DELPHI
ENERGY
FUTURE

POSSIBLE FUTURES:

FINDINGS FROM THE DELPHI ENERGY FUTURE 2040

STORAGE IS THE GAME CHANGER

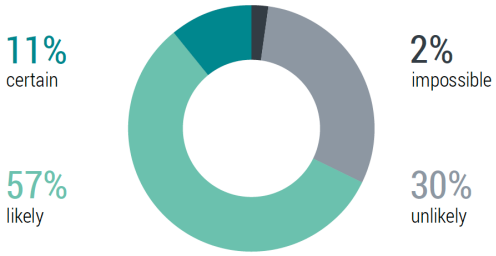
Storage systems are at the centre of all technologies needed to implement the energy transition. Decentrally operated high-performance storage facilities – in other words: batteries – are now affordable, generally available and easy to install, thanks to a rapid decline in prices. In rural Africa they are used in solar containers and help to buffer power output. In the power systems of industrialised countries they provide ancillary services on a broad scale in conjunction with renewables, thereby taking over this role from fossil-fired power stations. The world of electric mobility has been turned upside down: the latest generation of electric cars available in 2040 can travel up to 3,000 kilometres and is recharged using electrical induction. Combustion engines are hardly sold any longer as a result. Instead, used but still powerful batteries from electric vehicles are being sold in a global second-life market, which further pushes down the prices of this technology. The price/ performance dynamics prevailing in the computer chip industry at the start of the century now apply to power storage as well.

Power storage is at the centre of a cluster of mutually reinforcing technologies. It is not only driving a decentralisation of power generation but it also makes new generations of photovoltaics technology more economically viable, thin-film on facades for instance. Information and communication technology, which is needed for inter- connection and stabilisation purposes, is another factor reinforcing this development.

"Delphi Energy Future 2040" is a strategic foresight project in the energy sector, based upon the expertise of more than 350 experts from over 40 countries and all relevant sectors. This extraordinary study offers exciting insights into a worldwide discussion that evolve around the core question "What future awaits the energy systems in Germany, Europe and the world in the year 2040 and beyond?" To access all results, please download the full report free of charge here:
http://www.delphi-energy-future.com/results/

THESIS 34
By 2040 battery storage facilities providing frequency control services will have taken over the role of conventional power stations in maintaining system stability.

WILL THIS THESIS ACTUALLY TAKE PLACE?



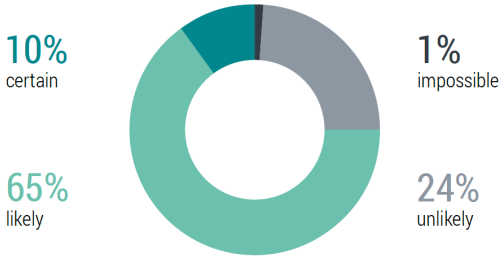
Electric mobility is the field where the enormous versatility of these new technologies is demonstrated most clearly: electric vehicles in 2040 are a storage facility, buffer, control unit and application all in one. Consistent advances in the development of these technologies have meant that high-performance renewable installations are now sold in retail stores and can be installed by users themselves. This further increases the number of "prosumers" – renewable installations are becoming a matter of lifestyle. The decentralised structures, in turn, have socio-political effects: municipalities and social bottom-up movements are gaining momentum. And not only in the developing world and in emerging economies but very much so in industrialised countries, too.

The immense amounts of data collected for control purposes in decentralised energy systems have attracted IT firms to a market that enables them to use their expertise and play to their strengths. Managing volatile electricity markets requires strong skills in the field of automated data processing: in power markets characterised by high levels of disintegration, continuously metered customers and real-time pricing, smart meters and appliances will assume the role of optimising demand. Energy trade is also expected to be organised along the lines of traditional exchanges, using fully automated trading systems. The threat: as digitalisation spreads, the risk that criminal data breaches and acts of cyberterrorism might unsettle the markets also increases. Creating a regulatory framework that facilitates extensive security measures will be a central regulatory task in order to ensure security of supply and thus remain internationally competitive.

THESIS 38

By 2040 the energy supply system will be structured in a cellular way: interconnected cells and "islands" of the size of a city or medium-sized region will generate their energy from solar power, wind power, storage units and a minor share of conventional reserves.

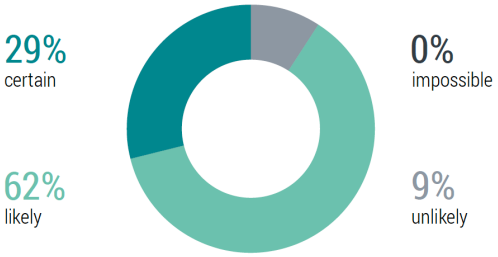
WILL THIS THESIS ACTUALLY TAKE PLACE?



THESIS 54

By 2040 the power market will be characterised by a high level of disintegration, load profiled customers and real-time pricing; smart meters and appliances will enable users to optimise their consumption.

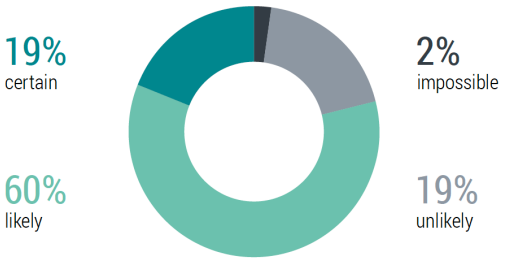
WILL THIS THESIS ACTUALLY TAKE PLACE?



Even economies with very power-intensive industrial sectors are now using large storage units – that is battery power plants – to secure system stability. The vast oversupply of electricity generated from renewables is made available for other uses through sector coupling – an "all-electric society" is thus emerging, which uses renewable power instead of fossil energy sources for heating and mobility purposes, too. Economies that have yet to electrify entire regions are building decentralised energy supply systems based on cellular structures. For more information, please read theses 33, 34, 38, 51, 53, 54 and 55.

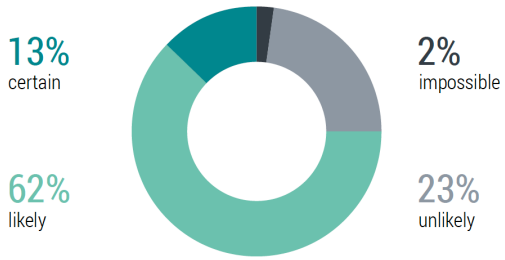
THESIS 55
By 2040 energy will be traded in fully automated trading systems based on complex algorithms, just like any other exchange-traded product.

WILL THIS THESIS ACTUALLY TAKE PLACE?



THESIS 33
By 2040 an "all electric society" will have become a reality. Electricity, especially power generated from renewable sources, will also provide mobility and heating, and will have displaced petroleum and natural gas in many industrial processes.

WILL THIS THESIS ACTUALLY TAKE PLACE?



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