transformation, reducing greenhouse gas emissions and adapting to climate change. Indeed thousands of cities, companies and citizens' organisations are implementing the low carbon economy and energy transition through projects covering energy, transport, food and waste management, often achieving important local co-benefits related to economic development, health and wellbeing.

Which of these non-state actors do you think will impact most your or your sector's contribution to delivering the EU's ambition to become a low carbon economy?

- Regional government
- Towns and cities
- Businesses
- Philanthropies
- Civil society (NGOs, ..)
- Religious groups

Do you have an example that you think is of particular importance to underline the role of such local and private sector actors in supporting the low carbon economy and energy transition?

*1000 character(s) maximum*

Shell Pernis refinery, Warmtebedrijf Rotterdam (residential heat provider) and the Harbour of Rotterdam are investing in a residual heat project in Katendrecht, a residential neighborhood in the city of Rotterdam. Pernis is committing to deliver residual heat to the Warmtebedrijf, who will deliver heat to 16,000 households. The Harbour of Rotterdam is investing in the heat transport infrastructure. Pernis could save an estimated 35,000 ton CO<sub>2</sub> per year with this project.

Such integrated projects are only possible in coordination and cooperation with all stakeholders from the very beginning. This project fulfils Shell's Pernis refinery annual energy efficiency obligation, which counts towards the 2020 energy efficiency target of The Netherlands. For Warmtebedrijf and the Harbour, this project is a test case and if successful, can be a stepping stone to larger projects in the region.

## Adaptation

The adverse effects of climate change will increase in the coming decades unless strong mitigation policies are implemented globally. In your place of living, which of the following actions do you think will be necessary to prepare for the likely effects of climate change? Please rank each option in the table below from 1 (important) to 5 (not important) to indicate which, in your place of living, you think will be necessary to prepare for the likely effects of climate change (not all options need to be ranked).

	1	2	3	4	5
Scientific research on the local effects of climate change in the place where you live	<input type="radio"/>				
Reinforcement of infrastructure (transport, energy, communication networks) to withstand natural disasters	<input type="radio"/>				
Preparation for floods (water retention, dykes, designated flood plains /areas, restriction of activities in areas at flood risks, floating houses etc.)	<input type="radio"/>				
Adaptation of agriculture to the changing climate (e.g. water efficient irrigation, selecting different crops)	<input type="radio"/>				
Heat wave action plans	<input type="radio"/>				
Increase of green areas in towns to cope with heatwaves / floods	<input type="radio"/>				
Encouragement of water saving and reuse	<input type="radio"/>				
Forest fire prevention (e.g. awareness raising campaigns, forest management...)	<input type="radio"/>				
Reinforcement and protection of the seacoast	<input type="radio"/>				
Early warning systems for natural disasters (heatwaves, floods, forest fires...)	<input type="radio"/>				
Communication to the public about the need to adapt to climate change	<input type="radio"/>				

Improved insurance products against damage from the effects of climate change	<input type="radio"/>				
Better understanding of the security effects of climate change on the EU (e.g. flows of migrants, global water and food scarcity, agricultural trade)	<input type="radio"/>				

Which adaptation measures are of particular importance for your sector and why?

*1000 character(s) maximum*

### Specific sectoral questions

These questions are focused on sector specific greenhouse gas reduction options, and as such are primarily directed to sectoral stakeholders.

### Reducing industrial greenhouse emissions

Industry has a diverse set of greenhouse gas emissions sources, the majority are linked to energy consumption but also a significant amount of emissions comes from chemical processes, for instance in the steel, cement and chemical sectors.

Industry has a number of mitigation options to reduce its greenhouse gas emissions. These typically involve improved efficiency (e.g. using more efficient products and technologies, reusing waste heat, etc.) and fuel substitution (e.g. electrification of its processes). But it also includes feedstock substitution, be it with bio-material or by employing Carbon Capture and Utilisation (CCU) technologies that see CO<sub>2</sub> emissions being re-used in other production processes. These technologies also often benefit from further integration of energy and industrial sectors.

Please indicate for which sector you see any of the above or other mitigation options of particular importance. Please indicate what your view is in terms of mitigation potential, economic potential and technology readiness. Assess each option as High, Medium, Low or Zero for each criterion and indicate in which year you think the technology would be ready for large scale deployment.

	Industrial Sector	Technology option	Mitigation potential	Economic viability	Technology readiness	Year of large scale deployment
1	Light industry	biomass - feedstock (commercial)	low	Low	Low	n/a
2	Light industry	hydrogen - bio - replacing natural gas	low	Low	Low	post 2050
3	Light industry	electrification	high	Medium	high	post 2030
4	Light industry	CCS	medium	Low	medium	post 2030
5	Light industry	efficiency	high	High	high	now
6	Heavy industry	biomass - feedstock (commercial)	medium	Low	high	n/a
7	Heavy industry	hydrogen - bio - replacing natural gas	Medium (high up to 50% electrification)	Low (medium up to 50% electrification)	medium	post 2040 (post 2030 up to 50% electrification)

8	Heavy industry	efficiency	medium	Medium	medium	post 2030
9	Heavy industry	electrification - complete	high	Low	Low	post 2050
10	Heavy industry	CCS	high	Medium	medium	post 2030

## Reducing greenhouse emissions from transport

Transport has a number of options to reduce its greenhouse gas emissions. While low- or zero-emission technologies are already successfully deployed for parts of the transport sector (e.g. cars and vans), the technological development is in earlier stages of development or deployment for other parts of the transport sector (e.g. long-haul trucks, aviation or maritime).

Please indicate for which part of the transport sector you see particular mitigation options and their importance. Please indicate what your view is in terms of mitigation potential, economic potential and technology readiness. Assess each option as High, Medium, Low or Zero for each criterion and indicate in which year you think the technology would be ready for large scale deployment.

	Transport Sector	Technology option	Mitigation potential	Economic viability	Technology readiness	Year of large scale deployment
1	All	Advanced biofuels (Liquid and gas)	Medium	Medium	Medium	2030
2	Aviation	Power to liquids	High	Low	Low	2050+
3	Aviation	Fuels from waste gases	High	Medium	Low	2030+
4	Road transport - light and heavy duty	Battery electric – grid is renewable	High	Medium	High	2025+ for light duty 2030+ for heavy duty
5	Road transport - light and heavy duty	Renewable Hydrogen produced with green electricity	High	Medium	High	2030+
6	Road transport - light and heavy duty	Power to liquids	High (with “green” electricity to produce PtX)	Low	Low	2050+
7	Heavy duty road and shipping	Natural Gas (LNG)	Medium	Medium	High	From now
8	Shipping	Ammonia	High	Low	Low	2045+

9	Shipping	Battery electric – grid is renewable	High	Low	Medium	2025+
10	Rail	electricity	High	High	High	Now

In addition, would you please indicate your choice for the following options that allow reducing the energy consumption and related CO<sub>2</sub> emissions?

For freight transport, would you consider switching from road to alternative modes like rail, waterways or coastal shipping?

- Yes
- No, too slow or complicated
- No, too expensive
- No opinion / I do not know

For first/last mile logistics in urban areas, would you consider switching from road to alternative modes like (electric) cargo bike or similar zero-emission vehicle?

- Yes, I am already doing it
- Yes, in the future
- No, too slow
- No
- No opinion / I don't know

### Reducing greenhouse emissions from agriculture

Several options exist to reduce greenhouse gas emissions in agriculture even though the mitigation potential of the agricultural sector, notably related to the sector's non-CO<sub>2</sub> emissions, is seen as more limited than for other sectors. Furthermore, agriculture is a sector that through its impact on land use also will affect how our natural sink, and thus the related CO<sub>2</sub> absorptions, will evolve.

Please indicate which mitigation options are of particular importance. Assess each option as High, Medium, Low or Zero for each criterion and indicate in which year you think the technology would be ready for large scale deployment.

	Agriculture sector	Technology option	Mitigation potential	Economic viability	Technology readiness	Year of large scale deployment
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

## Role of CO<sub>2</sub> removal

The objectives of the Paris Agreement are challenging and many scientists consider that it will be necessary at a certain point to remove a significant amount of CO<sub>2</sub> from the atmosphere in order to stay below 2°C and certainly in case the temperature increase should be limited to 1.5°C. There are a limited number of options to remove CO<sub>2</sub> from the atmosphere.

The removal of CO<sub>2</sub> can be accomplished by 1) capturing CO<sub>2</sub> via natural photosynthesis or artificial chemical processes, and then 2) storing CO<sub>2</sub> in long term geological sites or within biomass and (bio) materials.

Rank from 1 (important) to 5 (not important) on what role you think this removal and storage options can have in the EU to deliver negative emissions taking into account issues such as economic and technical feasibility, storage potential, environmental integrity and social acceptance.

### Capture of CO<sub>2</sub> from the atmosphere

	1	2	3	4	5
Intensive afforestation	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest and cropland residues	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Woody perennial plantations	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Direct Air Capture	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* If other, please specify:

*Text of 3 to 200 characters will be accepted*

Improved management of existing forests in Europe also provides important opportunity for CO<sub>2</sub> capture. Generally, Nature Based Solutions are proven, available, scalable and cost competitive.

### Storage of CO<sub>2</sub>

	1	2	3	4	5
Carbon capture and storage (CCS) with enhanced oil or gas recovery	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CCS in onshore geological sites	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CCS in offshore geological sites	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carbon Capture and Utilisation (CCU) (long lived products)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Increased permanent carbon stock in soils	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increased permanent carbon stock in plants	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What main barriers do you see currently preventing the large scale deployment of CCS, including on how to use it to generate negative emissions? What are the particular challenges related to biomass CCS? What type of CCU (Carbon Capture and Utilization) would lend itself to create long term storage? Are there other technologies that should also be considered? What policies do you think the EU should pursue to better help development and deployment?

*1000 character(s) maximum*

Current high capital and operating costs combined with the absence of an associated revenue stream and/or high enough price on CO2 emissions deter investment in CCS. If the value of CCS to society is to be realized, investment must be stimulated which in turn will reduce the cost of future deployments and improve the economic competitiveness of the technology. We welcome the proposal for an Innovation Fund in helping the development of CCUS technology at scale.

CCU could become effective in the EU's future energy system and support a circular economy. An important next step in the roll out of CCU would be to determine its mitigation value, as there is currently no established protocol to assess the mitigation value of CCU applications.

## Additional Comments

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If you wish to add further information, comments or suggestions - within the scope of this questionnaire - please feel free to do so here:

*1000 character(s) maximum*

Please see attached paper for our response on the opportunities we see for Europe's energy transition. We are committed to keep pace with the changes in Europe's wider energy system and to partner with European governments through this transition. In November 2017, Shell announced our ambition to halve the net carbon footprint of the energy products it sells by 2050 in step with society's drive to reduce greenhouse gas emissions. This means supplying energy products and services that our customers need, now and in the future, and developing a resilient portfolio in line with our purpose of providing more and cleaner energy to society.

In addition, you could also upload a document proving further information, comments or suggestions:

The maximum file size is 1 MB

## Contact

CLIMA-ENER-LONG-TERM-STRATEGY@ec.europa.eu

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