Commodity Outline

Sustainability in the Energy Sector

rfu research GmbH

About this Report

SECTOR REPORT

rfu research regularly analyses the social and environmental impact of more than 50 global commodities of various sectors: energy, metals, agriculture and forestry. Our findings are aggregated into a sustainability rating and detailed rating report for each commodity.

The comprehensive perspective of our research serves as an orientation for materiality of sustainability. It covers both production and utilisation, providing knowledge on the main actors and beneficiaries of this status quo.

The facts and findings are embedded into narratives that are relevant. The focus on the financial sector shows where a great deal of potential for change remains untapped.

ENERGY INDUSTRY

The events of recent years have shown what disruptions a shortage of energy supply - or even just the fear of it - can cause. The need for robust strategies towards an ecologically and socially just future is becoming increasingly urgent.

This report provides an overview of the status quo of the energy industry in order to identify the biggest levers for transformation. This includes an essential need for changing patterns of energy consumption.

Addressing the big picture it is necessary to acknowledge that it is difficult to write something "new" about the sector and its (prevailing un)sustainability.

I. Executive Summary

Fifteen energy commodities have been analysed from an sustainability perspective. Apart from crude oil, natural gas, coal and electricity also derivative products such as gas oil and regional specifics have been compared.

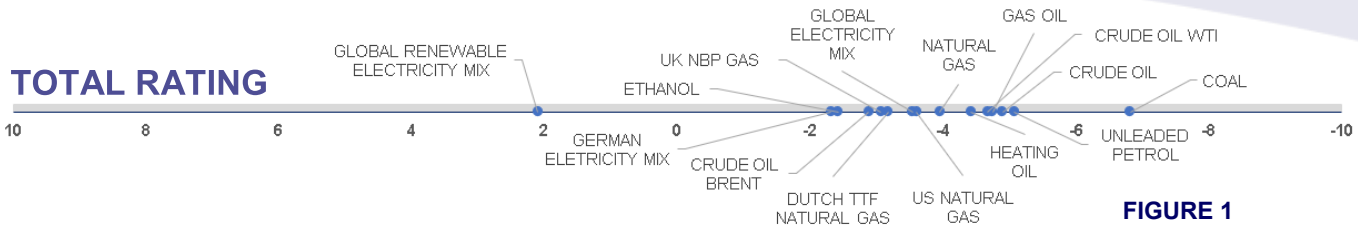


FIGURE 1

The rfu Commodity Rating aggregates the social and ecological research findings into a score. The rating scale ranges from very poor sustainability performance (–10) to very positive impact (+10).

LITTLE HAS CHANGED

It seems obvious, but it cannot be stressed often enough: Fossil fuels still dominate the big picture and energy transition is more a medial buzzword than a lived reality.

Negative ratings dominate the picture. Except for the global renewable energy mix all analysed energy commodities have a negative rating (see Figure 1).

Average results are significantly lower than metals and agriculture commodities. This is due to the devastating effects of the current energy use, particularly on climate change and human health.

The industry has made little progress towards sustainability. The share of fossil fuels in the global energy mix only declined from 87% (1973) to 82% (2022). The sector rather prevented more ambitious policies by lobbying and framing the public discussions with narratives (see Chapter V).

ESSENTIAL BUT NOT SUFFICIENT

Technological innovation is often the only story told. The road ahead requires much more - a change in cultural patterns and a reduction of consumption levels.

The **availability of energy** is intricately linked to quality of life, the fulfilment of basic human needs and poverty reduction. There are hardly any fields where energy isn't used at all.

The demand-side deserves more attention. Proposed solutions are technologically biased. Above a certain - relatively low - level of energy consumption, the increase in well-being seems to stagnate (see Chapter VII).

Current use patterns are in contradiction to core aspects of sustainability. At the same time vast amounts of energy seems to fulfil questionable needs and energy consumption is extremely unevenly distributed (see Chapter IV).

Who is benefiting? The question arises when looking at the production impacts and the distribution of profits among owners, investors, employees, government and local communities in the value chain. The energy sector is characterised by widespread controversies, conflicts and human rights violations (see Chapter III).

THE FINANCE SECTOR HESITATES

The depreciation of energy assets poses a significant risk for financial markets. While stranded assets are estimated to exceed USD 1 trillion, the financial ties with the fossil fuel industry remain rather stable.

Transparency and risk prioritised over altering financial flows. Risk management systems and reporting on climate issues surged due to legal requirements and societal expectations. Between 2016 and 2022 renewable energy represented only 7% of energy financing of major banks with GFANZ members as underperformers (see Chapter VI).

Comprehensive approaches are required to grasp the complex impact. Regulatory frameworks and industry standards tend to have a certain focus on climate change. The rfu Methodology applies a broad set of qualitative and quantitative indicators, including aspects beyond simple production metrics such as geographical risks, utilisation value, and distributive justice. (see Chapter II).

II. Methodology

The rfu Commodity Model strives for a holistic perspective, including social and environmental issues along the whole life cycle from production over utilisation to end of life. More than 50 indicators go beyond typical parameters.

In the rfu Methodology, **hypothetical "world commodity corporations"** are assumed.

STRUCTURE

Commodities follow a different delimitation logic than companies or states. Nevertheless, commodities are produced in corporate structures. We have therefore developed the **conceptual model** of a global sole and exclusive manufacturer – such as a hypothetical "World Crude Oil Group" or "Global Copper Corporation". To this we apply the basic structure, the criteria and the weightings of the rfu Corporate Methodology, which has been proven for over 15 years. The model emphasises the overall impact and is neither limited to risks nor economically relevant issues.

The model differentiates between the **environmental and social dimensions** as well as between **production and use**.

The **model is structured** in such a way that it differentiates between the social and the ecological dimension and at the same time differentiates according to the life cycle phases of production and utilisation (see figure 2). Each indicator is considered on social or environmental and production or utilisation levels (Level II). Both branches lead to the same total rating.

The social dimension itself is broken down into **stakeholder groups** (Level III): employees, society, customers and market partners in a broader sense including suppliers. The concrete criteria (Level IV) and indicators (Level V) are then assigned to these. On the right main branch, the evaluation of the utilisation dimension is derived from the different types of use (Level IV).

CRITERIA

Criteria and the weighting logic are set up parallel to those in the rfu Corporate Rating model. From its broad set of criteria, those relating to socio-ecological performance or products are primarily used in the commodity model. All programmatic and thus company-specific criteria, such as ESG strategy and the stakeholder investor, are not included.

The rfu Commodity Rating aggregates findings to an overall rating subsuming 20 criteria covering roughly 50 general and dozens of commodity-specific indicators. Theoretically, the rating scale ranges from –10 to +10. This scale is identical in its characteristics and logic to that in the rfu Corporate Model and the rfu Sovereigns Model.

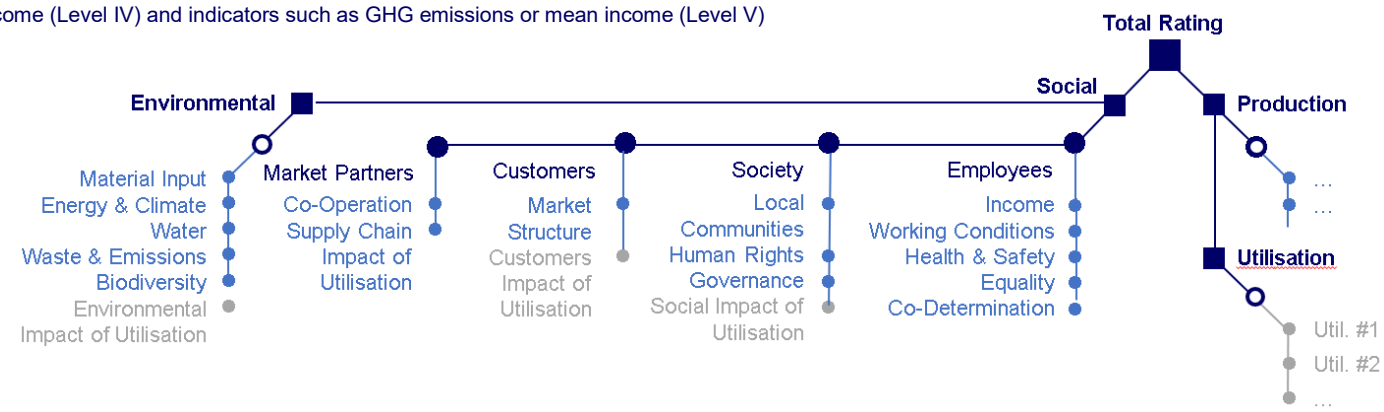
PRODUCTION EVALUATION

The production rating is **based on two different approaches**. A risk evaluation of the geographical origin and extensive commodity-specific research. Commodity-specific information on the respective indicators, which suggest a positive or negative deviation from the initial value, is added to this basic impact.

This **data** comes from various sources like scientific studies, media and NGO reports, life cycle assessments, statistics from industry associations and international organisations. A specific focus is placed on controversies.

FIGURE 2

The model distinguishes various levels: total rating (Level I), social/environmental sphere and production/utilisation (Level II), stakeholder (Level III), criteria such as energy & climate or income (Level IV) and indicators such as GHG emissions or mean income (Level V)



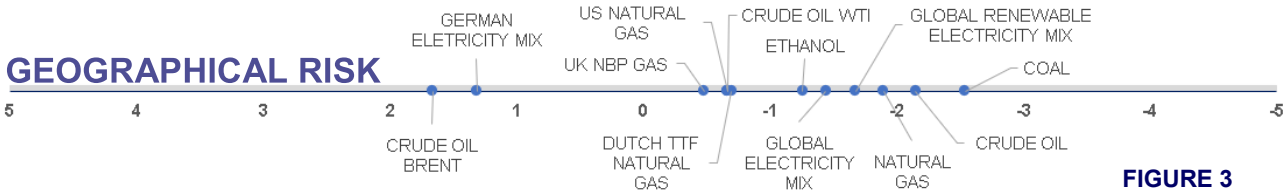


FIGURE 3

The rfu Sovereigns Model provides country-specific data on a broad range of social and environmental aspects to assess geographical risks.

GEOGRAPHICAL RISKS

There are close links between the geographical origin of a product and social and ecological risks. One core feature of our sustainability approach is to apply a link to the geographical distribution of a value chain to a broad range of **regional social and environmental risks**. For example: How well are employee rights protected or how much environmental harm due to waste spill is happening in the global mix of crude oil exploration?

This assessment includes a long list of different indicators, such as human rights risks, local income levels & income injustice, governance aspects (e.g. corruption) and environmental risks (e.g. energy mix, water- and biodiversity stress). From this perspective, coal is characterised by the highest risk, followed by crude oil and natural gas. Renewable energies are characterised by lower country-related risks in comparison to fossil fuels (see figure 3).

UTILISATION EVALUATION

The evaluation of the utilisation of commodities, products and services is an essential part of rfu's understanding of sustainability. Main reference points are human-needs-oriented approaches based on the work of Manfred Max-Neef, Hartmut Bossel and Ian Gough amongst others. In this sense we rate basic human needs such as food, heating of shelter, access to health or education more valuable than air travel or energy-intensive cars. To evaluate to what extent current consumption levels exceed ecological limits we apply the planetary boundary concept.

We distinguish between 90 different economic subsectors. Social and environmental benefits, harm, opportunities and risks are analysed. Associated studies and articles are continuously collected. It is of utmost importance to us to include ethical discourses around issues such as meaningfulness or pseudo-satisfiers into our rating methodology. We consider the risk of not including such normative interpretation much higher than doing so.

An important, but often underrated aspect of sustainability rating is the **societal value of utilisation.**

OUTLOOK

Part of the analysis is a qualitative assessment of the trends and potentials of the individual commodities, which is detached from the actual rating model. This is less to be interpreted in the sense of an economic outlook but provides a forward-looking perspective on the expected or possible contributions of the individual commodity to sustainable economies. Here, for example, it can be appreciated that some metals currently have a more conventional mix of uses but will play important roles in energy transition in the future.

More information in the rating model can be found at rfu.at or by contacting the authors.

LIST OF ANALYSED COMMODITIES

METALS

Precious Metals
Gold & Gold (LBMA)
Silver & Silver (LBMA)
Palladium
Platinum

Industrial Metals
Aluminium
Steel / Recycled Steel
Cobalt
Copper
Lead
Lithium
Molybdenum
Nickel
Tin
Tungsten
Zinc

ENERGY

Fossil Energy
Crude Oil & WTI & Brent
Gas Oil
Heating Oil
Unleaded Petrol
Natural Gas & US & TTF & UK NBP
Coal

Renewable
Renewable Energy Certificates (RECS)
Ethanol

Electricity
Global Electricity Mix
EEX German Power Future

AGRICULTURE

Meat
Feeder Cattle, Live Cattle
Lean Hogs
Chicken

Grains & Seeds
Rice
Corn
Wheat / Kansas Wheat
Soybean & Soyb..Meal & Soyb. Oil

Others
Cotton
Cocoa
Coffee
Sugar

FORESTRY

Lumber
Pulp / European Pulp, Chinese Pulp
Rubber

OTHER

Carbon Allowances
California Carbon Allowance
Regional Greenhouse Gas Initiative (RGGI)
European Emission Allowances (EUA)

FIGURE 4

The rfu Commodity Research currently covers more than 50 commodities. The coverage is constantly expanded. The methodology is also applied to value chains outside of typical commodity exchanges and applied to construction materials as well as certificates of carbon allowance schemes.

III. Production

Energy sources and regional origin remain very static over time. The phase-out of coal, oil and gas is not yet in sight. Which regions provide society with resources? Which social and environmental impacts go along with the different energy carriers?

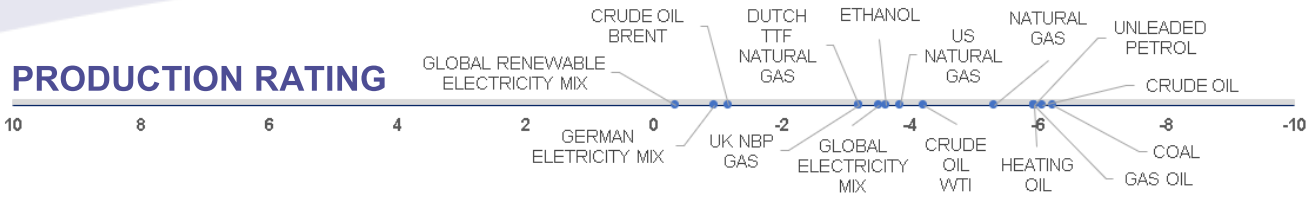


FIGURE 5
The production rating aggregates sustainability impacts from cradle to gate.

KEY FINDINGS

- Global production patterns have been **extremely stable** over the past decades.
- The production impact of **coal, oil and natural gas** differs much more than the impact of utilisation.
- **Ethanol** is similar to conventional energy in terms of production impact. The difference of the **global renewable energy mix** to fossil fuels is lower than expected due to conflicts and human rights violations.
- The **geographical risks** of global energy commodity resources hardly differ, neither from each other nor from metals or agricultural products.
- For a few regional specifics such as Brent Oil, reduced **country risks** and fewer controversies contribute to better ratings.
- Current trends of resource exploration for the energy system are associated with **increased risks** (e.g. risk technologies, extractivism, land-use change).

ENERGY SOURCES & ORIGIN

The largest energy carriers in the **global energy mix** are still fossil relicts. Together, oil, coal and natural gas account for the lion share. Less than one fifth is not fossil fuel-based. Hydro power accounts for 7% of the global energy consumption. Other renewables also have a share of 7%, with wind and photovoltaic being responsible for four fifths of this share. Nuclear power, celebrating a recent revival, contributes 4%. Clutching at straws we could highlight the promising trends of 2022: renewables have grown by almost 10% representing more than 80% of new energy capacities.

Resources are geographically unevenly distributed with different developments among the energy carriers (see figure 7). Overall, the USA and China dominate the picture of **major explorers and producers**. The Middle East still provides one third of crude oil supply. Over the last years, the USA have increased their production capacities massively due to the revolution in shale oil extraction, doubling their crude oil production. Coal deposits are highly concentrated regionally, with every second tonne being mined in China. Technological and financial capacities play an important role. The USA account for almost one third of the global nuclear power production. China's strong orientation towards renewables is reflected in a market share of one third.

The **key players might change** slightly. Saudi-Arabia, Venezuela, Canada, Iran and Iraq have almost two thirds of global oil reserves. USA, Russia, Australia and China account for two thirds of the global coal reserves. Russia, Iran and Qatar account for half of gas reserves. Looking into the near future, the USA, Qatar, Saudi Arabia and Brazil top the list of (almost) approved oil and gas extraction. Most of which better be left in the ground.

WHO IS BENEFITING?

The process of providing society with usable energy is complex and creates major impacts. The net **benefits for local communities** are controversially discussed under the term "resource curse", particularly regarding the exploration. The profits are often very un-

GLOBAL ENERGY MIX

(2022 in % of global total)

32%	OIL
27%	COAL
23%	NATURAL GAS
7%	HYDRO
7%	WIND, PV AND OTHER
4%	NUCLEAR

FIGURE 6
The share of fossil fuel in the global energy mix declined only from 87% (1973) to 82% (2022).

MAJOR PRODUCING COUNTRIES (% of global production in 2022)

	OIL		COAL		GAS		RENEWABLES		NUCLEAR	
1	USA	17%	China	52%	USA	24%	China	31%	USA	30%
2	Saudi Arabia	13%	India	10%	Russia	15%	USA	11%	China	16%
3	Russia	12%	Indonesia	8%	Iran	6%	Brazil	7%	France	11%
4	Canada	6%	USA	6%	China	5%	Canada	5%	Russia	8%
5	Iraq	5%	Australia	5%	Canada	5%	India	4%	South Korea	7%
6	China	5%	Russia	5%	Qatar	4%	Germany	3%	Canada	3%
7	UAE	4%	South Africa	3%	Australia	4%	Japan	3%	Ukraine	2%
8	Iran	4%	Germany	2%	Norway	3%	Russia	2%	Spain	2%
9	Brazil	4%	Kazakhstan	1%	Saudi Arabia	3%	Norway	2%	Japan	2%
10	Kuwait	3%	Poland	1%	Algeria	2%	Turkey	2%	Sweden	2%

FIGURE 7

The **appropriation of (energy) resources** has been a main characteristic of the **Anthropocene.** Looking at the trade balances, we find the Middle East, Russia, Australia, Canada, Indonesia and Norway supplying the world with energy carriers. Net importing regions are first and foremost Asia and Europe. Notably, embodied energy in imported products (e.g. steel, IT devices) ,is not considered.

equally distributed and the rise of local elites can hinder democratic development. Studies and quantitative data on this complex issue are scarce, provide mixed results and tend to focus on selected issues. The sector remains a hotspot for corruption and other governance issues.

Numerous regional stories of **extractivism** exist. The East African Crude Oil Pipeline is a good example. Under the leadership of Total Energies, the longest heated pipeline is constructed accompanied by conflicts and a broad countermovement. Urgewald's Reputational Risk Projects list features around 30 controversial projects. Many projects have a strong neo-colonial touch, constructed and financed by multinationals, often fulfilling Western energy needs and business interests. Ownership by local communities remains low.

CONFLICTS AND HUMAN RIGHTS

The **fossil fuel industry** is a key sector in terms of multifaceted human rights violations by companies and states. Extrajudicial killings and violations of indigenous peoples' rights have been very common. Well-known examples of serious cases can be found in the Niger Delta and the Amazon.

Renewable energy also has inherent risks. The Xinjiang region in China, for example, produces almost half of the world's solar-grade polysilicon. It is directly linked to severe human rights abuses such as forced labour. Severe human rights impacts have been observed with large hydro dams such as Ilisu (Turkey), Belo Monte (Brazil) or the current Grand Ethiopian Renaissance Dam.

The struggle for energy resources has been an important aspect in various **violent conflicts** in the past, such as the two Gulf wars or the Sudanese civil war. Security services hired by oil and gas companies have been linked to military or paramilitary groups in conflict areas. The war in Ukraine throws a spotlight on the obstacles of **geopolitical energy policy**. Nevertheless, it seems a threadbare argument to substitute Russian gas with imports from Azerbaijan or Iran for moral reasons.

ENVIRONMENTAL FOOTPRINT

In crude oil and gas extraction, **risk technologies,** including hydraulic fracking, deepwater exploration, tar sands and Arctic drilling are surging. Fracking is increasing, particularly in the USA, Argentina, Russia, Canada and Mexico. The share of deepwater products in global oil and gas production, defined as exploration below 400 metres, was 6% in 2022 and is expected to increase to 8% by 2030. Seismic surveys cause fragmentation of the landscape and are among the most intense anthropogenic marine sounds.

Increasing risks in the production due to production technologies such as fracking or deep-sea exploration.

Globally, about one fifth of World Heritage Sites (WHS) contains areas with concessions for oil and gas extraction. More than 1,350km^2 of undisturbed rainforest in the Amazon and Congo overlap with current or future oil and gas exploration blocks. Oil exploration in the Arctic is controversial. Direct and indirect infrastructure impacts of roads, networks, pipelines etc. contribute to **biodiversity loss**.

Human rights violations are common not only for fossil fuel exploration, but also for renewable energy (e.g. hydro dams).

In relation to fossil energy, wind and photovoltaic are associated with minor environmental effects. Other **renewable production systems**, most particularly hydro and biomass, can have tremendously negative consequences for ecosystems. Some hydro plants exceed the climate impact of coal power stations, some biofuels those of their fossil counterparts. The resource hunger for green technologies increases the human footprint into sensible areas, such as deep-sea mining (e.g. of manganese, nickel, copper or cobalt).

Free and open access to **energy statistics** is very limited. For digging deeper we recommend: Statistical Review of World Energy, Irena, Enerdata's yearbook, Global Energy Monitor or Fossil Fuel Registry.

IV. Utilisation

The availability of energy is essential for modern societies and shapes economic processes and cultural practices. Energy is almost everywhere. Heating, cooling, mobility, industry, information and communication technology. Above all, its consumption is distributed very unevenly.

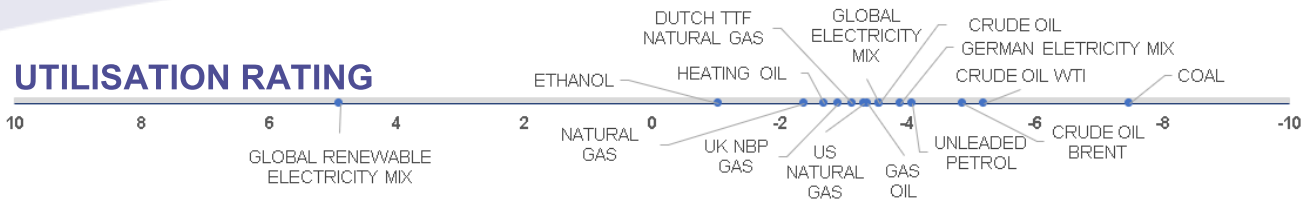


FIGURE 8

The utilisation rating aggregates sustainability impacts from the use of the commodities.

KEY FINDINGS

- The "basically good" characteristic of energy contributes to a broad variety of essential societal services that go along with a **relatively high societal value**.
- Energy demand is extremely **unevenly distributed.** Lower utilisation ratings for regions with excessive consumption levels are due to a shrinking Marginal Utility.
- The combustion of fossil fuels – mostly happening during utilisation – is the **single most important contributor to the climate crisis** and ocean acidity and is also **detrimental to human health**.
- The **negative results** for almost every energy commodity reflect the contradiction of current consumption patterns with a sustainable development.

FIGURE 9

While the **global energy demand** almost tripled since 1970, **per capita** consumption rose only by one third.

ENERGY DEMAND

historical energy data (1970-2022)

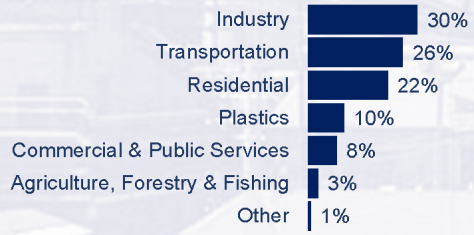
Year	Total (Exajoule)	Per Capita (Gigajoule)	U.S. Crude Oil (First Purchase Price in $)
1970	205	55	3.18
1980	281	63	21.59
1990	344	65	20.03
2000	397	65	26.72
2010	509	73	74.71
2020	564	72	36.86
2022	604	76	93.97

FIGURE 10

Energy is not produced as a means to an end in itself but a means for products and services. The same joule can be of very high or very low societal value.

GLOBAL UTILISATION MIX

share of global energy demand (% in 2021)



WHAT WE USE ENERGY FOR

Three sectors account for more than three quarters of **global energy consumption**: the industrial production in general, transportation and the residential sector. The non-energy use of energy carriers, such as plastics, commercial & public services as well as agriculture, forestry and fishing almost complete the picture.

Three sub-sectors account for almost half of the energy demand of the **industrial production**: iron & steel, the petrochemical industry and the production of non-metallic minerals - in particular cement. More than two thirds of the transportation sectors' energy demand can be attributed to road traffic, most of it to automobiles. Around 90% of energy used for transportation is derived from oil.

In the **residential sector**, the geographical background can be expected to vary significantly. In the European Union for example, space heating takes the lion share (63%). Water heating (15%), lighting and appliances (15%) as well as cooking (6%) are other main forms of energy utilisation.

The footprint of the **information and communication sector** – computers, smart phones, internet, data centres and so forth – is discussed controversially. Rough estimates suggest lower single digit figures, which are rapidly rising.

1 JOULE ≠ 1 JOULE

The analysis and **evaluation of the use phase** is at least as important as that of production. From an ethical point of view, it makes quite a big difference what one energy unit is actually needed for. Is it used to provide medical services or to move the SUV of a healthy businessman from A to B in an area where public transportation infrastructure is

CARBON FOOTPRINT AND HEALTH IMPACT OF ENERGY

climate impact (in gCOeg/kwh) and health impact (in death/Twh) for different electricity production systems

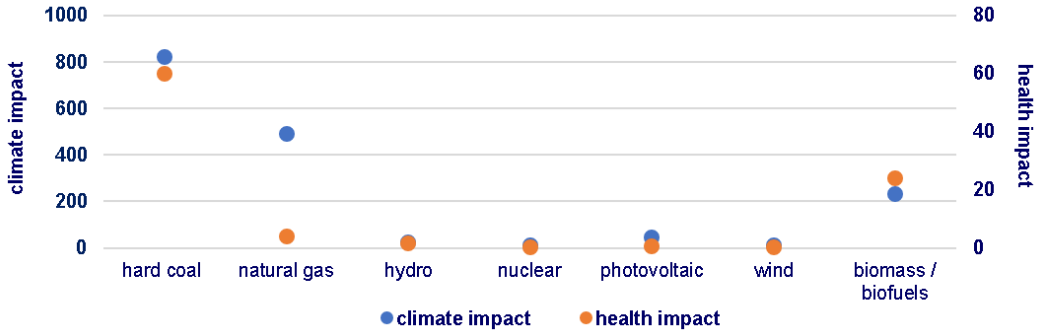


FIGURE 11

The **relative impacts on climate change and human health** per energy unit differ significantly between the electricity sources. Hard coal is on average characterised by far by the highest impacts. Biomass-based energy production has significantly higher impacts than other renewable energy production systems.

available. Heating oil's better rating is explained by a higher utilisation value of the importance of a heated home compared to unleaded petrol.

The **availability of energy** is far less correlated to well-being than often portrayed in the public discourse (see Chapter VII). Therefore we consider a shrinking Marginal Utility in terms of added societal value for each additional energy unit available above a certain threshold. This influences the utilisation impact of regional energy commodities (e.g. WTI or Brent Oil).

The **range of utilisation ratings is very broad** for the energy system in general. Commodities and services that contribute to an affordable, eco-friendly and sufficient energy provision for everybody receive a high rating. Several aspects of the status quo are in contradiction to this. Therefore, today's main energy commodities are clearly on the negative side of the rating.

CLIMATE CHANGE AND HUMAN HEALTH

Fossil fuel combustion accounts for roughly **three quarters of the global greenhouse gas emissions**. Relative impacts per energy unit are also far above average. In this context we expect a negative outlook for all fossil fuel ratings. When we consider the current business as usual actions, our carbon budget to limit global warming to 1.5°C is used up in 2029. The dramatically shrinking time budget highlights the urgency to exit fossil fuels and is reflected in a continuously declining rating unless far more ambitious measures are taken.

According to recent estimates, about **10 million people die prematurely each year** because of PM2.5 emissions. This exceeds all the deaths from the Corona pandemic combined (~7 million). The externalities of air pollution from fossil fuels were estimated at nearly USD 3 trillion in 2018, equivalent to 3.3% of global GDP.

ACCESS & AFFORDABILITY

Energy poverty is an increasing buzz word. The sector's pricing policy was often subject to criticism, in particular during the recent energy crisis. High profits were accompanied by a cost of living crisis, including high energy prices. Globally far more than 700 million people still lack access to consistent electricity.

UNEVEN DISTRIBUTION

Current levels of energy consumption range from under 5 GJ per capita in East and Middle Africa to 30 GJ in Central America, 118 GJ in Europe and 283 GJ in the USA. At the very top of the scale, we find Qatar (699 GJ). The same can be observed for petrochemical products: The USA and Europe consume about 20 times as much plastic and 10 times as much fertiliser as India.

A study among 86 countries suggests inequality in energy consumption is higher than in general household expense. Differences can also be found in terms of gender. Male lifestyles are associated with higher energy consumption than female lifestyles, with the main difference being in individual transport.

Unequal distribution is evident in annual per capita consumption ranging from around 5GJ (Middle Africa) to 699GJ (Qatar).

CARBON INEQUALITY

share of global carbon footprint (% in 2015)

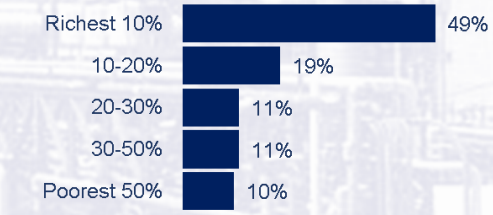


FIGURE 12

According to recent findings, in 2015 the world's richest 10% were responsible for 49% of the global carbon footprint, which is closely linked to energy consumption. Growing wealth inequality within a country is increasingly more relevant than the differences between countries and regions.

V. Governance

Governance aspects, particularly of the fossil fuel sector, have a significant influence on the rating. In search of their social licence to operate, the protagonists have a technology-driven focus.

KEY FINDINGS

- The market is dominated by **large state-owned or multinational corporations**.
- In no way do the **current efforts** of the sector do any justice to the current social and environmental challenges.
- Governmental supporting schemes for renewable energy **cannot compensate the legislative and financial tailwind for fossil fuels.**
- The conventional vision focussing on **technical solutions alone falls short**.
- The industry's efforts to **influence the societal discourse** on important ESG challenges have a strong negative impact on the rating.

MARKET STRUCTURE

The industry has a dominant role due to its size. The oil market alone exceeds the raw metals commodity trade in monetary terms.

The **biggest oil and gas companies** include China National Petroleum Corporation, Sinopec, Saudi Aramco, ExxonMobil, Shell and TotalEnergies. Several powerful institutions represent the industry, most notably, the Organisation of Petroleum Exporting Countries (OPEC) and the International Association of Oil and Gas Producers (IOGP).

Government and state-owned enterprises accounted for 36% of oil and gas supply, 50% of fossil fuel production and 55% of electricity networks in 2019.

The **renewable energy market** is diverse. For most technologies the biggest five companies account for more than half of the market share. China is dominating the photovoltaic and wind market. The International Renewable Energy Agency (IRENA) is one of the leading intergovernmental agencies.

While state-owned enterprises and infrastructures play an important role in the energy market, decentralised, locally-owned and organised structures are still exceptions.

WIDE-SPREAD PASSIVITY

The main actors perform weakly in cooperatively improving **social and environmental standards**. While most reports of energy companies contain seemingly endless - and a growing number of pages - on innovation and sustainability, the actual measures lag behind and self-declared goals seem rather cosmetic.

Expenditures are a good example for the passivity. Investments in clean technologies account for less than 3% of oil and gas companies' global capital expenditures in 2022 representing roughly 1% of global clean energy investments. The cash spending shows a similar picture (see figure 13).

Many producers suggest that their company will be the last one standing selling fossil fuels. The examples of companies rapidly **changing** their **business case remain rare** (e.g. Ørsted, Neste Oil).

SUBSIDIES AND LEGISLATION

Governments have answered the lack of market reaction with **legal frameworks and schemes supporting renewable energy** (e.g. incentives, grants). Despite such trends the fossil fuel industry still receives increasing subsidies (see Figure 14). Financing of low carbon solutions needs to accelerate rapidly.

Some governance frameworks rather saved the status quo. **The Energy Charter Treaty** (ECT) - one of the most important international agreements in the sector - protects foreign direct investments in energy infrastructure and includes dispute settlement procedures. It has been heavily criticised by many stake-

FIGURE 13

The expenditures of the Oil and Gas Industry do not prioritise the energy transition. The satisfaction of shareholder's monetary interests are a multiple of the investments towards developing a low carbon business case.

FINANCIAL PRIORITIES OF THE OIL AND GAS SECTOR

Distribution of Cash Spending by the Oil and Gas Industry (% in 2022)

ENERGY-RELATED GLOBAL MONETARY FLOWS

(in USD billion)

FIGURE 14

Monetary flows are increasingly moved towards clean energy, but governmental support for the fossil fuel industry remains high. Government spending on clean energy reached USD 130 billion in the first half of 2023. Following the global energy crisis, fossil fuel consumption subsidies globally even rose beyond USD 1 trillion in 2022 exceeding the total global renewable energy investments.

holders as an obstacle to the energy transition since oil, gas and coal companies have so far received more than USD 100 billion by the ECT tribunals. Recently, several member states, including Germany and France, announced their withdrawal.

THE SECTOR'S INFLUENCE

The energy sector is intertwined with the political system. Strong evidence indicates that the fossil fuel industry has been very active in hindering the political discourse by various means. This includes **influencing democratic institutions** through huge lobbying expenditures reaching triple-digit USD millions annually, disseminating disinformation, such as supporting deniers of the climate crisis, strategic law suits against NGOs or influencing scientific research.

THE CONVENTIONAL VISION

Which energy-related future do governments and the big players in the energy sector envision? Few key words dominate the **industry-driven discourse**: carbon capture, electrification of mobility, biofuels, hydrogen, technological innovation and efficiency.

Today a wide array of **energy and climate scenarios** exists to depict potential developments and influence international climate negotiations. All of them are based on a broad set of assumptions ranging from energy mix, economic and technological developments to variables on energy demand from housing, mobility and so forth.

PREVAILING TECHNO-OPTIMISM

Most scenarios strongly depend on so-called **negative emissions technologies (NETs)** and unprecedented technological developments. One of the most important is BECCS (bio-energy with carbon capture and storages). However, many experts suggest that the tantalising dream of carbon dioxide removals makes unrealistic claims. In 2021, hundreds of scientists asked political leaders not to emphasise forests as biomass for bioenergy. The relevance of hydrogen for the energy transition is also considered exaggerated.

E-mobility is another technology fuelling the hope of many. Imagining a globally just society and globalising the European Union's car density (0.57 cars / inhabitant) with today's technology would require more than 30 million tonnes of lithium. This volume is several hundred times higher than the current production and even exceeds the currently known lithium deposits (2022: 25 million tonnes). Even now, while we are still in the infancy of e-mobility, the exploration is already associated with massive consequences.

EFFICIENCY & REBOUND EFFECT

As early as 1865, the British economist William Stanley Jevons observed that increasing energy efficiency leads to an increase in demand, partly due to falling costs. This phenomenon — **the Rebound Effect** — can be found in many areas: Residential buildings, for example, consume less energy per m² but the average living space is increasing. Cars become more efficient in their fuel consumption but more kilometres are being travelled. Products are manufactured with less material and energy but more items are being sold.

A review of 33 studies shows that the overall economic rebound effects usually erode more than half of expected savings from increased efficiency. Technological innovations and improvements in energy efficiency have led to more productivity and growth, increasing the absolute overall impact.

Most industry-born solutions have in common that they promise that no significant change in consumption patterns nor in the institutional set-up of the energy sector is necessary. At the same time, it becomes challenging to find 1.5°C compliant scenarios and we lack imagination of meaningful intervention.

The **rebound effect** causes higher absolute energy consumption although technological innovations reduce the relative demand.

"Any intelligent fool can make things bigger, more complex, and more violent. It takes a touch of genius – and a lot of courage – to move in the opposite direction". E.F. Schumacher (1973)

VI. The Role of the Financial Sector

If we would take climate change and other externalities of the energy sector seriously, vast amounts of fossil fuel reserves and associated infrastructure would have to be considered worthless – with important implications for the financial sector and its risk management .

KEY FINDINGS

- The **financial sector and the energy industry are closely interwoven**. Vast amounts of investment and profits are distributed via financial markets and the gross monetary flows change only slowly.
- Estimates of global **stranded assets** exceed USD 1 trillion. This is yet hardly recognised in the risk management of financial institutions.
- The **financial industry** still applies rather toothless policies lacking clear divestment signals. Few financial actors have a strategic relevance for the transition.
- **Regulation of ESG issues** is increasing - with huge bureaucratic efforts and questionable definitions of sustainability.

A PROSPEROUS CRISIS?

Flourishing in the crisis: The aggregated annual profits of the five largest integrated private sector oil and gas companies - Chevron, ExxonMobil, Shell, BP and TotalEnergies – soared to USD 195 billion in 2022.

The fossil fuel industry is not in a crisis. Not at all. It is quite **prospering**. For the last decades the oil and gas sector has delivered annual profits of USD 1 trillion on average. In 2022, profits rose to the highest level in the history of the industry. These profits went along with high societal and environmental damages. The associated corporations were successfully avoiding the "polluter pays principle" by socialising these externalities. The economic impact of divestment campaigns for example has not yet inflicted relevant economic impact on the companies.

Ten investors could influence 50% of the emission potential of current reserves including Blackrock, Vanguard, the Government of India, State Street and Saudi Arabia.

Meanwhile, **new fossil fuel infrastructure** is still constructed: gas and coal power plants, LNG terminals, pipelines, fossil fuel driven cars, gas heating systems and much more. This contributes to a so-called carbon lock-in. Once money has been spent the more difficult it is to find a societal consensus not to use this carbon-intense infrastructure.

THE FINANCIAL SECTOR & ENERGY

The **financial sector plays a substantial role**. It provides loans for new infrastructure, trades with and invests in shares and bonds of energy corporations and provides essential financial services to a sector with significant ESG risks. Simultaneously, financial corporations use the term sustainability quite excessively. Particularly risk management systems received much attention in recent years. A strong increase in TCFD and PCAF reporting contributed to the operationalisation of carbon risks and more systematic reporting.

Fossil fuel-related policies emerged and excluded specific forms of fossil fuel financing but often leave some kind of backdoor open. So far almost 1,600 institutions with estimated assets under management of more than USD 40 trillion committed to some form of divestment. Most institutions still circumnavigate a clear cut with the industry. Company-wide divestments covering all product spheres – loans, investment, trading and campaigns – are still rare. Not providing financial services to actors blocking transition could be an unambiguous signal.

WHERE DOES THE MONEY FLOW

The financial sector still provides **vast amounts of financial resources** to the energy sector. In the business cases, related strategies, products and services, the transition is not reflected yet. From 2016-2022, the 60 biggest banks poured USD 5.5 trillion in terms of corporate lending and underwriting transactions into the fossil fuel sector. The 60 largest global banks have a fossil fuel credit exposure of around USD 1.35 trillion. Particularly syndicated loans are common for project finance.

Also the leading financial institutions of the Glasgow Financial Alliance for Net Zero (GFANZ) still provide significant amounts and are characterised by very limited policies considering the reduction of fossil fuel finance.

QUESTIONNAIRE

for your Financial Service Provider

- What kind of energy funding is your financial service provider excluding exactly?
- To which business segments apply these policies valid - loans, assets management, etc.?
- What is the ratio of renewable energy versus fossil fuel funding of recent finance activities?
- Does an unmistakable strategy to exit carbon-intense funding rapidly exist?
- How high are potentially stranded assets in monetary terms?

PROFITS, FINANCE AND RISKS

(in USD Billion)

FIGURE 15

Comparing the profitability of the fossil fuel industry with other figures (see figure 14) indicates the enormous potential of shifting financial flows towards climate mitigation and adaption.

Renewable energy activities represent only 7% of energy finance of global banks and, interestingly, GFANZ member were below average.

A recent analysis of more than 6,500 institutional investors showed that they hold more than USD 3 trillion in bonds and shares in coal, oil and gas companies. Only 23 institutions account for more than 50% and US-based investors make up almost two thirds hereof. Estimates for the global assets under management vary but are around and beyond USD 100 trillion.

Since fossil fuel exposures are not yet considered higher risk assets under the Basel Framework, the under-pricing of the credit risk is estimated at around 1.3%. Oil and gas companies hardly face any additional cost for borrowing. The MSCI World Index from 2010 to 2024 shows a slightly worse performance when fossil fuels are excluded.

Monetary flows are not the only influence. The role as shareholder and related engagement is also of relevance. A study showed that if the big three – Blackrock, Vanguard and State Street – would not vote at shareholders' meetings, support for ESG proposals at shareholder meetings would be higher. Particularly Vanguard opposes sustainability-related voting.

ECONOMIC RISKS

What would happen if we succeeded in building global frameworks that seriously combat the climate crises? Roughly 90% of the known fossil fuel reserves must not be touched to meet the 1.5°C target. The value of these **stranded oil and gas reserves** are estimated at more than USD 1 trillion. Industry experts already warn of a disorderly transition and that current scenario modelling underestimates the economic impacts.

The 200 largest fossil fuel companies (CU200) own 98% of the world's fossil fuel reserves and only ten entities can influence half of the emission potential of these reserves. Climate crisis lawsuits, which already show impacts on share prices and the denial of insurance coverage could pose further financial risks. In 2021, a Dutch climate lawsuit against Shell was a sensational success. Maybe one day fiduciary principles will incorporate a strong sustainability understanding.

ESG TRENDS

While globally the number of ESG-invested assets rose, the applied criteria are often less strict. Many **ESG-related policies** are reduced to risk and climate change-focused frameworks with limited impact so far. Such approaches leave behind important aspects like biodiversity, human rights or global inequality. Existing ESG labels provide a good overview on approaches.

Despite increased attention fossil fuel companies often find their way into ESG funds contributing to a lack of trust: 87% of investors in a study say that the ESG reporting of financial institutions includes greenwashing. A recent analysis suggests a rising trend in greenwashing, particularly in the financial sector.

REGULATORY FRAMEWORKS

The race for **interpretation of sustainability** accelerated. In this context **regulatory frameworks** have been developed. The recent labelling of natural gas and nuclear energy as sustainable in the EU taxonomy due to their supposed role as transition technologies is a brilliant example of “realpolitik” and successful lobbying of the fossil fuel sector.

It is questionable whether the large amounts of resources that flow into legal compliance support or hinder the transition in terms of changing the actual money flows. It also seems a matter of priorities. For the financial industry the financial performance remains - by far - more important than climate change or human rights.

A broad range of **frameworks and institutions** exists, including the Partnership for Carbon Accounting Financials (PCAF), the Partnership for Carbon Accounting Financials (PBAF), the Task Force on Climate-related Financial Disclosures (TCFD), the Paris Agreement Capital Transition Assessment (PACTA), the UN Principles for Responsible Investment (UN PRI), the UN Principles for Responsible Banking (UN PRB) Glasgow Financial Alliance for Net Zero (GFANZ) or Carbon Disclosure Project (CDP).

How does your financial servce provider act? Reclaim Finance provides studies, policy papers and an overview of financial institution’s policies for important energy related fields: oil and gas, coal and sustainable power. Carbon Tracker and BankTrack provide in-depth analysis on the energy transition and capital markets.

VII. A Glimpse of a Potential Future

The availability of energy is essential for a decent living but it's not linearly related to well-being! Above a certain – lower as you might guess – energy consumption, the well-being stagnates. What kind of future seems liveable?

The domestic energy consumption rose from 10-20 GJ per capita per year for hunter and gatherers to over 40-70 for people in agrarian societies and to 150 to 400 GJ in industrial societies. It is necessary to note that biomass including wood fuel, food as well as fodder crops and grazing for livestock, represents >99% for hunter and gatherers respectively >95% for agrarian societies.

An increase of biomass energy use poses a significant risk of land-use changes such as **deforestation or degradation**.

FIRST: A SHORT HISTORY OF ENERGY

The energy consumption historically depends strongly on different forms of social organisation. With the **Industrial Revolution,** the role of energy multiplied. Even before, the problems of biomass-based energy consumption were already increasing. It is not surprising that the term sustainability has been coined by the forest sector as deforestation was a widespread phenomenon. England's share of woodland, for example, declined from 15% in 1100 to 5% around 1900. Exploration and use of fossil fuels helped to stop this trend.

Post World War II **energy consumption exploded dramatically**, on an unprecedented scale. Between 1948 and 1972, the daily global consumption of crude oil grew from 8.7 million barrels to 42 million barrels, fuelling the reconstruction and subsequent economic miracle that helped millions of predominantly Europeans and North Americans to achieve security and prosperity. Power that helped to build new houses, to dig new wells, to be mobile, to open up land, to grow food and produce artificial fertiliser. Lighted shopping streets were a symbol of this development. This energy-driven road to a consumer society is also called the "50s syndrome".

The continuous absolute increase has only been interrupted during or after major global social events: the energy crisis (1980-1982), the financial crisis (2009) and the recent pandemic (2020). Global per capita figures have only increased by 20% from 1980 until today and remained stable since 2010.

WELL-BEING AND ENERGY SUPPLY

We can frame our energy history with quite different metaphors and analogies. Often, the story gets decorated with positively connotated words about progress, innovation and success. The **narrative** of sheer endless availability of energy necessary to maintain well-being is deeply embedded in our understanding of modern society. It is worth to take a deeper look at this relationship.

Different studies suggest that a decent living energy (DLE), **providing basic services**, lies somewhere between 10 and 40 GJ per capita per year depending on the applied technology. Stanford University noted in a paper that we just need to equally distribute the current average energy consumption of 79 GJ per capita (see figure 16). Most Western countries have already exceeded this threshold by far and the availability of more energy has hardly any effect on gratification. Above a certain amount, the marginal benefit in terms of quality of life from extra energy decreases sharply. The performance of ten countries is positively highlighted: Malta, Sri Lanka, Cuba, Albania, Iceland, Finland, Bangladesh, Norway, Morocco and Denmark.

WELL-BEING ENERGY THRESHOLDS & REGIONAL DEMAND

(in GJ/capita/year for 2017-2019)

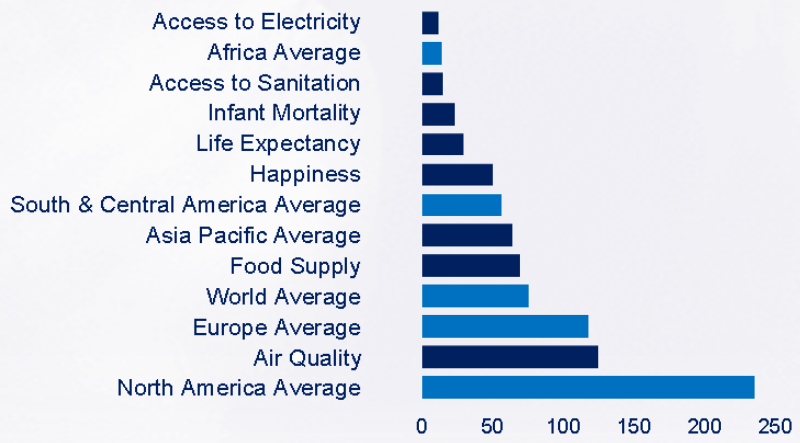


FIGURE 16

The thresholds have been calculated as the demand at which the 99th percentile curve reaches 95% of the maximum observed metric score. They found that important indicators such as life expectancy, infant mortality, happiness, food supply and access to basic sanitation services, improve steeply with increasing energy supply and then plateau at levels of average primary annual energy consumption between 10 and 75 GJ per capita.

ENERGY SUFFICIENCY

Relation of Well-Being (Social Rating of the rfu Sovereign Model) and Energy Consumption (in GJ/capita/year) for 2020-2022

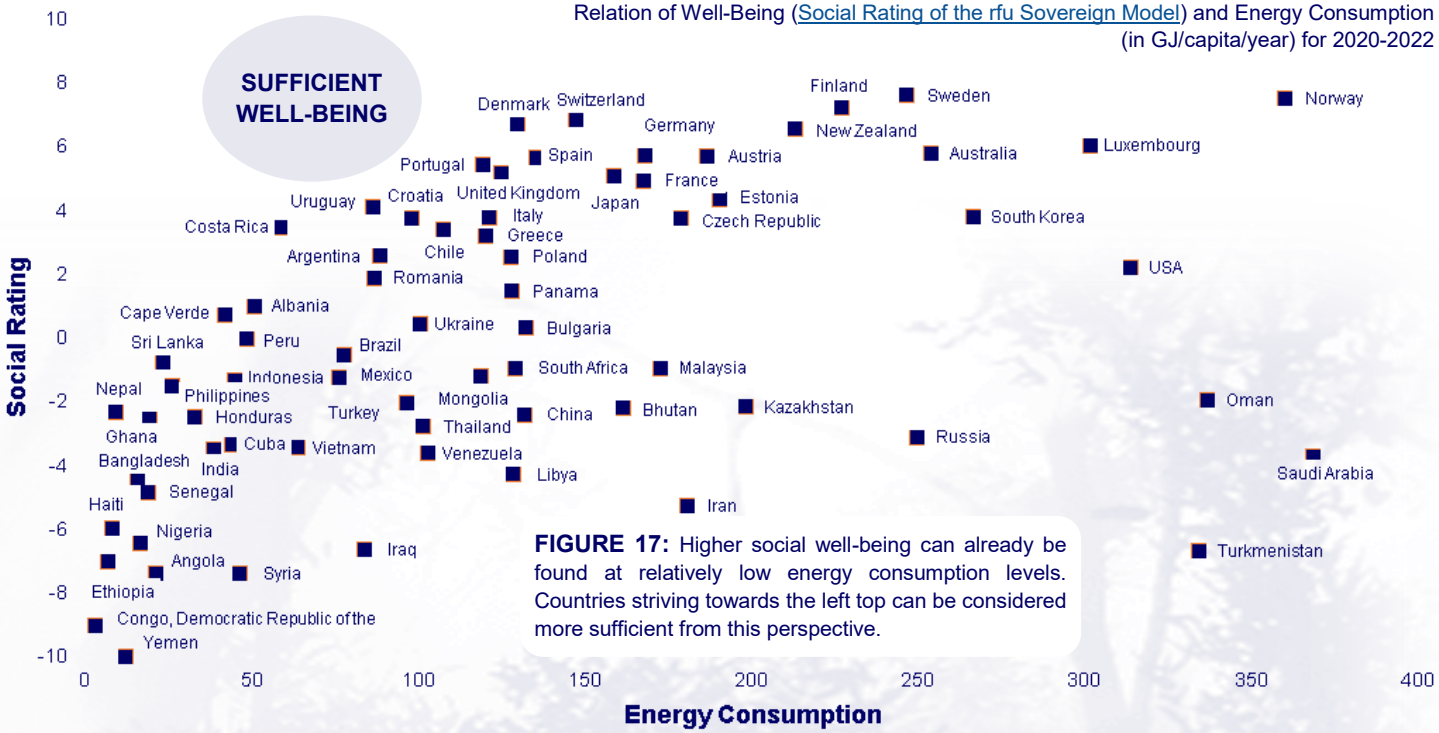


FIGURE 17: Higher social well-being can already be found at relatively low energy consumption levels. Countries striving towards the left top can be considered more sufficient from this perspective.

SOCIAL RATING AND ENERGY USE

When we compare **energy consumption and the results of the rfu Sovereign Model**, we observe quite different paths of achieving social well-being. While Norway and Sweden achieve their high social rating with a comparably excessive demand, countries such as Costa Rica, Sri Lanka, Cape Verde, Denmark or Uruguay achieve a much more successful ratio of well-being and energy consumption. Countries such as the USA, Russia or Saudi Arabia represent examples of the contrary – high energy demand with comparatively low social outcomes.

CULTURAL CHANGE

The postulate of "simply switching to renewables" seems to fall short. The way out offered to us with dazzling exit signs that read "e-mobility", "bio-fuels" and "green growth" turn out to be partly bragging after the second turn. The ecological and social impacts would in many cases be shifted to other areas.

That the latter has led into this crisis is difficult to accept for those who shaped the last decades of history. It is as well about a substitution of overconsumption, economic and technological paradigms, not only a substitution of fossil fuels. Moving beyond imperial (energy-intense) lifestyles remains hardly discussable in professional contexts.

The idea that less material wealth could also improve the quality of life is neither new nor is it rocket science. The recent pandemic provided a foretaste which products and services are essential. Countless **anchor points** exist, such as the old concept of a 2000-Watt society, Kate Raworth's Doughnut Economics or the scientific work of Julia Steinberger around "Living Well Within Limits". We could decide to prioritise the provision of associated basic energy needs through locally-owned production and storage facilities and associated sharing concepts (e.g. for mobility). Excess energy consumption could be regulated by legal frameworks and taxes. Efficiency gains, particularly through automation, could be translated into reduced working hours and not lower prices (and consequently overconsumption). Research on decent living standards, which are globally feasible with a minimum energy supply, portray a picture that seem less dramatic than opponents like to depict it.

The **shift of the definition of prosperity** from a material-driven perspective towards a definition that includes wealth in time and healthy relationships as well as environmental prosperity can be cultural work of great importance. We all should invite ourselves to step out of the paradigms we habitually apply in our world views.

"Energy-philosopher" Ivan Illich has put it as follows already in 1973: "Even if non-polluting power were feasible and abundant, the use of energy on a massive scale acts on society like a drug that is physically harmless but psychically enslaving".

Based in Vienna and founded in 1997, the rfu is Austria's specialist for sustainable investment. With an experienced team we support institutional clients in the development and implementation of sustainability-oriented investment strategies. A particular focus of our work is the coverage of asset classes and market segments for which there has previously been no or only insufficient coverage with ESG research.

For further information please visit our website and follow us on

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