

Roland Berger Trend Compendium 2030

Megatrend 3 Scarcity of resources





About the Roland Berger Trend Compendium 2030

What is it?

- > The Roland Berger Trend Compendium 2030 is a global trend study compiled by Roland Berger Institute (RBI), the think tank of Roland Berger
- > It describes the most important megatrends that will shape the world between now and 2030
- > The megatrends have a broad impact on the environment of companies, strongly influencing challenges and opportunities of their business

Our approach

- > We first screened relevant trend, scenario and future studies worldwide
- > Then we verified, analyzed and consolidated the results, using them to define the megatrends
- Next, we broke down the megatrends into subtrends, looking at each from a global perspective and the viewpoints of industrialized and developing countries
- > Finally, we identified corporate actions that companies worldwide should consider taking today

 For your own presentations, for discussions with clients and business partners or as springboards for acquisition approaches

Use it!

> Following the description of the subtrends and the recommended corporate actions, you will find the most important sources to help you keep track of the changes in the world, as well as dig deeper into the trends presented



The Roland Berger Trend Compendium 2030 focuses on stable long term developments

- > The Roland Berger Trend Compendium covers megatrends long-term developments with major impact (usually global) on societies, economies and the natural world
- > The forecasts are based on estimates reflecting the "normal" case, i.e. a stable development of the global economy with no unexpected events ("black swans"). Major political or financial crises, large-scale natural disasters or similar far-reaching events are not integral to our assumptions
- > To incorporate today's volatile, uncertain, complex and ambiguous (VUCA) environment into strategic planning we recommend to combine the megatrends of the Roland Berger Trend Compendium with the Roland Berger scenario planning approach

Methodology



It covers seven megatrends that shape the future development of our world



Megatrends



Scarcity of resources leads to global challenges – There are three key subtrends

Subtrends of megatrend "Scarcity of resources"



Energy – GDP growth in emerging markets is fueling the demand for energy

Water and food – Satisfying the world's hunger and thirst with limited sources

Other commodities – Mastering regional imbalances



Global primary energy demand will increase 17% by 2030 – Driven by the strong growth of demand in non-OECD countries

Evolution of primary energy demand, 2015-2030 [Gtoe]





Most of the additional demand from non-OECD countries comes from Asia, especially from China and India

Evolution of annual primary energy demand in different regions, 2015-2030 [Mtoe]





Growing population, GDP growth, urbanization and the expanding middle class are main drivers for the increasing energy demand (1/2)

World

- > Growing population and GDP growth drive increases in energy use. According to the ExxonMobil "Outlook for Energy 2016"¹, total demand for primary energy (comprising demand of all sectors: residential/commercial, industrial, transportation) will increase by 17.4% to 16.7 Gtoe by 2030
- > Further drivers for the increasing energy demand (connected to GDP growth) are increasing urbanization and expanding middle class, both leading to a growing number of households (as urban households are smaller than rural ones) and a higher penetration of household appliances, consumer electronics, personal vehicles and other demands for energy
- > Looking at the end use sectors, industrial energy demand will increase strongest (+19.9%) by 2030, followed by transportation (+17.1%). The lowest increase is predicted for the residential/commercial sector (+15.6%).
- > Energy efficiency improvements mitigate this trend. According to the ExxonMobil study, the energy intensity (energy use per unit of GDP) will drop 17.1% between 2015 and 2030

¹⁾ There are several other studies describing the future development of the primary energy demand, e.g. from International Energy Agency (IEA), Energy Information Administration (EIA), Massachusetts Institute of Technology (MIT), BP and Shell. The studies describe a similar development as in the ExxonMobil study. In our Trend Compendium 2030 we mostly prefer the ExxonMobile study, esp. because this study uses two different growth rates for the time ranges from 2010 to 2025 and from 2025 to 2040



Growing population, GDP growth, urbanization and the expanding middle class are main drivers for the increasing energy demand (2/2)

Developed vs. developing countries

- Increasing energy demand arises only from non-OECD countries. Their demand will grow 29.0%, while the demand of OECD countries will decline 0.2% (according to the "ExxonMobil Outlook for Energy 2016"; according to other sources the demand of OECD countries could slightly increase). In 2030 the non-OECD countries will account for 66.0% of the worldwide demand, whereas in 2015 it was only 60.1%
- > Demand growth will be especially strong in non-OECD Asian countries. Asia Pacific will account for nearly 65.1% of the world increase in energy use by 2030
- > China's energy demand will increase by 25.2% between 2015-2030. In 2030 China's energy demand will be 3,744 Mtoe, more than twice the demand of Europe or 56% higher than the demand of the USA
- India's energy demand will even increase by 48.2% to 1,309 Mtoe in 2030 higher than Africa's entire demand (which at 1,209 Mtoe in 2030 is an increase of 41.7% compared to 2015)

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Until 2030, the vast majority of the world's primary energy demand is projected to continue to be met by fossil fuels

Evolution of primary energy demand by sources, 2015 and 2030¹ [Gtoe]



Renewables ...

- > ... like wind and solar with highest growth rates
- ... doubling its share of total primary energy demand within 15 years
- > ... overtaking the share of hydro power
- > ... but in 2030 still with a volume not bigger than 10% of oil's volume

Note: Gtoe = Gigatonnes of oil equivalent 1) Due to rounding the sums are slightly below 100.0%



The reserves and resources of fossil energy products are huge compared to the production of energy

Fossil energy production, reserves and resources, 2015



Note: Gtoe = Gigatonnes of oil equivalent, conv. = conventional (oil or gas extracted from the ground by conventional means)

1) Production: Extraction of energy resources 2) Reserves: Deposits which are known in detail and can be recovered economically using current technologies 3) Resources: Deposits which are either proved but are at present not economically recoverable, or which are not demonstrated, but can be expected for geological reasons



North America, CIS and Austral-Asian have the largest energy resources – Middle East with strong reserves, but small resources

Fossil energy production, reserves and resources, 2015 [Gtoe] ¹⁾



1) Regional distribution excluding coal resources in the Antarctic, and excluding resources of oil shale, aquifer gas, natural gas from gas hydrates, and thorium. For the definition of production, reserves and resources see the previous chart



There is a long static reach of fuels, especially for hard coal and lignite – But some form of scarcity may arise nevertheless

Current potential of world energy reserves and resources, static reach¹ in 2011 [years]



Scarcity ...

- > ... depends on the relation of production and consumption of fuels, expressed in fuel prices
- > ... depends in the near future regarding the supply side on the amount of reserves. Current reserves are much smaller than current resources
- > ... depends on the regional distribution of reserves and resources. A concentration of reserves and resources in a few countries is critical. especially if these countries are politically instable or are organized in a cartel (like OPEC)

Reserves²⁾

Resources³⁾

1) Static reach: Reach of fossil fuels based on the current global consumption and the current amount of reserves and resources. Constant consumption in the future and fixed reserves are assumed. As these input factors are dependent on the geological and technological changes as well as economic and political developments, the static reach is not a predictive instrument but provides a snapshot in time of a dynamically developing system 2) Reserves: Deposits which are known in detail and can be recovered economically using current technologies 3) Resources: Deposits which are either proved but are at present not economically recoverable, or which are not demonstrated, but can be expected for geological reasons



The future development of the oil price is uncertain – Roland Berger predicts the oil price to stay low for much longer

Brent crude oil price paths [real 2015 USD per barrel]



The evolution of the oil price

- > The past developments showed the huge volatility of the oil price. In 2014/2015 it more than halved within half a year to below USD 50 per barrel
- > The oil price is influenced by several different factors such as the evolution of the world economy, exploitation of shale/tight oil, development of local/regional crises, political development in oil exporting countries, OPEC oil price decisions and climate policies
- > A Roland Berger study¹⁾ predicts oil prices generally remaining in the USD 45-55 per barrel band for the next five years due to continued US tight oil cost improvement, OPEC's incentive to increase production, and strong but stable demand

1) The study, published in November 2016, has the title "Lower for much longer – Adam Smith in the Permian". Authors are Frederic Choumert, Jonathon Wright and Michelle Briffett



Especially due to the boom of shale gas and tight oil exploitation in the US, the energy supply landscape will change in the future

Important facts regarding the evolution of energy supply

- > Due to an increasing production of oil (2035 vs. 2014: +41%) and natural gas (+63%) coupled with a nearly flat energy demand the US will become energy self-sufficient by 2021. Tight oil and shale gas contribute most to the increase in oil and natural gas production. In 2035 the US produces 112% of their energy consumption, compared to 89% in 2014 and a low of 69% in 2005. The US remains the world's largest producer of natural gas, accounting for 25% of global output in 2035. The country becomes a net exporter of natural gas in 2017 and a net oil exporter in 2029
- > Russia continues to be the world's largest primary energy exporter and the second largest oil and gas producer. Its exports will meet over 4% of world's energy demand in 2035. Unlike in the US, all natural gas production comes from conventional reservoirs while tight oil production commences in the 2020s
- > Middle East remains the world's top oil producer and exporter. The region continues to make up roughly one third of world production and half of all inter-regional exports
- Fossil fuels production in China continues to rise with increases in gas (2035 vs. 2014: +136%) and coal (+10%) more than offsetting declines in oil (-5%). By 2035 China is the second largest shale gas producer, after the US, and has overtaken the US as the biggest nuclear producer with a world share of 31% (2015: 7%). As China's energy demand increases even stronger than energy production, China will be the world's largest net importer of energy in 2035
- > The EU's primary energy production is expected to decline by 10% (2035 vs. 2014). By 2035 renewables are the largest source of power generation in the EU with a share of 36%

Despite fossil fuel's dominance, the sun is our biggest energy supplier, delivering on land over 1,300 times the earth's energy consumption

Energy input by solar radiation power per year and its distribution on earth [Ptoe]



14.2 Gtoe = total energy

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consumption on earth in 2015

18.8 Ptoe =

usable energy input by solar radiation on land per year

= 1,324 xtotal energy consumption on earth in 2015

Note: Ptoe = Petatonnes of oil equivalent



Conclusion: We don't have an energy problem – But we have to be very careful as to what energy sources we should use in the future

Some remarks regarding the use of fossil fuels and renewables

- > There are huge reserves and resources of fossil fuels
- > But if we only focus on using fossil fuels we will accelerate the problems we already have with global warming (see also trend 4: "Climate change")
- > Another downside of fossil fuels is that the exploitation of non-conventional sources such as tight oil and shale gas is relatively costly and may endanger the environment
- > The sun delivers far more energy than we will ever need to use. Solar radiation can be used directly, e.g. via photo-voltaic cells or collectors. The main form of an indirect use is wind power as wind is the result of the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth
- > Using much more solar power or other renewables than today to generate energy can help to satisfy the growing energy demand and at the same time protect our climate
- > The combination of energy production by renewables and energy consumption via new technologies like e-mobility can lead to a further reduction of greenhouse gas and other harmful emissions
- > A challenge for using renewables as the main source of energy is the strong variability of the output of important renewables like sun and wind power. Innovations are needed in new storage technologies to tackle this challenge



Global water demand will increase 32% by 2050, driven heavily by the growing use for manufacturing and electricity

Global water demand, 2015¹⁾ vs. 2050 [km³]



1) The values for 2015 are linearly extrapolated with the values for 2000 and 2050 2) BRIICS: Brazil, Russia, India, Indonesia, China, South Africa 3) RoW = rest of the world



Low water resources have been widespread for many years – Even some European countries face occasional or local water stress

Renewable internal freshwater resources per capita, 2014 [m³]





In 2050, over 50% of the world's population will live in water stressed areas – A huge risk to predicted growth for developing economies

Population and GDP generation in water stressed areas under unchanged conditions

How many people live in water short areas?¹⁾

How much share of GDP is generated in water scarce regions?¹⁾



Water stress: 20-40% of population lives in water short areas

Water scarcity: >40% of population lives in water short areas No/moderate stress: <20% of population lives in water short areas

1) 2050 projection under business-as-usual water productivity and medium growth

Source: IFPRI, Veolia Water

Clean water and sanitary facilities are a key factor for a growing and healthy city – A major challenge for megacities all around the globe



1) Population data refer to 2015 from the World Urbanization Prospects (2014 rev.), other data refer to the WWF study "Big Cities. Big Water. Big Challenges. Water in an Urbanizing World" (2011)

Source: WWF, UN

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The increasing world population and a higher per capita consumption are the drivers for the rising global food demand

Increase in globally required food calories compared to population growth [%, billion] and evolution of per capita food consumption [kcal/person/day]



> Population growth accounts for 3/4 of the increase in world food calories demand



- > Another reason for the increase in global food calories demand is the rise of the per capita food consumption, particularly in the developing countries
- Main reasons for the rise are a better access to food, more consumption of food with high calorie content, shift to more consumption of meat and to manufactured and fast food

Bera

Due to efficiency gains in agriculture only slightly more cropland and pasture will be needed to satisfy the growing food demand

Worldwide evolution of land use, 2015 vs. 2030 [Mha, %]

2015 2030 Total: 13,264 Mha Total: 13,225 Mha Cropland Cropland Other Other **Biofuels Biofuels** 11.6% 11.9% 20.1% 20.1% 0.3% 0.4% Pasture 23.7% 24.7% Pasture Natural 24.9% Natural 25.4% forest forest 5.5% 5.4% 12.5% 13.4% Managed forest Managed forest Natural grassland Natural grassland

Comments

> Despite strong increase in food demand by 2030 (+21%), the area of cropland and pasture will increase only slightly due to rising efficiency in agriculture

Berge

- > But compared to past yield growth is declining.
 - E.g. yield growth for cereals is expected to drop from an average of **2.0% per annum** for the period **1980-2000** to **1.0% in 2000-2050**
- > Animal-based food needs almost 5 times more land per nutrition value than plantbased food

Note: Mha = Megahectars



Future food price developments are difficult to predict – They are influenced by many factors and uncertainties

Influence factors on the development of food prices





With growing prosperity there is a shift from expenditures for food and beverages to other expenditures, even in developed countries

Real GDP per capita growth compared to real expenditure on food and beverages per capita¹⁾, 2030 vs. 2015 [EUR]



2015 - Expenditure on food and beverages per cap. [EUR] 2030 - Expenditure on food and beverages per cap. [EUR]

Note: GDP = gross domestic product 1) Only non-alcoholic beverages



Water is used for different purposes and we will compete for this essential resource

World

- > Global water demand will increase by about 32% from 2015 to 2050
- > Water scarcity is both a natural and a human-made phenomenon. Although access to drinking water has improved continuously in the last decades and more than 90% of the world population now has access to improved drinking water sources¹), there are a lot of challenges in the future. E.g. population growth and the intense urbanization will increase demand for water supply, sanitation services and electricity.
- > Water of acceptable quality and in adequate quantity is needed to fulfill food production demands. Simultaneously, food production and supply often have a negative impact on the quality and sustainability of water resources. At the moment agriculture is the biggest water user, with irrigation accounting for 65% of global water usage. Manufacturing and electricity will gain shares in the next few decades, accounting for 47% of global water demand in 2050
- > The relevance of water in energy production is often not properly taken into account, such as in extractive industries for coal, uranium, oil or gas. Irrigation of corn or sugar cane for the production of ethanol is also crucial, such as for cooling purposes in power plants
- > Demand for food will rise by about 21% until 2030 and 43% until 2050. Despite the growing demand for food cropland and pasture will increase only slightly due to efficiency gains in agriculture
- > The amount of water required to produce one kilogram of food is strongly dependent on food type: whereas bovine meat requires over 15,400 liters, chicken meat requires approx. 4,300l, cereals require approx. 1,600l, and vegetables only around 320l per kg

1) Improved drinking water sources include piped water on premises (piped household water connection located inside the user's dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection).



Growing population and better living conditions in developing countries are driving a huge increase in water and food demand

Developed vs. developing countries

- > Nine of the ten countries with the lowest levels of freshwater resources per capita in the world are located in the Middle East. Kuwait, Bahrain and United Arab Emirates represent the bottom three. Countries that are rich in energy have the financial resources to develop infrastructure such as desalination and treatment plants, but others will run into major problems
- > A growing population and an increasing standard of living are driving the rising demand for water, most notably by middle income households in developing and emerging economies through their greater demand for food, energy and other goods. Changing consumption habits are key factors to slow down our planet's exploitation, e.g. switching to diets with limited meat consumption
- > The global demand of food calories will increase by 43% between 2015 and 2030. The main reason therefore is population growth, accounting for 3/4 of the increase. Per capita calorie consumption will increase by 1.2% in the developed countries and 4.4% in the developing countries by 2030
- > Irrigation has been a key success factor to produce enough food for everyone. More water will be needed to nourish 3 billion more people by 2050. But increasing competition for water (e.g. for manufacturing) and inefficient irrigation practices could complicate future food production
- If no measures to protect the environment and to reduce consumption are taken, the number of people living in water stressed or water short areas is expected to increase sharply, from 54% 2010 to 68% by 2050
- > In **developed economies** the general water replenishment situation is predicted to **remain stable**, that is if climate change and economic development do not trigger unforeseen events



An EU study identified 20 other critical raw materials from today's perspective

Results of the EU 2014 raw materials criticality assessment



Current economic importance ²⁾

1) Current supply risk considers the three factors substitutability, recycling rates and concentration of production in countries with poor governance (measured via the Worldwide Governance Indicators (WGI) by the World Bank) 2) Current economic importance measures the benefit of each raw material to the European manufacturing economy. It is considered the share of consumption of each mineral being used in different sectors, multiplied with the economic importance (gross value added) of these different sectors for the economy



The majority of critical raw materials is produced outside of Europe – China is the major supplier

Regional production concentration in 2014 of EU critical raw materials [%]



1) Platinum-group metals 2) Percentage share refer to the study "Report on critical raw materials for the EU" (2014) from the European Commission 3) REEs = Rare Earth Elements

In 2030, barytes, borate and molybdenum with increased supply risk, if countries continue to produce the same share of their reserves

Comparison of supply risk today and in 2030 (constant production-to-reserves share)¹⁾



Comments

- > The diagram shown here is out of a study which uses the same measure for the current supply risk as the EU study (chart 28). For the supply risk in 2030 all influence factors remain unchanged except for the production distribution in 2030
- > The scenario used on this slide assumes that countries continue to produce today's share of their reserves every year by 2030, resulting in a gradual shift of production towards reserverich countries
- > The supply risk attending to barytes, borate, molybdenum will particularly increase by 2030. Their production is predicted to move to countries with a relatively higher political risk

1) The values 1 (low supply risk) to 6 (high supply risk) result from a formula considering the recycling rate and substitutability of the material, the economic and political stability of each country and the production share of each country

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Demand is rising continuously – But resource scarcity is a problem only for specific commodities

World

- Raw materials such as metals are an important basis for economic development and growth. Iron is the most commonly used metal worldwide (95% of production in terms of weight). World reserves are at 190 billion tons (Bt)¹ iron ore containing 85 Bt iron. Resources are calculated at more than 800 billion tons (Bt) of iron ore containing more than 230 Bt of iron. Assuming stable yearly production of around 3.4 billion tons iron ore (2014), current reserves² will last for around 56 years, while resources will last for around 234 years. Copper is another frequently used metal, main applications include electrical wires, roofing and plumbing and industrial machinery. Its current reserves are 720 million tons (Mt). Identified copper resources are of 2.1 Bt and a mean of 3.5 Bt in undiscovered copper is expected. Global yearly production is currently at 18.5 Mt (2014), i.e. reserves will last about 39 years, resources more than 3,000 years
- > An EU study identified 20 critical raw materials. Among them are heavy rare earth elements³ (RE) like terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium, several light rare elements and other resources like coking coal, silicon metal and cobalt. By 2020 and beyond especially the demand of heavy rare earths will grow strongly. Other heavily demanded resources are gallium and niobium. Strong demand exists also for cobalt, light rare earths, indium, magnesium metal and coking coal
- > By 2030 barytes, borate and molybdenum are expected to face the greatest supply risk if countries continue to produce the same share of their reserves. Under the assumption that production distribution in 2030 will equal the current distribution of reserves phosphate rock will see a significant increase in supply risk, as reserves are extremely concentrated. The economic importance of the raw materials in 2030 will stay nearly the same as today

^{1) 1} American ton equals 0.907112 metric tonnes. 2) For the distinction between reserves and resources see slide 10 of this document. 3) Rare earth elements (REEs) is an umbrella term for 17 elements, e.g. neodymium, scandium or dysprosium. RE are not really "rare", but evenly spread over the Earth's crust. Rare are only economically exploitable reserves. REEs can only be extracted jointly, the volume of single REEs depends on the composition of the natural mineral deposit. Experts assume that the heavy REEs could become scarce



The main challenge is to master regional imbalances (1/2)

Developed vs. developing countries

- > The majority of critical raw materials are produced outside of Europe. Approximately 50% of the global copper reserves can be found in Chile (29%), Australia (12%) and Peru (11%). The US accounts for over 90% of all beryllium and Brazil 89% of all niobium production. Regarding iron, most resources are in Australia, Russia and Brazil. Agricultural industry is quite dependent on phosphorus fertilizers processed from phosphate rock. The world's phosphate rock reserves are highly concentrated, with Morocco (which also controls Western Sahara's reserves) owning 75%, followed by China (6%), Algeria (3%) and Syria (3%). Some studies assume that peak phosphorus¹⁾ could already occur by 2030
- > China is the major supplier for most raw materials. For instance, 82% of tungsten, 76% of antimony and 73% of germanium were produced by the country in 2014. More than 4/5th of global supplies and 42% of the world reserves of rare earth elements are still owned by China. Other rare earth reserves can be found in Brazil (17%), Australia (2%) and India (2%). Currently the recycling rate of the rare earth elements is below 1% but should be 60% according to scientists in order to mitigate criticality today

1) Peak phosphorus is the point in time at which the maximum global phosphorus production rate is reached



The main challenge is to master regional imbalances (2/2)

- > Conflicts could arise relating to the trade in raw materials due to opposing private-sector and national interests, especially between developed and developing countries. The polarity between exporting and importing countries will make trading raw materials an issue of national political interest
- In general, recycling could be a way to decrease dependence on the extraction of some raw materials. Currently, 600 million tonnes of recyclables are handled every year. And with annual revenues of more than USD 200 billion, the value is as high as the GDP of Portugal. By 2030, the European Commission plans to achieve a recycling target of 65% for municipal waste and 75% for packaging waste. The member states will also be set a 30% resource efficiency target by 2030, which will be linked to raw material consumption and gross domestic product (GDP). Projections for the US estimate that with a recycling rate of 75% in 2030, the country could create nearly 1.5 million jobs. Also, China has immense recycling potential. In 2030 China will likely produce twice as much municipal solid waste as the United States. Between 2012 and 2025, global waste generation is expected to double nearly from 1,289 to 2,216 million tonnes
- > But for many raw materials the recycling rates are still too low: The existing recycling rate for many critical minerals, e.g. for barytes, borate, fluorspar, gallium, germanium, indium, magnesite, phosphate rock and rare earth elements are close to zero. Projections of the future promise hope: By 2030, 9% of neodymium and 7% of dysprosium should be available globally from recycling. Long-term investments in rare earth recycling technologies will further increase this potential

Major recycling potential – Between 2012 and 2025, global waste generation is expected to nearly double to 2,216 million tonnes

Urban waste generation projections by region, 2012¹⁾ to 2025 [Mt]



Note: Mt = million metric tonnes

1) Data refer to the latest available data in 2012

Source: World Bank

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Diverted waste volumes will increase the share of recycling and incineration

Development of regulation in EU 27, 2004-2020

Change in total waste treatment [%]



Comments

- In recent years, the share of landfilling has decreased steadily while recycling has gained significant share
- > Most landfill volumes are expected to be recycled in the future
- > The main driver is the regulatory change in Europe, with clear targets for banning landfill and increasing recovery share (incineration and recycling) – By 2030 the European Commission plans to achieve a 70% municipal recycling target and 80% for packaging. By 2025 they aim to reduce landfill by 25% and set out a 65% target for organic waste recycling



Summary: Good and bad news

Energy

 Globalization drives the economic power of emerging markets 	but leads to an increase in primary energy demand of 17% by 2030
> The share of renewables excl. hydro and biomass/ waste (i.e. solar, wind etc.) will grow 80% by 2030	but will be only at 3.2% of total primary energy demand by 2030
> There are huge energy reserves and resources	the most important fuel – oil – has the lowest static reach
Water & food	
More than 90% of the world population has access to improved drinking water sources …	 but over 50% of the world's population will live in water stressed areas by 2050
> More people will have access to sufficient food	 but it will only be feasible with changing consumer habits (e.g. less meat consumption)
> The efficiency of water management will increase	but in segments like energy production and manufacturing lurk hidden needs



Summary: Good and bad news

Other commodities

- > There are many raw material resources in the world ...
- > Not all rare earth elements are really scarce ...
- > The innovation potential of recycling technologies is increasing significantly ...

- ...but
 most of them are located outside of Europe

 ...but
 for heavy rare earth elements the scarcity could become critical
 - but for important resources like for the rare earth metals the recycling rate is still only 1%



We need to find ways to efficiently reduce consumption, reuse and remanufacture products and recycle materials

- > The scarcity of resources can be reduced via a holistic approach. The main aim should be to reduce the need for resources (both on consumer and producer side) which can be obtained for example by innovation, rising efficiency or the production of durable products. Instead of throwing products away they can be reused by others or companies could offer the possibility of remanufacturing an "outdated" product to get a "new" up to date version of that product. If none of those options are possible the materials should at least be recycled
- > Advantages of such an approach are savings of raw materials and energy, a reduction of CO₂ emissions, the production of durable goods, a push for innovation and additional job opportunities
- > Reducing the consumption of necessary input materials is the first aim of the holistic approach in order to cope with scarce resources. This requires leveraging energy and resource-saving technologies. Energy efficiency, the "hidden fuel" in the words of the International Energy Agency, is crucial to establishing a sustainable energy system and maintain competitiveness
- > Resources should be saved in the production process and in the product itself. Products should be designed to require fewer materials, though without reducing quality. A more efficient layout and new technologies in the production process can save energy and other resources





Reduce dependency on resources whenever possible

- > To reduce the dependency on a specific resource, companies should try to use substitute resources that are less scarce. In the case of energy resources, companies should consider producing the energy they need themselves (e.g. using own small power stations, solar panels on the roofs of their plants or office buildings, windmills on the property, etc.)
- > Diversifying the product portfolio and supplementing it with services is another way companies can become less dependent on single resources
- > Raising the potential number of suppliers reduces the dependency on single raw materials suppliers, but also has downsides – for instance, higher prices due to smaller order volumes
- > Another way to secure resources is through the backward integration of suppliers
- > To mitigate their vulnerability to price fluctuations, companies (also medium-sized) should hedge resource prices or integrate automatic price adjustments into their long-term contracts with customers
- > Think about cradle to cradle (C2C) approaches. Here production takes into account the entire life cycle of the product, optimizing recyclability, renewable energy use, water efficiency and quality. The C2C model often also leads to cheaper production costs as it eliminates the need for waste disposal





Appeal to consumers

- > Consumers will become increasingly aware of resource scarcity. This awareness should be taken into account by offering products with resource-saving features and by focusing on such product features in communications
- > Resource-saving production processes (saving materials and energy) should also be highlighted and used for marketing purposes
- > A label "Remanufactured" placed on products or packaging could appeal to the growing number of environmentally conscious consumers, particularly to the Millennials
- > In addition, companies should also appeal to consumers and other stakeholders via PR, investor relations, etc. to establish an image of responsible resource use





Key sources and further reading (1/3)

Most important data sources

- > ExxonMobil. The Outlook for Energy 2016: A View to 2040 <u>http://corporate.exxonmobil.com/en/energy/energy-outlook/download-the-report/download-the-outlook-for-energy-reports</u>
- > BP. Energy Outlook 2016 Edition: Outlook to 2035 <u>http://www.bp.com/en/global/corporate/energy-economics/energy-outlook-2035/energy-outlook-downloads.html</u>
- > U.S. Energy Information Administration. Annual Energy Outlook 2016 <u>https://www.eia.gov/forecasts/aeo/index.cfm</u>
- > U.S. Energy Information Administration. International Energy Outlook 2016 http://www.eia.gov/forecasts/ieo/
- > BGR. Energy Study 2015 <u>https://www.bgr.bund.de/EN/Themen/Energie/Downloads/energiestudie_2015_en.html</u>
- > Aquastat. FAO's Global Information System <u>http://www.fao.org/nr/water/aquastat/main/index.stm</u>
- > UN. The UN World Water Development Report 2016 <u>http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2016-water-and-jobs/</u>
- > Barilla Center <u>https://www.barillacfn.com/en/</u>





Key sources and further reading (2/3)



Most important data sources

- > FAO. World Agriculture: Towards 2030/2050 http://www.fao.org/docrep/009/a0607e/a0607e00.HTM
- > OECD. Environmental Outlook to 2050 <u>http://www.oecd.org/environment/indicators-modelling-</u> outlooks/oecdenvironmentaloutlookto2050theconsequencesofinaction.htm
- > OECD. Critical Minerals Today and in 2030: An Analysis for OECD Countries http://www.oecd-ilibrary.org/environment/critical-minerals-today-and-in-2030_5jrtknwm5hr5-en
- > European Commission. Report on Critical Raw Materials for the EU <u>http://ec.europa.eu/DocsRoom/documents/10010/attachments/1/translations</u>
- > USGS (US Geological Survey). Commodity Statistics and Information <u>http://minerals.usgs.gov/minerals/pubs/commodity/</u>
- > ESRC Centre for Climate Change Economics and Policy, Grantham Research Institute on Climate Change and the Environment. Critical Minerals Today and in 2030: An Analysis of OECD Countries <u>http://www.lse.ac.uk/GranthamInstitute/publication/critical-minerals-today-and-in-2030-an-analysis-of-oecdcountries/</u>
- > World Bank. What a Waste: A Global Review of Solid Waste Management <u>http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/0,,contentMDK:231</u> <u>72887~pagePK:210058~piPK:210062~theSitePK:337178,00.html</u>



Key sources and further reading (3/3)

Further reading

- > IEA. World Energy Outlook 2015 <u>http://www.worldenergyoutlook.org/weo2015/</u>
- > MIT. Energy and Climate Outlook 2015 http://globalchange.mit.edu/files/2015%20Energy%20%26%20Climate%20Outlook.pdf
- > WWF. Big Cities. Big Water. Big Challenges. Water in an Urbanizing World <u>http://www.wwf.de/fileadmin/fm-wwf/Publikationen-</u> PDF/WWF_Big_Cities_Big_Water_Big_Challenges.pdf
- > Veolia Water. Finding the Blue Path for a Sustainable Economy <u>http://www.veolianorthamerica.com/sites/g/files/dvc596/f/assets/documents/2014/10/19979</u> <u>IFPRI-White-Paper.pdf</u>
- > Chatham House. Resources Futures <u>http://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Envir</u>onment%20and%20Development/1212r resourcesfutures.pdf





Please contact us if you have any questions or comments – Six more megatrend insights await on our website



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Trend Compendium

https://www.rolandberger.com/en/ Dossiers/Trend-Compendium.html

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