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The Energy Challenge

A Licence for Navigating the Future

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Welcome

Shaping the Future!

New forms of energy, complex regulations, growing investment needs, volatility: the energy sector is facing a huge global challenge. The good news is that this situation provides unique opportunities of potentially historic proportions. It's also where the application of strategic creativity opens up previously unseen possibilities to positively shape a sustainable future for the entire industry.

Looking at the past tells us that times calling for radical change are also times of innovation. In particular, creativity is fuelled when crises make it necessary to rethink existing structures. The KPMG study “Energy – Quo Vadis?” marks the beginning of a series of publications, handbooks, studies and cases for future-proofing, published by the KPMG Global Energy Institute EMA. It provides decision-makers in the energy industry with professional support for taking a sustainable approach to opportunities.

This management book builds on the “Quo Vadis” study and shows how to implement a strategic foresight process by applying a toolkit of scenarios, wild cards, trends, uncertainties and more. The range of options is extensive, and is designed to facilitate intensive analysis and use of the challenges and opportunities that lie ahead.

Our goal is simple: to help companies deepen their skills in shaping the future of their organisations for a sustainable tomorrow.

Welcome

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The Trend Universe: Tomorrow's Opportunities

“Oil is a useless secretion of earth – a sticky liquid that stinks and cannot be used in any way.”

Academy of Sciences in St. Petersburg (1806)

What's in it for us – and when?

Assuming you started thinking about the future for longer than yesterday, you will have certainly experienced the following: the higher the hierarchic level of an audience, the more impatient they usually are about the future. When the in-depth discussion turns to Scanning (see Chapter 2) and Scenarios (see Chapter 3) at keynote speeches or seminars, at some point someone raises their hand impatiently and asks how “all that” is supposed to benefit their organisation. That's what it ultimately always boils down to. And this is absolutely fine. In fact, the earlier you consider the wishes of your target group in terms of the usefulness of your observations about the future, the better it is for you and for your mutual future. Scenarios paint quite an illustrative picture of what changes we can get ready for in the future. They answer the question: how might tomorrow's world be? You'll receive a more concrete, more success-orientated image of the future if you ask two other questions:

1. What will the future bring us? That means: which future developments can we already foresee today? Generally, these developments are called trends – and trends are pretty close to market opportunity, if you make use of them.
2. What surprises might be in store for us in the future? These are the so-called 'wild cards'. They are developments that seem extremely improbable, but which could have a disastrous and/or promising effect if they do occur.

We already know that business is booming for trendsetters and trend surfers. Trends show us 'what we can get' today and even more so in future. That's why we take a look at trends in these wild cards in the next chapter.

Triad of the future

It should now be clear that we need all of these three things for the future: scenarios, trends and wild cards. Together, the three establish a highly differentiated and relatively concrete picture of the future. It is also possible to define strategic foresight differently. But within the scope of this book:

Foresight = scenarios + trends + wild cards

All three tools complement each other in Phase 2 of the foresight process. Those who only have trends on the screen overlook *The Big Picture*. The big picture is delivered by scenarios. But those who work only with scenarios tend not, to invert a well-known expression, to "see the trees for the wood".

Trends are individual developments, while scenarios are comprehensive future stories, in which you present the inter-dependencies between the dimensions and factors. Scenarios can develop in many different directions. The trend has only one direction. Bell-bottom trousers are trendy again? That is a concrete direction: sales increase.

People who are familiar with trends in addition to scenarios see more. But they can still be surprised – namely from events whose development didn't materialise as a trend, but as structural breaks, disruptions and wild cards. Therefore wild cards belong to foresight (see Chapter 5). But first we are going to deal with something a little less wild.

Trends: What can you do with them?

There are many types of trends; for example, short-term ones, also known as fashion. There are medium- and long-term trends and even megatrends like globalisation, digitalisation, individualisation, climate change or sustainability. Megatrends are long-term transformation processes with global reach. They are responsible for creating sustainable and revolutionary change in society and business.

But before we get too caught up in definitions and categories, let's concentrate on something of significant importance when it comes to trends. Specifically, these four questions:

1. Do we have all the trends relevant for us on our screen?
2. How long will a specific trend last from today's perspective?
3. Which opportunities and threats result for us from this trend? By the way, this is already a transfer question (also see Chapters 6 and 7).
4. How do we respond to this trend? This is a transfer question as well.

These questions seem trivial but, unfortunately, are not asked often enough in practice. Regardless of which company we visit, we meet managers and employees who complain that the customers always want more, that the market is heading in the wrong direction and that they have been left behind by progress. Take note: they are not asking about future development; they are complaining about the current state of things.

Those who suffer from trends are dealing with them incorrectly.

Experienced future managers don't suffer from trends, they surf them. Trend surfing – the sport of future champions.

If trends surprise you, wild cards will give you the shock of a lifetime.

The imperative of futurology is: know your trends!

The future is a matter of character

The impact of personality factors on business decisions is generally unknown, at worst a taboo subject. Character? It's 'out of bounds' when it comes to management: don't ask about it.

Generally, there are three character traits that make it difficult for the owners of these traits to keep track of trends: egocentricity, limitation and insecurity.

- The *egocentric* lives in the unfounded belief that trends don't concern him, because he sets the trends.
- The *limited* individual might recognise trends with the help of the trend radar, but can't follow them because they don't correspond to his core competence.
- The *insecure* person ultimately encounters everything new with an initial – yes, sure, logical – insecurity. He waits to see 'how everything develops'.

Character is the art of getting in your own way.

It's frequently argued that corporate groups are immune to this phenomenon, because trend management isn't managed by one individual manager who is strongly influenced by his personality. In corporate groups, the work is done by a separate department like 'Trend Management & Innovation.' But, ultimately, the recommendations end up on the table of a single decision-maker, who may well possess one of the three character traits described above – and others. Even if this person is member of a committee, he or she will influence its decisions. Just think of the 'halo' or the 'herd' effect in groups.

This phenomenon also plays out, unfortunately, in the opposite direction: Trend apostles, professional optimists, visionaries and do-ers have a tendency to jump on the bandwagon of every weak trend. At a large US corporate group for consumer goods, for example, there was a division manager who everyone referred to only as ‘Brand-a-Month-Mike’, because he pulled a new company brand out of his hat every four weeks so that he could be involved in every trend.

Those who aren’t aware of the influence of personality traits on trend decisions are flying blind.

A little exercise

In this context, there will be a little exercise a bit later.

Observe your spontaneous personal reaction while reading this chapter on the trend universe (p. 117 f.): Scepticism? Laughter? Delight? Doubt? Devaluation? Frustration? Annoyance? Interest? Excitement? Enthusiasm?

Ask yourself: what does my reaction to the different trends say about the specific traits of my personality? Those who recognise the character-induced tendency of their personal reaction to trends are less likely to overlook opportunities and threats. This is also future competence. And it’s the reason why personal strengths and weaknesses are analysed in management seminars. Only they often don’t dig deep enough and are not explicitly based on future competence. You can eliminate this deficiency. Just think about our little experiment while you’re reading what comes next.

A whole universe of trends

There are many different trends at any given point in time, which means that things can get very complex, very quickly. So let’s reduce the complexity by limiting ourselves to the trends with an anticipated impact on the scenario object – in our case, the energy industry.

We can further reduce the numbers by categorising each trend. During the course of this chapter, you will find energy industry trends in four categories:

1. Generation
2. Distribution
3. Storage
4. Consumption

And for all of them, you have the opportunity to train how you deal with trends. The 38 trends (p. 117 f.) are everything from entertaining to incredible. You should, however, keep this question in mind for every trend: if this trend takes hold, what does it mean for us in terms of opportunities and/or threats? And one other question: where do the 38 trends come from?

The trend truffle pig

It's not so easy to discover a trend – otherwise there wouldn't be so many market participants who seem to be asleep while they're happening. There also wouldn't be any trendsetters, no avantgardists, trend scouts, trend pioneers or first movers.

The material you'll find on the following pages may sometimes strike you as amusing or even absurd, but we have worked on this for several weeks, identifying the individual topics, verifying them with reliable sources, selecting and analysing. This also means that, even if you discover a trend on the following pages and think "how utopian", it isn't. The following trends have all been substantiated reliable sources. This a key quality criterion for your trend management, too:

Don't be fooled by false statements. A trend can always be reliably proven.

An idea is not a trend – even if it's a really good idea. An (emerging) trend is only something that is already reflected in reality – for example, in the form of a prototype, a previous market test, a pilot project, research project by a

prestigious group of scientists or a study of some kind. It requires extensive research in order to find out if a trend really exists. Trends don't just fall into your lap: they take work. Actually, performance is a more accurate term: work in time. Time is a decisive dimension in trend management. If, for example, you see a new fashion trend in the shop window, it's actually too late – at least if you are a distributor or a fashion designer.

A trend is only interesting if you discover it early on. Preferably earlier than the competition.

Early enough to jump on for the ride and to benefit from the trend opportunities.

Trend and countertrend(s)

There's no prize to be won if everybody is already riding the trend. Especially not the innovator ROI or the first mover advantage. Which means:

Trend explorers who can read weak signals better than others are ahead of the game.

That is craftsmanship. Sites for the application of this art can be found in trend databases, on the internet or in expert talks, at trend conferences, in newspaper cuttings or in historical analogies. There is nothing new under the sun. Many patterns from the past can be transposed to the present and future – if you have an eye for the past.

The 'trend truffle pig' can even make a find if there is a trend reversal. For instance, after social media became popular on the internet, several countertrends emerged. Many of the early users are de-registering and deleting their profiles in order to decelerate and create digital downtime. That is a countertrend. Another: as a response to the ever-present smartphone dependency, many people are showing an interest in meeting up in the evening for a beer and having real discussions with real people – without first electronically communicating with them.

There is no trend without countertrend(s).

You needn't wait for such a countertrend to cross your path. You can even play 'name the trend' and guess the countertrends. "If X establishes itself, what would the opposite be?" What is the opposite of a trend? A niche. A trend is not a dictatorship; not everybody is going to follow a trend. The only question is: do the non-followers create an economically viable niche for my business concept? It's a question that's rarely asked. When CDs replaced vinyl, many traditional album pressing plants wailed "Our business model is dead!". Many who smelled the countertrend coming and stored the old presses are successfully pressing records today.

Those who complain about a trend still don't see the countertrend.

And there will always be one. Even if there were a trend dictatorship – which there isn't – there would still be those who would swim against the current. That is a characteristic of the pluralistic society. And if there actually is no countertrend? That's because it doesn't exist *yet*. "Everyone does X – we do Y." Create your own countertrend. Strong slogan, great marketing. Why is it that we hear such trend-opposing slogans so rarely?

The core competence bias

What's the superlative of the individual? The organisation. We talked above about how an individual's particular personality traits can change his relationship to the future and to trends without him even being aware of it. The character to the individual is the group dynamic to the organisation.

Let's take, for example, the trend toward digitalisation. Without naming names – because we are familiar with all of them. There were a lot of companies in imaging and photography that appeared to 'be asleep' as digitalisation took hold. Of course they didn't sleep through it; they saw it and discussed it. But then they decided not to follow it. Because they were future blind?

If an organisation doesn't act on what it sees, it is not due to blindness, but rather bias.

We will take an in-depth view of these cognitive distortions in Chapter 7. But at this point it makes sense to discuss a bias, distorted thought and decision, which is primarily responsible for organisations not taking advantage of trend-based future opportunities. This is the core competence bias.

In many companies – which also no longer exist – there was no talk then that digitalisation was merely a passing trend. Nobody says such things when they can see that all around them the competition, newcomers, lateral entry industries and start-ups are investing billions in the new technology. No, the responsible managers at the time identified the trend as a trend, and possibly even a megatrend. But they concluded that digitalisation didn't fit in with their core business.

The opposite was the case: digitalisation threatened the analogue core business. This threat provoked an often unconscious false rationalisation of the rejection of the trend. It was pointed out that the digital image quality of a mobile phone would never be able to compete with the image quality of a reflex camera.

"I can see that, but I don't act on it because my actions would threaten our core competence" says the core competence bias.

The bias is a distortion in perception and consequently a distortion in decision-making. What can be done about it?

The bias therapy

To create a little anticipation for Chapter 7, those trapped in a 'bias' unconsciously fade out parts of reality. In fact, you could say that people create their own bias without realising it – which is what, unfortunately, makes it so terribly effective.

The bias is the most elegant way to trip over your own feet.

If fading out parts of reality is the problem, the solution is quite simple: fade them all in again! In one of the companies that was able – just – to get its megatrend digitalisation act together in time, an engineer patiently explained to his (persistently biased) colleagues that the currently poor quality of digital cell phone images would quickly and dramatically improve in quality. He explained this so often that this part of the reality that had been faded out by his co-workers was faded back in.

After the faded-out parts of reality are faded back in, it is still tedious and time-consuming to convince the individuals who are stuck in their distorted perception. But, without fading them back in, it's impossible.

The core competence bias is thereby only one of many distorted perceptions. A person or an organisation that is faced with large numbers of these distortions is known as 'trend-resistant'. This is acceptable in the fashion world – even if you get outed as a trend-objector and stared at in fashion-conscious circles. But when applied to economic success, the rule is:

Trend resistance = Success resistance

Viewed in this way, the topic 'trend biases' is existential: we reject trends relative easily or fall for them too early (depending on their character – see above). But precisely because that happens without reflection, it is so terribly dangerous. It's the reason why, of course, ultimately everyone is responsible for all their decisions – even the ones that are made without reflection. If only because it means having to bear the consequences.

Twenty-five bad reasons to kill a good idea

Since this phenomenon is as universal as the air we breathe, science addressed it early on – the two futurists Kees von der Heijden and George Burt, for example.⁶⁴ Inspired by their ground-breaking work, here are the

most popular, valid and erroneous reasons why we normally and unthinkingly ignore potential future opportunities:

1. “We already had something like that – it didn’t work!”
2. “I’m sure management will dump this idea!”
3. “That doesn’t fit with our core business.”
4. “That is too expensive for us.”
5. “Too risky.”
6. “That’s not what we do.”
7. “The people are not ready for this.”
8. “Our success speaks for itself.”
9. “Policy-makers won’t approve.”
10. “Why something new? What we have works just fine!”
11. “What do you know about that?”
12. “The situation is more complicated than that!”
13. “That just feels wrong.”
14. “We don’t have time for that.”
15. “I’m busy now, come back later.”
16. “Good idea, but we should first take care of business as usual.”
17. “Doesn’t sound very promising.”
18. “We don’t have the competence for that.”
19. “We don’t have the people for that.”
20. “The department heads will veto this.”
21. “That’s technically impossible.”
22. “Nobody will buy that!”
23. “We already have 200 projects! What else do you want us to do?”
24. “The line is over there.”
25. “Take a number.”

The biggest enemy of progress is not politics, technology or money. It is human preconception and the resulting defence strategies: denial, evasion, delaying, belittling, devaluing, ignoring.

Management by 'excuse bank'

The list above has been making the rounds for years; its practice transfer is impressive. One manager, for example, gave the list to her team along with an 'excuse bank' and instructed everyone who uttered a phrase from the bias list to donate five euros for the next team party.

The team members didn't perceive of it as pressuring or patronising, but as a lofty competition and amusing game. They are still having fun with this – and never again did they hastily dismissed a trend with a casual comment. This takes us from an irritating phenomenon to an amusing turning point in trend management and corporate culture. It's a nice turnaround, which illustrates a basic human weakness in future competence:

Those who discover a trend, or suggest something new and expect to receive a pat on the back, have not yet understood the biggest problem in the future of humanity: humans. Resistance, reactance, defence and other unwanted reactions are likely to happen to the discoverer.

All the things you can do with trends

You can deny them, mock them and sweep them under the carpet – as we have previously seen.

If you have begun to consciously look for trends, and have also tapped into the appropriate sources like trend databases, you'll encounter plenty of trends.

But what will you do with all the trends you've identified? Prioritise them! Prioritisation is usually carried out on the basis of some key questions: which trends are interesting for us? Which ones do I focus on by examining them in depth? Which will I observe more closely in the near future? Where would we be merely wasting resources if we looked at the trend in greater depth? Which trend would give us little return at high cost if we followed up on it? Which trends are very alarming? Which are extremely attractive?

Many future managers use these questions to draw up hitlists, radars, (technology) atlases and/or cockpits. This creates the necessary oversight and transparency. Not to mention the fact that it isn't possible only to observe and prioritise trends; you can shape them too.

Shaping trends

The pharmaceutical industry is known for spending billions to root out unwelcome trends. That is legitimate. If I sell strawberry ice cream and the trend is moving toward vanilla ice cream, then I can advertise: "Eat more strawberry ice cream!". Free competition practically demands this of suppliers. On the other hand, attractive trends can be placed, pushed, publicised and sponsored.

Trends can only be actively shaped by those who discover their weak signals in time on the radar.

If the trend is already in full swing, it is relatively difficult to influence it. Big companies like to influence trends, and they're good at it too. Small companies can surf the waves of the trends created by their bigger counterparts. And even the wake of a trend will give you a good ride.

Plus: if you're small, a trend niche could be the perfect fit.

This strategic option is unfortunately frequently overlooked. There is a lot of complaining about trends that break away from your own company and products, instead of finding the right trend niche and making yourself at home there. That's because one thing depends on the other: if you have to complain about a trend, your trend radar has usually failed in the run-up. If you had known about a trend early enough, you wouldn't have to complain.

Trend niches have always been around. There are always people who don't follow the trend. They're there. But that's not the question. The question is: will I discover the niche target group(s) in time to get myself organised and adapted to them?

Classifying trends

If you have been systematically observing trends for a while now, you will have noticed:

Trends must be classified!

Only classified trends are useful for trend management. If it hasn't been classified, it can't be managed. That's why the following trends are classified in the four categories described above, as well as by time dimension (each in brackets). Based on expert opinion, it depicts the year from which the strong acceptance and dissemination of the trend can be expected.

The year also naturally shows how much time you still have to prepare yourself for the trend. In addition, in the case of the energy industry, we differentiate between whether the relevant trend is a 'single application/special solution/large-scale project' or a 'mass application/highly scalable solution'.

We recommend having a pen ready while reading the following 38 trends. Nothing compares with the first impression. Even a spontaneous categorisation is a categorisation. If you don't have an affinity for the energy industry, should skip the following 38 trends? Absolutely not! As an adept future manager, you should check whether and how the observed trend could also be applicable to your own industry.

The Next Big Thing

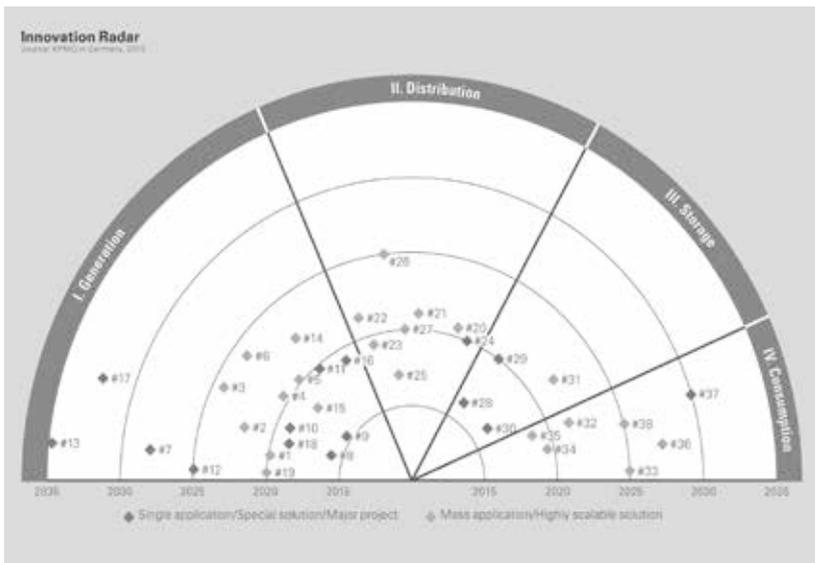
This expression is almost a cliché in public discussion. In particular, American management seems virtually obsessed with the idea that the future is not a sequence of incremental innovations, but of centenary, if not millennium events and trends, like the discovery of petroleum, the development of the personal computer or the internet. In light of this extremely attractive concept, trend observation becomes even more significant than it already is:

Behind which trend will we find The Next Big Thing? It could be any trend!

So we should keep an eye on all of them. That's why the following innovations and opportunities provide a tightly focused overview of a small selection of trend candidates, which absolutely must be on your innovation radar.

That said, the most you will learn here in the way of future opportunities is that these examples are 'symphonies' of the future – the ideas have been selected on the basis that they represent a symphony of future movements. Some of the ideas will reach market maturity in five years, others in ten, while others ...

As far as we can tell at the moment, because technological advances continue to develop and it is very possible that the number of years on your own radar will look very different. The time of occurrence has been pushed backward or forward since you are continuously updating your radar. If you're not, we highly recommend that you do. Trend observation is worth it. Because each of the following individual developments can revolutionise the energy industry or a dedicated market niche within the industry.



Energy generation trends

#1 Power from Moonlight (2020)

That sounds romantic. But the Beta.ray collectors from Rawlemon are so highly efficient that they can even transform moonlight into electricity.⁶⁵ An initial mass product to charge mobile telephones should be on the market soon. In four to five years, they also plan to begin serial production of window facades for office buildings that use super-efficient collectors to turn incoming light into energy, with an incredible efficiency of over 50 percent. But even this fantastic efficiency can be improved.

#2 Nantenna Solar Power (2023)

Researchers at the University of Missouri want to use nanoantennas (Nantennas) to increase the efficiency of solar cells to more than 90 percent – and they want to do it in the next five years. Today's silicon cells are still not able to achieve this.⁶⁶

#3 Bionic Energy (2024)

US scientists have succeeded in creating a bionic electrical source with an inorganic semiconductor and organic proteins.⁶⁷ By using cadmium telluride, light is transformed into the protein cytochrome C, which plants use for photosynthesis. An idea like this won't make it past the laboratory door! And if it does? About how many ideas, which move billions today, has that been said? A trend pro would never say that. He keeps track of the trend. And as soon as negotiations for licensing contracts begin, he sounds the alarm.

#4 Electricity through Body Contact (2021)

Physical physics. More precisely: the triboelectric effect. Researchers at Peking University have developed a foil for electric devices that generates energy when the user touches the device during normal operation.⁶⁸ How many power plants won't need to be built if mobile telephone users, video gamers or joggers can independently supply their devices with power – simply by doing what they always do?

#5 Super Wind Energy (2021)

Smitha Rao and J.C. Chiao from the University of Texas in Arlington have constructed a windmill that is only 1.8 millimetres wide.⁶⁹ Ten of them fit on a grain of rice. Hundreds on a slip-on protective sleeve: And your mobile is charged again. Thousands could be installed on the wall of a building, for the generation of electricity and light.

Question: how do I react to such technology developments? Do my eyes light up? Or am I worried? Of course, this super-individualised power production is the ultimate threat for classical business models. Who will build the mini slip-on windmills and finish the facades? Who will build and supply the periphery and connectivity for this technology?

#6 Plant Power (2024)

No, not by way of composting. But by using a plant's traditional properties: plants have transformed light into energy since the beginning of time. Unfortunately, they store this energy in the form of sugars. Now, researchers at the University of Georgia have developed a method that 'captures' the electrons harvested from the light before the plant has a chance to turn it into sugar.⁷⁰ In the future, this could lead to solar farms equipped with 'sunflowers' instead of glass panels. And, afterwards, the wilted plants could still be used for secondary energy generation in biogas facilities.

#7 The End of the Greenhouse Effect (2028)

Our hunger for plastics is enormous – and risks causing climate catastrophe. Newlight Technologies brings two things together, which at first don't look like they belong together: climate catastrophe and the hunger for synthetic material.

The company has developed a process that uses air and greenhouse gas to produce a plastic that is biodegradable.⁷¹ In addition, it is more cost-effective and efficient than plastics produced from crude oil.

#8 Floor Power (2017)

The energy that dancers release at a party, a rock concert or a rave need not be lost in music. The Dutch artist and inventor Daan Roosegaarde installed spiral springs underneath the panels of a dance floor to drive a generator.⁷² The panels are generally 75 x 75 x 20 centimetres in dimension and can produce up to 35 watts. That makes 5 to 20 watts per dancer. And while these dancers are dancing, it produces the energy for the light show and sound system.

#9 Pedal Power (2016)

Actually, you have to ask yourself why it took so long for someone to think of this – it's so obvious. The 'Green System' by SportsArt Fitness transforms the ergometre into a dynamo.⁷³ Pedal-pushers don't just burn calories; their exercise produces electricity.

According to the manufacturer, the dynamo turns 75 percent of the energy generated into electricity, so that 10 units of training equipment in a fitness studio generate up to two kilowatt hours (kWh). At a typical energy requirement of 15 kWh per 100 kilometres, an electric car could, for example, drive a distance of 13.3 kilometres.

#10 Solar Film Power (2019)

3M and BASF already have versions of it in their portfolios. Now the start-up New Energy Technologies has followed suit and developed a transparent solar film, which transforms sunlight into electricity.⁷⁴ If, for example, this is attached to the windows, fuselage and wings of an aircraft, it saves the space and weight that would have been taken up by tanks and energy storage devices.

#11 Saltwater Replaces Petrol (2025)

Scientists at the Naval Research Laboratory in Washington D.C. have developed a method that allows the US Navy to refuel aircraft carriers on the open sea and which, at first sight, seems incredible: the vessels are fuelled with sea water.⁷⁵ The researchers extract carbon dioxide and hydrogen gas from the sea water in a catalytic converter. This produces a liquid hydrocarbon fuel, for which the ship's engine doesn't even require conversion.

#12 BAT Beats Wind Turbine (2025)

Conventional wind turbines often suffer from weak ground winds. They also need an energy infrastructure out on the open field in order, for example, to supply a distant city. The Buoyant Airborne Turbine (BAT) can do without both by lifting itself zeppelin-like 600 metres in the air, at any location in the world where strong winds blow.⁷⁶ A zeppelin-turbine like this can hover directly over any city.

#13 Nuclear Fusion via Crowdfunding (2035^{Plus})

Since nuclear fusion doesn't seem to be advancing very far on the back of 'traditional' scientific research, Lawrenceville Plasma Physics in New Jersey wants to build a fusion reactor with money from crowdfunding.⁷⁷

An ambitious project, indeed. But would you bet that it fails? Imagine that the project is a success. All the energy problems facing humanity would be solved at once. And a money-making machine would have been invented.

#14 Solar Paint Power (2023)

Just look what you can use to produce energy – for example, so-called quantum dots. These are electricity-generating nanoparticles which, when mixed with paint, create paintable solar cells. This paint makes every wall an energy producer – even without glass panels. Researchers at both the University of Notre Dame (USA) and at the University of Toronto (Canada) are working feverishly on this solar paint.⁷⁸

#15 Jet Turbines for Wind Energy (2018)

The engineers from Ogin used jet turbines from aircraft as a model to create a wind turbine, which looks more like a jet turbine than a wind turbine.⁷⁹ It is a turbo-success. This type of jet-wind turbine is meant to supply three to four times more energy than a conventional wind turbine of the same size.

#16 Power with Maritime Hybrid Generators (2018)

Mitsui is developing a maritime hybrid generator called Savonius Keel and Wind Turbine SKWID.⁸⁰ 'Savonius' and 'Darrieus' are the two types of turbines used. The generator can harvest energy from both wind as well as tidal range and, consequently, supply 300 households with electricity.

#17 The Autarkic Ark (2033)

Like Noah, Russian architect Alexander Remizov has designed an ark⁸¹ – just in case the energy transition goes wrong, the pole caps melt or any other man-made catastrophe sends humanity into exile. His ark is energy self-suf-

ficient due to the use of solar, wind and hydrothermal energies. The plants underneath the floating dome produce enough oxygen to ensure survival.

#18 Fall Wind Power (2018)

A 685-metre-high solar wind energy tower is being planned in the desert of Arizona.⁸² The height is necessary in order for it to work efficiently: 9.5 million litres of water will be continuously pumped into the spire of the tower and sprayed out into the heat of the Arizona desert, where it will evaporate. The evaporation cools the air, which falls in the direction of the desert floor, accelerating to a speed of up to 80 km/h because of the immense height of the tower. This subsequently drives the turbine, which in turn produces electricity. The nature of the water cycle ensures that the water will be collected, purified and returned to the groundwater.

#19 Breath Power (2020)

Isn't there anything that you *can't* use to produce energy? Luckily nobody is asking that question of the innovators and researchers whose ideas we are discussing here. Quite the opposite; they are considering everything.

Like the Brazilian designer Joao Lammoglia, who created a breathing mask that produces electricity.⁸³ Wearing the mask while sleeping, jogging, cleaning the house, watching television or anything else generates electricity. Sleepers actually do produce 'electricity while they sleep'. The integrated mini-turbines in his design concept turn breathing air into electricity.

Energy Distribution Trends

#20 Cable to Battery (2012)

What would happen if your shirt could power your mobile phone? Researchers at the University of Central Florida have developed a cable that can store electricity.⁸⁴ If the cable is processed into fibres or used in textiles, it transforms every piece of clothing into a battery.

Electricity no longer comes from the socket, but from a boutique. Today's fashion companies would be tomorrow's energy giants. So much for the topic 'energy industry threatened by newcomers from non-energy sectors'.

#21 Wireless Energy Supply (2022)

Although it's still a long way from energy supply with high voltage current, the US company uBeam is already successfully supplying electricity to smaller energy consumers through ultrasonic waves.⁸⁵ Electricity is quasi-transmitted through the air: No more power line conflicts!

#22 Air Power (2022)

And here's another method to transmit electricity by air: scientists at Duke University in the USA have succeeded in transmitting energy over an unprecedentedly long distance using low frequency magnetic fields.⁸⁶

#23 Wi-Fi Power (2019)

The first successful airborne electricity transmission was achieved by the Cota system developed by the start-up Ossia.⁸⁷ The system transmits energy over a distance of up to 10 metres. It uses a wave spectrum, the same technology applied by wifi, Bluetooth and ZigBee. Tests showed that en-

ergy transmission was successful even if the receiver was not within visible range of the sender.

#24 Cutting Storage Requirements (2020)

IT companies are working with predictive analytics to determine the strongly fluctuating output of solar farms and wind parks 15 to 30 minutes in advance.⁸⁸ This should be achieved using a sensor-supported new algorithm. The cost-intensive upkeep of standby power plants could thereby be reduced, consequently reducing the costs for renewable energies.

#25 Energy Pirates (2018)

The German designer Dennis Siegel has developed the electromagnetic harvester up to prototype stage.⁸⁹ In the video, he moves through the city with it and uses induction to ‘steal’ part of the energy from fluorescent tube lights, the ticket validator in the subway, the mobile phone from the friendly woman sitting next to him – and any other electrical device in the vicinity. He can then use this energy to charge a conventional AA battery. You only have to be near the devices for the harvester to tap into their reserves. Harvest and charge.

#26 Streetwise Electricity (2025)

American husband and wife team Brusaw collected more than USD 2 million through crowdfunding. They want to use the money to start serial production of solar roadways.⁹⁰ The solar tiles on the street produce the electricity for street lights, traffic lights, residents and other users, and even, for example, for electric cars (transferrable via induction or kerbside socket).

If all American highways were solar streets, the USA could produce triple the electricity it currently consumes. Now that’s an idea that sounds dangerously attractive or threatening – depending on who is looking at it.

#27 Fantastic Plastic Energy (2020)

A research team at the Swedish University of Linköping didn't just develop an electrically conductive plastic; it can even be used to generate electricity.⁹¹

To achieve this, the researcher treated poly(3,4-ethylenedioxythiophene) (PEDOT) with a ferrous solution. In the plastic that was produced as a result, fluctuations in temperature cause the electrons to start flowing to the conductor surface – which is commonly known as electricity.

Energy Storage Trends

#28 Salt Stores Power (2017)

Now that does sound a little crazy, but it is actually pure physics – and significantly more cost-effective than modern batteries. If energy is produced but not needed immediately, this energy is used to melt smelting salt and stored until the next consumption peak. An important point: it is stored hot, since it has been melted. When the next consumption peak arrives, a heat exchanger extracts the bonded smelting energy from the smelting salt and transforms it into electricity.⁹²

#29 Submarine Spheres (2020)

This innovation by the two physics professors Horst Schmidt-Böcking and Gerhard Luther even tops the waves created by Jules Verne's *20,000 Leagues Under the Sea*. The team has designed the concept of submerging enormous hollow spheres on the floor of the ocean.⁹³ These spheres function according to the principle of pumped-storage power plants, which make use of the high water pressure at the bottom of the sea. In off-peak periods, the surplus electricity is used to pump the sea water out of the spheres. At peak times, the sea water is allowed to flow back in as a result of its natural pressure. The turbines subsequently harvest electrical power from the resulting kinetic energy of the flow.

If people were aware of all the innovations in development, nobody would even think of uttering the words “energy shortage threat”.

#30 The Biobattery (2017)

Did you notice the year quoted here? This innovation is on the brink of market maturity. Its idea comes from the medical industry. Implanting a pacemaker is a routine procedure these days. But implants could serve humanity better if the energy supply from lithium batteries and toxic electrolytes was not so problematic.

For this reason, researchers at Carnegie Mellon University in the USA have created an edible bio-battery made of pigment cells, which are found in octopus ink – thanks to fundamental research. The good thing: when the battery is dead, it is simply digested.⁹⁴

#31 Wood Power (2022)

The older generation or history buffs are familiar with the trusty wood carburettor. But wood can also supply other types of energy. Researchers at the University of Maryland (USA) have coated wooden fibres with tin and placed them in a sodium solution. The prototype of this wood battery made it through 400 loading cycles.⁹⁵ For your information: sodium costs significantly less than lithium. In the future, this new battery could store huge amounts of energy – for example, from solar farms.

Energy consumption trends

#32 Electricity from Body Heat (2022)

Pretty wasteful that the human body emits thermal energy every day and doesn't put it to use. Something should be done about that.

Airbus, for example, is working on an idea for a passenger seat that harvests electricity from body heat and uses it on site.⁹⁶ After all, a double-decker A380 has up to 800 human power sources on board.

#33 Firefly Power (2025)

Fireflies light up the night. They apply bioluminescence to transform 95 percent of the energy used into light, five percent into heat. Not even a modern LED light can claim such efficiency. As a result, researchers are currently attempting to transfer firefly DNA to trees (!) as part of creating a type of biological street light.⁹⁷

#34 The Electric Bracelet (2019)

A Korean research team has developed a bracelet with fashion appeal, which harvests electricity from body heat.⁹⁸ The yield is enough to charge a mobile phone.

#35 The Power Shoe (2018)

Inventors at Carnegie Mellon University have developed the innovation award-winning recipient 'SolePower'.⁹⁹ It is a sports shoe that takes the kinetic energy released during jogging, transforms it into electrical energy, and stores it – for example, to charge a mobile phone.

#36 Biolight (2023)

The 'biobulb', from a group of developers studying at the University of Wisconsin, doesn't generate its light with electricity, but with microbes.¹⁰⁰ The lamp is actually a closed miniature eco-system that only needs sunlight to regulate itself, and has the external effect of generating light.

#37 Rotating Houses (2030)

The University of Porto in Portugal has developed a ‘Casa em Movimento’ (moving house).¹⁰¹ It’s a concept for a house that rotates in synchronisation with the sun to facilitate optimal illumination in the rooms and optimal yield from the solar panels.

#38 Heat from the Wall (2025)

Innovative drywall panels can reduce the heating costs of buildings with conventional wall construction by up to 40 percent. Half of the plaster in the panels is replaced with paraffin beads. These absorb heat during the day and release it at night.¹⁰²

What does it all mean?

This compendium of 38 innovations is meant to test your future competence. How? Well, the answer can be found in your reactions on reading it.

Some react happily, because they take joy in the innovative spirit. Others are frightened, because they suddenly see the gaps in an innovation radar which they have updated only sporadically. There are others who would prefer to give their R&D some immediate development assignments. Many react gruffly and don’t understand why it’s good to have “so much technology”. They see the future coming towards them and (still) don’t know what to do with it.

The amateur sees the future for its trends and innovations. The expert establishes they relate to their own company and strategy.

We can’t do that for you. Because we don’t know your company. We can, however, be of assistance. But you are the expert for your company. Individuals who can establish the relationship between trend and business are on their way to becoming experts. A so-called trend portfolio provides a solu-

tion to establishing this relationship. You can use it to record the impact of trends on your business, including their probability of occurrence.

A well-developed trend portfolio gives you tips on how you could or should respond to trends. Take a proactive approach, tackle it immediately, or just watch or even ignore, because you shouldn't unnecessarily waste resources on it. Developments and impending trends can take many forms. Some companies involve themselves in the dissemination loops of the researchers, who are carrying out interesting projects for them. Others assemble project groups to create business models for selected innovations. And yet others start co-operations with other companies, when the innovations are too big to handle alone. The important thing is: you can only do all that if your own trend universe is big enough for you to keep an eye on the innovations, trends and trend candidates that are relevant for you.

How big should your trend universe be?

The answer is simple: as far as trends go, you can never have enough or too many. You pick them out from the internet or another source, enter them into the internal trend or innovation profile, specify if and how they should be monitored – and it's off to the next trend. Need to keep track of hundreds of trends? No problem, thanks to modern IT. The computer is patient. The question is: how can I stay on top of them all? That's why good categorisation is so important (see above).

“How many trends?” is not a question experienced future managers ask themselves. They tend to be people who can't get enough of innovations, trends, scenarios, UFs and wild cards. First, because it's fun and leads to success: there is hardly anything more interesting than the future – and those who are at the front of the line cash in on the innovator ROI. Second, it could be that The Next Big Thing is hiding behind the ideas and innovations. This is the best motivation of all for those who are wildly curious – and for the installation and maintenance of a comprehensive and continuously updated trend database.

The avant-gardes have that and do that. They have their own trend intelligence, their own trend management or a trend transfer department. This means an entire department with people doing nothing else except discovering, analysing, describing, documenting, observing and updating trends. This gives them a decisive edge over the competition at just the right moment in time.

Checklist: The 15-second test

Instead of answering another list of questions, try this little quiz. Get your smartphone stopwatch out and see if you can answer each of the following questions in 15 seconds:

1. How many general, social or technological trends can I think of?
2. How many trends in my own industry can I spontaneously think of?
3. Of the trends that I've identified, how many countertrends can I think of – actual or imaginable?
4. For which trends in the past ten years did my company do particularly well?
5. Which trends did our competitors handle better?
6. Which employees in and beyond my scope of management are particularly trend-conscious (not in a fashion sense)?
7. What are the most prevalent trend killers in our meetings?
8. What is characteristic of those trends that we tend to follow?
9. Which types of trends do we often overlook because they don't correspond to our preferences, our competence, our awareness?
10. Select any trend from recent years – whether industry-specific or general – and ask yourself: which companies saw it coming? Who missed it?

Who saw it?

The last test question is hugely important. Each and every manager can spontaneously name trends that have been recognised by some companies and overlooked by others. Gatorade, for example, recognised the sports drink trend at an early stage and was therefore faster than industry leaders like Pepsi or Coca Cola. Apple recognised the trend towards the digitalisation of music, while a large percentage of the music industry was caught out by it. This list could go on forever. In management seminars it is a popular game and an eye opener: if you play this game using your own company, the competition and the trends of the past 20 years, the results are always surprising. This game shows time and again which type of trends are reliably and traditionally well-recognised by a company or a manager, and which are just as reliably missed.

What you see is important. What you overlook is more important.

Of course the biases (see Chapters 6 and 7) are coming into play again here. Unfortunately, the factors that you overlook don't really care what your reason is for overlooking them.

We all are victim to biases. Every single person. That's why we are all more or less trend-blind. The question is: where are your blind spots?

Particularly technology-savvy individuals often and willingly overlook social, political or fashion trends – and vice versa. Many social institutions are 'completely surprised' when they receive yet another upgrade for a technology, although their old system allegedly still works fine. But do we reject the innovation after careful consideration? Or is that an anti-future reflex because we weren't able to see it coming? We therefore provide you with our concluding recommendation:

Take care of your trends before they take care of you.

Afterword

Most people want to have future competence, but often complain that they simply don't have enough time for scenarios and other labour-intensive foresight methods. We used to take a deep breath in preparation for an all-out attempt at persuasion; nowadays, this happens much faster. We ask a simple question:

Think back three, four or more years. Think about a decision that you made back then, to the best of your knowledge and in good conscience, which turned out to be wrong. Ask yourself: would I have made a better – a right – decision with scenarios?

This really brings it home. No more talk of “Too much work!” or “No time!” Because we all have the time needed to avoid bad decisions and expensive embarrassments. The approach should also make it clear that the future doesn't ‘come’ and it doesn't ‘bring’ us anything. The decision-maker with future competence doesn't wait for the future to ‘come’ or to ‘bring’ him anything; he shapes the future with the power of his own mind.

The future is work and absolutely fair: if you make the effort, you will be rewarded by the future.

You should by now have become pretty familiar with the procedures and methods of this work from these pages: environmental analyses, scenarios, trends, wild cards and the prevention of cognitive biases. The techniques and tools are known today to every modern company in the energy industry. The crux of the matter is that they are usually understood only by a small handful of people with responsibility. If one of these ‘licence holders’ leaves the organisation, future management risks being derailed.

The Highlander motto, “There can be only one”, does not apply to future competence. Instead: one is never enough.

For this reason, strategically thinking managers transform the techniques into a culture. This transformation of the pure future techniques into a cross-functional future culture which is cultivated at relevant meetings, projects and decisions is critical to success. Unfortunately, though, it's often underrated.

It is mainly the amount of work needed that is underestimated – a common element of most cultural changes. To bring about this cultural transformation, a critical mass of employees and managers need to learn about more than just the tools of foresight; they also need to learn how to actually apply them, in pilot projects or – through process management or coaching – in an environment where transfer is actively ensured. As huge as this challenge seems, the immensity of the upheavals taking place within the energy industry demands the effort. If the industry is making major leaps, we can't move in steps of just two or three. This is particularly critical, given the effort needed to bring about big cultural changes. But the hard work involved *will* pay off – through more transparency, increased competence, improved market opportunities and greater future security.

And, in case you haven't noticed yet, you're not holding a book in your hands. You are holding a 'navigator' for direct implementation of an organisational foresight process; the kind that every modern company needs today. From the first to the last chapter, you have learned about all of the steps that a foresight department, a strategy team, an executive management or a transformation team needs to successfully shape the future.

Yet the closer look that we have taken at this subject shows us there is no 'one' future. Not from today's perspective. There are only multiple, alternative versions of the future. If you plan for *the* 'one' future, you're already going down the wrong path. The right way to plan is for and with *futures*. The scenario approach is the planning instrument of future managers. Once you've got your 'driver's licence' in your pocket, you can rely on scenarios and be confident you're on the right path.

So, as you embark on your journey, we wish you 'happy travels'!

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Literature

(Date accessed: September 2015)

- Becker, M./ von der Gracht, H. A. (2014) Lernen im Jahr 2030. Von Bildungsavataren, virtuellen Klassenräumen und Gehirn-Doping in der Führungs- und Fachkräfteentwicklung. Incore et al.: Berlin.
- Federal Institute for Geosciences and Natural Resources (BGR) (2014) Energy Study 2014: Reserves, Resources and Availability of Energy Resources. BGR: Hannover.
- Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) (2014) GreenTech made in Germany 4.0 - Environmental Technology Atlas for Germany. BMUB: Berlin.
- BP (2013) BP Energy Outlook 2030. January 2013.
- BP (2015) BP Energy Outlook 2035. February 2015.
- Carbon Tracker/ Grantham Research Institute (2013) Unburnable Carbon 2013: Wasted capital and stranded assets.
- Center for Security Studies (CSS), ETH Zurich (2012). Energy Infrastructure Attack Database (EIAD) [Data file]. Retrieved from www.css.ethz.ch
- Citygroup (2014) Disruptive Innovations II: Ten More Things to Stop and Think About.
- Costa, Sérgio (2011) Die Zukunft Europas: Kosmopolitische Vision. In: Süddeutsche Zeitung, 20.07.2011, <http://sz.de/1.1122136>
- European Commission (2011) Energy Roadmap 2050. EC: Brüssel.
- ERP (2010) Energy innovation milestones to 2050, Energy Research Partnership report. ERP: London.
- Exxon Mobil Corporation (2014) The Outlook for Energy: A View to 2040. Irving, USA.
- GBN (2007) Energy Strategy for the Road Ahead. Scenario Thinking for Business Executives and Corporate Boards. San Francisco, USA.
- Glenn, J. C./ Florescu, E. (2015) 2015-2016 State of the Future. The Millennium Project: Washington.
- Harrop, P./ Das, R. (2010) Energy Harvesting and Storage for Electronic Devices 2010–2020. IDTechEx.
- IEA (2014) World Energy Outlook 2014. IEA: Paris.

- Institute for the Future (2011) Reinventing Energy Futures. IFTF: Palo Alto.
- KPMG Global Energy Institute (2011) A New Energy World, New Business Models.
- KPMG Global Energy Institute (2013) 2013 Energy Industry Outlook Survey. Is energy independence on the horizon?
- KPMG Global Energy Institute (2014) No paper chase: Transforming risk management at energy and natural resources companies.
- KPMG Global Energy Institute (2014) The Agile Utility.
- KPMG (2014) Survival of the Smartest 2.0: Which companies will survive the digital revolution?
- Marlinghaus, S. T./ Rast, C. A. (Eds.) (2013) Driving Impact. Value creation in the world of tomorrow. mi-Wirtschaftsbuch: Munich.
- OECD/ IEA (2003) Energy to 2050. Scenarios for a Sustainable Future. Paris, Frankreich.
- Royal Dutch Shell (2013) New lens scenarios. A shift in perspective for a world in transition.
- RWE AG (2012) The power of participation: An assessment of the opportunities and limitations of civic participation in Germany. RWE: Essen, Germany.
- Shell International BV (2009) Shell energy scenarios to 2050. The Hague, NL.
- Swiss Re (2013) Building a sustainable energy future: risks and opportunities. Zurich, Schweiz.
- trend:research (2010) Smart Grids in Europa bis 2030: Die Zukunft intelligenter Stromnetze in Europa: Anforderungen, Technologien und Marktpotenziale. Bremen et al., Germany.
- U.S. EIA (2014) Annual Energy Outlook 2014. With Projections to 2040. Washington, USA.
- von der Gracht, H. (2013) Survive: So bleiben Manager auch in Zukunft erfolgreich. Redline: Munich.
- World Economic Forum (2009) Thirst Energy: Water and Energy in the 21st Century. WEF: Geneva.
- World Economic Forum (2013) Energy Vision 2013 - Energy transitions: Past and Future. WEF: Geneva.
- World Business Council for Sustainable Development (WBCSD) (2010) Vision 2050: The New Agenda for Business. WBCSD: Geneva.
- World Wildlife Fund (WWF)/ Ecofys/ OMA (2010) The Energy Report: 100% Renewable Energy by 2050. WWF: Gland.

Endnotes

(Date accessed: September 2015)

- 1 Twain, M. (1860) Letter To Orion Clemens, 6/1860, 27. June 1860, City of Memphis en route from Memphis, Tenn., to St. Louis, Mo
- 2 Cf. Rivera, L. A. (2015) Pedigree: How Elite Students Get Elite Jobs, Princeton University Press: Princeton/Woodstock
- 3 von der Gracht, H. A./ Salcher, M./ Lichtenau, P./ Bird, S. (2015) Energy – Quo vadis? 2035^{plus}: Scenarios for tomorrow's energy sector. KPMG Global Energy Institute EMA/ incore: Berlin, <https://assets.kpmg.com/content/dam/kpmg/pdf/2015/06/energy-quo-vadis-summary-eng.pdf>
- 4 Tharp, T. (2006) The Creative Habit: Learn It and Use It for Life: Learn It and Use I for Life, Simon & Schuster: New York et al.
- 5 Royal Dutch Shell (2012) 40 years of Shell scenarios: 1972–2012, The Hague, NL | Wack, P. (1985) Scenarios: Uncharted Waters Ahead. In: Harvard Business Review, Vol. 63, No. 5, September-October, 1985, p. 73-89
- 6 European Commission (2009) Mapping Foresight: Revealing how Europe and other World regions navigate into the future, November 2009, Brussels
- 7 KPMG International (2012) Expect the Unexpected: Building business value in a changing world
- 8 Cf. Porter, M. E. (2008) The Five Competitive Forces that Shape Strategy. In: Harvard Business Review, Jan 2008, Vol. 86, Issue 1, p. 78-93
- 9 Cf. Fleisher, C. S./ Bensoussan, B. E. (2003) Strategic and competitive analysis: methods and techniques for analyzing business competition, Prentice Hall: Upper Saddle River, NJ
- 10 Twain, M. (1860) Letter To Orion Clemens, 6/1860, 27. June 1860, City of Memphis en route from Memphis, Tenn., to St. Louis, Mo
- 11 Bacevich, A. J. (2010) The Carter Doctrine at 30. In: World Affairs Journal, 01.04.2010, www.worldaffairsjournal.org/blog/andrew-j-bacevich/carter-doctrine-30
- 12 Anishchuk, A. (2014) As Putin looks east, China and Russia sign \$400-billion gas deal. In: Reuters, 21.05.2014, www.reuters.com/article/2014/05/21/us-china-russia-gas-idUSBREA4K07K20140521
- 13 Anderson, R. (2014) How American energy independence could change the world. In: BBC News, 03.04.2014, www.bbc.com/news/business-23151813 | Nestler, F. (2014) Die schöne neue Ölwelt von Saudi-Amerika. In: DIE WELT, 15.04.2014, www.faz.net/aktuell/finanzen/devisen-rohstoffe/energiepolitik-die-schoene-neue-oelwelt-von-saudi-amerika-12897326.html
- 14 Ostermann, D. (2014) Lässt sich der Kampf um Energieressourcen entschärfen? In: Badische Zeitung, 15.04.2014, www.badische-zeitung.de/ausland-1/laesst-sich-der-kampf-um-energieressourcen-entschaerfen--83294598.html
- 15 Chivers, C. J. (2007) Russians Plant Flag on the Arctic Seabed. In: The New York Times, 03.08.2007, www.nytimes.com/2007/08/03/world/europe/03arctic.html

- 16 German Federal Agency for Civic Education (bpb) (2011) Rohstoffvorkommen und -verteilung. In: bpb Informationsportal Krieg und Frieden, <http://sicherheitspolitik.bpb.de/rohstoffe-und-konflikte/hintergrundtexte-m4/rohstoffvorkommen-und-verteilung>
- 17 The Economist (2014) Europe's energy woes. The storm over new European Union climate-change targets, 25.01.2014, www.economist.com/news/europe/21595018-storm-over-new-european-union-climate-change-targets-europes-energy-woes | Beckman, K. (2014) Experts issue plea for new European energy policy to overcome »crisis of confidence«. In: ep energy post, 17.03.2014, www.energypost.eu/experts-issue-plea-new-european-energy-policy-overcome-crisis-confidence
- 18 Szulecki, K./ Westphal, K. (2014) The Cardinal Sins of European Energy Policy: Nongovernance in an Uncertain Global Landscape. In: Global Policy, Global Policy, Vol. 5, p. 38-51, DOI: 10.1111/1758 – 5899.12153 | Stratmann, K. (2014) »Verhalten der EU führt zu extremer Verunsicherung«. In: Handelsblatt, No. 119, p. 5, 25.06.2014
- 19 DIE ZEIT (2014) Energiewende: Deutschlands CO2-Emissionen steigen weiter an, 08.04.2014, www.zeit.de/wirtschaft/2014-04/grafik-co2-emissionen
- 20 ZEW (2014) Energiemarktbarometer, Juli/August 2014. ZEW: Mannheim, <http://ftp.zew.de/pub/zew-docs/zn/schwerpunkte/energiemarkt/Energiemarkt0714.pdf>
- 21 German Federal Ministry of Justice and Consumer Protection (1967) Law to Promote Economic Stability and Growth (June 8, 1967), <http://germanhistorydocs.ghi-dc.org/pdf/eng/Chapter9Doc4.pdf>
- 22 FAO (2009) How to Feed the World in 2050, Food and Agriculture Organization, United Nations: Rome, www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf
- 23 Kagan, J. (2010) Third and Fourth Generation Biofuels: Technologies, Markets and Economics through 2015. GTM Research: Boston et al., USA | Beckman, K. (2014) Boeing reveals »the biggest breakthrough in biofuels ever«. In: ep energy post, 27.01.2014, www.energypost.eu/exclusive-report-boeing-reveals-biggest-breakthrough-biofuels-ever | EIRIS/imug (2014) Biofuels Report. EIRIS: Boston et al.
- 24 Graham-Rowe, D. (2012) Tank gegen Teller. In: Spektrum Wissenschaft, 20.02.2012, www.spektrum.de/news/tank-gegen-teller/1142590
- 25 F.A.Z. (2012) Welthungerhilfe für Verkaufstop - Die Präsidentin der Welthungerhilfe, Bärbel Dieckmann, unterstützt die Forderung nach einem Verkaufsstopp des Biotreibstoffs E10. Ihr Motto lautet: »Erst Teller, dann Tank.«, 23.08.2012, www.faz.net/aktuell/politik/inland/biosprit-debatte-welthungerhilfe-fuer-verkaufstop-11865487.html
- 26 LobbyControl (2011) Mehr Transparenz und Schranken für den Lobbyismus, Positionspapier, www.lobbycontrol.de/wp-content/uploads/LobbyControl-Positionspapier.pdf | Müller, B. (2012) Die neue Energielobby: Die Energiewende verändert das Politikfeld Energie und damit auch das dortige Lobbying. In: politik & kommunikation, Issue 4/2012 »Follow me - Das Lobbying der Sozialen Netzwerke«, www.politik-kommunikation.de/ressorts/artikel/die-neue-energielobby
- 27 Cf. König, J. (2014) Energiewende: Zweifel an der Versorgungssicherheit, Der Präsident des Bundesverbands der Energiewirtschaft beklagt mangelnde politische Verlässlichkeit, Interview mit Johannes Kempmann. In: Deutschlandradio, 13.08.2014, www.deutschlandradiokultur.de/energiewende-zweifel-an-der-versorgungssicherheit.1008.de.html?dram:article_id=294438
- 28 <http://occupywallst.org>
- 29 Puig, S. M. (2011) The »Indignados«: New Spanish Social Movement against the crisis. In: Bryne, J. (Eds.) (2011) The Occupy Handbook. Back Bay Books: New York, p. 209-217 | Schwillk, H. (2011) Der schwäbische Wutbürger erobert die ganze Welt. In: DIE WELT, 24.05.2011, www.welt.de/kultur/article113391878/Der-schwaebische-Wutbuenger-erobert-die-ganze-Welt.html

- 30 Althaus, M. (2012) Schnelle Energiewende – bedroht durch Wutbürger und Umweltverbände? Protest, Beteiligung und politisches Risikopotenzial für Großprojekte im Kraftwerk- und Netzausbau. In: *Wissenschaftliche Beiträge* (2012, 15), Technical University of Applied Sciences Wildau (Germany)
- 31 Allensbach Institute (2011) Akzeptanzprobleme großer Infrastrukturprojekte – Ergebnisse einer bundesweiten Repräsentativumfrage, 09.11.2011, Allensbach am Bodensee, www.baustoffindustrie.de/root/img/pool/downloads_2011/130911/text_handout_koecher.pdf
- 32 Walter, F. (Eds.) (2013) Die neue Macht der Bürger, Rowohlt: Reinbek bei Hamburg | Walter, F. (2011) Studie über »Wutbürger«: Alt, stur, egoistisch. In: *SPIEGEL Online*, 08.09.2011, www.spiegel.de/politik/deutschland/studie-ueber-wutbuenger-alt-stur-egoistisch-a-784664.html
- 33 Shah, T./ Karten, I. (2011): Wege aus der »Dagegen-Falle«. In: *Politik & Kommunikation*, Issue 03/2011, p. 42-43, www.politik-kommunikation.de/ressorts/artikel/wege-aus-der-dagegen-falle
- 34 VDI (2013) VDI-Standard: VDI 7000 Early public participation in industrial and infrastructure projects. VDI: Düsseldorf | VDI (2013) VDI-Standard: VDI 7001 Communication and public participation in planning and building of infrastructure projects - Standards for work stages of engineers
- 35 Drewes, D. (2013) Europas neue Wutbürger. In: *Kölnische Rundschau*, 10.07.2013, www.rundschau-online.de/politik/eu-richtlinien-europas-neue-wutbuenger,15184890,23653584.html
- 36 Masini, E. B. (2011) How to Teach Futures Studies: Some Experiences. In: *Journal of Futures Studies*, June 2011, 15(4), p. 111-120 | Slaughter, R. (2008) Futures Education: Catalyst for our Times. In: *Journal of Futures Studies*, 12(3), p. 15-30
- 37 Wells, H. G. (1932) Wanted – Professors of Foresight! In: BBC Radio, 19.11.1932, cited in: Slaughter, R. (ed.) *Studying the Future*, Australian Bicentennial Authority/Commission For the Future, Melbourne, 1989, p. 3-4, http://foresightinternational.com.au/wp-content/uploads/2015/09/Wells_Wanted_Profs_of_Fsight_1932.pdf
- 38 Phadnis, S./ Caplice, C./ Sheffi, Y./ Singh, M. (2015) Effect of Scenario Planning on Field Experts' Judgment of Long-range Investment Decisions. In: *Strategic Management Journal*, 36(9), p. 1401-1411 | Phelps, R./ Chan, C./ Kapsalis, S.C. (2001) Does scenario planning affect performance? Two exploratory studies. In: *Journal of Business Research*, 51(3), p. 223-232 | Visser, M. P./ Chermack, T. J. (2009) Perceptions of the relationship between scenario planning and firm performance: A qualitative study. In: *Futures*, 41(9), p. 581-592
- 39 Cf. "socio-ecological dilemmas" in Ernst, A. (2010) Individuelles Umweltverhalten – Probleme, Chancen, Vielfalt. In: Welzer, H./ Soeffner, H.-G./ Giesecke, D. (Eds.): *KlimaKulturen: Soziale Wirklichkeiten im Klimawandel*, Campus: Frankfurt, p. 128-143
- 40 GfK (2014) Smart Home: großes Interesse bei Verbrauchern. Haushaltsausstattung und Interesse der Konsumenten sind Wegbereiter für Smart Home, press release, 20.05.2014, www.gfk.com/de/news-und-events/presse/pressemitteilungen/seiten/smart-home-gro%C3%9Fes-interesse-bei-verbrauchern.aspx
- 41 Olson, P. (2014) The Quantified Other: Nest And Fitbit Chase A Lucrative Side Business. In: *Forbes*, 17.04.2014, www.forbes.com/sites/parmyolson/2014/04/17/the-quantified-other-nest-and-fitbit-chase-a-lucrative-side-business
- 42 *Süddeutsche Zeitung* (2014) Wirtschaft: Stromausfall in der Bilanz, 08.03.2014
- 43 F.A.Z. Institut f. Management/ Steria Mummert Consulting (2010) *Branchenkompass 2010 Energieversorger*. Frankfurter Allgemeine Buch: Frankfurt a.M.
- 44 Balsler, M./ Hagler, M. (2013) Stecker raus. In: *Süddeutsche Zeitung*, 10.03.2014
- 45 Simpson, J. (2014) Energy in your pocket. In: *Utility Week*, 12.06.2014, www.utilityweek.co.uk/news/energy-in-your-pocket/1018842
- 46 Rooney, S. N. (2013) Fuel Poverty and the EU: Are policymakers doing enough to tackle fuel poverty? In: *europainfos*, #165, November 2013, www.comece.eu/europainfos/en/archive/issue165/article/6094.html

- 47 Heitker, A. (2014) Schöne neue Energiewelt. In: Börsenzeitung, No. 96, 21.05.2014, p. 8
- 48 Ohnsman, A. (2014) Tesla Making Patents 'Open Source' to Boost Electric Cars. In: Bloomberg, 12.06.2014, www.bloomberg.com/news/articles/2014-06-12/tesla-making-patents-public-to-expand-electric-car-market
- 49 Gates, B. (2010) Innovating to zero! TED2010, www.ted.com/talks/bill_gates
- 50 www.google.com/green | Elsner, D./ Semle, F. (2012) Banken in Social Media: Das Social-Media-Dilemma. In: Handelsblatt, 03.04.2012, www.handelsblatt.com/meinung/gastbeitraege/banken-in-social-media-das-social-media-dilemma/6444560.html | Bershidsky, L. (2014) Who Would Use Facebook as a Bank? In: Bloomberg, 14.04.2014, www.bloombergview.com/articles/2014-04-14/who-would-use-facebook-as-a-bank
- 51 Calculation of Peter Hidas of the Gartner Group, cited in: Kovac, S. (2014) Google: one million servers and counting, 05.07.2007, <http://web-ghost.co.uk/google-one-million-servers>
- 52 Allianz Global Investors (2013) The "green" Kondratieff – or why crises can be a good thing. Allianz: Frankfurt a.M.
- 53 VCI (2013) Zukunft der Energiespeicher. VCI: Berlin | VDE (2012) Energiespeicher für die Energiewende. Speicherungsbedarf und Auswirkungen auf das Übertragungsnetz für Szenarien bis 2050. VDE: Frankfurt a.M. | Stahl, C. (2014) Was ist ein intelligentes Stromnetz? In: Handelsblatt, 18.07.2014, www.handelsblatt.com/technik/das-technologie-update/weisheit-der-woche/energieverbrauch-was-ist-ein-intelligentes-stromnetz/10202600.html
- 54 Kaiser, A. (2014) Ölkonzerne: Big Oil läuft in die Megaprojekt-Falle. In: manager magazin online, 04.02.2014, www.manager-magazin.de/unternehmen/energie/big-oil-supermajors-in-der-megaprojekt-falle-a-951444.html
- 55 Mundt, T. (2011) Kontrollierte Kernfusion: Kann Sonnenfeuer schon bald Atomkraft ersetzen? In: DIE WELT, 06.11.11, www.welt.de/wissenschaft/article13696760/Kann-Sonnenfeuerschon-bald-Atomkraft-ersetzen.html
- 56 Gibney, E. (2014) Five-year delay would spell end of ITER. Osamu Motojima, head of the international fusion project, speaks out on delays, leaks and rumours. In: Nature, 31.07.2014, doi:10.1038/nature.2014.15621
- 57 André, R. (2014) Foiled Energy Projects. In: Americas Quarterly, Spring 2014, <http://americasquarterly.org/content/foiled-energy-projects>
- 58 Gilbert, D./ Scheck, J. (2014) Big Oil Companies Struggle to Justify Soaring Project Costs. In: The Wall Street Journal, 28.01.2014, <http://www.wsj.com/articles/SB1000142405270230327704579348332283819314> | Kaiser, A. (2014) Ölkonzerne: Big Oil läuft in die Megaprojekt-Falle. In: manager magazin online, 04.02.2014, www.manager-magazin.de/unternehmen/energie/big-oil-supermajors-in-der-megaprojekt-falle-a-951444.html
- 59 Grove, A. S. (2010) Only the paranoid survive: How to exploit the crisis points that challenge every company. Crown Business: New York et al.
- 60 Glenn, J. C. & Gordon, T. J. (2009) Integration, comparisons, and frontiers of futures research methods. In: Futures Research Methodology – ver. 3.0, CD-Rom, Millennium Project, www.millennium-project.org
- 61 van't Klooster, S. A./ van Asselt, M. B. A. (2006) Practising the scenario-axes technique. In: Futures, Vol. 38, Issue 1, p. 15-30 | Ramírez, R./ Wilkinson, A. (2014) Re-thinking the 2X2 scenario method: grid or frames? Technological Forecasting and Social Change (86), p. 254-264
- 62 Cf. Gerold, L./ Holtmannspötter, D./ Neuhaus, C./ Schüll, E./ Schulz-Montag, B./ Steinmüller, K./ Zweek, A. (Eds.) (2015) Standards und Gütekriterien der Zukunftsforschung. Ein Handbuch für Wissenschaft und Praxis. Springer VS: Wiesbaden
- 63 Schnaars, S./ Ziamou, P. (2001) The essentials of scenario writing. In: Business Horizons (44), p. 25-31 | Hirschhorn, L. (1980) Scenario Writing: A Developmental Approach. In: Journal of the American Planning Association (46), p. 172-183 | Chermack, T. J. (2007) Assessing the quality of scenarios in scenario planning. In: Futures Research Quarterly (22), p. 23-35

- 64 Van der Heijden, K./ Burt, G. (2008) Scenario Planning & Art of Strategic Conversation, Seminar at Centre for Scenario Planning & Future Studies, Strathclyde Business School, University of Strathclyde, June 2008
- 65 DIE WELT (2014) Deutscher erzeugt mit Glaskugel Strom aus Mondlicht, 22.02.2014, www.welt.de/wirtschaft/article125019977/Deutscher-erzeugt-mit-Glaskugel-Strom-aus-Mondlicht.html
- 66 University of Missouri (2011) New solar technology could break photovoltaic limits. MU engineer part of team making solar panels more effective in collecting energy, press release, 16.05.2011, <http://munews.missouri.edu>
- 67 Beaumont-Thomas, B. (2014) Scientists create bionic particles 'inspired by Terminator'. In: The Guardian, 23.05.2014, www.theguardian.com/science/blog/2014/may/23/bionic-particles-terminator-university-michigan-pittsburgh
- 68 Meng, B./ Cheng, X./ Zhang, X./ Han, M./ Liu, W./ Zhang, H. (2014) Single-friction-surface triboelectric generator with human body conduit. In: Applied Physics Letters, 104(10), p. 103904
- 69 Woollaston, V. (2014) Matrix-style batteries come a step closer: Scientists manage to charge a Phone using a human HAND. In: Daily Mail, 31.03.2014, www.dailymail.co.uk/sciencetech/article-2593349/Matrix-style-batteries-come-step-closer-Scientists-manage-charge-phone-using-human-HAND.html
- 69 The University of Texas at Arlington (2014) Technology uses micro-windmills to recharge cell phones, press release, 10.01.2014, www.uta.edu/news/releases/2014/01/microwindmill-rao-chiao.php
- 70 University of Georgia (2013) Power plants: UGA researchers explore how to harvest electricity directly from plants, press release, 09.05.2013, <http://news.uga.edu/releases/article/power-plants-uga-researchers-explore-how-to-harvest-electricity-direct>
- 71 Markham, D. (2012) Newlight Turns Greenhouse Gases into High-Performance Biodegradable Plastic. In: TreeHugger, 14.11.2012, www.treehugger.com/clean-technology/turning-greenhouse-gases-high-performance-biodegradable-plastic.html
- 72 Cf. www.sustainabledanceclub.com/products/sustainable_dance_floor
- 73 Powell, M. (2011) Green gym: Exercise powers machines. In: The Seattle Times, 14.07.2011, www.seattletimes.com/business/green-gym-exercise-powers-machines
- 74 Zipp, K. (2013) New Technology Generates Solar Energy On Glass Windows. In: Solar Power World Online, 13.03.2013, www.solarpowerworldonline.com/2013/05/new-technology-generates-solar-energy-on-glass-windows
- 75 Clifton, L. (2014) U.S. Navy's ability to make fuel from seawater a 'game-changer'. In: Digital Journal, 07.04.2014, www.digitaljournal.com/news/politics/usa-navy-s-ability-to-make-fuel-from-seawater-a-game-changer/article/379930
- 76 Cardwell, D. (2014) Going Higher for Power. In: The New York Times, 21.03.2014, p. B1
- 77 Surden, E. (2014) Lawrenceville Firm Using Crowdfunding to Advance Fusion Energy Research. In: New Jersey Tech Weekly, 10.06.2014, www.njtechweekly.com/art/2374-lawrenceville-firm-using-crowdfunding-to-advance-fusion-energy-research
- 78 Kamat, P. V. (2013) Quantum Dot Solar Cells. The Next Big Thing in Photovoltaics. In: The Journal of Physical Chemistry Letters, 4(6), p. 908-918
- 79 Clarke, C. (2013) Smaller, Jet-Engine Turbines May Solve Some Wind Power Woes. In: KCETLink, 15.10.2013, www.kcet.org/news/define/rewire/wind/smaller-jet-engine-turbines-may-solve-wind-woes.html
- 80 Ngak, C. (2013) World's first wind-current power system to be installed off Japanese coast. In: CBS News, 14.05.2013, www.cbsnews.com/news/worlds-first-wind-current-power-system-to-be-installed-off-japanese-coast

- 81 Blinda, A. (2011) A New Ark for Humanity: Floating Hotel Could Defy Rising Sea Levels. In: Spiegel Online International, 05.01.2011, www.spiegel.de/international/zeitgeist/a-new-ark-for-humanity-floating-hotel-could-defy-rising-sea-levels-a-737887.html
- 82 Nguyen, T. C. (2014) Can this 2,250-foot tower produce enough clean energy to replace power plants? In: The Washington Post, 07.07.2014, www.washingtonpost.com/news/innovations/wp/2014/07/07/can-this-2250-foot-tower-produce-enough-clean-energy-to-replace-power-plants
- 83 Thornhill, T./ Waugh, R. (2012) A breath of fresh air: Clever gadget transforms the air from your lungs into energy to charge your phone. In: Daily Mail, 11.03.2012, www.dailymail.co.uk/sciencetech/article-2113539/AIRE-mask-uses-lung-power-charge-mobile-phone.html
- 84 University of Central Florida (2014) New NanoTech May Provide Power Storage in Cables, Clothes, press release, 02.06.2014, <http://today.ucf.edu/new-nanotech-may-provide-power-storage-cables-clothes>
- 85 Campbell, K. (2014) Start-up eyes wireless charging for devices. In: CNBC.com, 25.03.2014, www.cnbc.com/id/101478378
- 86 Duke University (2014) 'Superlens' Extends Range of Wireless Power Transfer, press release, 09.01.2014, www.ee.duke.edu/news/4578
- 87 Etherington, D. (2013) Cota By Ossia Aims To Drive A Wireless Power Revolution And Change How We Think About Charging. In: Techcrunch, 09.09.2013, <http://techcrunch.com/2013/09/09/cota-by-ossia-wireless-power>
- 88 LaMonica, M. (2013) Better Weather Analysis Could Lead to Cheaper Renewables. In: MIT Technology Review, 13.08.2013, www.technologyreview.com/news/518051/better-weather-analysis-could-lead-to-cheaper-renewables
- 89 Yirka, B. (2013) German student builds electromagnetic harvester to recharge a battery. In: Phys.org, 12.02.2013, <http://phys.org/news/2013-02-german-student-electromagnetic-harvester-recharge.html>
- 90 The Economist (2014) Crowdfunding Solar Roadways. On the not so sunny side of the street, 05.06.2014, www.economist.com/blogs/schumpeter/2014/06/crowdfunding-solar-roadways
- 91 Linköping University (2011) New plastic turns heat into electricity, press release, 10.05.2011, www.liu.se/forskning/forskningsnyheter/1.269628/1.271949?l=en
- 92 Woody, T. (2012) Secret Ingredient To Making Solar Energy Work: Salt. In: Forbes, 04.05.2012, www.forbes.com/sites/toddwoody/2012/04/05/secret-ingredient-to-making-solar-energy-work-salt
- 93 Küffner, G. (2011) In der Tiefe der Meere: Hohlkugeln speichern überschüssigen Windstrom. In: F.A.Z., 01.04.2011, www.faz.net/aktuell/technik-motor/umwelt-technik/in-der-tiefe-der-meerehohlkugeln-speichern-ueberschuessigen-windstrom-1608012.html
- 94 Bourzac, K. (2013) Biodegradable Batteries to Power Smart Medical Devices. Prototype batteries that dissolve safely in the body could power ingested devices. In: MIT Technology Review, 18.12.2013, www.technologyreview.com/news/522581/biodegradable-batteries-to-power-smartmedical-devices
- 95 Bora, K. (2013) New Eco-Friendly Battery Made of Wood And Sodium Can Be Charged More Than 400 Times. In: International Business Times, 20.06.2013, www.ibtimes.com/new-eco-friendly-battery-made-wood-sodium-can-be-charged-more-400-times-1315221
- 96 Gordon, S. (2014) Games areas, panoramic windows and seats that harvest body heat to power the cabin: Airbus reveals what flying will be like in 2050. In: Daily Mail, 09.06.2014, www.dailymail.co.uk/travel/article-2652950/Airbus-reveals-future-flight-panoramic-windows-games-rooms-planes.html

- 97 Griffiths, S. (2014) End of the street lamp? Avatar-style glowing trees inspired by fireflies could soon light up our night skies. In: Daily Mail, 31.03.2014, www.dailymail.co.uk/sciencetech/article-2593328/End-street-lamp-Avatar-style-glowing-trees-inspired-fireflies-soon-light-night-skies.html
- 98 Geon-ho, K. (2014) Worn as clothes, thermo-element generates electricity using body temperature – Drawing attention as a wearable device battery. In: Korea IT News, 08.04.2014, http://english.etnews.com/electronics/2942182_1303.html
- 99 Gray, M. (2013) SolePower Shoe Insert Charges Mobile Devices Just By Walking, Tackles Energy Poverty. In: HuffingtonPost, 09.06.2013, www.huffingtonpost.com/2013/09/06/solepower-mobile-charging_n_3882835.html
- 100 University of Wisconsin (2013) The Next Bright Idea: Microbe-Powered >Biobulb< Earns WID Students Spot in Popular Science Magazine Competition, press release, 19.08.2013, <http://wid.wisc.edu/featured-science/the-next-bright-idea-microbe-powered-biobulb-earns-uw-students-spot-in-popular-science-magazine-competition>
- 101 Designboom Architecture (2012) solar decathlon 2012: casas em movimento, 06.10.2012, www.designboom.com/architecture/solar-decathlon-2012-casas-em-movimento
- 102 Coxworth, B. (2012) Phase-change drywall boards store and release heat to save power. In: gizmag, 02.08.2012, www.gizmag.com/phase-change-paraffin-drywall-boards/23569
- 103 Cf. World Future Society (WFS), www.wfs.org; WFS (2002) The Future: An Owner's Manual, A brief overview of the study of the future and the services of the World Future Society.
- 104 Cf. <http://community.iknowfutures.eu>
- 105 Cf. Special Issue "Exploring Future Business Visions Using Creative Fictional Prototypes". In: Futures, Volume 50, p. 1-108 (June 2013), Edited by Dr. Gary Graham, Dr. Vic Callaghan and Dr. Anita Greenhill
- 106 Tieman, R. (2013) Chemicals: Science views waste in role as raw material of the future. In: Financial Times, 22.10.2013, www.ft.com/intl/cms/s/0/2ef57b06-2c26-11e3-acf4-00144feab7de.html#axzz3klvp1cfV | DECHEMA/ GDCh/ DGMK/ VCI (2010) (Eds.) Change in the Raw Materials Base, Frankfurt et al.
- 107 Miller, C. C. (2010) Mixing In Some Carbon. In: The New York Times, 21.03.2010, www.nytimes.com/2010/03/22/business/energy-environment/22cement.html
- 108 Global Carbon Project (GCP) (2013) Global Carbon Budget 2013, www.globalcarbonproject.org/carbonbudget
- 109 Matthes, S./ Donner, S. (2013) CO2-Recycling: Der Klimakiller als Rohstoff. In: WirtschaftsWoche, 24.05.2013, www.wiwo.de/technologie/forschung/co2-recycling-der-klimakiller-als-rohstoff/6642990.html | BMBF (2013) CO2: Vom Klimakiller zum Rohstoff [press release 027/2013], 09.04.2013, www.bmbf.de/press/3432.php
- 110 Danova, T. (2013) Morgan Stanley: 75 Billion Devices Will Be Connected To The Internet Of Things By 2020. In: Business Insider, 02.10.2013, www.businessinsider.com/75-billion-devices-will-be-connected-to-the-internet-by-2020-2013-10?IR=T
- 111 IDC Research (2013) Worldwide Internet of Things (IoT) 2013–2020 Forecast: Billions of Things, Trillions of Dollars. IDC: Framingham, US
- 112 Leon, B. (2014) Students from China's Zhejiang University successfully hack a Tesla Model S to win \$10,000. In: New York Daily News, 08.08.2014, www.nydailynews.com/autos/chinese-university-students-successfully-hack-tesla-model-s-article-1.1896540
- 113 Kushner, D. (2013) The Real Story of Stuxnet: How Kaspersky Lab tracked down the malware that stymied Iran's nuclear-fuel enrichment program. In: IEEE Spectrum, 26.02.2013, <http://spectrum.ieee.org/telecom/security/the-real-story-of-stuxnet>

- 114 Demarest, J. (2014) Statement Before the Senate Judiciary Committee, Subcommittee on Crime and Terrorism, 15.07.2014, FBI: Washington, D.C., www.fbi.gov/news/testimony/taking-down-botnets
- 115 German Federal Office of Criminal Investigation (BKA) (2012) Cybercrime. Bundeslagebild 2012. BKA: Wiesbaden
- 116 Brockhaus Enzyklopädie (2006) Kernenergie, 21st Vol. 2006
- 117 Gillis, J. (2013) In Search of Energy Miracles. In: The New York Times, 11.03.2013, www.nytimes.com/2013/03/12/science/in-search-of-energy-miracles.html | Bullis, K. (2011) Advanced Reactor Gets Closer to Reality. Terrapower is pushing ahead with a reactor design that uses a nearly inexhaustible fuel source. In: MIT Technology Review, 27.07.2011, www.technologyreview.com/news/424824/advanced-reactor-gets-closer-to-reality
- 118 Schrank, R. (2011) AGATE revolutioniert die Kernforschung: Konzept zur Reduktion radioaktiver Abfälle. In: Brunel-Magazin - Der Spezialist, S. 6-9 | HZDR (2014) Mikroorganismen filtern Uran aus Grundwasser, press release, 08.05.2014, www.hzdr.de
- 119 Markoff, J. (2014) Microsoft Makes Bet Quantum Computing Is Next Breakthrough. In: The New York Times, 23.06.2014, www.nytimes.com/2014/06/24/technology/microsoft-makes-a-bet-on-quantum-computing-research.html
- 120 Simonite, T. (2013) The CIA and Jeff Bezos Bet on Quantum Computing. In: MIT Technology Review, 04.10.2013, www.technologyreview.com/news/429429/the-cia-and-jeff-bezos-bet-on-quantum-computing
- 121 FZ-Jülich (2010) Weltrekord: Jülicher Supercomputer simuliert Quantencomputer. Größte Simulation eines idealen Rechners auf Quantenbasis / Effiziente Multi-Core-Software entwickelt, press release, 31.03.2010, www.fz-juelich.de/SharedDocs/Pressemitteilungen/UK/DE/2010/index7d86_htm.html?nn=723014
- 122 IEA (2013) Technology Roadmap. Energy efficient building envelopes. IEA: Paris, www.iea.org/publications/freepublications/publication/TechnologyRoadmapEnergyEfficientBuildingEnvelopes.pdf
- 123 University of Southern California (2014) Contour Crafting: Robotic Construction System, www.contourcrafting.org
- 124 Alexander, M. (2014) The 3D printer that can build a house in 24 hours. In: Property118.com, 22.01.2014, www.property118.com/the-3d-printer-that-can-build-a-house-in-24-hours/62972
- 125 Ankenbrand, H. (2015) Eine Villa aus dem 3D-Drucker. In: F.A.Z., 06.03.2015, www.faz.net/-gqi-80mjx
- 126 IEA (2013) Technology Roadmap. Energy efficient building envelopes. IEA: Paris, www.iea.org/publications/freepublications/publication/TechnologyRoadmapEnergyEfficientBuildingEnvelopes.pdf
- 127 IEA (2013) Technology Roadmap. Energy efficient building envelopes. IEA: Paris, www.iea.org/publications/freepublications/publication/TechnologyRoadmapEnergyEfficientBuildingEnvelopes.pdf
- 128 Halper, E. (2013) Electric cars may hold solution for power storage. In: Los Angeles Times, 29.12.2013, <http://articles.latimes.com/2013/dec/29/business/la-fi-electric-cars-20131229>
- 129 www.erneuerbar-mobil.de/de/projekte/foerderung-von-vorhaben-im-bereich-der-elektromobilitaet-ab-2012/kopplung-der-elektromobilitaet-an-erneuerbare-energien-und-deren-netzintegration/inees
- 130 Choudhury, N. (2013) World's largest battery storage system to be installed in Japan. In: PVTech, 19.04.2013, www.pv-tech.org/news/worlds_largest_battery_storage_system_to_be_installed_in_japan

- 131 Bullis, K. (2014) Panasonic Agrees to Help Tesla Build Its Gigafactory. Panasonic support is crucial if Tesla is to make the world's largest factory for making electric car batteries. In: MIT Technology Review, 31.07.2014, www.technologyreview.com/news/529616/panasonic-agrees-to-help-tesla-build-its-gigafactory
- 132 Original quote: "The Medium is the message"; McLuhan, M. (1964) *Understanding Media: The Extensions of Man*. The New American Library: New York
- 133 Tuckman, B. W. (1965) Developmental sequence in small groups. In: *Psychological bulletin*, 63(6), p. 384-399
- 134 Spehr, M. (2014) Ferrari California T: Das erste Apple-Auto. In: F.A.Z., 10.12.2014, www.faz.net/-gya-7x8nt
- 135 Steingart, G. (2014) *Handelsblatt Morning Brief*, 05.08.2014
- 136 Molitor, A. (2012) *Ins Licht gerückt*. In: brand eins, Heft 02, Februar 2012, p. 136-139, www.brandeins.de/archiv/2012/markenkommunikation/ins-licht-gerueckt
- 137 Zimbardo, P. G./ Boyd, J. N. (2008) *The Time Paradox: The New Psychology of Time That Will Change Your Life*. Free Press: New York et al., p. 18 | Zimbardo, P. G./ Boyd, J. N. (1999) Putting time in perspective: A valid, reliable individual differences metric. In: *Journal of Personality and Social Psychology*, Vol. 77, Issue 6, p. 1271-1288
- 138 The test can be downloaded in 10 different languages via: www.emcdda.europa.eu/html.cfm/index89378EN.html
- 139 Musser, G. (2011) *Time on the Brain: How You Are Always Living In the Past, and Other Quirks of Perception*. In: *Scientific American*, 15.09.2011, <http://blogs.scientificamerican.com/observations/time-on-the-brain-how-you-are-always-living-in-the-past-and-other-quirks-of-perception>
- 140 Kleinschmidt, C. (2009) *Die Zukunft ist schon da - in Ihrem Gehirn!* In: P.M. *Welt des Wissens*, 9/2009, p. 72-77
- 141 Kleinschmidt, C. (2009) *Die Zukunft ist schon da - in Ihrem Gehirn!* In: P.M. *Welt des Wissens*, 9/2009, p. 72-77
- 142 Goodwin, P. (2010) *Why hindsight can damage foresight*. In: *The International Journal of Applied Forecasting*, 17, S. 5-7 | Pohl, R. (Ed.) (2004) *Cognitive illusions: A handbook on fallacies and biases in thinking, judgement and memory*. Psychology Press
- 143 Online survey of 1,017 individuals (18-35 years old) by Mindline, published in STERN magazine, No. 34, 13.08.09, p. 66 [Accessed via STATISTA]
- 144 Survey of 7,000 adults on behalf of car manufacturer FORD, cited in: *DIE WELT (2015) Umfrage: Ansnhallen auf der Rückbank*, 08.04.2015, www.welt.de/motor/news/article139266760/Umfrage-Ansnhallen-auf-der-Rueckbank.html
- 145 Ecken, P./ Gnatzy, T./ von der Gracht, H. A. (2011) *Desirability bias in foresight: Consequences for decision quality based on Delphi results*. In: *Technological Forecasting & Social Change*, Vol. 78, Issue 9, November 2011, p. 1654-1670
- 146 Milne, R. (2008) *Siemens 'too white, German and male'*. In: *Financial Times*, 24.06.2008, www.ft.com/intl/cms/s/0/1199a7f0-4205-11dd-a5e8-0000779fd2ac.html#axzz3p0HvJVmz
- 147 Morris, E. (2007) *From Horse Power to Horsepower*. In: *ACCESS*, No. 30, Spring 2007
- 148 Cf. Dobelli, R. (2013) *The art of thinking clearly*. HarperBusiness: New York
- 149 Vester, F. (1978) *Denken, Lernen, Vergessen – Was geht in unserem Kopf vor, wie lernt das Gehirn, und wann lässt es uns im Stich?*, dtv: Munich
- 150 von der Gracht, H. A./ Gaizunas-Jahns, N. (2014) *Networked Thinking, Networked Learning – Radical Change in Corporate Education*. Incore: Berlin

- 151 Beck, H. (2008) Übermut tut dem Portfolio selten gut. In: F.A.Z., Serie »Denkfehler, die uns Geld kosten«, Nr. 7, 18.12.2008, www.faz.net/aktuell/finanzen/fonds-mehr/behavioral-finance-7-uebermut-tut-dem-portfolio-selten-gut-1657480.html
- 152 Cf. Kuosa, T. (2011) Evolution of futures studies. In: *Futures - The journal of policy, planning and futures studies*, Vol. 43, Issue 3, p. 327-336
- 153 Cf. IFK (Ed.) (2013) *The Future of ICT-Based Futures Research: Scenarios for 2020*, IFK, KPMG et al.: Wiesbaden, www.effizienzcluster.de/files/1/31/763_the_future_of_ictbased_futures_research_v5_lowres.pdf | Bañuls, V. A./ Salmeron, J. L. (2011) Scope and design issues in foresight support systems. In: *International Journal of Foresight and Innovation Policy*, Vol. 7, Issue 4, p. 338-351
- 154 Durst, C./ Kolonko, T./ Durst, M. (2012) Kooperationsdilemma in der Zukunftsforschung – Ein IT-basierter Lösungsansatz der Bundeswehr. In: Mattfeld, D. C./ Robra-Bissantz, S. (Eds.): *Tagungsband der Multikonferenz Wirtschaftsinformatik 2012*, Institut für Wirtschaftsinformatik
- 155 von der Gracht, H. A. et al. (2012) The Competitiveness Monitor as an innovative foresight support system for mobility, logistics and beyond. In: Clausen, U./ ten Hompel, M./ Klumpp, M. (Eds.): *Efficiency and Logistics*, Springer Verlag: Berlin/ Heidelberg, p. 31-41
- 156 www.millennium-project.org/millennium/GFIS.html
- 157 <http://community.iknowfutures.eu>
- 158 Noack, P./ Gaya-Piqué, L./ Haralabus, G./ Auer, M./ Jain, A./ Grenard, P. (2013) Technology Foresight and nuclear test verification: a structured and participatory approach. In: *Geophysical Research Abstracts*, Vol. 15, EGU2013 – 10434 – 1, EGU General Assembly 2013, <http://meetingorganizer.copernicus.org/EGU2013/EGU2013-10434-1.pdf>
- 159 www.shapingtomorrow.com
- 160 Skulimowski, A. M. J. (2012) A Foresight Support System to Manage Knowledge on Information Society Evolution. In: *Lecture Notes in Computer Science*, Volume 7710, 2012, p. 246-259
- 161 www.parmenides-foundation.org
- 162 Turoff, M./ White, C./ Plotnick, L./ Hiltz, S. R. (2008) Dynamic Emergency Response Management for Large Scale Decision Making in Extreme Events. In: Fiedrich, F./ Van de Walle, B. (Eds.): *Proceedings of the 5th International ISCRAM Conference – Washington, DC, USA*, p. 462-470, www.iscramlive.org/dmdocuments/ISCRAM2008/papers/ISCRAM2008_Turoff_etal.pdf
- 163 Crewdson, J. (2006) Internet blows CIA cover: It's easy to track America's covert operatives. All you need to know is how to navigate the Internet. In: *Chicago Tribune*, 12.03.2006, http://articles.chicagotribune.com/2006-03-12/news/0603120396_1_agency-employees-or-operatives-cia-director-porter-goss-two-dozen-secret-cia
- 164 www.millennium-project.org
- 165 Mattauch, C. (2010) Der Nostradamus der Neuzeit. In: *WirtschaftsWoche*, 05.03.2010, www.wiwo.de/technologie/spieltheorie-der-nostradamus-der-neuzeit-seite-all/5626730-all.html
- 166 Beuth, P. (2011) Die Polizei als Hellseher. In: *ZEIT ONLINE*, 19.08.2011, www.zeit.de/digital/datenschutz/2011-08/predictive-policing | Friend, Z. (2013) Predictive Policing: Using Technology to Reduce Crime. In: *FBI Law Enforcement Bulletin*, 09.04.2013, <https://leb.fbi.gov/2013/april/predictive-policing-using-technology-to-reduce-crime>
- 167 Cf. *Eurasia Review* (2015) World Economic Forum Launches Global Strategic Foresight Community, 18.01.2015
- 168 Gilbert, D. T. (2006) *Stumbling on Happiness*. Random House: New York, p. 19

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“Globally, the greatest challenge for energy is going to be cooling,” says Martin Freer, director of the Birmingham Energy Institute at the University of Birmingham. “With the growth of the middle class in India and China, there will be an associated demand for air conditioning. The United Nations’ Intergovernmental Panel on Climate Change suggest that by the middle of the present century, the demand for cooling will outstrip the demand for heating.”

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