Bundesministerium
für Wirtschaft
und Energie

Bundesministerium
der Finanzen

Blockchain Strategy of the Federal Government

We Set Out the Course for the Token Economy

Contents

Blockchain technology is a building block for the internet of the future

Blockchain technology[1] is one of the most frequently discussed innovations forming part of the digital transformation of business and society. Characteristics such as decentralisation, reliability, and security against fraud open up a broad spectrum of innovative opportunities for applications and new forms of cooperation. Since the publication of the White Paper on Blockchain[2] ten years ago there has been substantial technological and economic development. Blockchain technology enables every conceivable type of assets, rights and debt relationships, relating to material and immaterial goods, to be represented by tokens, and their tradeability and exchangeability to potentially be simplified. It remains to be seen which ramifications this development will have worldwide. This applies especially to its potential for conveying trust in digital spaces. To clarify and tap into blockchain technology's potential, and to prevent opportunities for its misuse, the Federal Government's action is required. Particularly with regard to the Federal Government's Climate Protection and Sustainability Goals, it is necessary to carefully weigh up the areas of potential and the risks. Thus the Federal Government is hereby laying out a comprehensive blockchain strategy, one that takes into account blockchain technology's relevance.
This strategy sets the framework conditions for innovations based on blockchain technology. Due to this technology's dynamic development, it is necessary to constantly scrutinise the framework conditions to ensure that they remain up-to-date.
The strategy stated here depicts a holistic, Federal Government view of blockchain technology, shows the goals and principles of the Federal Government with regard to blockchain technology, and proposes specific measures in five areas for action. An essential foundation for developing the strategy was a broad-based process of consultation[3] in the spring of 2019. 158 experts and representatives of organisations submitted their respective standpoints. The 31 questions posed produced a total of 6,261 replies.

Moving beyond bitcoin – on the path to the token economy?

Blockchain technology's development was based on the vision of a system with decentralised distribution, one that is to take over from central organisational units and is to make transactions possible directly between the given network's participants.
The most famous application – by no means the only one – is the cryptocurrency, Bitcoin. The upward leap in cryptocurrencies' market prices and the novel mode of financing, represented by so-called 'initial coin offerings' (ICOs), brought the growth of public interest in blockchain technology. Simultaneously the growth in bitcoin trading led to a huge upturn in electricity consumption associated with it. Just recently, applications beyond the cryptocurrency context are increasingly moving into focus. Germany has experienced the emergence of a dynamic ecosystem of developers and providers of blockchain-based services. This gives Germany a promising starting point for developing a token economy. Every conceivable type of values, rights and debt relationships, relating to material and immaterial goods, could be represented by tokens and their tradeability could be simplified. However, there are no reliable estimates of the climate-relevant ramifications that a scaling-up of blockchain technology would bring; there continues to be a major need for research on this.

1 This strategy uses the term 'blockchain' as a synonym for 'distributed ledger technologies'. In general terms, what the Federal Government understands as being distributed-ledger technologies is information-technical systems, run on a decentral basis, such as registers or books of accounts, in which participants can directly exchange values (for instance currencies or items of information). In most instances the verification is performed through decentralised processes, established system-wide (namely consensus protocols), and not through any central body. The systems enable all participants to gain access to the current status and to a checkable history of the transactions conducted, with a time stamp. In this context, a participant need not be an active part of the system (node). Blockchain technology's particular feature is that the transactions are summarised to form blocks and that these are linked up with one another;

2 https://bitcoin.org/bitcoin.pdf;

3 The online consultation's aim was to identify the most pressing challenges facing experts, application users and developers, to be addressed by the Federal Government in connection with blockchain technology. The outcome of the online consultation is publicly accessible at www.blockchain-strategie.de;

We want to expand Germany's leading position

The Federal Government has set itself the goal of using the opportunities in blockchain technology and of mobilising the areas of potential that it offers for the digital transformation. The young, innovative blockchain ecosystem in Germany is to be maintained and shall continue to grow. Germany is to be an attractive base for development of blockchain applications and for investments in scaling them up. Simultaneously, big companies, SMEs and start-ups, in addition to the public sector, the Laender (Germany's Federal States), civil-society organisations and individual citizens are to be enabled to make informed decisions about use of this technology. To reach this goal, we strive both to ensure the compatibility of blockchain-technology-based applications with current law and also to prevent misuse. Our aim is to create a regulatory framework directed at investment and growth, one in which market processes work without state interventions and the sustainability principle is safeguarded. Where blockchain applications offer a clear added-value in relation to existing solutions, primarily with regard to user-friendliness for individuals and companies, it is public administration that will function as a lead application-user in individual cases; a precondition for this is to ensure that this does not adversely affect trust in safe, reliable action. The build-up of competences in this basic technology contributes to Germany's and Europe's digital sovereignty.

Our principles for implementing the strategy

Using this strategy, we are pursuing a regulatory policy that creates incentives to make investments, releases forces of innovation, secures stability and thus contributes to inclusive growth that is compatible with the Federal Government's sustainability goals. These principles guide our actions:

- **Advancing innovations:** The Federal Government is advancing digital innovations in order to strengthen Germany's and Europe's competitiveness. It is only with entrepreneurial innovations that the German economy can continue to maintain its leading position; it is also only with digital innovations that the public sector can fulfil its function in the digital age. The use of blockchain technology releases economic potential and other forces of innovation.

- **Giving an impetus to investments:** Unambiguous and stable framework conditions establish an attractive, secure environment for investments. In this way, the Federal Government provides security of investment in digital technologies.

- **Guaranteeing stability:** In economic-policy terms, the Federal Government's higher-level goal is to maintain balance in the overall economy and to safeguard the finance system's stability.

- **Strengthening sustainability:** The use of blockchain applications must harmonise with the Federal Government's goals on sustainability and climate protection. The Federal Government recognises the potential and risks that certain blockchain solutions present with regard to reaching these goals.

- **Making fair competition possible:** A central concern of the Federal Government is to establish a level playing-field for all technologies. A guiding principle for actions is that of technology neutrality. Existing obstacles to the development and application of technologies are being eliminated, provided that doing so is compatible with the existing laws' fundamental objectives.

- **Deepening the digital single market:** The developments in Germany find themselves automatically interlocked with developments throughout the European Union. It is only with a completed digital single market that Germany can remain globally competitive on a lasting basis.

- **Expanding international collaboration:** We collaborate closely with our European partners, the European Commission and other international bodies, such as the OECD, on blockchain technology.

- **Integrating the stakeholders:** For a comprehensive strategy development, it is fundamentally necessary to integrate the knowledge of developers and also of application users in setting-up a state framework. In conducting the online consultation, the Federal Government involved experts, companies and civil-society organisations in development of the strategy; it will continue to do this.

- **Guaranteeing IT security and data protection:** It is only if blockchain applications satisfy what experts demand, regarding IT security and the legal requirements of data protection, that risks can be minimised, abuse prevented and a high acceptance level attained.

- **Making provision for adaptations:** Because of the high speed of technological development, further action by the Federal Government can become necessary in the future. Against this background, the Blockchain Strategy of the Federal Government should be checked and further developed at regular intervals, as a learning strategy.

In addition, all measures in this strategy are being paid for as part of the existing approaches taken in the individual plans affected, or respectively are refinanced within the individual plans affected. For any financing requirement beyond that, to implement the strategy, the budget-policy rulings in the Government's coalition agreement apply.

The Federal Government's blockchain agenda

By the end of 2021, the Federal Government will launch measures in the following five areas of action, to use blockchain technology's opportunities and to mobilise its potential. These are the priority measures in the respective activity areas:

1. Securing stability and stimulating innovations: blockchain in the finance sector

- The Federal Government aims to open up German law for electronic securities.
- The Federal Government will publish a draft legislation to regulate the public offering of certain crypto-tokens.

2. Bringing innovations to maturity: advancing projects and regulatory sandboxes

- The Federal Government is piloting a blockchain-based link-up of energy facilities to a public database.
- The Federal Government is funding the testing-out of blockchain-based verification of higher-education certificates.
- The Federal Government will introduce sustainability-oriented requirements as an important decision-making criterion in implementing state-funded or state-initiated blockchain projects.

3. Making investments possible: clear, reliable framework conditions

- The Federal Government will conduct a round-table discussion on blockchain and data protection issues.

4. Applying technology: digitised public-administration services

- The Federal Government is piloting blockchain-based digital identities and evaluating other suitable applications.

5. Distributing information: knowledge, networking and cooperation

- The Federal Government will conduct a series of dialogues on blockchain technology.

1. Securing stability and promoting innovations: blockchain in the financial sector

In the financial sector, blockchain technology has found its first practical application with the crypto-currency bitcoin. As previously stated, blockchain technology makes it possible to issue, transfer, store and trade digital assets (i.e. crypto-tokens).

Until now, there have been no provisions in German legislation for issuing civil-law-based securities on a blockchain. A claim to an asset must be incorporated in a legal document (in paper form). The consultation indicated that many stakeholders regard the tokenisation of assets, and especially of securities, as one of blockchain's key applications in the future. By reducing the need for intermediaries, issuing securities on a blockchain could make the processing and settlement of securities trading faster and more secure.

In addition, some tokens are used for investment and financing purposes but that are not securities. The new, blockchain-based forms of financing that started to emerge globally around 2015, with so-called Initial Coin Offerings (ICOs), mostly represent tokens that are not securities, confer no equity, and include no stake in the issuer's corporate development, e.g. through interest or dividends. Rather, most investors received so-called utility tokens or crypto-currencies through these ICOs.

Utility tokens grant access to the digital platforms that are developed by the issuer and/or to the claims and services offered on these. In this context, the primary objective of many investors is not the acquisition of future rights of use but rather an expected increase in the token's value.

The consultation revealed that, in part, the suitability of these tokens for financing companies and projects is questioned. At the same time, these tokens were viewed as having a high level of potential over the next five years. A binding legislative framework that also protects investors is seen as a precondition for positive developments. Notably, this framework should also establish legal security over the need toclearly evidence the legal implications of particular token designs.

1.1 The Federal Government aims to open up German law for electronic securities

The Federal Government aims to open up German law to accomodate electronic securities. The current requirement for securities to be incorporated in a legal document (i.e. in paper form) should no longer apply unequivocally. Electronic securities should be regulated on a technology-neutral basis so that, in the future, they can also be issued on a blockchain. As a first step, the legislation should be opened up to electronic bonds. Subject to further assessment electronic shares and units of investment funds should follow. On 7 March 2019 the Federal Government published a paper on key points thereby launching a consultation process on the topic. Based on this, the Federal Government intends to publish draft legislation this year.

1.2 The Federal Government will publish draft legislation to regulate the public offering of certain crypto-tokens

In its paper on 'Key Points for the Regulatory Treatment of Electronic Securities and Crypto-Tokens', published on 7 March 2019, the Federal Government launched a further consultation on the regulating the public offering of those tokens that do not constitute investments or securities as defined by the Directive on Markets in Financial Instruments[4]. The majority of participants were in favour of a common European approach. At the same

4 Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014, on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU;

time, the timely development of regulation was seen as crucial. Therefore, there is broad consensus for national regulation in the interim.

Against this backdrop, the Federal Government intends to publish draft legislation on regulating the public offering of certain crypto-tokens this year. This would ensure that certain, yet to be defined crypto-tokens could only be issued after the publication of a prospectus that complies with legal requirements and has been approved by the Federal Financial Supervisory Authority (*BaFin*). Through this measure the Federal Government seeks to ensure a high level of investor protection. It also creates legal certainty around the implications of particular token designs.

1.3 The Federal Government intends to create legal certainty for crypto exchanges and custodians

Many of those consulted stressed the need for regulation to address investor protection and anti-money-laundering rules.
In early December 2018, the G20 agreed[5] to set AML/CFT standards with regards to crypto tokens. The Amendments to the Fourth EU Anti-Money Laundering Directive[6] have a similar objective. For the purposes of AML/CFT prevention crypto-asset custodians and those providing services related to these should become subject to national AML/CFT requirements.
In Germany, crypto-exchanges converting crypto assets into fiat currency and *vice versa* already require a licence from the Federal Financial Supervisory Authority (*BaFin*). They also have to comply with AML requirements. On 31 July 2019, the Cabinet endorsed draft legislation to implement the amendments to the Fourth Anti-Money-Laundering Directive. It sets out licencing requirements for the issuers of crypto assets that serve as investments as well as wallet providers that store, administer or safeguard private keys for particular crypto assets. The draft legislation not only targets the effective combating of money laundering and terrorist financing. It also ensures that the level of customer protection around crypto assets matches the expected increase in prevalence due to the entrance of big technology companies into the market.

1.4 At the European and international levels, the Federal Government seeks to galvanise efforts to ensure that stablecoins do not become an alternative to state currencies

An essential prerequisite for blockchain to become an efficient technology for creating, transferring and trading tokenised rights is the possibility to synchronise legal transactions (delivery against payment). This requires stable blockchain-based means of payment. Most traditional crypto-currencies fail to fulfil this requirement due to their high volatility. Some of those consulted by the Federal Government viewed so-called stablecoins as a possible solution to this. These seek to ensure stability through state currency or liquid asset backing. Some participants in the consultation also discussed the introduction of a blockchain-based central bank digital currency.
In principle, the European Directive on E-Money[7]provides a regulatory regime for stablecoins. At the European and international levels, the Federal Government seeks to galvanise efforts to ensure that stablecoins do not become an alternative to state currencies. It will also further expand the existing dialogue with the Bundesbank on central bank digital currency, in order to assess the current state of play.

2. Bringing innovations to maturity: advancing projects and regulatory sandboxes

a. Funding on projects and regulatory sandboxes

Blockchain-based solutions are also finding ever greater use outside the finance sector, namely in private business, civil society and the public sector. The Federal Government's goal is to accompany and support these measures

5 http://www.g20.utoronto.ca/2018/2018-leaders-declaration.html;

6 Directive (EU) 2018/843 of the European Parliament and of the Council of 30 May 2018, amending Directive (EU) 2015/849 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing, and amending Directives 2009/138/EC and 2013/36/EU;

7 https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32009L0110;

without placing competing technologies at a disadvantage. As the Federal Government sees it, the online consultation's results vindicate its policy of systematically establishing real-life laboratories in Germany as an economic-policy and innovation-policy tool. Especially for still-young technologies, like blockchain, pilot projects and regulatory sandboxes offer an ideal chance to test out use of the technology in practice, as well as approaches to regulating it. This means that insights can be gained, both about the opportunities, risks and effects of the technology, and also about the legal limits and the need for adaptation. In the context of the Regulatory Sandboxes Strategy, before year-end the Federal Government will start a competition open to innovation, on regulatory sandboxes as testing-grounds for innovation and regulatory arrangements; this will take up and render support to specific ideas and projects from actual practice. We will also move forward the additional activities aimed at networking and information on regulatory sandboxes and strengthening of them.

2.1 The Federal Government funds practice-oriented research, development and demonstration of blockchain technology in the energy sector

The online consultation highlighted that there are various instances of application of blockchain technology in the energy sector, in which this technology generates added-value. This ranges from pricing, via switchover of providers, through to the structuring of prosumer roles. Overall, the participants in the consultation evaluate blockchain technology as having significant potential for the energy transition. Yet especially in energy-sector applications, one must not lose sight of overall efficiency and thereby energy efficiency. The blockchain technology currently in use can entail substantial additional consumption of electricity and resources. So it must be ensured that any positive effects caused by expansion of instances of application, in terms of transparency and process efficiency, are not undermined by substantial negative effects regarding protection of the climate and resources. However, to date there are no comprehensive surveys of experience gained on the market, for assessing whether the existing legal framework makes use of the technology possible and which negative consequences it would bring. In this regulated environment, no universally-valid statements can be made. Rather, it is important to learn from individual applications. The Federal Government will continue its project funding. Various Federal Government projects are examining the opportunities for the energy transition, offered by blockchain technology:

- The Federal Government's 7th Energy Research Programme studies the aspects of digitisation that are relevant to the energy transition. This involves making it easier for start-ups to take part in the programme.

- Within the framework of Smart Service Welt II, energy-sector blockchain applications are used for learning in practice. These application examples range from a blockchain-based virtual large-scale storage unit for operators of photovoltaic facilities, via energy trading using blockchain, through to blockchain-based peer-to-peer trade.

- The 'SINTEG' funding programme, showcasing intelligent energy, uses five large showcase areas to test sample solutions for a digitised energy sector.

- The Copernicus project 'ENSURE - New Network Structures' likewise gives consideration to blockchain technology used in the energy transition.

These projects' results are evaluated in terms of their positive and negative effects, and the regulatory obstacles that emerge are addressed.

2.2 The Federal Government is piloting a blockchain-based link-up of energy facilities to a public database

In May 2019 the Federal Government commissioned the feasibility study 'Blockchain-Based Registration and Management of Energy Facilities, Helped by the Smart-Meter Gateway'. The results will be published at the end of this year. Backed up by the recently-issued positive interim report, preparations have already begun for piloting the blockchain-based link-up of an energy facility to a public database. The project phase is expected to start in 2020 – subject to a positive final evaluation of feasibility. This is the basis for gaining the first valid insights for deducing recommendations for action.

2.3 The Federal Government will establish a cross-technology piloting laboratory for the energy sector

The next step towards implementing blockchain technology in the energy sector is to test specific applications under real-life conditions. In conjunction with existing funding measures and projects, the Federal Government is beginning to set up a cross-technology piloting laboratory for the energy sector. Jointly with players in the energy sector, society and public authorities - and based on selected applications - systemic efficiency-gains are to be examined and technical assessments made. Particular attention is to be given to possible negative effects, e.g. regarding energy efficiency, to be able to make a holistic assessment. Here, in particular, researchers are also to direct their efforts at synergies with other, new technologies, such as artificial intelligence or big data in this New Technology Lab; the aim is to examine such technologies' ramifications and challenges in terms of the national economy, society, regulatory arrangements, and effects on social cohesion.

2.4 The Federal Government is fostering the build-up of a test environment for developing and applying secure digital business processes

The Federal Government is fostering an 'Industry 4.0 Law Testbed'. This involves building-up a test environment enabling companies to develop secure digital business processes and to test them comprehensively. The focus is on legal questions regarding the negotiation and processing of contracts between machines, via so-called 'Smart Contracts'. The applications to be used as examples are the Logistics and Production activity areas. In the technical implementation, in particular, blockchain is among the technologies used. First results of the four-year project are scheduled to be ready for the Digital Summit 2020; then, at relevant events such as the Platform on Industry 4.0 and at trade fairs, they are to be presented to the companies directly and made publicly accessible. Additionally, from February 2020, the Federal Government will advance the development and application of platform-based, secure, digital business processes, with its funding measure called 'Internet-Based Services for Complex Products, Production Processes and Facilities'; this includes the 'SealedServices' project (among others). The goal is to develop and test out innovative services and business models that emerge from the consistent process of networking within the whole value creation chain. The plan is to guarantee dynamic networking among companies, while simultaneously safeguarding data's security, integrity and sovereignty; this is to be achieved through blockchain-based infrastructure yet to be developed, securing the trustworthy interchanging of information.

2.5 The Federal Government supports innovative blockchain solutions in developing countries

The blockchain lab of the Gesellschaft für Internationale Zusammenarbeit GmbH (a company engaged in international development), founded in 2018, taps into the transforming potential that blockchain and associated technologies have for implementation of the UN 2030 Agenda for Sustainable Development. The Federal Government is striving to expand the lab approach, so as to create framework conditions for use of blockchain in developing countries, and also to support innovative blockchain solutions, e.g. in the context of piloting activities. Pilot projects emerge in close cooperation with private business and with the regulating public authorities and government departments involved. With the lab approach, the develoPPP programme can be used to provide support, from the proof-of-concept phase and a first pilot phase, through to scaling. So this approach makes it possible to have a test lab for policymakers and also for local talents and private business, for working on solutions together.

b. Funding sustainable projects

Blockchain technology is often associated with very substantial consumption of energy and raw materials. A key factor in this is the Proof-of-Work consensus mechanism; this does indeed demand enormous calculation capacity. The online consultation confirmed this procedure's inefficiency; the point was made that numerous more efficient consensus mechanisms exist. There was a demand that the state must take into account the criterion of sustainability when applying blockchain technology and funding it.

2.6 The Federal Government will introduce sustainability-oriented requirements as an important decision-making criterion in implementing state-funded or state-initiated blockchain projects

Especially with its climate-protection goals in mind, the Federal Government will support the use and further development of sustainable, energy-saving blockchain applications. Thus, before implementation of state-funded or state-initiated projects in the realm of blockchain, the Federal Government will make sustainability-related requirements an important decision-making criterion. Using experts' inputs, the Federal Government will check which aspects must be taken into account in this, and to what degree a simple, flexible and transparent methodology of assessment can be set up. Criteria of this kind can also become a role model beyond Germany.

2.7 The Federal Government is exploring the state funding of environmentally-sustainable blockchain applications

Until mid-2020, the Federal Government is exploring possibilities on how it could give state funding, in harmony with European state-aid law, to environmentally sustainable blockchain applications and to blockchain applications contributing to the protection of the environment, the climate and nature.

c. Funding projects in other application areas

The consultation process gave rise to a number of applications in which blockchain-based solutions show a high level of potential. Frequently named sectors were energy, logistics and supply chains, but also (for instance) healthcare or the verification of education/training certificates. In the context of a Federal Government competition of ideas on blockchain, prizes were given to possible applications in health care. Possible further steps are being sounded out with the winners.
In selecting the projects to be funded, a key role is given to the principles of sustainability, accessibility and transparency of the technological solutions. The aim is to influence this still-young technology so that it generates an added-value in society. Also, preference is given to solutions that enable networking and knowledge transfer between involved parties in private business, civil society and public bodies.

2.8 The Federal Government is examining whether, and how, blockchain-technology use can contribute to transparency in supply chains and value creation chains

In many aspects, blockchain technology makes it possible to increase transparency, efficiency and security along value creation chains. The Federal Government aims to advance the possibilities that blockchain technology provides for supply chains and value creation chains. In this context, in particular, funding is to go to projects aimed at proving products' sustainability and at developing standards. The Federal Government is examining whether blockchain technology can be used and promoted, firstly, to secure supply chains that are environmentally and socially sustainable, efficient and secure, and secondly to contribute to the closing of product cycles.
The funding initiative 'Industry 4.0 – Collaborations in Dynamic Value-Creation Networks' examines the significance and applicability of blockchain-based approaches in the industrial environment. The emphasis for this is on cooperations between companies (Smart Contracts) and transfer of process data. Blockchain technologies are used in the collaborative projects 'Platform for Integrated Management of Collaborations in Value-Creation Networks' and 'Collaborative Smart-Contracting Platform for Digital Value-Creation Networks'.
In the context of the funding measure 'Resource-Efficient Recycling Business – Innovative Product Recycling', the alliance-based project DIBICHAIN will examine blockchain-technology use for the digital depiction of product cycles for an application in aircraft construction.
In a pilot project, the Federal Government is evaluating how blockchain applications can contribute; this can be through transparent, complete and trustworthy information along the supply chain, making sustainable consumption decisions easier and providing security, e.g. in the food chain. Similarly, in global value-creation chains the Federal Government will examine whether certificates of proof can contribute to higher yields for the producers at the start of product cycles.

2.9 The Federal Government is funding research and development of effective governance structures for using blockchain technologies in the logistics sector

In the context of the programme 'Innovations for Tomorrow's Production, Services and Work', with the ongoing funding initiative 'Service innovations through digitisation', funding is directed to the research and development of effective governance structures. In particular, the blockchain applications find practical use in marine logistics ('Sofia' project), among other areas, in connection with process sequences and Smart-Contract-based approaches. Taking the insights gained in the basic report 'Opportunities and Challenges of DLT (Blockchain) in Mobility and Logistics', the Federal Government supports what is increasingly an end-to-end digital depiction of the goods-flows and freight papers. Additionally, the Federal Government is funding the alliance-based project 'Blockchain-based administrative framework for transparent, efficient and trustworthy value-creation chains of unregulated products'. Development is in progress on a blockchain-based system of supply-chain transparency and quality assurance, for end-to-end monitoring and proving of products' process status, location and current condition.
The alliance-based project 'Risk-Avoidance in Temperature-Regulated Supply Chains through Blockchain Technology', will develop a Supply Chain Risk Management approach; this uses a blockchain to improve the proactive management of risks in temperature-regulated logistics.
The alliance-based project 'Blockchain-Based Decentralised Energy-Trading Platform' is developing an approach for a blockchain-supported energy-market platform.

2.10 The Federal Government will develop and fund blockchain applications contributing to consumer protection

Furthermore, the Federal Government sees blockchain technology's potential in consumer protection. Transparency provides the opportunity to check whether provisions established in law (e.g. transport conditions applied to products) are being fulfilled. Because the system is decentralised, the users can become more independent of central platforms; this can strengthen user sovereignty. Conversely, consumer protection faces a challenge from applications based on blockchain technology (example: sale of tokens, assertion of rights without a central authority, adherence to the General Data Protection Regulation). The Federal Government's goal is that blockchain-based procedures are also to contribute to the implementation and securing of consumer rights guaranteed by law. To attain this goal, the Federal Government will develop and fund blockchain applications that contribute to consumer protection, for instance in the food chain.

2.11 The Federal Government is funding the testing-out of blockchain-based verification of higher-education certificates

As part of the Federal Government's initiative 'Secure Digital Education Spaces', it joins forces with the Laender and the umbrella organisations of chambers of commerce; it will check and, subject to positive results, fund the use of blockchain solutions to verify proofs of competence (references, ECTS), initially in the contexts of international student mobility and of vocational references relating to final examinations and to further training. Additionally, it is planned to test out and to develop, by the spring of 2020, end-to-end digitally-verified certificates of competence and work-performance references ('digital credentials'), within the European Commission's Europass II project, now in progress.

3. Making investments possible: clear, reliable framework conditions

The Federal Government's goal is to arrange the framework conditions in such a way that they offer sufficient investment security. Reliable framework conditions permit companies and organisations to assess whether investments in blockchain technology are worthwhile. A clear and technology-neutral legal framework ranks among the reliable framework conditions. At the technical level, reliable framework conditions are created by development of standards, by the possibility of acquiring certifications, and by compliance with IT security requirements. These conditions must also always be assessed from the perspective of environmental sustainability. The Federal Government is accompanying and rendering support to this.

a. Legal framework conditions

Consistent with technology neutrality, the legal framework must not favour or disadvantage blockchain technology in relation to other technologies. Alongside questions of capital-market law, the consultation process also primarily addressed questions of company law and also of data protection and consumer protection. In particular, compatibility of blockchain with the General Data Protection Regulation (GDPR) is a constantly recurring topic. From the Federal Government's viewpoint, blockchain technology does not give rise to any need to change the GDPR. Rather, blockchain technology needs to be shaped and used in a way that complies with data protection requirements. Any areas of uncertainty among developers and users of blockchain solutions ought to be addressed, so as to foster the development of solutions that fulfil demands for consumer protection and data protection. In this context, existing technical solutions should be used (among others, use of hash values, pseudonymisation, zero-knowledge-proof), as should principles of privacy-by-design and privacy-by-default. Alongside questions of consumer protection and data protection, the consultation process addressed questions of company law. Primarily, the matter raised was the enforceability of law in blockchain structures, especially if they cross national borders.

3.1 The Federal Government will conduct a round-table discussion on blockchain and data protection issues

The round table on implementation of the requirements in the General Data Protection Regulation has developed as an established dialogue format for exchanging inputs between the business community and data protection authorities. Thus, in the first half of 2020, one of the round-table sessions is to be devoted to questions of data protection law, emerging in connection with blockchain technology. For this, the round-table discussion is to be extended to include representatives from the users' side and from civil-society organisations, especially from the realm of internet policy. This event is to serve as a status review on the blockchain and data protection range of topics. The format used can throw light on blockchain's positive characteristics from the data protection viewpoint, as well as clarifying data protection-law requirements in connection with instances of blockchain use. The following questions must be taken up in this context: Which data, stored on a blockchain, constitutes personal data? How does one safeguard the right to get data deleted when using blockchain technology? How is the right to information to anyone about their own personal data being guaranteed by a central coordinating body?
The round table provides a format for exchange in order to examine practical, frequently-arising scenarios and, where possible, in order to highlight paths to solutions. The work's results will be communicated, the aim being to apply existing guidelines, as used by data protection authorities, for actual practice in the blockchain context; where applicable, the aim is to introduce proposals for additional guidelines that data protection authorities are to use. In this regard, relative to these recommendations' implementation and use, supervision from the data protection law perspective is solely the responsibility of the independent data protection authorities. In addition, the round table is to give the participating experts the chance to sound out further approaches to solutions in interacting with issues of actual blockchain practice, in relation to data protection law; such issues include the drawing up of data protection law standards or certifications.
The prospect is that any open questions regarding data protection law requirements for blockchain applications should be dealt with as follows: if there is a lack of clarity in the interpretation, effort should be made to establish clarity, in cooperation with the relevant data protection authorities; this is done to shape blockchain applications in compliance with data protection requirements.

3.2 The Federal Government is examining the use of blockchain technologies in the context of provision of proof

The Federal Government will examine whether, or to what extent, it is possible to formally recognise irreversibility and also proof of non-changeability for provision of proof as regards storage of data and documents by using hash values. Also, the Federal Government is examining options for accepting the blockchain-technology-based depiction of information and documents. It is looking at how data, secured in blockchain-based applications, can (firstly) be provided to courts or (where applicable) official verification bodies, in order for the data to function as proof, and (secondly) whether it is thereby possible to guarantee tradeability, as law requires. In

particular, concepts must be available that can guarantee the data's long-term security, even after the cryptographic algorithms originally used have expired in terms of their suitability for security.

3.3 The Federal Government will observe and examine blockchain applications in the creative-arts sector

There is potential in researching and developing blockchain-based concepts for solutions used to administer copyright-protected content. Blockchain-based procedures can also contribute in the processes of enforcing copyright and of remunerating utilisation; this must take into account the freedoms of use established in law. Such requirements notably apply to complex works, involving many people, such as making a film, but also in the music industry. Against this background, the Federal Government will observe and examine blockchain applications with regard to content protected by copyright law. In particular, it will examine whether, and to what extent, blockchain-based procedures can contribute to simplifying the application of the freedoms of use permitted by the law.

3.4 By the end of 2020, the Federal Government will examine possible opportunities for application of blockchain technology in company law and law on cooperatives

It is conceivable that use of blockchain technology can make processes substantially easier in the realm of company law, for instance in the administration of stakeholdings (handling of shares, making avail of shareholder rights, or similar matters). This could also apply to making avail of membership rights in cooperatives. Numerous questions remain unresolved and open on this, especially with regard to the necessary technical preconditions and the specific opportunities for application. So the use of blockchain technology in company law is to be examined by commissioning an external report.

3.5 The Federal Government will concern itself with the legal framework conditions that apply to new forms of cooperation

The online consultation revealed that blockchain technology makes new forms of cooperation possible – even between competitors. In most cases, networks based on blockchain technology are formed by various companies or organisations bringing together their forces. Blockchain technology and Smart Contracts also make forms of cooperation of a new kind possible; these are characterised by the absence of a central body that holds responsibility, and by decision processes based on Smart Contracts (DAO - decentralised autonomous organisations). The Federal Government supports the development of digital innovations of this kind and will concern itself with the legal framework conditions that apply to such structures.

3.6 The Federal Government is checking the suitability, feasibility and potential of an international arbitration authority

Cross-border blockchain networks can provide new challenges from the legal viewpoint, for instance on the matter of which legal system is applied. In the realm of blockchain technology, in which the contracting parties usually do not know one another, it is complicated, and possibly unjust to the interests involved, if there is a classic negotiation to attain a consensus-based dispute resolution.

3.7 The Federal Government is examining options for adapting proof-of-identity practice in official authorisation processes

Blockchain technologies can only fully have their effect if it is possible to depict processes entirely digitally. Thus the identification of natural or juridical persons in the context of official authorisation has hitherto required those involved to appear in person. The Federal Government is examining whether, despite the major security requirements associated with authorisation of vehicles for road use, the case could be made for lowering the proof of identification required in the authorisation process from the trust level 'high' to the trust level 'substantial'.

b. Standards and certifications

The online consultation revealed that, regarding blockchain, there is a significant wish for standards, certifications, and requirements to provide information. If standardised interfaces exist, it is easier for companies to gain market entry and the security of investments is increased. This effect is all the greater if the norms and standards are applied at European and international level. Users and developers want interoperable standards - these serve as the basis for linking-up various blockchain applications. Especially in the case of Smart Contracts, that activate automated transactions and that feature a high level of complexity, there is a demand for additional transparency. A layperson in technical terms cannot follow what it is that the Smart Contract does indeed technically implement. This prompts the demand for a duty to provide information to be imposed on Smart Contracts. The information on the content of the Smart Contract should be made easily comprehensible for users; that way, it can serve as the basis for further acceptance and wider uptake of the technology. The online consultation also revealed the demand that such contracts should be certified by an official authorised body. Traceability of the technology is guaranteed, in particular, by open-source solutions. In this regard, publicly documented standards and interfaces are used to ensure that the various applications and IT systems are interoperable; this reduces dependence on providers whose software uses proprietary interfaces and formats. Open-source solutions thereby contribute to the advancement of digital sovereignty.

3.8 The Federal Government is commencing the build-up of a Smart Contract register in the energy sector

In the energy sector, in particular, Smart Contracts offer major potential for automation and for increasing efficiency. This makes it all the more important to transform contractual relationships into digital language or respectively into digital code. So the Federal Government will soon begin with the build-up of a register; this is to list the energy sector's latest contractual status and thus enable Smart Contracts to be registered and systematised. Jointly with dena (Germany's energy agency) and representatives from science, business and society, our first step will be to conduct an exchange of views on which items of content could be transferred into Smart Contracts – independently of the code used. The goal will be to build up a public platform with dena's help, one that is freely accessible, one with content that may be permanently viewed, assessed, discussed and commented upon. That way, the register can support users and developers in designing Smart Contracts; this is because they can refer back to similar instances of application. The Smart Contracts Register in the energy sector should function as an example for other business sectors, as well as a basis for designing and building-up other registers.

3.9 The Federal Government will explore possibilities to introduce accredited certification procedures for Smart Contracts

Certificates of conformity, confirming that a Smart Contract does indeed technically depict the content that the provider confirms is present, can increase Smart Contracts' general acceptance and also trust in them. Especially for users without a specific technical background, one difficulty is that of checking a Smart Contract's actual content as compared to the content that is presented. Up to now, there are no specific certification procedures in the realm of blockchain/Smart Contracts. The Federal Government will explore possibilities to introduce accredited certification procedures; these can be used by developers/providers on a voluntary basis, so as to increase trust in blockchain technology and the use of Smart Contracts.

3.10 The Federal Government is planning to commission a study that offers an overview on technical processes used for digital identification, authentication and verification of devices

To unleash blockchain technology's full potential in the context of the Internet of Things, it is essential that devices can be unequivocally identified. Procedures must be structured in a consistent, interoperable and secure way, so that, when secure digital identities for devices are designed, principles and requirements such as confidentiality, integrity and availability are built into them properly. In particular, the determination of norms can make this available. The Federal Government sees it as being notably industry's task to develop technological solutions for this. To provide support, the Federal Government is planning to put out to tender a study that contains an overview of a large number of technical procedures, used for digital identification, authentication and

verification; the study is to allocate these procedures to particular applications in actual practice. In particular, the following must be taken into account: blockchain, embedded SIM/embedded Universal Integrated Circuit Card, multiple-factor authentication, and additional procedures for hardware and software. It is also the intention to examine the degree to which sufficient open-source software and open hardware (especially with regard to cryptochips) are already available on the market, or is being developed, and where the market requires further development. Consideration must also be given to use of Secure Elements for the implementation of secure identities in the realm of Consumer IoT and Industry 4.0. The Secure Elements' cryptographic functions could be used within the framework of blockchain applications. The results of the study to be published are to serve established companies and new market entrants as a guide on the path to secure, digital identities. It is also intended to help in preparing for a standardisation.

3.11 The Federal Government is actively involving itself in the development of standards at international level and backing the use of open interfaces

Uniform norms and standards are essential for the compatibility of various blockchain applications. Open-source licences predominate in blockchain applications; in combination with this, transparency and trust in applications can be generated and investments made more secure. A variety of organisational bodies at international level are working on the issue of developing joint standards for blockchain technology. Accordingly, DIN, as Germany's national organisation for establishing norms and the Federal Republic's representative in various ISO working groups, is working in ISO/TC 307 'Blockchain and Distributed Ledger Technologies', dealing with topics such as interoperability and IT security of blockchain applications; it also participates in the working group on 'Smart Contracts and their Application', directed at verification of the contracting parties and at the enforcement of Smart Contracts. With regard to environmental sustainability in the blockchain realm, the Federal Government will evaluate the development and establishment of European or international sustainability standards and certification procedures.
The Federal Government welcomes the participation opportunities, made possible by blockchain, for young and small companies, civil-society initiatives and organisations (e.g. within the framework of Citizen Science/CivicTech), and for developers. To maintain these opportunities for participation, the Federal Government is committing itself to ensuring that application solutions for blockchain are characterised by open, interoperable interfaces for link-up with other (blockchain) applications; a precondition is that this can be done without restricting data protection and data security. When applying for research and development projects, the provision of interoperable interfaces and also the use of free software licences and hardware licences respectively are, where applicable, factors to be evaluated positively.

3.12 The Federal Government is intensively pursuing measures to open the interfaces in the healthcare sector

As a matter of principle, the interfaces used in healthcare are also open for possible future technologies (such as blockchain). Therefore, consideration is continuously being given to use of future technologies - in harmony with the data security and IT security requirements for health data. The Federal Government is also making it possible for innovative health-care sector applications to gain access to telematics infrastructure.

c. Security

The Federal Government always makes technology neutrality a precondition as it structures information-security regulations and requirements. In this regard, it views 'information security' as an across-the-board task that must permeate all aspects, from the start and throughout the technology's whole life cycle ('security by design'). In the online consultation there was a demand that the information-security requirements must also apply to blockchain technology. The Federal Government will take this into account in the further structuring of stipulations on information-security regulations and requirements. In May 2019, the Federal Office for Information Security (BSI) issued an analysis of blockchain technology from the information-security perspective – namely its document 'Structuring Blockchain Securely. Concepts, Requirements, Assessments'[8]. This deals with

8 www.bsi.bund.de/blockchain

aspects such as data security, long-term security, and familiar attacks. It also discusses legal requirements that influence the designing of blockchain applications.

3.13 The Federal Government is analysing blockchain technology from the perspective of its information security

The BSI is using its expertise to support the secure development and operation of blockchain technology. Fundamental security aspects are already indicated in the document 'Structuring Blockchain Securely. Concepts, Requirements, Assessments'. This gives developers and potential users a good foundation, enabling them to assess opportunities and risks presented by blockchain solutions, and to take information security into account from the start ('security by design'). The Federal Government will take these recommendations into account in implementing its measures. Accompanying the dynamic ongoing development of blockchain technology, the BSI will continue to update its analyses.

3.14 The Federal Government is funding the development of innovative cryptographic algorithms and protocols

In the framework research programme for information security, 'Autonomous and Secure in the Digital World', the Federal Government is funding the development of innovative cryptographic algorithms and protocols in the realm of post-quantum cryptography, as well as procedures for simple exchange of cryptography (cryptoagility); where appropriate, these can also be applied in the realm of blockchain technology. Cryptoagility also has much significance for blockchain applications.

4. Applying technology: digitised public-administration services

a. Digital identities for individuals

Digital identities for individuals, consistent with the state of the art, act as an important foundation for digital networking, because they make communication, data exchange and transactions possible. When structuring digital identities, various goals must be taken into account, for instance practicability and user-friendliness, but also data protection, prevention of misuse, and the guaranteeing of autonomy in terms of information.
The consultation process showed that blockchain technology entails potential for the further development of digital identities. Private market players state that they use blockchain technology to offer digital identities. At the same time, functioning digital identities constitute a precondition for many blockchain applications. Yet the consultation process also made it clear that the state is viewed as the central organiser or respectively regulator of individuals' digital identities. It is seen as having a duty to guarantee security and data protection by means of regulations. There is a need to examine the suitability of blockchain-based procedures for maintaining a Register of Births, Marriages and Deaths; for registering citizens' place of residence, passport status, and ID card status; and also for foreign citizens' administrative affairs.

4.1 The Federal Government is making state digital identities available and is examining possibilities for linking them up with blockchain applications

The Federal Government is making state means of identification available and constantly further developing them, both to advance user-friendliness and also to safeguard the high level of security (e.g. eID function of the new ID card). Apart from this, in various public-administration procedures, the Federal Government is examining whether, and to what extent, it is also possible to accept derived digital identities from the private sector, either for public-administrative procedures or respectively for certain legal transactions.

4.2 The Federal Government is piloting blockchain-based digital identities and evaluating other suitable applications

The Federal Government is piloting blockchain-based digital identities. It will examine whether these blockchain-based digital identities offer the prospect of a clear added-value compared to existing solutions, and whether they can be structured in a way that satisfies data protection law's requirements. Suitable additional applications are also being evaluated in this context. As a matter of principle, the Federal Government represents the principles of security of identity and of technology neutrality regarding implementation and further development of digital identities.

4.3 In a funding project, the Federal Government will test out the interoperability of secure digital identities for individuals

Solutions for digital identities have already been available on the market for some time. None of the solutions has been able to successfully assert itself, across the spectrum of uses. With the blockchain-based self-sovereign digital identities, a further solution is now under development. In an innovation competition on secure digital identities, the Federal Government is planning to test out the interoperability of various technologies (centralised / decentralised) and providers, in regional showcase initiatives.

b. Trust services

The eIDAS Regulation[9] introduced Europe-wide, uniform, electronic trust services. This makes inexpensive and trustworthy electronic transactions possible across national borders. It was acknowledged in the online consultation that the eIDAS Regulation created trust in digital business processes and that it was also rendered possible to make electronic visits to public authorities. Simultaneously came the demand for eIDAS infrastructures to be linked up with concepts of self-sovereign identity. The central operator, provided for by the eIDAS Regulation, is regarded as an obstacle to blockchain technology.

4.4 The Federal Government is considering test operation of a blockchain to make information on electronic trust services available on a lasting basis

The Federal Government is pursuing the goal of reproducing, in technical terms, trust services offered on the blockchain. This could be made possible with test operation of a blockchain. Further application areas, internal to the given public authority, could emerge in the course of such an operation.
Likewise, the Federal Government is aiming to raise awareness of what remain largely unknown electronic trust services, among public authorities, individuals and companies. A website is to be set up for this, presenting how analog processes, requiring a trustworthy transaction, can be rearranged into digital processes without a media breach.
At the European level, the Federal Government is taking part in the considerations aimed at structuring a self-sovereign digital identity, in the context of the European Blockchain Partnership. The eIDAS Regulation plays a crucial role in this.

c. State blockchain infrastructure

Blockchain technology is characterised by a decentralised infrastructure on which the most diverse range of applications can be provided. The online consultation gave rise to the demand for a public infrastructure used for blockchain applications. This blockchain infrastructure, it is stated, should support companies or organisations in developing specific applications. By contrast, other participants do not see the state as a suitable party to be involved in the build-up of a blockchain infrastructure; they consider it to be enough if the state operates nodes. State infrastructure activities are associated with the hope of setting standards for interoperability and establishing governance structures for decentralised networks.
As regards infrastructure, a further demand expressed was that the state makes available a decentralised public-key infrastructure in order to enable the secure exchange of certificates.

9 Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC.

The Federal Government welcomes the fact that first blockchain infrastructure systems are being built up at municipal level, thereby creating a basis for making blockchain technology an option in implementing administrative services.

4.5 The Federal Government is participating in the build-up of the European Blockchain Services Infrastructure

Build-up of the European Blockchain Services Infrastructure (EBSI) is being moved forward through the European Blockchain Partnership. Germany is a member of this partnership. The first applications are to be implemented on the EBSI at the start of 2020. These applications include the exchange of certificates and a blockchain-based register of the European Court of Auditors. The prospect is that the infrastructure should also be made available for the private sector. The Federal Government will ensure that Germany actively takes part in the EBSI.

d. Public-administration projects

In the consultation process, a spectrum of possible applications of blockchain technology in public administration was named. Emphasis was given to potential efficiency increases, resulting from simplified data exchange across horizontal and vertical administration levels, reduced duplication of data, and lower transaction costs. There was also a description of the technology's potential with regard to transparency, participation and traceability of administrative processes for members of the public.
Yet the Federal Government does not see it as an end in itself to replace functioning administrative processes and existing public registers by using blockchain-based solutions. Instead, there should be a check in the individual case, reviewing whether there is a demand for implementing administrative processes by using blockchain technologies, and how purposeful this is. For instance, it does not appear purposeful when public registers also fulfil the function to legally prove their content (above all, the Land Registry, the Register of Companies, and the Register of Births, Marriages and Deaths). Highly-promising applications are vehicle-holding or digitally-supported verification of original documents provided, often stored on a decentralised basis, such as certificates and letters of reference.
Beyond the public sector, showcase projects in e-government can have a positive effect on Germany as a blockchain location; they can also serve as a role-model for development of private applications and be a source of valuable experience. Accompaniment and coordination of these activities ensure that they are effectively interlocked at European level, at German national level, and in the Laender.

4.6 The Federal Government will introduce, advance, and give publicly effective support to showcase projects that use blockchain technologies, for instance in public administration

In the individual case, the Federal Government will introduce, advance, and give publicly effective support to showcase projects that use blockchain technologies in an exemplary way in public administration. One option for accelerated implementation of blockchain projects is to set up a competence centre for blockchain applications in public administration. The Federal Office for Migration and Refugees (BAMF) is currently piloting a blockchain solution in the AnkER facility in Dresden, to provide support to communication and cooperation in processes of applying for asylum, across public-authority boundaries. For instance, the blockchain-based public-administration platform TruBudget is already being used in Burkina Faso and is piloted in other developing countries. The open-source application used by the Kreditanstalt für Wiederaufbau (KfW bank) uses blockchain characteristics to make it possible to manage the use of donor funds, in a transparent, secure and traceable way that previously was not readily presentable.

4.7 The Federal Government is examining possible applications that deviate from the traditional requirement to use the written form

As part of implementing the Online Access Act, with regard to public-administration services, the Federal Government is examining possible applications at federal level, in which there can be a deviation from required use of the written form and the requirement to appear in person; a precondition is that such instances do not come within the scope of the Public Administration Procedures Act (VwVfG), Section 3a, Para. 2. Dispensing with the requirement to appear in person is helpful in making blockchain technology useful for public-administration procedures. The Federal Government will advance the implementation of these applications by means of

alternative digital processes such as blockchain technology. In doing this, the Federal Government will also work towards reducing written communication, both between public authorities and individuals and also between public authorities themselves (e.g. with the Platform on International Mobility of Students for the international exchange of education credits, or of already-attained educational qualifications). For there to be a basic trust in the security and confidentiality of communication, data and IT structures, also with the use of blockchain technology, simple and secure solutions are needed which build up, or respectively further develop, current standards, norms and interfaces and are encrypted end-to-end.

4.8 The Federal Government is examining and testing out the development, funding and use of secure validity tokens for relevant application areas

Digital validity tokens can be allocated to certificates and public documents, in order to verify them digitally (e.g. for certificates generally, public education institutions, birth certificates or (in general terms) documents that the provider must verify, such as work-performance references and other 'digital credentials'); doing so offers major potential for administrative processes to be digitised, simplified and speeded up, both for citizens and for public authorities. The Federal Government will examine the development, funding and use of secure validity tokens. As part of its initiative 'Secure Digital Education Spaces', the Federal Government is involved with the work of selected partners from education, within the framework of the EU project, 'Europass'. This also includes the pilot testing of 'digitally signed credentials', for end-to-end digitally verified certificates of competence and work-performance references (2019-2020). In this regard, use of electronic seals can guarantee the provenance and confidentiality of the data. Blockchain technology counts as a highly-promising option. Its feasibility shall be tested out for the verification purpose referred-to here.

4.9 The Federal Government is conducting pilot projects to introduce blockchain-based applications for a more efficient and transparent determination of the customs value of e-commerce transactions in third countries

In cooperation with the private sector, the Federal Government is examining the introduction of blockchain-based applications for a more efficient and transparent determination of the customs value of e-commerce transactions in third countries. For this purpose, a first pilot project in Africa is being set up; this integrates a third country's customs authorities and also key international protagonists participating in trade supply chains.

4.10 The Federal Government will examine the application of blockchain technology in the area of vehicle-holding

The Federal Government is considering the set up of a project that checks whether a blockchain-based system could contribute to linking-up systems that contain vehicle data; this shall be done especially with a view to administering entitlements to use vehicles. This project is set to cover the next six years.

5. Distributing information: knowledge, networking and cooperation

Blockchain technology is a comparatively young but highly complex technology. Notably for SMEs, complex application cases emerge in which the technology can purposefully be used. This is why there were demands in the online consultation to support the exchange of views between SMEs, start-ups, large companies, and other relevant organisations. Networking at events contributes to highlighting knowledge of best practice and application possibilities of the technology.

Extensive technological understanding is needed to develop blockchain-based applications. The Federal Government is aware that there is strong demand for experts in this area. Against this background, the Federal Government welcomes the objectives and fields of action decided upon by the Laender in their strategy, 'Education in the Digitised World'. The Federal Government is driving forward the qualification of professional-training personnel in the area of digitisation; it thus also supports the efforts by the Laender to ensure that their teaching personnel are suitably qualified. Basic digital competences serve as the basis for attaining qualifications at a deeper level.

5.1 The Federal Government will conduct a series of dialogues on blockchain technology

A series of dialogues is to continue the exchange of views on blockchain technology, begun in various workshops and the online consultation, between politics, business, civil society and experts. Within this series of dialogues, on a topic-specific basis, particular issues relating to blockchain technology are to be discussed.

5.2 The Federal Government is advancing exchange of information in the context of the Digital Hub Initiative and through the *Mittelstand 4.0 Centres of Excellence* (for medium-sized firms)

The Federal Government's Digital Hub initiative is promoting start-ups' networking efforts with medium-sized and large companies, as well as with other players in the digital ecosystem. This also includes start-ups focused on the development and use of blockchain technology. In addition, the *Mittelstand 4.0 Centres of Excellence* (for medium-sized firms) are pursuing the passing-on of knowledge on innovative technologies and on their possibilities in actual practice and in SMEs' development. The *Mittelstand 4.0 Centres of Excellence* have integrated blockchain into what they offer, as a technological innovation and as a driver of new business processes and models.

5.3 The Federal Government is providing support to new forms of cooperation on an application-related basis

Within the framework of funding programmes, the Federal Government is funding cooperation between science and digital platforms and also companies that use blockchain on an application-related basis. Beyond this, blockchain is deployed in specific application cases in the non-university research establishments, using institutional funds from the Federal Government and the Laender. This includes applications in science (Max Planck Society's international bloxberg cooperation), in part by means of cooperations with companies (e.g. in the context of Fraunhofer Blockchain Labs). Making 'New Sources for New Knowledge' into its mission, the Federal Government is also working, in its cross-department 'High-Tech Strategy 2025', to ensure that Open Innovation's opportunities find more comprehensive use. By increasing its funding, the Federal Government will significantly increase the number of new, open forms of cooperation among companies, and also between civil-society protagonists and scientific institutions.

5.4 The Federal Government will expand existing open data initiatives and put into effect the improvement of opportunities for further use of open data

Blockchain solutions can offer substantial added-value for the legally-secure access to data and to further use of such data. Yet such solutions' development depends on the availability of data. However, especially for small companies, data access remains difficult. The Federal Government will expand existing open data initiatives. In addition, the Federal Government will improve re-use of open data; this comes in the context of implementing Directive (EU) 2019/1024 on open data and the re-use of public-sector information. In this regard, the Federal Government welcomes the inclusion of union wide high-value data sets, which will be specified in an implementing act.

The national research-data infrastructure will enable better coordination of research data and improve data accessibility; open access and open data also form part of the pact for research and innovation.

The energy sector produces a large quantity of data. In particular, producer data and consumption data are of particular interest for use by third parties (research, business and society). It is being examined whether additional data for third parties could be made available, in compliance with the GDPR. As part of this, there is to be a pilot project to test out a data platform and to analyse the resulting business options; this project visually presents the provenance and concentration of CO2 in a given urban district.

5.5 The Federal Government is reviewing the options for making technology assessments regarding new blockchain-based applications

The Federal Government is reviewing the options for making accompanying and continuous technology assessments (from the start of 2021), as well as scenario studies and feasibility studies; these relate to new

applications made possible through blockchain technology (e.g. with reference to energy consumption and shifts in power relationships, sustainability goals within the framework of the UN 2030 Agenda).

Appendix: Table of Measures

Measures		Managed by
1.1	The Federal Government aims to open up German law for electronic securities	BMF, BMJV
1.2	The Federal Government will publish draft legislation to regulate the public offering of certain crypto-tokens	BMF, BMJV
1.3	The Federal Government intends to create legal certainty for crypto exchanges and custodians	BMF
1.4	At the European and international levels, the Federal Government seeks to galvanise efforts to ensure that stablecoins do not become an alternative to state currencies	BMF
2.1	The Federal Government funds practice-oriented research, development and demonstration of blockchain technology in the energy sector	BMWi
2.2	The Federal Government is piloting a blockchain-based link-up of energy facilities to a public database	BMWi
2.3	The Federal Government will establish a cross-technology piloting laboratory for the energy sector	BMWi
2.4	The Federal Government is fostering the build-up of a test environment for developing and applying secure digital business processes	BMWi
2.5	The Federal Government supports innovative blockchain solutions in developing countries	BMZ
2.6	The Federal Government will introduce sustainability-oriented requirements as an important decision-making criterion in implementing state-funded or state-initiated blockchain projects	BMU
2.7	The Federal Government is exploring the state funding of environmentally-sustainable blockchain applications	BMF, BMU
2.8	The Federal Government is examining whether, and how, blockchain-technology use can contribute to transparency in supply chains and value creation chains	BMBF, BMZ, BMU, BMEL
2.9	The Federal Government is funding research and development of effective governance structures for using blockchain technologies in the logistics sector	BMVI, BMBF
2.10	The Federal Government will develop and fund blockchain applications contributing to consumer protection	BMJV, BMEL
2.11	The Federal Government is funding the testing-out of blockchain-based verification of higher-education certificates	BMBF
3.1	The Federal Government will conduct a round-table discussion on blockchain and data protection issues	BMWi, BMI
3.2	The Federal Government is examining the use of blockchain technologies in the context of provision of proof	BMJV, BMI

Measures		Managed by
3.3	The Federal Government will observe and examine blockchain applications in the creative-arts sector	BMJV
3.4	By the end of 2020, the Federal Government will examine possible opportunities for application of blockchain technology in company law and law on cooperatives	BMJV
3.5	The Federal Government will concern itself with the legal framework conditions that apply to new forms of cooperation	BMJV, BMWi
3.6	The Federal Government is checking the suitability, feasibility and potential of an international arbitration authority	BMJV, BMWi
3.7	The Federal Government is examining options for adapting proof-of-identity practice in official authorisation processes	BMVI
3.8	The Federal Government is commencing the build-up of a Smart Contract register in the energy sector	BMWi
3.9	The Federal Government will explore possibilities to introduce accredited certification procedures for Smart Contracts	BMWi
3.10	The Federal Government is planning to commission a study that offers an overview on technical processes used for digital identification, authentication and verification of devices	BMWi
3.11	The Federal Government is actively involving itself in the development of standards at international level and backing the use of open interfaces	BMWi
3.12	The Federal Government is intensively pursuing measures to open the interfaces in the healthcare sector	BMG
3.13	The Federal Government is analysing blockchain technology from the perspective of its information security	BMI
3.14	The Federal Government is funding the development of innovative cryptographic algorithms and protocols	BMBF, BMI
4.1	The Federal Government is making state digital identities available and is examining possibilities for linking them up with blockchain applications	BMI
4.2	The Federal Government is piloting blockchain-based digital identities and evaluating other suitable applications	BMI
4.3	In a funding project, the Federal Government will test out the interoperability of secure digital identities for individuals	BMWi
4.4	The Federal Government is considering test operation of a blockchain to make information on electronic trust services available on a lasting basis	BMWi
4.5	The Federal Government is participating in the build-up of the European Blockchain Services Infrastructure	BMWi, BMI, BMVI
4.6	The Federal Government will introduce, advance, and give publicly effective support to showcase projects that use blockchain technologies, for instance in public administration	BMI, BMZ
4.7	The Federal Government is examining possible applications that	BMWi

Measures		Managed by
	deviate from the traditional requirement to use the written form	
4.8	The Federal Government is examining and testing out the development, funding and use of secure validity tokens for relevant application areas	BMI, BMBF
4.9	The Federal Government is conducting pilot projects to introduce blockchain-based applications for a more efficient and transparent determination of the customs value of e-commerce transactions in third countries	BMZ
4.10	The Federal Government will examine the application of blockchain technology in the area of vehicle-holding	BMVI
5.1	The Federal Government will conduct a series of dialogues on blockchain technology	BMWi, BMBF
5.2	The Federal Government is advancing exchange of information in the context of the Digital Hub Initiative and through the *Mittelstand 4.0 Centres of Excellence* (for medium-sized firms)	BMWi
5.3	The Federal Government is providing support to new forms of cooperation on an application-related basis	BMWi, BMBF
5.4	The Federal Government will expand existing open-data initiatives and put into effect the improvement of opportunities for further use of open data	BMI, BMWi
5.5	The Federal Government is reviewing the options for making technology assessments regarding new blockchain-based applications	BMBF

Overview of Ministries (see Appendix)

BMBF	Federal Ministry of Education and Research
BMEL	Federal Ministry of Food and Agriculture
BMF	Federal Ministry of Finance
BMG	Federal Ministry of Health
BMI	Federal Ministry of the Interior, Building and Community
BMJV	Federal Ministry of Justice and Consumer Protection
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMVI	Federal Ministry of Transport and Digital Infrastructure
BMWi	Federal Ministry for Economic Affairs and Energy
BMZ	Federal Ministry of Economic Cooperation and Development