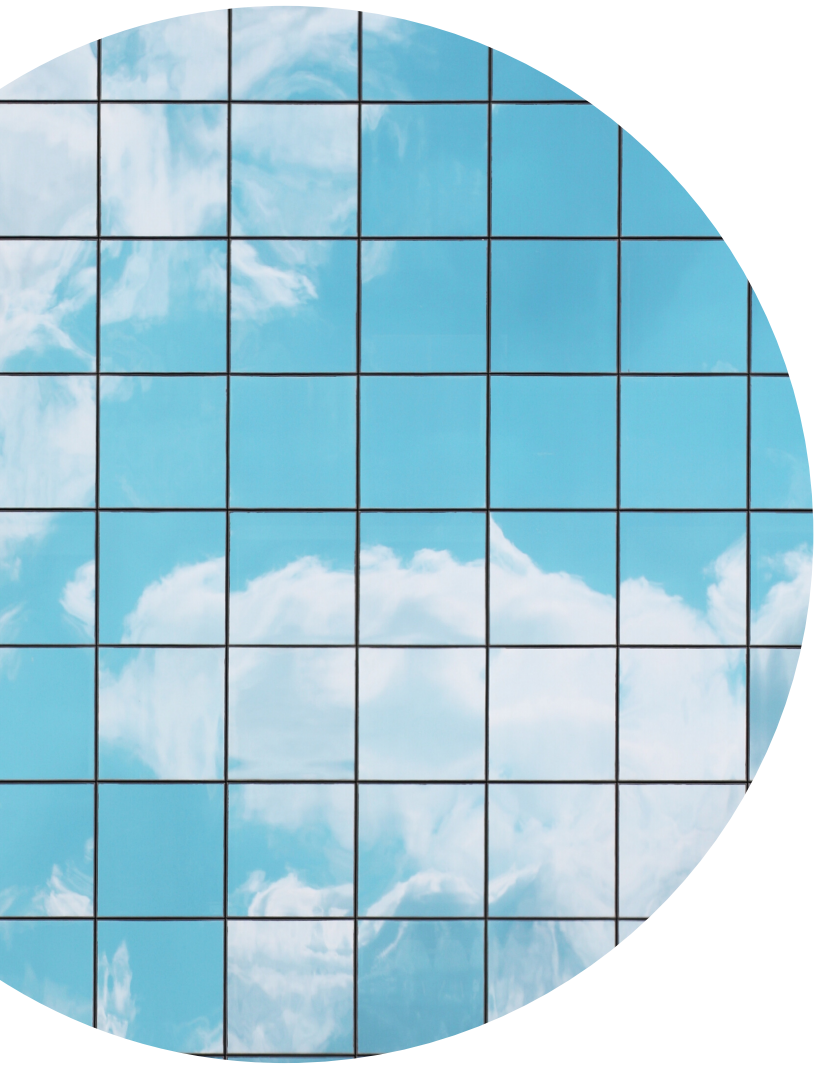
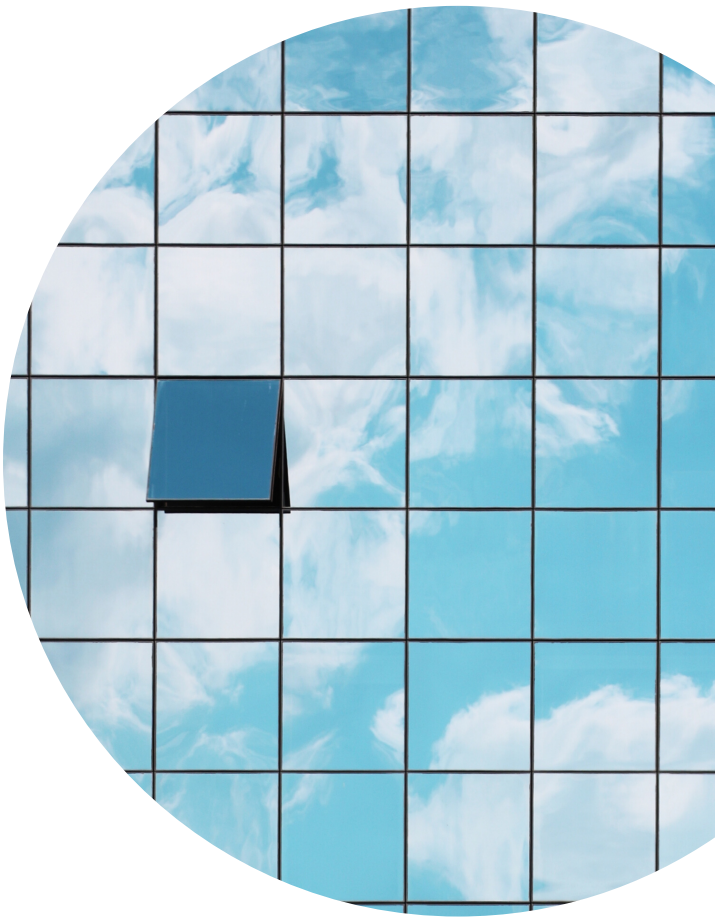
European Association for Storage of Energy

# Energy Storage for a Decarbonised Europe by 2050

Brussels, November 2019





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# Executive Summary

## EASE fully supports the European Commission President-Elect Ursula von der Leyen's proposal for a European Green Deal.

We believe that a range of concrete policy measures are needed to support the achievement of ambitious decarbonisation targets, while supporting the competitiveness of European industry. These measures should aim at facilitating the transition to a renewables-based energy system supported by energy storage and other flexibility providers, in order to ensure security of supply, efficient energy system operation, and the competitiveness of EU industries.

Supporting the development and deployment of energy storage technologies should be a central element of the European Green Deal. Energy storage can provide much-needed flexibility across different timescales, which is essential to transition to a system dominated by variable renewables. Storage can be installed in consumers' homes, commercial and industrial facilities, and at larger scale connected directly to the grid.

Therefore, energy storage has the potential to support decarbonisation and flexibility in many different locations of the grid, and can adapt very well to different energy mixes, demand profiles, and other attributes that differ across the EU Member States.

Energy storage is therefore a key element of the energy transition, supporting several key priorities of the European Green Deal:

- Achieving ambitious 2050 and 2030 decarbonisation targets requires increased deployment of energy storage solutions, which can support a cost-effective transition by facilitating integration of high shares of variable renewables (vRES).

- Investing in energy storage research, demonstration, and deployment is essential to support the EU's global leadership in clean energy technologies.

- Energy storage will support the energy transition across the entire EU and in particular, has the potential to facilitate the transition of industrial, coal, and energy intensive regions (since existing infrastructure can be upgraded or complemented with energy storage solutions), and islands (where energy storage allows reducing the use of costly imported fossil fuels).

- Deployed behind-the-meter, energy storage can support energy efficiency and energy optimisation, as well as citizens' engagement in and ownership of the energy transition.

- Energy storage can support the decarbonisation of the mobility sector, helping achieve the EU's zero-pollution ambition.

- Energy storage can also increase overall system efficiency by enabling sector integration. Power-to-Gas and Power-to-Liquid technologies, by converting renewable and low-carbon electricity into other energy carriers, can contribute to the higher integration of vRES, bring additional and longer-duration flexibility to the energy system, and help in decarbonising the EU economy in line with the Paris Agreement.

# EASE Recommendations

The energy storage sector is committed to supporting the EU's ambitious decarbonisation efforts. But actions by EU policymakers are essential to enable energy storage to reach its full potential:

- Ambitious targets must be set for decarbonisation. EASE supports the target of a net-zero emissions power system by 2050, as well as an upward revision of the 2030 greenhouse gas emission reduction objectives.

- Keeping in mind the need for increased energy storage deployment to achieve very high vRES levels while reducing curtailment and ensuring optimal use of renewable energy, policymakers should increase their efforts to support the development and deployment of all energy storage technologies. In particular, rapid implementation of the Clean Energy for All Europeans Package is essential to support the achievement of the European Green Deal objectives.

- Technology neutrality should be at the centre of EU energy storage policy: the whole "toolbox" of different energy storage technologies should be developed and deployed across the EU in order to provide flexibility in different locations and at different timescales.

- Improving the modelling used for assessing decarbonisation pathways and associated policy options is a key priority, as this will inform the future legislation and market design, not only for energy storage but for the broader energy system. Energy systems need ever faster balancing, in seconds and minutes, while energy system models often do not resolve below the hour. This is a key barrier that prevents accurate modelling of the energy system and realistic assessment of decarbonisation pathways.

- In order to support the development of storage solutions capable of providing flexibility at a longer duration and/or through sector integration, it is essential to clarify the regulatory framework applicable to Power-to-Gas and Power-to-Liquid facilities and to create a supportive environment for the development and deployment of these technologies.[1]

- The role and value of behind-the-meter storage should be fully recognised in the EU's decarbonisation strategy and energy efficiency measures, for instance in the Smart Readiness Indicator.

Scaling up investments in clean energy is essential, and increased investments in storage solutions will yield particularly high returns. A strategy for green financing, the Sustainable Europe Investment Plan, and the evolution of the European Investment Bank into Europe's "climate bank" will be a great help. EASE supports the Just Transition Fund and other measures to facilitate financing and deployment of clean energy projects in industrial, coal and energy intensive regions, as well as on islands.

[1] Please see EASE's Recommendations on Certification of Renewable and Low-Carbon Hydrogen.

# Introduction

## The EU's response to climate change has been designated by Commission President-elect Ursula von der Leyen as one of the top priorities of the next EU legislative term.

In the first 100 days of the von der Leyen Commission's entry into office, a proposal will be put forward for a European Green Deal with a comprehensive strategy for achieving ambitious decarbonisation targets.

The energy storage sector supports this important initiative and is committed to playing its part in supporting the cost-effective, secure, and efficient transition to a net-zero emissions power system by 2050.

Energy storage deployment can facilitate this transition in many ways, for example by:

- Enabling higher shares of variable renewable energy sources (vRES) in the energy mix, while reducing vRES curtailment in times of oversupply;
- Supporting electrification of the heating, cooling, and transport sectors as well as linking the electricity and gas sectors;
- Supporting secure, cost-effective, and efficient operation of the grid by providing key flexibility services at all levels of the energy system, including transmission and distribution;
- Extending the lifetime of existing grid assets and avoiding the risk of stranded assets in the gas grid;
- Allowing active consumers to optimise self-consumption and/or provision of flexibility services to the grid;
- Ensuring security of supply: avoiding photovoltaic and wind curtailment can reduce dependence on importing fuels;
- Improving energy efficiency of existing power generation assets;
- Enabling a faster energy transition on islands and in isolated areas.

However, energy storage can only reach its full potential if it is supported by EU policymakers and considered across all relevant policy initiatives:

- EU Strategy for Greenhouse Gas Emissions Reductions;
- European Green Deal;
- Gas Decarbonisation Package;
- Energy Efficiency and Consumer Engagement;
- Alternative Fuels Infrastructure Directive.

# EASE's Views on the 2050 Long-Term Strategy and Decarbonisation Targets

## EASE welcomes the European Commission's proposed 2050 strategy which stresses the essential role of storage for achieving the EU's greenhouse gas emissions reduction targets.

One of the most important focus areas of the next European Commission will be the setting of ambitious targets for greenhouse gas emissions reductions and the elaboration of a strategy to achieve these targets and deliver on the Paris Agreement. The debate on targets and decarbonisation pathways was kick-started by the European Commission's 2018 "Clean Planet for all" communication, which was accompanied by an in-depth analysis.

In all scenarios put forward by the Commission, energy storage capacity is expected to increase significantly compared to today's levels. As the Commission's proposal sets the groundwork for the EU's approach, to be enshrined in a European Climate Law and supported by the European Green Deal, EASE would like to make some suggestions that could strengthen this strategy and enable the levels of storage deployment that will be needed to reach the ambitious decarbonisation targets.

## The Scenarios and Decarbonisation Targets

EASE is committed to facilitating the achievement of a net-zero emissions power system by 2050. We believe that an 80% reduction will not be sufficient for achieving the 2°C target for global warming. In light of the recently published IPCC Special Report on the impacts of global warming of 1.5°C above preindustrial levels, decisive action must be taken as soon as possible in order to reaffirm the EU's commitment to achieving the Paris targets and secure investor confidence in clean energy technologies.

For this reason, we also support a revision of the 2030 targets to increase the greenhouse gas emission reduction objectives. We believe that it is important to set challenging short-term as well as long-term targets in order to clearly signal the EU's commitment to addressing the climate challenge.

With increasing shares of variable renewables and a more complex, decentralised energy system, there is a strong need for additional flexibility sources such as storage facilities, closer coordination of national energy policies, and network operators being given the necessary leeway in operational tasks. This should be respected in parallel to the setting of the political objectives for the future. The achievement of decarbonisation targets must be consistent with the objectives of security of supply as well as competitiveness, which are the two other major axes of European energy policy.

# Energy System Modelling

The European Commission's Communication "A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy" is mainly based on the PRIMES (Price-Induced Market Equilibrium System) energy system model that focuses on prices as a means of balancing demand and supply simultaneously in several markets for energy and emissions. However, the PRIMES model does not take into account intra-hour effects, and therefore does not fully recognise the added value of short-term flexibility.

Since a large portion of energy storage facilities provide short-duration services (e.g. ancillary services such as primary frequency control with a duration of 15-30 minutes), the value of energy storage is systematically underrepresented in the PRIMES model. As there may be a strong need for short-term flexibility in a scenario with 95% renewables, we believe that the scenarios under consideration must include flexibility needs at different timescales, including intra-hour. In addition, the modelling should also integrate capacity and technical network constraints that can be solved with energy storage; otherwise its value would be significantly underestimated.

New modelling methodologies are also required to capture the impact that network constraints and congestions will have on energy prices. Storage can help reduce network issues and unless this is captured in a model, the value it generates is significantly underrepresented. At times of low demand of electricity and high renewables penetration, there is an increase in the cost to operate the system, therefore models should also account for technical limitations that storage can help solve.

# Storage Capacity Modelling

All scenarios developed by the Commission in its in-depth analysis supporting the "Clean Planet for All" Communication converge on one element: storage capacity will significantly increase to enable integration of higher shares of variable renewables in a faster and more efficient way. Total stationary storage used in the power system is expected to reach between 250 TWh and 450 TWh by 2050. Although the Communication stresses the essential role of storage and foresees significant increases in energy storage capacity across all scenarios, we find that there are some issues with the modelling and estimations for storage deployment.[2]

## Front-of-meter energy storage

In the analysis supporting the 2050 strategy, storage devices located front-of-meter are clearly taken into account and their storage capacity is quantified. However, since the modelling does not cover intra-hour effects, shorter duration energy storage applications are not considered and the related capacity is not quantified.

Furthermore, there is a misalignment between the definition of energy storage under the Electricity Directive (recast) and the different categories described in the analysis.

The Electricity Directive defines energy storage as "deferring the final use of electricity to a later moment than when it was generated or the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy or use as another energy carrier."

[2] It must be noted that the European Commission warns that the scenarios in this study have a normative rather than a forecasting character. They indicate cost-effective pathways for the achievement of given 2050 decarbonisation objectives, assuming perfect operation of energy markets and willingness of economic actors/consumers to invest in new technologies.

The analysis supporting the 2050 strategy separates storage into conventional/"direct" storage and "indirect" storage. Indirect storage, defined as the production of e-fuels "at times of high availability of renewables and, in this way, reducing the needs of storage for the system", is not quantified in the analysis.

However, the document makes a further distinction for "explicit chemical" storage of electricity using hydrogen and e-fuels, which are produced at times of abundant energy and used at times of scarce energy: "In the context of explicit chemical storage, the power system, and not final demand consumers, use hydrogen and e-fuels." Unlike "indirect" storage, explicit chemical storage is quantified in the analysis. Therefore, the 2050 strategy is limited to Power-to-Power technologies; it classifies Power-to-X facilities as "indirect" energy storage and does not quantify their capacity.

EASE stresses that the expected capacity increase of Power-to-X should also be quantified in the analysis. To do otherwise would be inconsistent with the definition of energy storage in the Electricity Directive (recast), which also includes Power-to-X technologies as energy storage.

**The expected capacity increase of Power-to-X should also be quantified in the analysis. To do otherwise would be inconsistent with the definition of energy storage in accord to the Electricity Directive.**

## Behind-the-meter and distributed energy storage

In the Commission's analysis, behind-the-meter energy storage devices are identified as a demand component. They appear to be implicitly included in the modelling related to energy efficiency/energy performance in buildings. The expected storage capacity behind-the-meter is not quantified, however, nor is the contribution of distributed storage to flexibility.

The role of demand response as a whole has not been sufficiently taken into account. This is particularly important since according to the European Market Monitor on Energy Storage [3], from 2019 onwards, the majority of electrical energy storage capacity installed each year will be residential or commercial & industrial storage. This is not even counting the number of thermal storage devices installed behind-the-meter, which can provide even more flexibility to the system.

Furthermore, distributed storage such as electric vehicle batteries is likely to play a much more important role than suggested in the strategy. While the impact of electric vehicles (EVs) on greenhouse gas emissions reductions is quantified in the analysis, the impact of EV roll-out in terms of providing flexibility to the grid (via smart charging/vehicle-to-grid services) is not analysed.

EASE therefore emphasises that the potential of all distributed flexibility resources, including distributed storage, should be correctly assessed in the EU's 2050 strategy. Distributed storage, supported by digitalisation, can provide flexibility at low cost via smart-charging, vehicle-to-grid services or enhancing the "smartness" of the entire energy storage infrastructure to achieve the highest level of renewable penetration.

**The potential of all distributed flexibility resources, including distributed storage, should be correctly assessed in the EU's 2050 strategy.**

[3] Please see EASE - Delta-ee "European Market Monitor on Energy Storage 3.0".

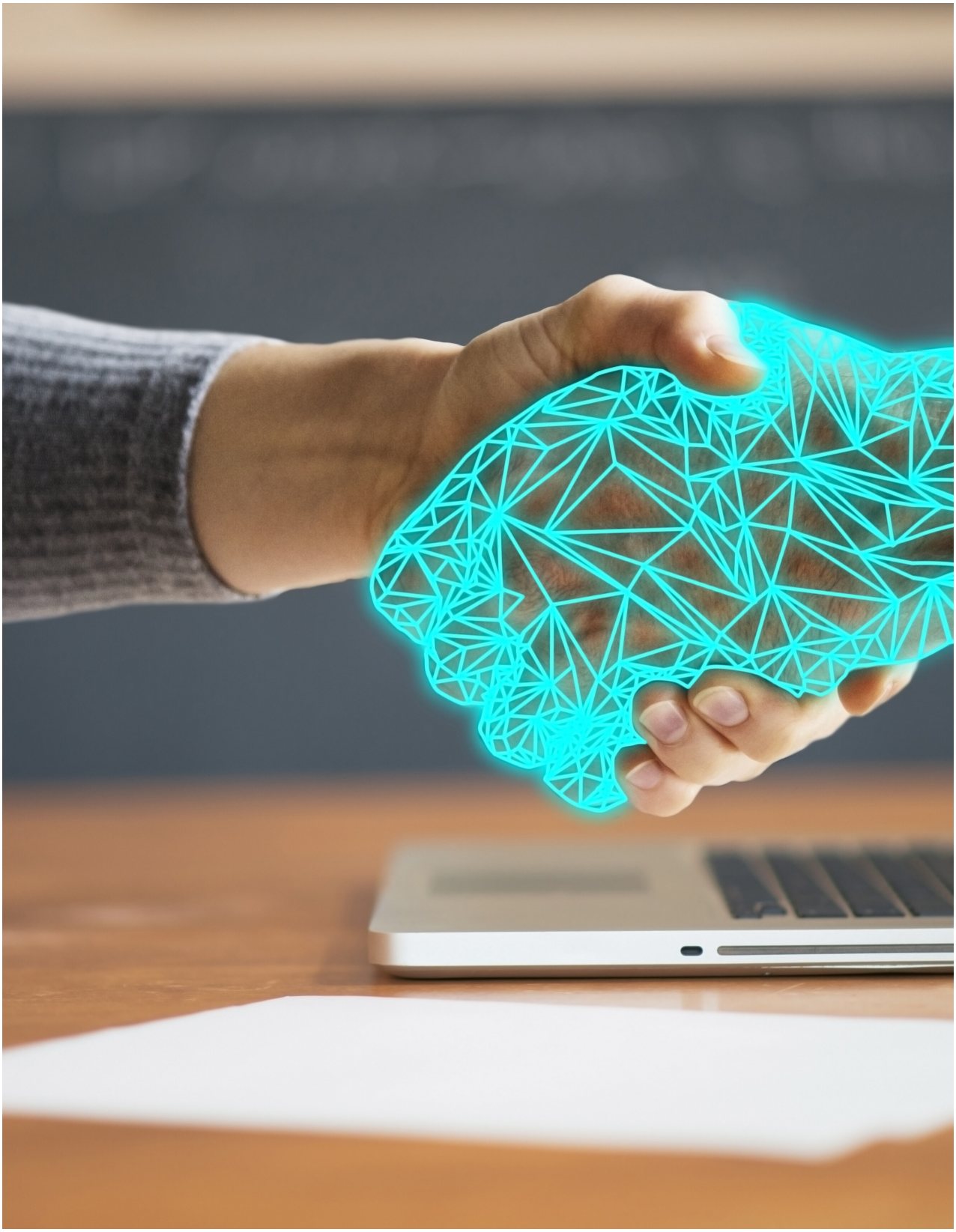
# Technology Neutrality

When the Commission analysis delivers an energy storage capacity forecast, it is based either on a handful of mature storage technologies such as pumped hydro storage or batteries, or on some cross-sectoral conversion and storage solutions, namely Power-to-Gas. This means that the approach is not technology neutral and does not consider the huge diversity of storage technologies, deployment possibilities, and applications. The analysis therefore misses some of the aspects that make energy storage such a versatile and valuable technology at all different locations of the grid.

EASE supports a technology neutral approach. It is important to ensure a level playing field for all energy storage solutions in order to allow market forces to drive the choice of technology, thereby avoiding picking winners and losers through administrative decisions. Future energy systems will rely on a wide range of services based on energy storage. This set of service needs - with varying performance and charge/discharge cycle requirements - entails a significant role of different storage technologies. [4] Therefore, a wide range of different storage solutions will be needed in the future energy system and many innovative energy storage technologies are expected to be deployed in the coming years.

We recognise that the reliability of the simulation result depends on the quality of the input data and that where less established technologies are included in the modelling, this should be cautiously approached. However, high-quality input data is available for the most advanced energy storage technologies. We believe power-to-heat and heat storage technologies, Compressed and Liquid Air Energy Storage (CAES, LAES) or Redox-Flow Batteries are good candidate technologies to be included due to the wide availability of data. [5]

[4] Energy storage can provide valuable flexibility to the system at various time-scales, from seconds and hours to weeks and months. Short-duration storage technologies such as flywheels and batteries can respond to imbalances created by higher shares of RES within milliseconds, while longer-duration technologies like pumped hydro storage (PHS) or hydrogen storage can provide weekly, monthly, or even seasonal storage. Therefore, all storage technologies are needed to ensure a smooth energy transition. See “EASE Reply to European Commission’s Questions on “The Future of Energy Storage in the EU”.
[5] Please see EASE’s “Thermal Storage Position Paper”.



It is important to ensure a level playing field for all energy storage technologies in order to allow market forces to drive the choice of technology, thereby avoiding picking winners and losers through administrative decisions. Future energy systems will rely on a wide range of services based on energy storage.

# EASE's Recommendations for the 2019-2024 Legislative Term

Given the vital importance of pursuing a successful decarbonisation strategy, we believe key actions should be taken now to unleash the full potential of energy storage solutions. With this in mind, EASE proposes several recommendations related to the EU's policy priorities across the energy sector.

# On the Establishment of a Regulatory Framework Conducive to the Development of Storage

- To maximise the benefits of clean energy technology innovations for the whole European society, it is important to promote forward-looking regulation, fostering innovation, more flexible behavior, and consideration of the role of new players in an energy system that is more complex than in the past.

- Rapid implementation of the Clean Energy for All Europeans Package is essential in order to open up markets across the EU to energy storage technologies. Support should be given to Member States that are implementing policies for energy storage for the first time in their regulatory frameworks.

- The immense value of energy storage should be duly considered in the elaboration and implementation of all European and Member State policy measures, including National Energy and Climate Plans, the Clean Energy for EU Islands initiative, the European Green Deal, energy efficiency legislation (e.g. Smart Readiness Indicator), revision of the gas market, the review of the Alternative Fuels Infrastructure Directive, and Horizon Europe.

- Long-term contracts should be allowed for services offered by storage facilities – provided there is a level playing field with other flexibility technologies, and when it is economically efficient - in order to increase investment certainty and speed up the deployment of storage solutions.

- Vehicle-to-grid integration technologies and processes, including smart charging, will enable mitigating peaks created by a high number of electric vehicles charging simultaneously. EV batteries could actively work as storage systems and solve this issue by managing electricity loads across infrastructure assets and time. In order to do so, network tariffs should be designed to incentivise EVs to recharge when it is most efficient for the system. Appropriate taxes, grid fees, and levies placed on energy storage facilities are key to allow for a robust storage business case. In particular, double charging of storage facilities should be avoided, i.e. no double taxes on the part of energy stored to be fed back to the system, when storage is providing beneficial services to the grid. [6]

- In each system where it will be relevant, specific market products should be developed that reward technologies bringing a clear added value in ensuring stability and operability of the system in a cost-effective manner (e.g. fast frequency response in Ireland). The value of energy storage facilities' exceptionally fast reaction time or flexibility and their contribution to the reduction of renewable curtailment are not yet recognised at European level. There is often a lack of clarity about which services can be combined or "stacked" on one device, i.e. enabling a storage facility to provide various services to various stakeholders (generators, consumers, network operators). "Stacking" multiple revenues is key to improve the business case for storage, and this should be considered when developing and tendering market products. [7]

[6] Please see EASE Paper: "Energy Storage: A Key Enabler for the Decarbonisation of the Transport Sector".
[7] Please see EASE Paper: "Maximising Social Welfare of Energy Storage Facilities through Multi-Service Business Cases"

# On the 2050 Long-Term Strategy and Decarbonisation Targets

- EASE is committed to facilitate the achievement of a net-zero emissions power system by 2050, and calls on the EU to raise its greenhouse gas reduction target for 2030. We consider that an 80% reduction will not be in line with a “post-Paris” perspective.

- It is fundamentally important to improve the modelling used to assess decarbonisation pathways. This will inform the future legislation and market design, not only for energy storage but for the broader energy system. We understand that modelling has limitations as it can only suggest a least-cost trajectory. However, we believe that a concerted effort should be made to develop better modelling based on reliable data and realistic assumptions.

- The modelling should consider synergies between sectors, in particular energy and transport, which constitute new sources of flexibility and will help to accelerate the energy transition. By 2050, forward-looking scenarios anticipate consumer behavior that will lead to greater flexibility and more active participation in the functioning of the electricity system. This subject is not sufficiently studied by the long-term scenarios selected in support of the 2050 strategy. It should be given a more prominent place in order to better understand the consequences of new flexibility, sector integration, and more active consumers for the energy system. In each of the long-term scenarios, the utility of electricity networks and their coupling with other energy networks (gas, heat) and sectors (EV) for the community should be measured and cost-benefit analyses systematically conducted, taking into account the widest possible range of technological options available by 2050.

- The huge potential of behind-the-meter storage should not be underestimated, as was done in the in-depth analysis. Behind-the-meter storage can provide flexibility at low cost, via smart-charging and vehicle-to-grid services.

# On Technology Neutrality

There is a huge diversity among different energy storage technologies, which represents an immense added value for the system. The aim of policymakers should be to create a level playing field between different energy storage solutions, allowing a whole "toolbox" of diverse technologies and applications to emerge. This has several key benefits:

- Specific solutions can be developed to provide a given set of applications (e.g. ancillary services, arbitrage, back-up power, integration of v-RES, sector integration, end user energy management, EV charging integration, ...) in a variety of locations (e.g. non-interconnected islands, weak grids, customer premises, commercial and industrial locations, ...).

- Different technologies can meet flexibility needs at different time scales (seconds to minutes, hours, days, weeks, even months). Hybrid storage systems – combining two or more storage technologies into one facility – could also be allowed to develop where there is a business case.

- Energy storage can support Member States with different energy mixes, decarbonisation challenges, and demand profiles decarbonise with energy storage solutions that can fit their specific needs.

- Breakthrough technologies and innovative approaches in the energy storage sector can be deployed more rapidly, as they will face fewer barriers due to policies elaborated with a focus on specific technologies.

EASE highlights the following priorities with relation to ensuring technology neutrality in policymaking:

- The definition of energy storage in the recast Electricity Directive should be followed by EU policymakers and implemented across all Member States to ensure a framework that is open to all storage technologies on a level playing field, including Power-to-X.

- The flexibility of all of the different types of storage should be considered, wherever possible, in the modelling for decarbonisation pathways.

- The EU should avoid picking winners and losers based on a short-term view of energy system developments.

- Well-functioning markets should be developed for flexibility services, including for different timescales (short-duration, medium-duration, long-duration). They must be open to the participation of all energy resources and should be neutral on whether such participation is direct (i.e. same energy carrier) or indirect (i.e. energy conversion to a different energy carrier).

- Policymakers should ensure integrated system planning and effective coordination between the different energy carriers across all timeframes – i.e. coordination of infrastructure planning, risk preparedness, system operation, etc. to ensure a level playing field for both power-to-power and power-to-x technologies.

The aim is that market forces should be allowed to drive the choice of technology, thereby avoiding picking winners and losers among the different technologies through administrative decisions.

# On the European Green Deal

EASE supports the proposal for an ambitious European Green Deal, which can help unite citizens and industries across Europe behind a common goal and vision for the future. We support the fact that the initiative connects the dots between decarbonisation, industrial competitiveness, sustainable investments, and social cohesion/a just energy transition.

In our view, this strategy should consider the following:

- Ambitious targets for 2030 and 2050 are essential to set the direction of travel and increase confidence for investment in clean energy technologies.

- The Just Transition Fund is a valuable tool that can help islands, industrial, coal and energy intensive regions transition to a more sustainable energy system. Energy storage can play an important role in these areas, and should be considered as a key enabling technology for the Fund.

- Promoting the circular economy and sustainability of clean energy technologies, including storage, is an important aspect. However, clear and transparent methodologies for calculating the carbon footprint of various technologies must be developed with support from industry and other stakeholders. This should ensure that approaches such as sustainability requirements for energy storage technologies are fair, actionable, technology neutral, and based on the best available data related to technology performance, costs, etc.

- The funding for projects under Horizon Europe should reflect the priorities set by the European Green Deal, for instance by increasing funding for clean energy technologies.

# Conclusion

## Europe has the opportunity to become the world leader in clean energy technologies, if it dedicates appropriate funding for research, development, and demonstration efforts as well as ensuring a supportive regulatory framework in the near term and a strong carbon emissions price.

As demonstrated by the EU decarbonisation strategy for 2050, whatever the scenario, energy storage technologies are playing a valuable role in the transition to a low-carbon energy system. This role is only set to increase, as the EU pursues an upward revision of the 2030 decarbonisation target and an ambitious European Green Deal.

This strong increase in energy storage demand raises questions: how will the market evolve to cope with the need for storage, how will the sector develop, and what technologies and applications will be deployed?

EASE supports the EU's ambitious proposals for a European Green Deal with the key goal of a net-zero emissions power system by 2050. It is now up to European and national policymakers to ensure that the appropriate market design is put in place so that the energy storage sector can live up to its full potential in terms of enabling the low-carbon transition.

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About EASE:

The European Association for Storage of Energy (EASE) is the leading member - supported association representing organisations active across the entire energy storage value chain. EASE supports the deployment of energy storage to further the cost-effective transition to a resilient, low-carbon, and secure energy system. Together, EASE members have significant expertise across all major storage technologies and applications. This allows us to generate new ideas and policy recommendations that are essential to build a regulatory framework that is supportive of storage.

For more information please visit www.ease-storage.eu

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Disclaimer:

This response was elaborated by EASE and reflects a consolidated view of its members from an energy storage point of view. Individual EASE members may adopt different positions on certain topics from their corporate standpoint.

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