Fossil Fuels Are No Longer Competitive.

How to Replace 30% of Oil GDP in The Gulf Countries ?

The
Global
Sustainable Competitiveness
Index
2023

Summary & Conclusions

Demand for oil set to decline drastically after 2030 – are the Gulf countries ready?

In China, demand for fossils is expected to peak in 2024; the International Energy Agency projects global demand to peak in 2025.

For countries that generated income from fossils that means decreasing and eventually disappearing income. The higher the fossil income proportion, the higher the exposure to decline in standard of life. The question is the timing of "eventually disappearing", and when the oil income decline is starting to seriously impact government revenues.

The global economy has seen significant dynamics of renewable technology markets, picking up pace in the replacement of fossils including (but not limited to) the road transport sector. With renewables becoming even more cheaper, deployment will only intensify. With declining demand, oil prices and profits decline. And that is before accounting for any potential future market policies in response to climate change.

- **In a business-as-usual world, oil revenues will start to decline drastically by 2030 at the latest. More likely after 2027.**
- **Oil revenues and profits will be marginal after 2035 compared to today**
- **Oil producing countries: how to replace the oil income?**

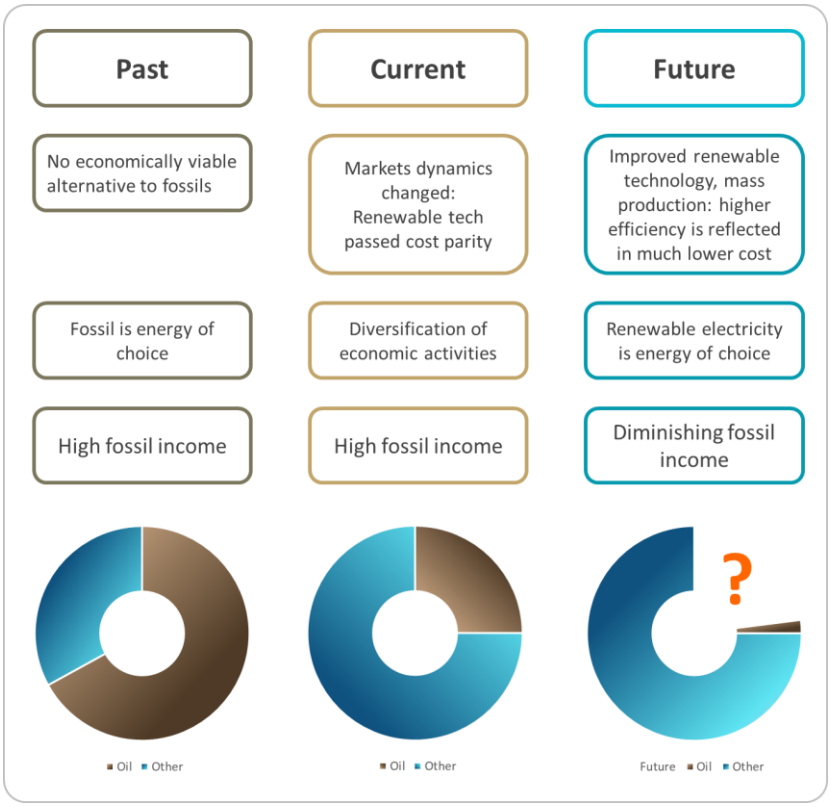
The countries in the gulf country co-operation – Bahrain, Kuwait, Oman, Qatae, Saudi Arabia and the United Arab Emirates (UAE) - generate between 15-40% of their GDP from the sales of fossils. Are they prepared to replace the oil income?

Oil Income in Gulf countries, past & future

Gulf countries, some a bi more than others – have invested oil income in other economic areas and have successfully developed their economies

Development of renewable technology, the markets and climate change suggest that oil income will be reduced and then marginalised in the near future.

If Gulf countries intend to maintain their current high standard of life, they urgently need to develop serious alternatives to completely replace fossil income. The sooner the better for themselves.



Conclusions

The Oil markets & oil business

- The markets for renewables and electricity-powered consumption have reached momentum that is now unstoppable. It's simple economics: Renewables are – by a large margin – more efficient and cheaper.
- Market developments flush more investments in R&D, production and installation - everything renewable and electric will become even cheaper in the near future. The outlook suggests half the cost in the next 10 years, redoubling market dynamics.
- As a consequence, fossils and fossil-powered consumption are no longer competitive. Demand for oil will peak between 2025 and 2027, and therefore start to decline, slowly at first, and faster over time. Demand, revenues and profits for and from fossils will decline in accordance.
- The renewable transition will happen faster than the "mainstream" is currently expecting.
- Demand for oil will decline after 2030, even assumed a business-as-usual scenario with no or very limited climate change-forced policies.
- Policies and targets induced by climate change (e.g. incentives and financing framework for renewables, and taxing of fossils) are likely further accelerating market dynamics. It is highly likely that the demand for fossils will be a fraction of today's, and might well be close to zero by 2040.

Gulf Corporation Countries Sustainable Competitiveness

- GCC countries currently generate between 15 and 40% of their GDP and close to 100% of government revenues from fossil exploitation – income that is set to drastically decline after 2030 (at the latest), and might well be close to zero by 2040
- Diversification efforts so far have resulted in the development of alternative income streams, (hub functions, service centres, tourism, hospitality). The UAE and Qatar are quite advanced in diversification, with Saudi Arabia and Kuwait having made somewhat less progress in reducing dependency on fossil income
- The transition to renewables is set to happen faster than previously anticipated. GCC countries therefore have to revise their development visions, and investment plans to accelerate their own transition.
- Thanks to the financial resources (sovereign wealth funds) and past investments in new business areas, infrastructure, education and health, GCC countries are in a reasonable position to successfully manage a transition to advanced economies without fossil income.

However, circumstances and the pace of development require acceleration of current efforts to diversify the GCC economies if decline of living standards are to be avoided.

In collaboration of government agencies, universities and the private sector, Gulf countries should identify priority business and technology areas aligned with the respective country characteristics. And then allocate resources based on cost-benefit analysis on a range of proposals and projects and development areas.

Resources and investments need to be allocated wisely in areas that promise the highest return on investment in terms of sustainable competitiveness.

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Fossil Fuels are no longer competitive.

1 Fossil fuels are no longer competitive

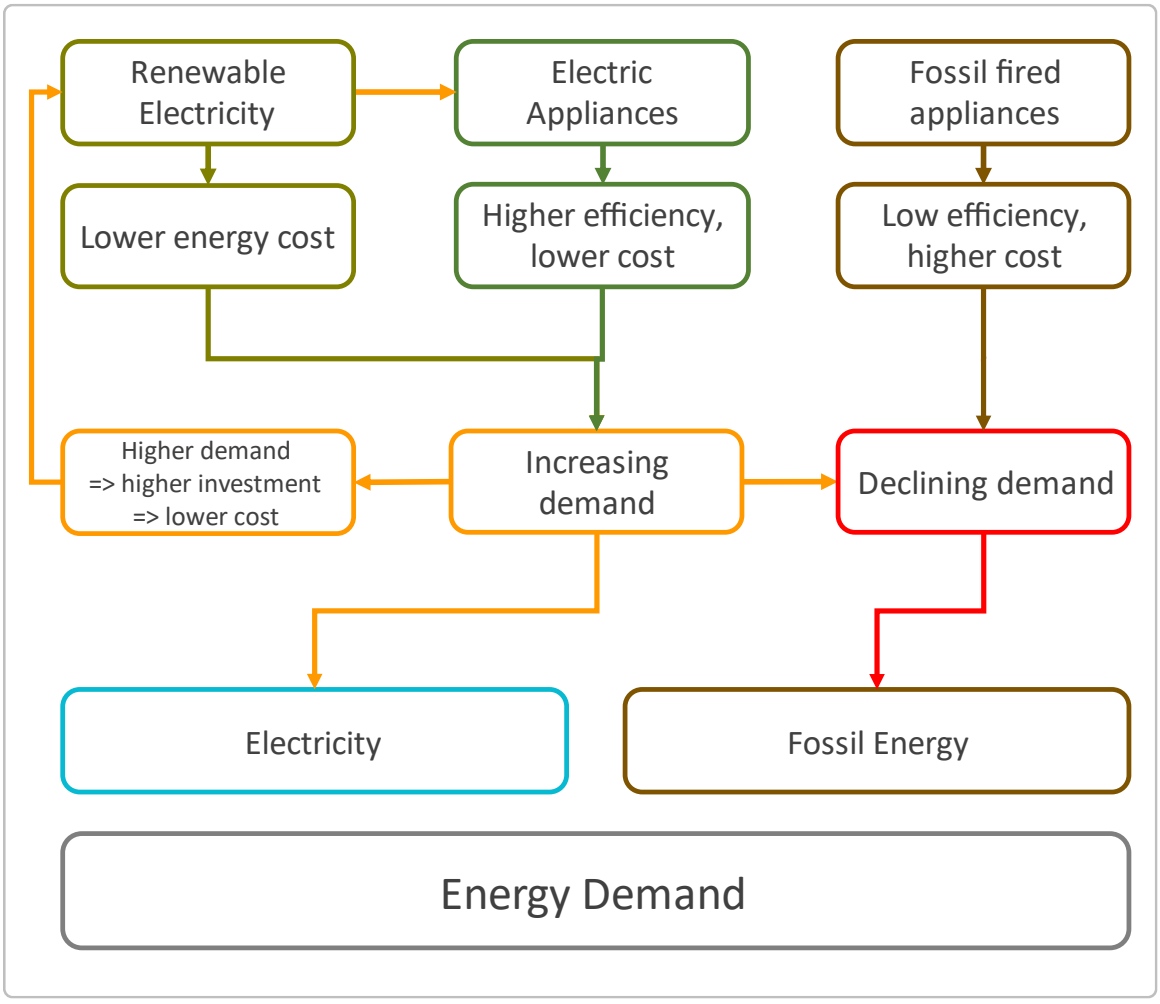
How to replace fossil GDP?

- The IEA predicts that global demand for oil will peak between 2025-2027
- Electric systems (cars, heating) are more efficient and therefore cheaper to operate than fossil equivalent – and electric cars will be cheaper than gasolines in 2025 at the latest
- Solar/wind electricity is now the cheapest source of energy – and is expected to become even cheaper

⇒ **Fossil fuels are no longer competitive**

- **Petro-states (in the Gulf region and elsewhere) currently generate between 20-30% of their GDP from fossils**
- But: revenues and profits from fossils will decline sharply after 2030

The rise of renewables and the decline of fossils



Oil demand is set to decline drastically after 2030

Controlling fire is what in the early stages of evolution distinguished human from other species. It allowed us to survive and thrive in colder climate. Making a fire is age-old technology.

When using fire in technological applications, transforming heat energy to movement, the efficiency is limited by the laws of thermal physics to roughly 35%. Electricity in contrast, has an energy-to-wheel efficiency of 100%.

Oil, gas and coal need to be extracted from the ground, and then transported to where the energy is needed. Electricity, in contrast, can be generated everywhere, can be transmissioned through cables, and stored in batteries and kinetic storage.

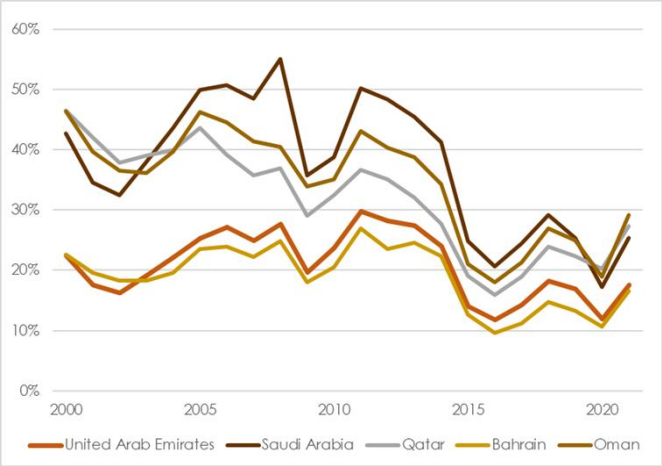
Renewable energy is now the cheapest from of energy in human history – at a cost of 40% of the cheapest form of fossil electricity generation (gas). The efficiency of electric appliances is between 2-5 times greater than fossil counterparts.

Fossil fuels are no longer competitive.

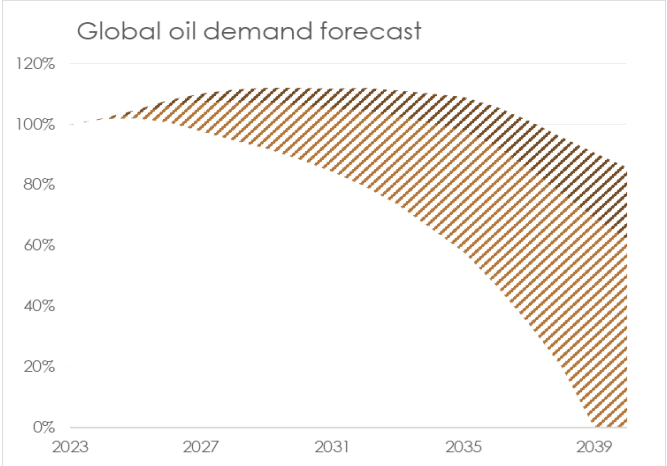
The International Energy Agency (IEA) predicts that global demand for oil will peak between 2027 and 2030 due to cheaper alternatives. When demand starts to decline, prices start to fall. Over-capacity will lead to price competition, further putting pressure on revenues and profit margins.

At the same time, the cost of renewable electricity, batteries, and electric transport and heating systems will further decline, if forecast are to be trusted up to 50% by 2035 – accelerating the decline of fossil demand.

It is highly likely that demand for, and revenues generated from fossils will decline somewhere between significantly and drastically after 2030.



Data source: World Bank
Fossil rent of Gulf area countries as % of GDP



Data source: IEA, BP, SolAbility
Future oil demand estimations

The bad news: Gulf countries currently generate between 15 and 30% of their revenues from sales of fossil products. Government revenues are almost exclusively funded by fossil income. While efforts to diversify the income are underway, current plans do not allow to compensate for the loss of current income.

The good news: Thanks to the oil income, the Gulf countries dispose over significant funds, and financial resources. Investments in education have been made, and modern infrastructure has attracted a highly educated and diverse community. The basis for a successful transformation away from fossil to other income sources is therefore given.

Renewables & electric appliances:

More efficient, less costly

2 Renewable Energy Technology & Cost

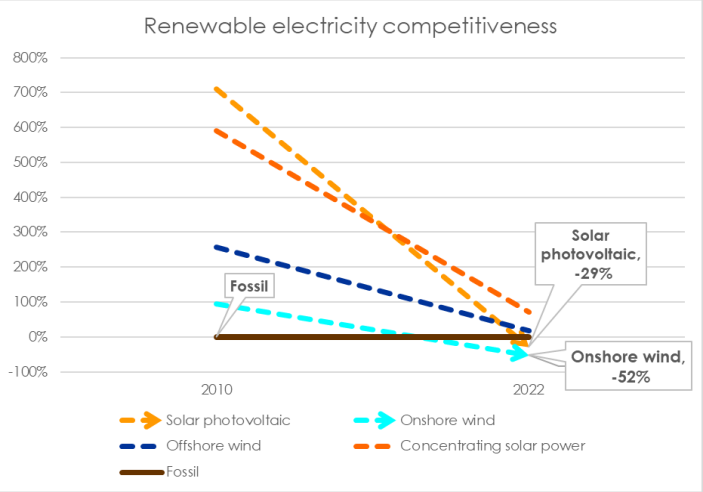
2.1 Electricity generation

With mass production and increasing demand, cost of renewable energy generation has fallen drastically within the last 15 years. Renewable generated electricity is now significantly cheaper than fossil generated electricity.

Development of electricity generation cost

Small incentives, mass production, installation learning curves and market dynamics have resulted in massive cost reduction for renewable technologies over the past decades.

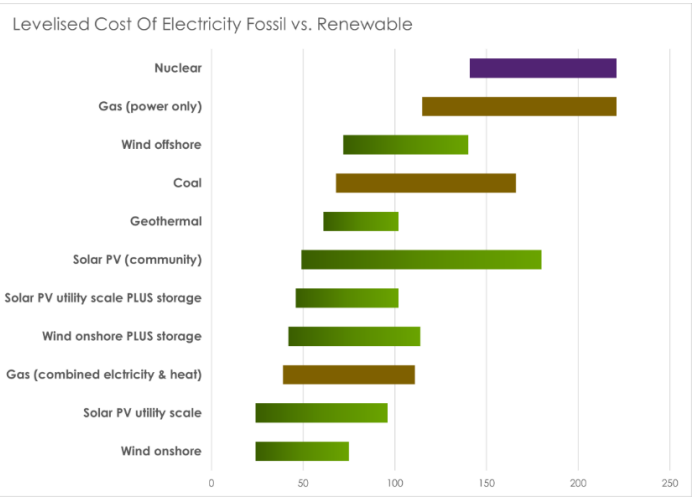
Data source: IRENA, IEA



Renewable vs Fossil Electricity Generation Cost

Wind and Solar electricity generation are now the cheapest source of energy. For new projects, cost of solar and wind electricity is now only 40% of the cheapest fossil alternative (combined heat-power gas turbines). Costs for renewables are expected to further come down by 50% - putting a factor of five (5) between renewables and fossil.

Data source: Lazard, IRENA



- Cost for solar PV has decreased by nearly 800% since 2010; wind electricity by 300%
- New renewable electricity from wind and solar are now less than half the cost compared to the cheapest fossil alternative (gas-fired combined heat/electricity generation)

⇒ Fossil electricity generation is no longer competitive

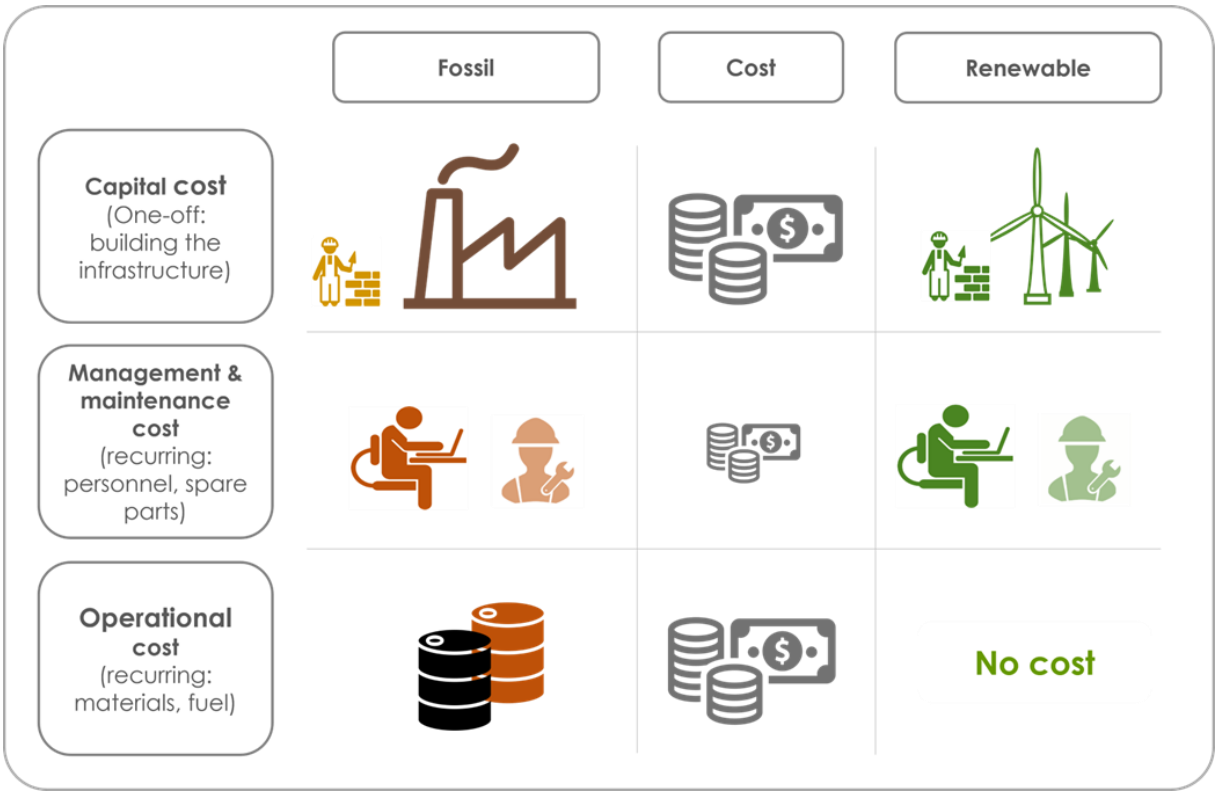
Why renewable electricity is cheaper than fossil

Every built power plant has 3 major cost sections:

- Capital cost (financing required to build the facility)
- Maintenance cost (control, repair, spare parts)
- Operating cost (day-to-day cost to run the facility)

In terms of capital cost, renewables are now on par (or below) fossil projects, relative to installed capacity and expected harvest. Maintenance costs differences between fossil and renewables are insignificant.

Operation cost of fossil electricity is high (the cost of buying fuel), while renewable operating cost is close to zero – the fuel (the sun, the wind, ocean currents) are free.



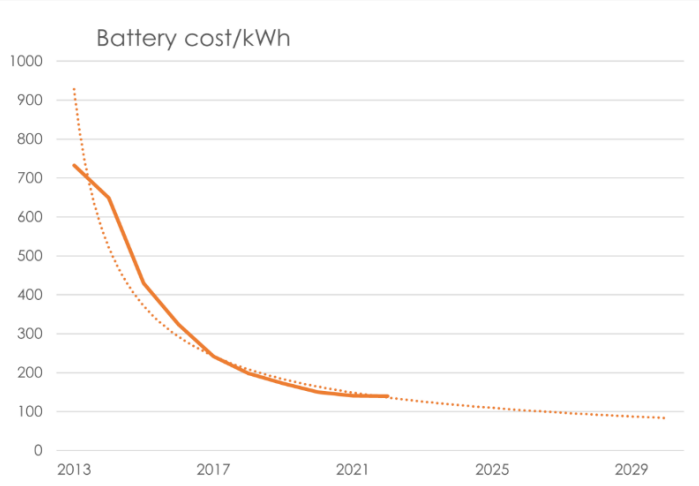
2.2 Electricity storage

With the increasing use of portable electronic devices (lap-tops, mobile phones) and the electric vehicles, investments in development of battery technology have seen huge budget increases.

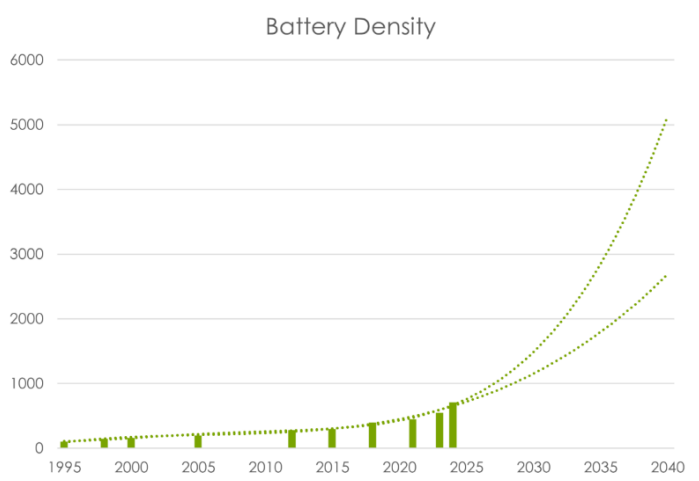
The only application currently out of reach remains commercial aviation and seasonal electricity storage in cold climatic environments.

Battery cost have been reduced 4-fold since 2010, Given the global investment push into battery technology, costs are expected to decline further significantly. Making renewable electricity and electric road transport even more competitive.

Data source: WRI, RMI, Irena, IEA



A key factor for battery technology is the battery density – the amount of energy/electricity stored per volume/weight of the battery. While the growth of energy density has been almost exponential and is expected to grow steeply in, energy storage capacity will remain below energy density of liquid fuels such as kerosene, making electric commercial aviation unfeasible for the foreseeable future



With better technology and increasing production, the cost of batteries has dropped significantly over the past years, and are expected to keep falling even further. Toyota, for example, expects to double density, while halving both weight the cost of batteries before 2027 compared to 2023 levels. By 2030, EVs that are not on the road will be connected to the grid, solving most electricity storage problems (except for seasonal storage).

Electricity storage (compensation for solar/wind down-time) was long considered the bottleneck of renewable electrification. However, battery development trends and learning curves suggest that this is no longer the case, putting further pressure on fossils.

2.3 Heating systems

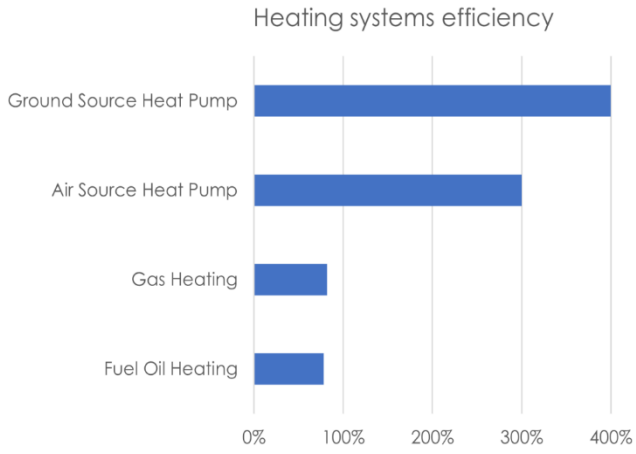
Since humanity learnt to control fire, heat has been provided by fire – wood, coal, and in modern times, oil and gas-powered central heating systems. Heat pumps are comparable new, powered by electricity. Heat pumps do not generate heat energy – the transport heat energy using the temperature differences between two mediums. This process allows a heat pump to generate more energy in the form of heat than the energy input in form of electricity.

The process – transporting heat – can be reversed, meaning a heat pump can also be used as cooling device., eliminating the need for a separate heating/cooling system, further reducing cost.

Heat pumps: efficiency

Oil/gas fuelled heating devices generate heat. Heat pumps, in contrast, transport heat energy. Heat pumps are therefore not limited by the energy input. Conventional fuel-fired heating can reach efficiency grades of up to 90%, while the output of a heat pump is up to 4 times the energy input (depending on temperature differences).

Data source: Heat Pump Association, IEA

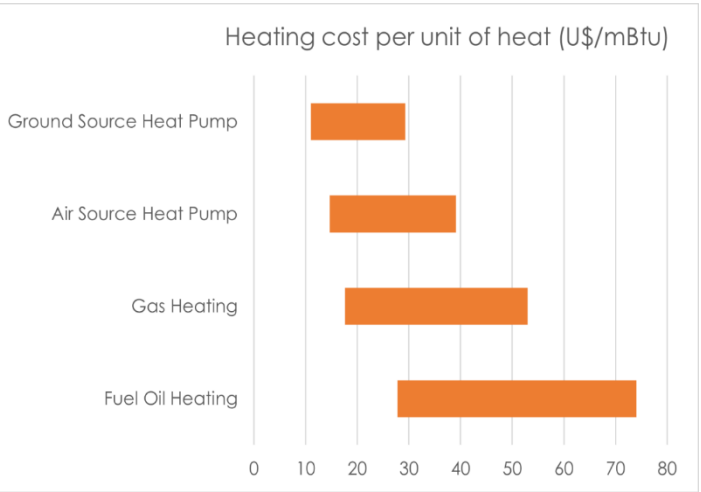


Heat pumps operating cost:

The operating cost of a heating devices depends on a set of variables – electricity generation cost, taxes and/or tax breaks on fossil energy, and VAT.

In the worst case, heat pump operating costs are comparable to fossil-fired heating systems. Under normal circumstances, heat pump's operating costs are significantly lower due to the higher factor between energy input and energy output.

Data source: Heat Pump Association, IEA



- Heat pumps are more efficient than fossil-fired systems,
- Heat pumps have lower operating cost than fossil heating systems
- Heating pumps can serve as heating *and* cooling devices – eliminating the need and cost for dual systems (separate heating and air-conditioning devices)

Most new installed heating systems are now heat pumps. In many countries, installing heat pumps in new buildings will become mandatory in the near future.

It is not a question if – but only when fossil fired heating system will disappear.

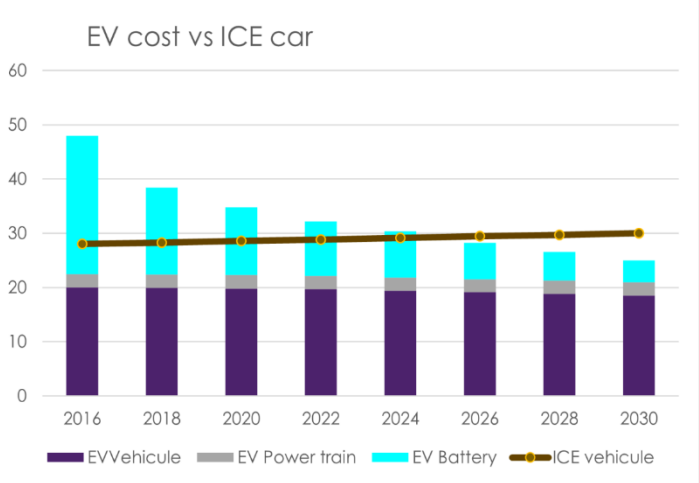
2.4 Road Transportation

Electric cars sales have picked up speed, and already make up the majority of new car sales in selected countries. Due to increasing demand and strategic decisions by car makers, significant vehicle production capacity has shifted towards EV over the last few years.

Purchase cost

Electric cars don't need a central engine, no gears and no power train – EVs are simpler in their design construction. However, until recently, high battery costs have been the main cost element of electric vehicles. With sinking battery cost and mass production, electric vehicles have reached market competitiveness vs. fossil fuelled cars – and are expected to be cheaper than fossil counterparts shortly

Data source: RMI, Bloomberg

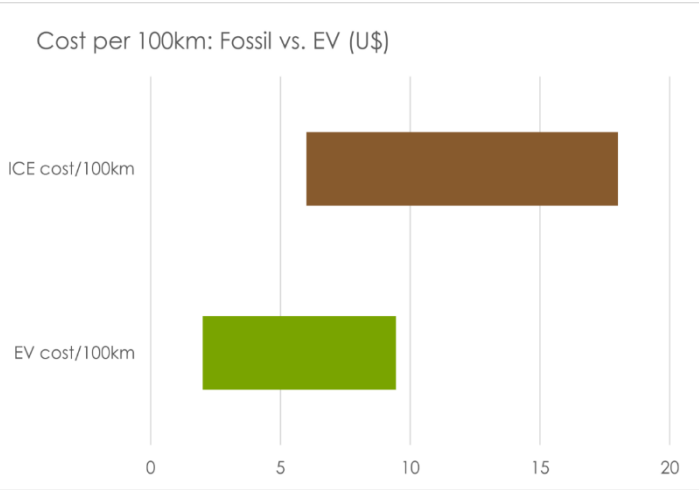


Operating cost

The efficiency of an internal combustion engine is limited by the laws of thermo-physics, and can reach a maximum of 35%, In ICE cars, between 20-25% of the energy contained in the gasoline is turned into moving energy.

Electric motors directly convert energy to movement, and can reach up to 100% efficiency.

Data source: RMI, Bloomberg



- Purchase price of electricity vehicles will be lower than fossil fuelled cars across the board by 2025/26
- Operating an ICE needs 3-4 times more energy than an electric vehicle.
- Electric cars are significantly cheaper to get from A to B.
- Electric vehicles will make up the vast majority of car sales by 2030

⇒ Fossil-powered internal combustion engine vehicles are the past. The need for fossil gasoline will decline drastically after 2030

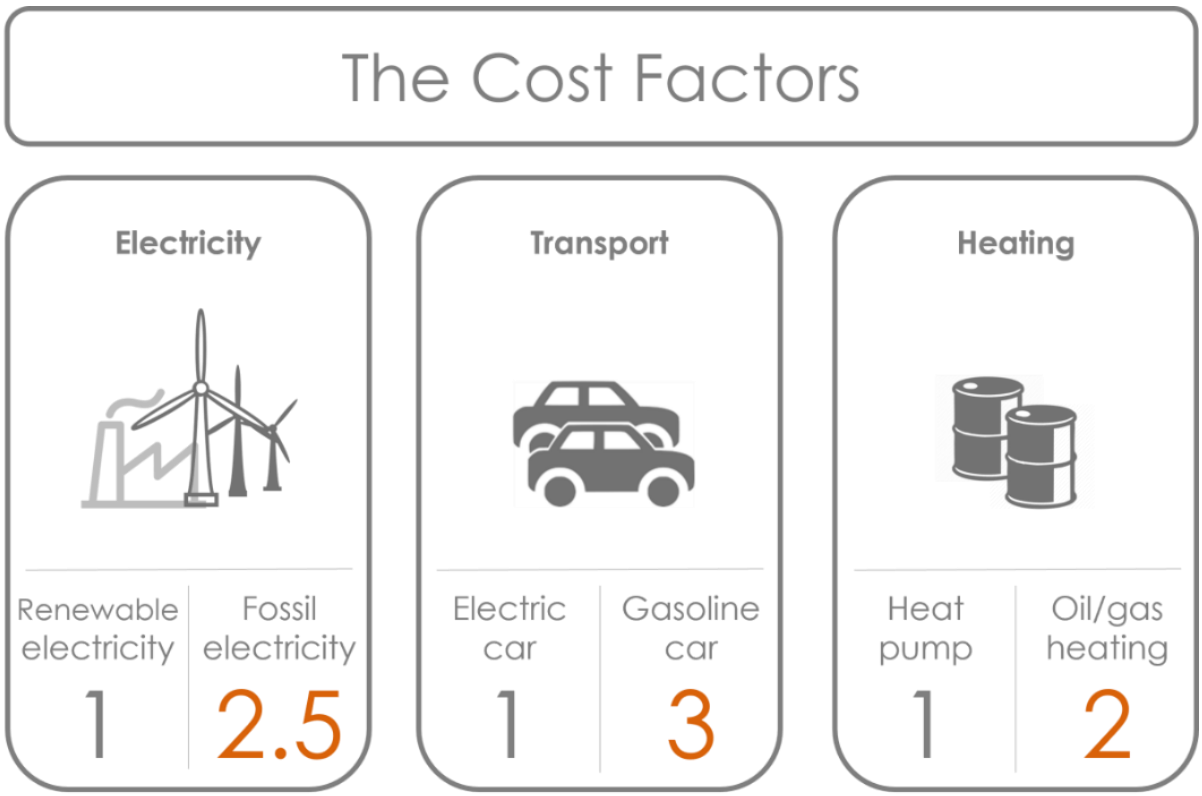
Demand for fossil energy is

Declining

3 Demand for fossils

Rnewable vs fossil cost

Expectations on forecasts on development of renewable technologies and sales of electric vehicles in the past have routinely underestimated growth. The markets always go with the cheapest alternative - despite slow permits, issues regarding regulatory red tape and the heavy subsidises for fossils. The cost question is already answered:



New renewable technology – generation, heating, and transport - is now cheaper than fossil equivalents, by a factor of 2 or more. Investments driven by market dynamics are set to further improve technology and reduce costs in the near future – by around 50% in the next 5 years (batteries) to 10 years (renewable generation). The economic argument is set.

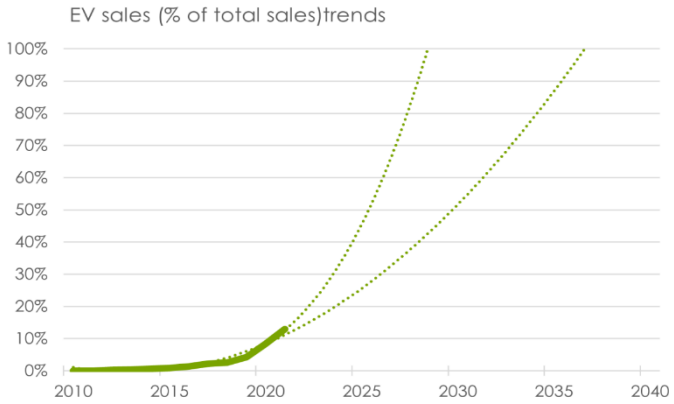
3.1 Where is the money flowing?

It is notoriously difficult to make predictions, especially about the future. However, past predictions on the developments and deployment of renewables have routinely underestimated market dynamics. There is substantial amount of misinformation regarding renewables and electricity-powered systems still circulating on social media, but investors are hardly influenced by social media. The cost argument is settled. There is a factor of 2 or 3 between renewables and fossil alternatives, and that factor is set to double with still decreasing renewable costs. The cost developments are reflected in today's market developments:

Electric vehicles market share development

EVs have reached almost 20% of newly sold cars in 2023. EVs are reaching purchase cost parity with ICEs in 2024/2025. Not many people will by a gasoline care after that – EVs are expected to reach near 100% of new sales in 2030.

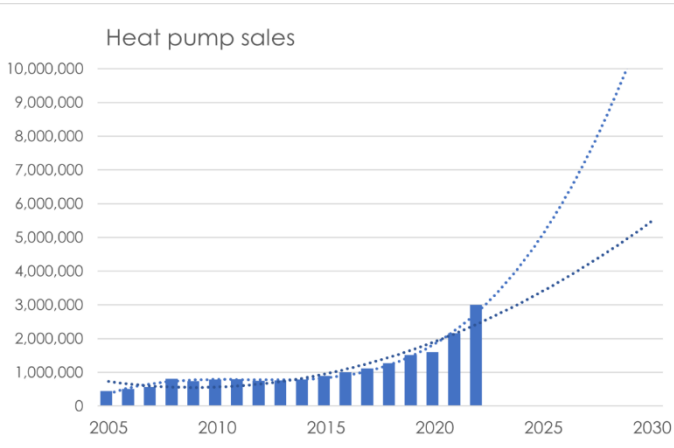
Data source: IEA, RMI



Heat pump sales

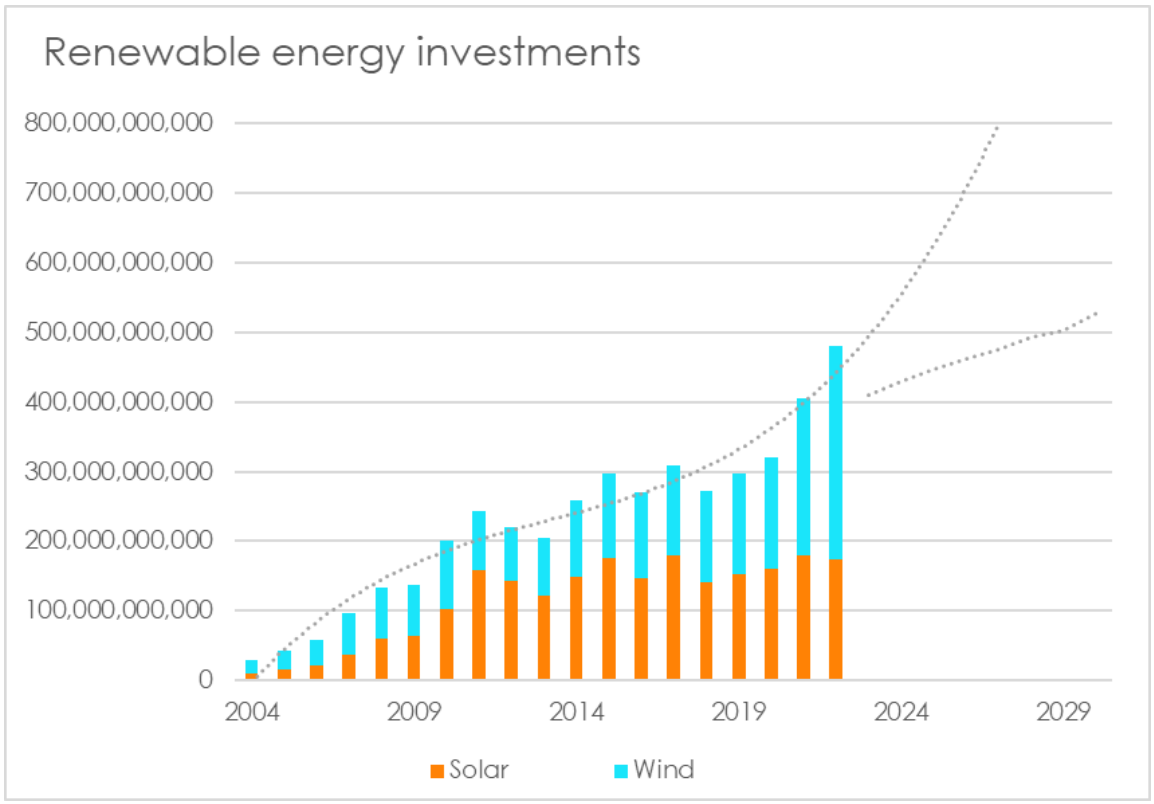
Heat pumps are expected to gain near 100% of markets share of new installed systems by 2026/2027.

Data source: Heat Pump Association, IEA



3.2 Renewable investments

The changing cost reality is reflected in international investments in renewable energy generation, both wind and solar PV, with a majority of new electricity generation now covered by renewables. Due to increasing demand for electricity and the lower costs and construction time, Investments in renewables are set to increase further in the future.



Data source: IEA, IRENA

Renewable energy investments have tripled since 2010 – and are expected to continue step increase in the foreseeable future

Renewable energy investments have tripled since 2010 – and are expected to continue step increase in the foreseeable future, both due to market demands for cheap energy and climate change driven policies.

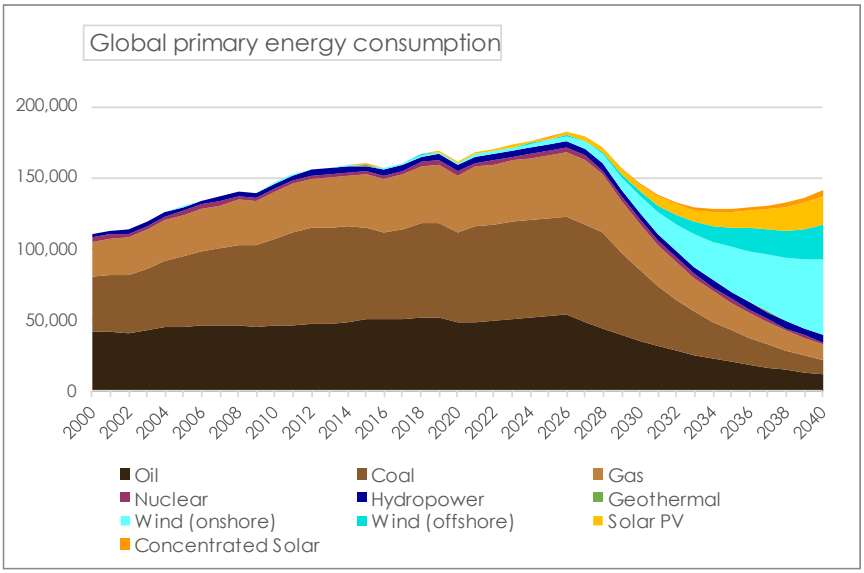
However, the increasing share of renewables is not yet reflected in global CO2 emissions, which are expected to rise by 1% in 2023.

3.3 Future energy mix and climate change policies

Business as usual, conservative:

Under a business-as-usual scenario, the deployment and development of renewables and electricity-powered consumption is expected to start biting noticeably into fossil demand by 2028, accelerating after 2030 due to market dynamics.
It should be noted that past projections tended to underestimated the power of economics at the base of the rapid deployment of renewables.

Data source: historic data by IEA, BP, IRENA. Simulation by SolAbility based on projections by IEA, IRENA

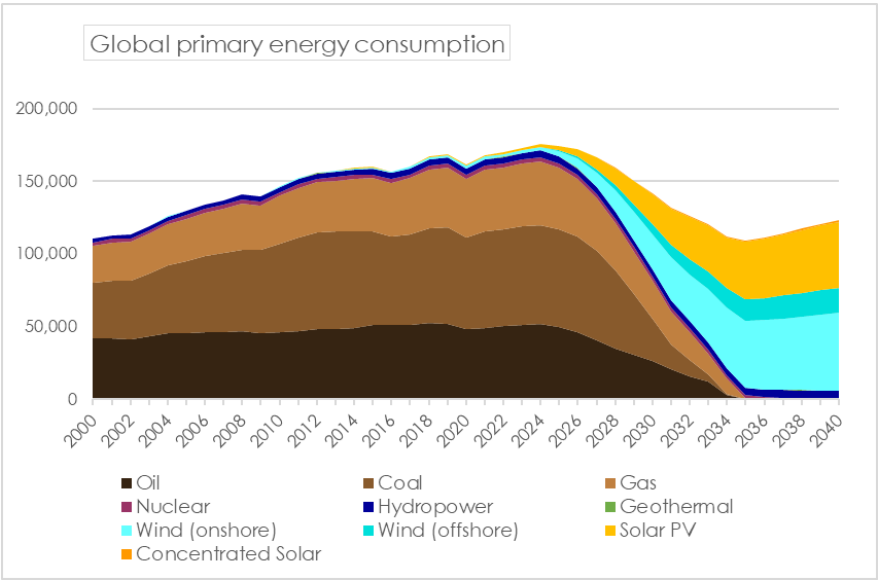


If business-as-usual persists, this is the future energy mix, showing step decline of demand for fossils and availability of renewables after 2030; demand for fossils would be at app. 25 % of current demand by 2040. This simulation is based on effective current cost and financing, with conservative estimations of future cost of the new & renewable technologies and financial flows. Market dynamics are difficult to predict. Most likely, market dynamics are going to significantly accelerate the transition away for fossils and combustion towards the less costly renewables and electric-powered consumption as compared to the BaU scenario.

Including climate policies

Future energy mix projection taking into account potential policies combatting climate change. The proportion of fossil energy is expected to start decline after 2026, with accelerating pace of deployment of renewables after 2028. Depending on the quality of climate policies (incentive and financing frameworks for renewables, taxing of fossils), renewables will cover 199% of all energy needs between 2032 to 2037

Data source: historic data by IEA, BP, IRENA. Simulation by SolAbility based on projections by IEA, IRENA



This is how the future energy mix looks if humanity were to be serious about its own survival. Using today's technology and the application of basic economics on a global scale, renewables could power the World economy by 2035 – i.e. eliminating demand for fossils by 2035. Global co-ordination to counter global warming seems unlikely at this point but cannot be excluded. Demand for fossil is therefore expected to decline even faster – asking even bigger questions off the oil-producing states and companies.

3.4 Declining oil/gas/coal demand

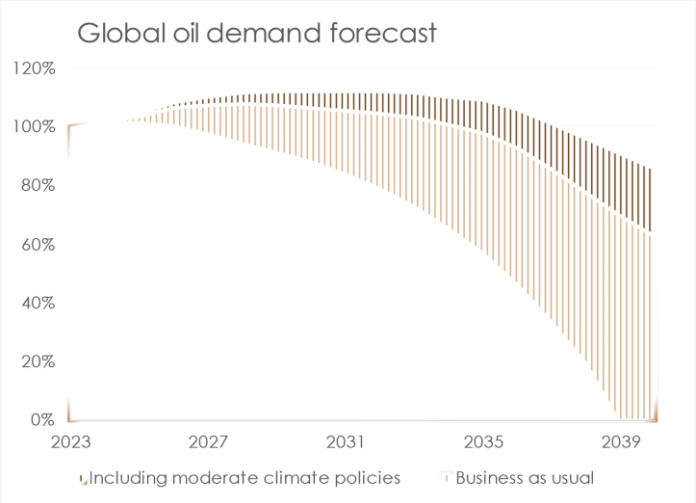
As set out before, renewables are now the cheapest form of energy, and electric systems – road transport, heating - the cheapest for everything that requires energy in real life. Renewable technology is superior both in terms of physical efficiency and financial cost. On top of the economic deficit of fossils, policies in response to global heating are highly likely to further impact the energy markets – by removing the fossil subsidies or taxing of fossils, and market incentives in favour of renewables.

Fossil fuels can no longer compete.

Future investments from main-stream capital resources– both from the markets and fiscal resources – is therefore going to flow towards new renewables and electricity.

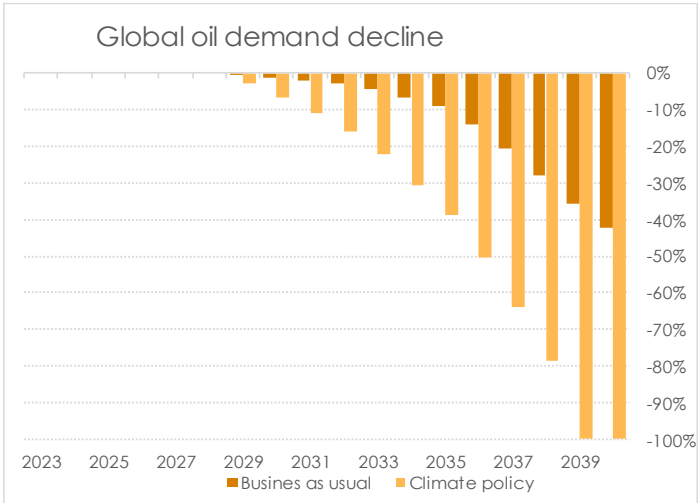
Simulations indicate that – under a very conservative business-as-usual scenario - demand for fossils will decline by 40% by 2040, even without any climate change-related policies. More realistic seems a combination of market forces and renewable incentive policies as response

to the accelerating global heating. Government policies – through elimination of fossil subsidies, policy incentives (tax breaks, integrated planning, credit guarantees, R&D, fossil taxes) will massively accelerate private investments. Even moderate climate policies could eliminate almost the entire demand for fossils by 2040.



Historical data: IEA, BP; future projections by SolAbility

Projections are the sum of a wide range different dynamics and therefore not exact. Market dynamics are however most likely to outpace expectations. The cost factor between fossil and renewable is now simply too big.



Historical data: IEA, BP; future projections by SolAbility

The radius of scenarios is wide. However, market dynamics and the accelerating speed of global warming suggest the transition will happen quicker than expected. Oil producing countries and the oil industry should calculate with no more than 20% of today's market by 2040 when making investments today.

- **Assumed an - unlikely – conservative scenario, demand for fossils will decline by 40% by 2040**
- **Factoring in global warming response policies, fossil demand could be almost completely eliminated by 2040**

Regardless of how fast and how big the decline will unfold – the decline of fossil demand is inevitable.

This, in turn, ask questions of all countries and players that are generating their company and government revenues from the sale of fossils.

3.5 Gulf countries oil dependency

The expected decline in demand for oil and the subsequent draining up of fossil revenues, countries that rely on the sale of fossil products will experience a decline in income. They therefore need to reconsider their approach to development and particullarely, their investments. While a number of countries have issued visions, have developped concepts, and are activly invsting in cenpets beyond the sale of fossils, none of these countries currrently seem in line to replace the fossil income in the time-frame required to maintain current GDP levels. More, and faster, is required.

For the purpose of this report, we concentrate on the gulf region countries (Saudia Arabia, Kuweit, United Arab Emirates, Qatar, Bahrain) that historically have generated a high proportion of their revenues and income from petro-products.

The GDP of all the Gulf countries is tighly related to the price of oil on the global markets, and fluctuations in oil proce can lead to significant changes in GDP (or oil share of GDP).

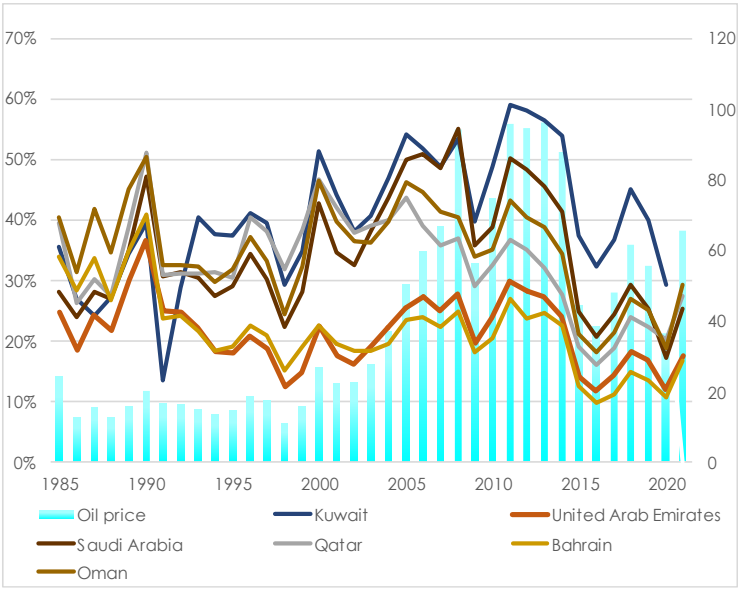
Oil rent in as percentage of GDP

Depending on the year (and the global market price of oil), the share of oil income on the GDP ranges from 15 to 45%

- For the UEA and Bahrain, the fossil share of GDP has been 15-20% for the last 10 years
- For Saudi Arabia, Qatar and Oman, 20-30%
- For Kuwait, 40%

These figures are even more extreme if we look at the share of fossil exports: between 50% (UEA) and 90% (Kuwait) of exports are generated from fossils. Making matters more complicated, most government revenues (the state budgets) are almost exclusively financed by fossil revenues.

Data source: IEA, BP, World Bank



By 2040 at the latest (better 2035), the Gulf countries need to replace between 15 to 40% of their GDP, between 50 and 90% of their exports, and nearly 100% of government revenues with different sources of income.

How can that be achieved? Are the Gulf countries ready?

The Gulf countries have managed to reduce their dependency on fossil income somewhat over the last 30-40 years. The UEA seems to be the most advanced Gulf nation in terms of successful economic diversification away from fossil income.

Gulf Countries'

Sustainable Competitiveness

4 Sustainable Competitiveness of The Gulf Countries

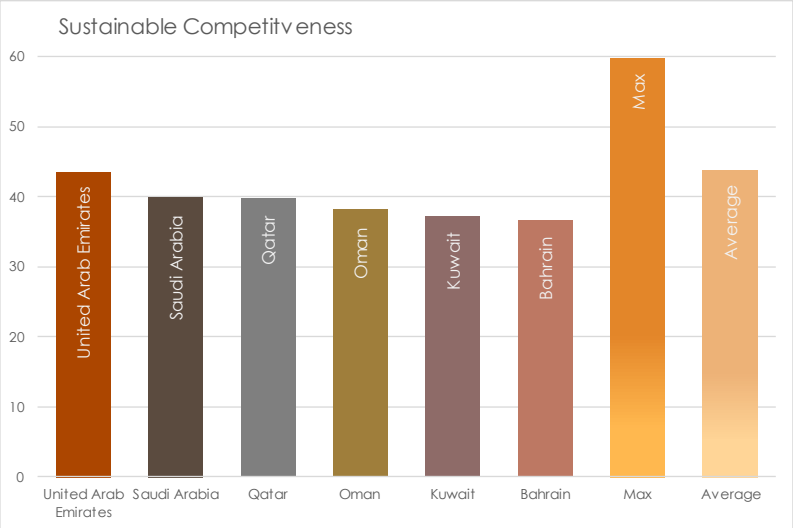
Sustainable Competitiveness Score

In the overall sustainable competitiveness rankings of the Global Sustainable Competitiveness Index, GCC countries score around, or below global averages:

Sustainable Competitiveness score of the Gulf Countries:

The UEA is ranked 84, Saudi Arabia 126, Qatar 129, Oman 118, Kuwait 160, and Bahrain 165

Data source: GSCI, SolAbility



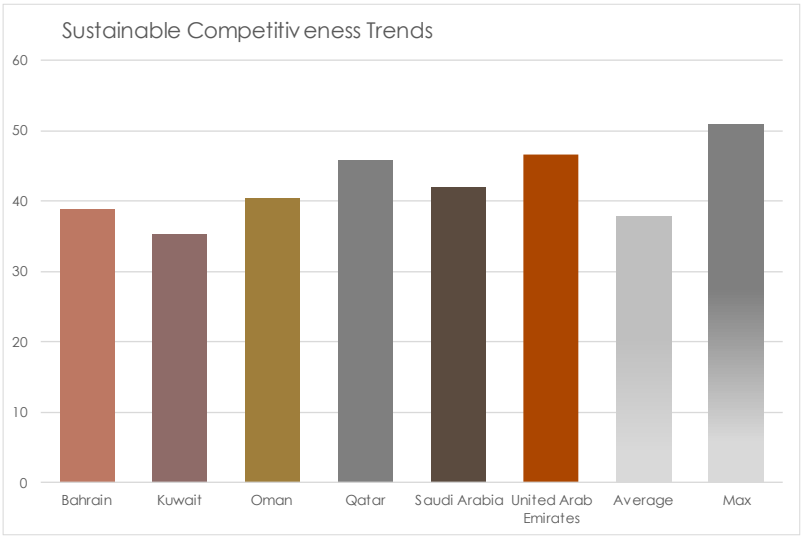
Past & future: trends

However, the picture is different when only looking at the trends over the recent past:

Trends and developments of sustainable competitiveness in the Gulf Countries

When only looking at trends, Qatar ranks globally 4th, the UEA ranks 5th, Saudi Arabia 34, Oman 66, Bahrain 73, and Kuwait 92

Data source: GSCI, SolAbility



The overall picture is therefore mixed: while the Gulf countries are not classified very well, the GCC region is one of the globally most improved regions within the ranking of the Global Sustainable Competitiveness Index.

Given the trends observed and the investments made in potential alternative income sources, the Sustainable Competitiveness score of the Gulf countries is expected to increase in the coming years. However, the improving trend is coming from a modest current level – all Guld countries have significant room to improve upwards, and it cannot be stated that the improvement curve is sufficient to face the challenges from the declining main income source – fossil energy.

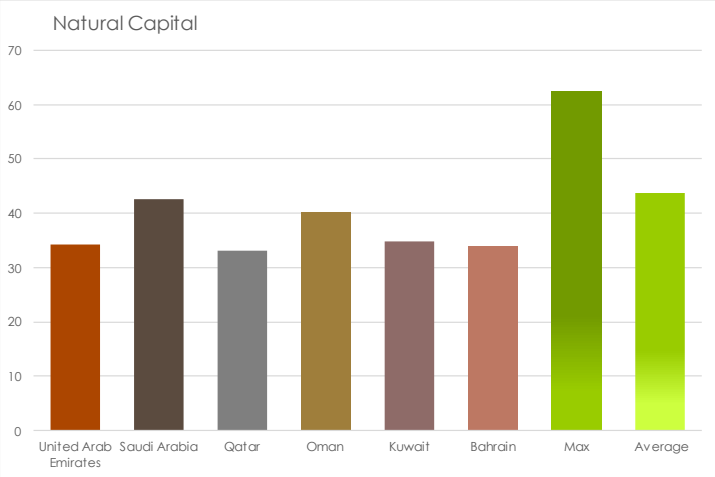
4.1 Natural Capital & Resource Intensity

Natural Capital

The Natural Capital is the given natural capital, defined by climatic, biodiversity and resource indicators, and the level of degradation of the same.

The GCC region is arid, and therefore with limited biodiversity richness, partly explaining the regions low score in the Natural Capital Dimension. The main natural capital in the GCC regions are mineral resources, and the sun. Gulf countries score particularly low - as expected in this corner of the World – in water resources and agricultural independency. The lack of domestic water sources, and agricultural fertility.

Data source: GSCI, SolAbility



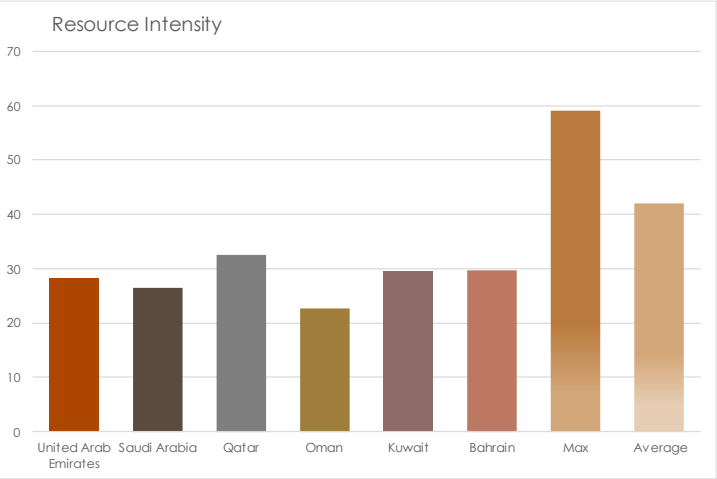
Resource Intensity, Resource Efficiency

The Resource Intensity & Efficiency Index measures all kind of resource consumption, per capita (intensity) and per value generated (efficiency)

GCC countries have a comparable high per-capita resource consumption, paired with limited resource efficiency

GCC countries are amongst the World's lowest performers in both resource intensity (per capita consumption of resources) and resource efficiency (resources used per GDP generated), also due to the abundance of cheap local fossil resources. However, given the climatic conditions, local energy needs could be covered equally cheap by renewables, in particular solar.

Data source: GSCI, SolAbility

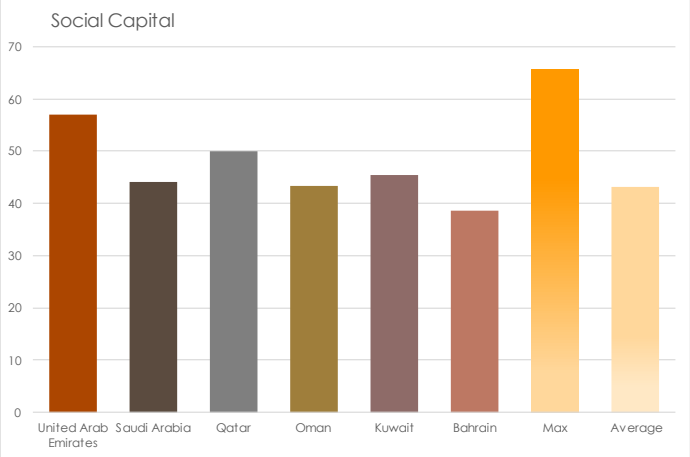


4.2 Social Capital

Social Capital Performance 2023

The UAE is ranked 11th globally in respect to Social Capital, reflecting the investments – past and current - in health care, and the integration of gender integration in the work force.

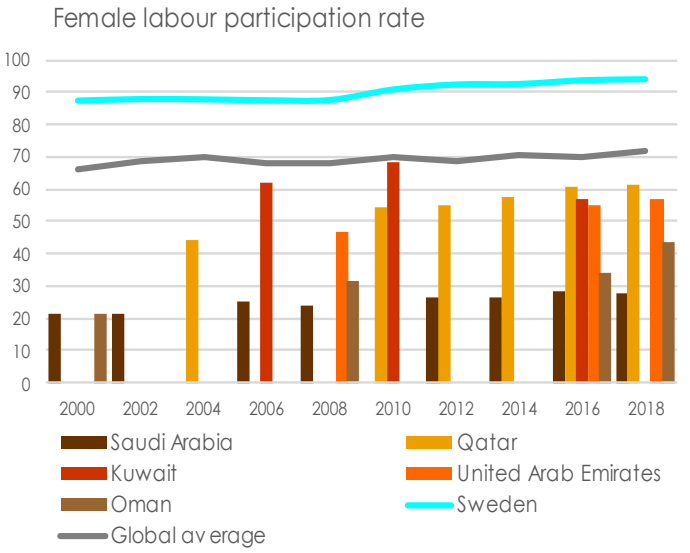
Apart from the UAE however, GCC countries are ranked around the global average: Bahrain 109, Kuwait 69, Oman 79, Qatar 40, and Saudi Arabia 73 - showing significant room to improve on a number of issues.



A key social capital indicator that correlates very strongly with overall sustainable competitiveness is the integration of the female population in the labour markets. Beyond gender equity questions, neglecting the female population as national resource is equal to neglecting the potential of a large proportion of the populations.

Given the historic and cultural context of the Golf region, female labour participation was historically below the global average. However, since 2000, efforts have been made to increase female integration. In the UAE, Kuwait and Qatar, female integration has reached between 50 and 60%, up from 40-50% a decade ago. Efforts have and are being made also in Saudia Arabia, where female labour participation has gone form 20% in 2005 to now 30%.

However, all GCC countries are still far below the leading nations in Scandinavia, where female participation in the labour market is higher than 90%.



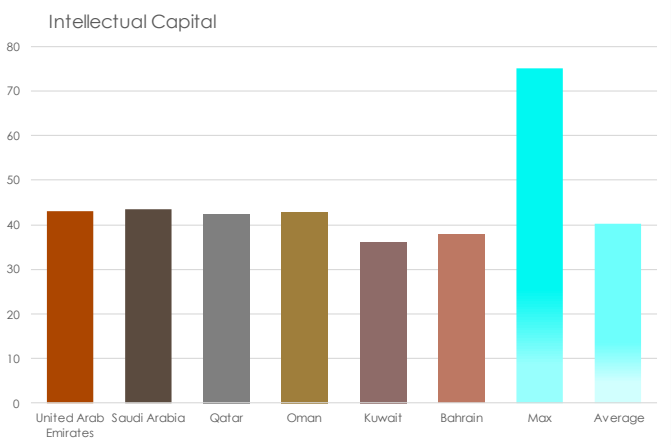
4.3 Intellectual Capital

The Intellectual Capital is maybe the most important sector defining future development potential in a global economy driven by innovation and technology.

Intellectual Capital Performance 2023

Saudi Arabia is ranked 49, while the UAE is ranked 55 globally. Bahrain is 112, Kuwait 99, Oman 91 and Qatar 54.

Data source: GSCI, SolAbility



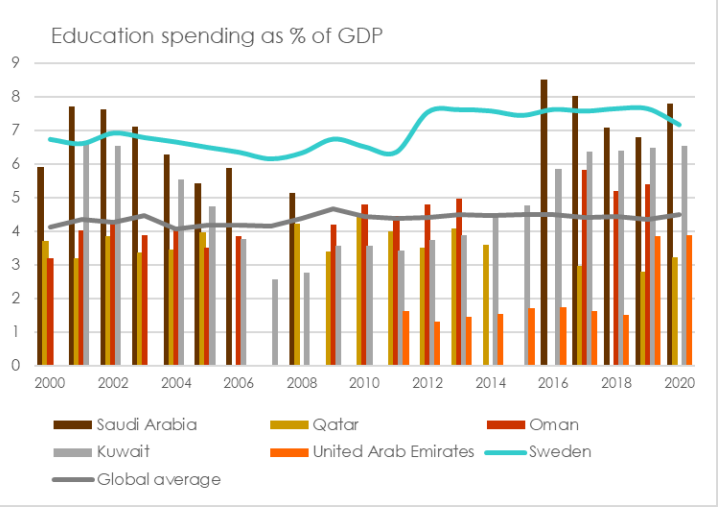
Two of the key indicators for measuring intellectual capital performance are state spending and R&D investments. Both of these two indicators correlate fairly strongly with overall development and the sustainable competitiveness score.

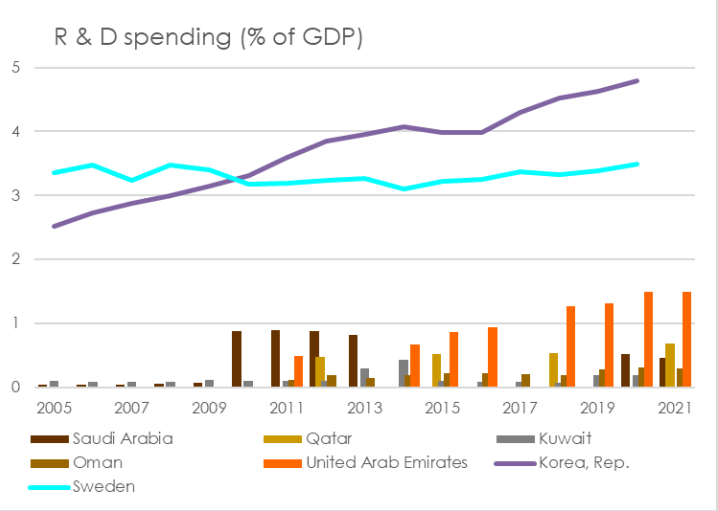
In terms of education spending, Gulf region countries are in line with global average or above. Sudia Arabia even tops Sweden in some years, but resource allocation appears to be somewhat erratic. The other countries remain one or two percentage points above the highest spenders globally

The Gulf countries will need to replace a significant share of their income and revenues currently generated by fossils. R&D is a key factor in determining future success in high-tech industries and services.

In this area, the Gulf region countries are currently far below the leading economies globally. The lack of R&D indicator is also a sign that there is still comparable little industrial activity and future high-tech industry at home in the gulf area. In order to replace the fossil income, the gulf countries area need to invest in attracting or foster home-grown future technologies and industries.

Data source: World Bank, UNESCO





How to Replace 30% of Oil GDP in The Gulf Countries ?

Alternative Income Streams

5 The Alternatives

5.1 Current affairs

As laid out in the previous chapters, global demand for fossil energy is expected to decline significantly in the mid-term future, driven by cheaper alternatives (renewable electricity and electric systems), as well as climate change related policies. Assumed a conservative, business-as-usual scenario, demand for fossils will decline by 40% by 2040. More realistically is to include global warming response policies, which could lead to fossil demand almost completely eliminated by 2040.

The IEA expects global demand for oil to peak between 2025 and 2027.

- When oil demand peaks, the supply-demand equitation starts to kick in
- Future expectations are often priced into market developments
- Commodity trading and hedging are most likely affected before peak oil demand is reached
- Spot prices for fossil commodities will start to decline at the latest, but highly likely before global oil demand peak
- At the same time, geopolitical volatility and risks are expected to remain high in the foreseeable future (Israel, Russia; China/Taiwan and South China Sea; Central and Western Africa; Yemen, Syria/Iraq; Iran; Libya), adding a risk premium on the price of fossil energy

⇒ **As of 2023, Gulf countries can expect between 3, and a maximum of 5 more "fat" years**

After that, both demand and price of fossil energy products will start to go downhill. With demand falling, key company and government revenues in GCC countries will start to decline.

=> The Gulf countries need to seriously think about how to replace fossil income streams

In collaboration of government agencies, universities and the private sector, Gulf countries should identify priority business and technology areas aligned with the respective country characteristics.

In a next step, cost-benefit analysis on a range of potential projects and development areas identified need to be conducted to facilitate informed resource allocation.

Resources and investments need to be allocated wisely in areas that promise the highest return on investment in terms of sustainable competitiveness.

The problem is: it needs to happen fast.

5.2 Challenges & Opportunities

The challenges

- GCC countries need to replace a significant proportion (20-30%) of the national GDP within the next 5 -15 years
- As a consequence, nearly 100% of government revenues must be replaced – either by taxing people and businesses, or generating income through state-business. Either way, the coming changes represent a challenging shift, for governments and population alike
- While future development plans incorporate reducing reliance on fossil income, these plans remain vague – and are insufficiently timed in light of the pace of current developments
- Delaying the details and fine-planning of an alternative vision far beyond plans for 3 or more years most likely will result in significant loss of GDP and government revenues
- National oil/gas companies and their suppliers need to re-define their business model - or risk becoming marginalised
- GCC countries need a sustainable competitiveness vision & implementation strategy

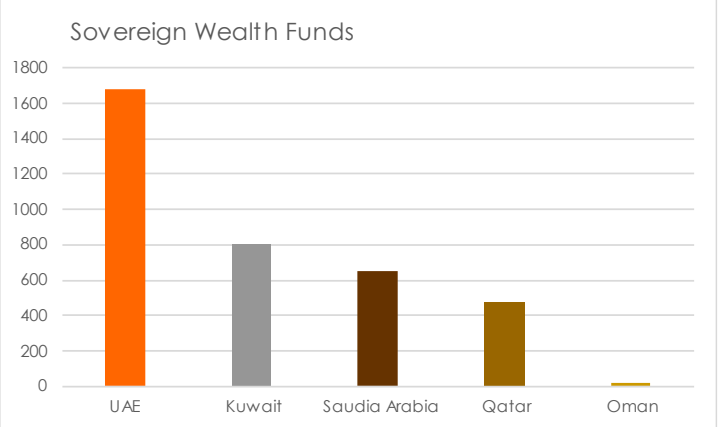
The opportunities

- Social Capital: GCC countries have invested significantly in Social Capital => a key element and basis of sustainable & competitive development in an innovation-driven global economy
- The path so far: the UAE has successfully diversified its economy over the past 30 years, proving that the reliance on fossil income can be overcome. Other countries in the GCC have also started diversification efforts, but are not yet that far.
- The location, part one: GCC is geographically and through investments a hub between Asia, Europe and Africa – potential that can further be exploited
- The location, part two: past investments in infrastructure and amenities have made the GCC a magnet for expats with high educational level. There is large pool of young & educated expats: intellectual capital and bright minds to facilitate the necessary transition – and more can be attracted
- Business opportunities: when technologies become redundant, new technologies emerge. Every technological transition (challenge) carries new opportunities in the new technology fields
- Capital reserves: GCC countries have accumulated large capital reserves and national funds. Financing the further sustainable competitiveness transition

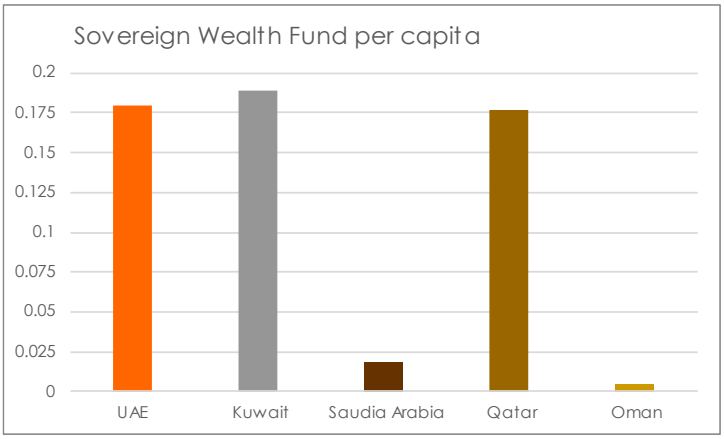
5.3 Capital Resources

Thanks to continuous demand for oil, Gulf countries have enjoyed a continuous flow of income over the last decades, nearly amounting to what economists call a "free lunch". Some of that income has been diverted for future use in sovereign wealth funds. Gulf countries therefore have considerable financial resource at their disposal to finance the required transition.

The United Arab Emirates (UAE) has accumulated the highest wealth in a number of state-owned investment corporations, amounting to a total of more than U$ 1'700 (1.7 trillion), followed by Kuwait with more than U$ 800 billion, and Saudi Arabia (more than U$ 600 billion).

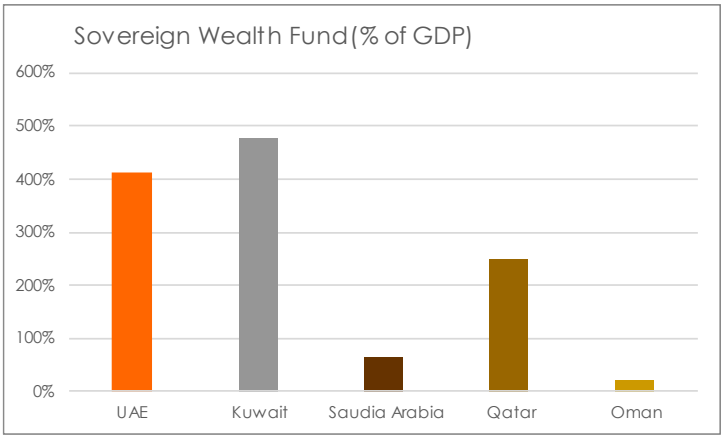


When evaluating the capital resources per capita, the picture changes – the UAE, Kuwait and Qatar's sovereign savings amount to more than U$ 175'000 per person (residents, including citizens and non-citizens). Saudi Arabia's per capita sovereign fund value is small by comparison at roughly U$ 20'000 per resident-



The most important measurement is the value of the sovereign wealth fund in relation to GDP. This relation best expresses a country's financial strength for developing alternatives to fossil income.

Kuwait's and the UAE's wealth fund exceed 400% of the respective countries annual GDP, putting these two countries in a particular strong position to finance a meaningful transition. Qatar's wealth fund is also more than 200% of its GDP, while Saudi Arabia's savings are around 60% of GDP.



Based on financial resources, Kuwait, the UAE and Qatar appear to be in the strongest position to finance effective transition, while Saudi Arabia – the World's largest exporter of fossils, and the region's largest country by population and economy – seems in a less advantageous starting position

5.4 Hydrogen is NOT the alternative

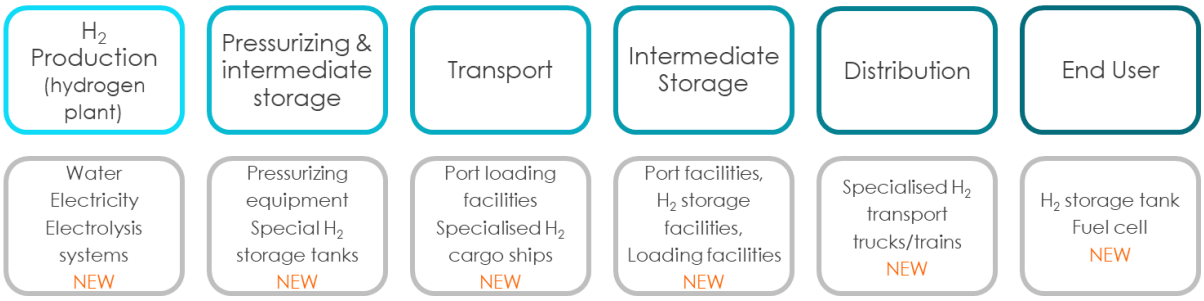
A word about hydrogen:

Hydrogen is sometimes touted as a replacement for fossils, and therefore as a potential future business for oil producing countries and/or fossil companies.

It is not. **Hydrogen is not competitive.**

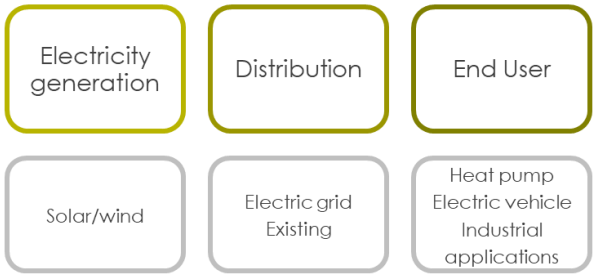
Hydrogen – as an international business - would require building new, large and complex transformation, distribution, and re-transforming facilities and systems:

Global Hydrogen Infrastructure



Renewable is much simpler. For heating and road/rail transport, solar/wind is transformed to electricity locally, maybe temporally stored in a battery, and the reused to power an electric device. No need for transformation, no need for transportation systems:

Renewable Electricity Infrastructure



The renewable electricity infrastructure is much simpler. And: local renewables do not require the transformation of one energy form (electricity) to another (hydrogen) and then backwards – it is also much more efficient. Renewable is much cheaper.

There is limited specific use for hydrogen in high-temperature industries (metals, some chemical processes, cement), but that hydrogen can be produced cheaper and without the need for a global infrastructure locally.

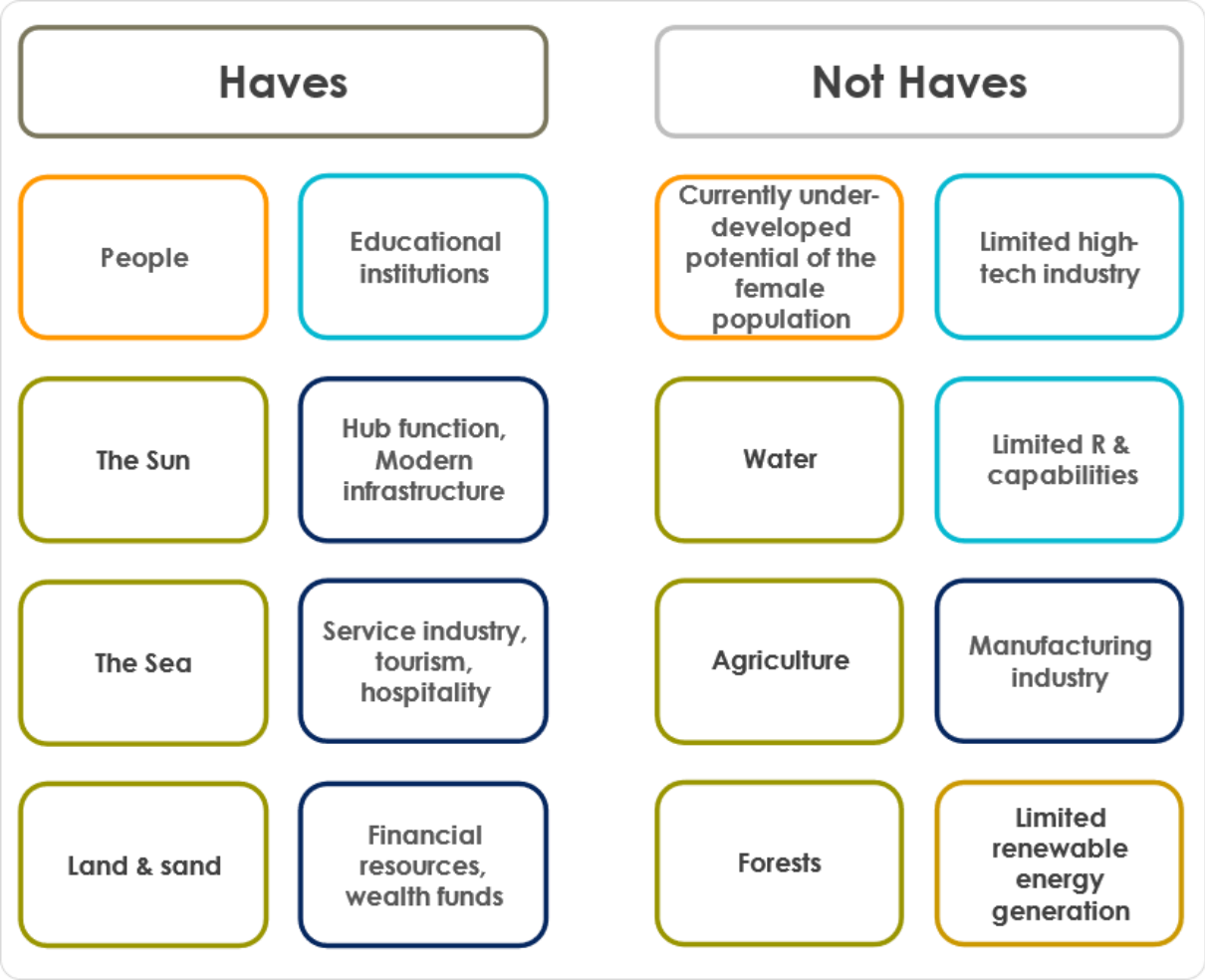
Since renewables are so much simpler, more efficient and cheaper, hydrogen is not competitive.

Investments in hydrogen therefore would represent a miss-allocation of capital - capital that could be used with a higher return on investment for other, simpler and cheaper technologies. Technologies that are sustainable AND competitive.

5.5 Haves and Not Haves

The basis to develop alternatives, is a strength-weakness analysis: identifying areas which the Gulf region countries already have developed sustainable competitiveness, and areas that are (as of now) less competitive

Gulf countries' strengths and weaknesses



Based on the strengths and weaknesses, and the threats (diminishing fossil income), it is possible to develop alternatives. But what are the opportunities? In an ideal case, the current haves can be used an combined to develop or improve the current not-haves.

Given the current specifics of Gulf countries, the following areas could potentially develop into key future revenue streams:

- Water
- New agriculture technologies
- Greening deserts
- Solar energy, solar fuels, solar plastics
- Tourism
- Culture
- Specific IT areas related to the key areas
- Global service providers

5.6 Potential future revenue streams

There are two ways to acquire technology: buying, or developing. Only buying technology might improve infrastructure and the standard of living. Attracting technology, or developing technology, also provides jobs and new income streams. For example, gulf countries can commission desalination plants from somebody else for in-country human, industrial and agricultural needs. Or they can invest in bringing the technology developers to their countries – or develop the technology themselves, possibly in collaboration with domestic universities and private players companies.

Investments should therefore aim at attracting and/or developing specific technologies. Developing technologies and businesses related to domestic challenges is not only beneficial to the issue, but can eventually transform domestic challenges into new business streams. **Important note:** suggesting a complete roadmap would require in-depth analysis, and is beyond the purpose of this report. This list contains an number of potential income generation areas, but is not complete.

5.6.1 Water tech

Water scacity is a key issue in the Golf region, and is likely to become a more pressing issue in many parts of the world. Future technologies related to water include

- **Desalination:** Desalination is a key technology in arid regions with limited natural water resources – with high demand expected globally with increasing pressure on water resources. GCC will need more desalination plants in any case – so why not making a business out of that need?
- **Smart irrigation:** smart irrigation allows for agricultural activities even in comparable arid regions. Transporting and distributing water in the most efficient form possible is therefore another significant future business opportunity
- **Smart distribution:** using of advanced technology and data-driven systems to manage, monitor, and optimize water supply and distribution networks – for domestic use initially, and then exporting expertise
- Water recycling & efficiency

5.6.2 New agriculture tech

GCC countries rely on imports to cover the needs of their population – arid hot regions are not particular fertile. In addition, climate change is making traditional agriculture significantly more volatile

- **Vertical indoor agriculture and aquacultures:** in-door food production that is resilient to climate change, powered by renewable elctricity, and combined with modern robotics, could offer sucuring domestic food security and export opportunities.
- **Low-tech agriculture:** agriculture based on permaculture and similar natur-based approaches designing agricultural systems that mimic natural ecosystems, aiming to create self-sustaining, regenerative, and productive environments. Permaculture has proven to be able to cultibate organic food in arid areas.
- **Cultured meat:** Climate change demands that humanity reduces its meat consumption – or develops alternatives to meat, available in the form of muscle cells cultivated in bio-reactors. When cost party to "naturally grown" animal meat is reached, sales of cultivated meat will increase sharply, given the obvious hygenic advantages and ondependence of location and the availability of meadows.
- **Synthetic diary product alternatives**: strong demand for non-diary diary product replacements make synthetic diaries a strong growth market.

5.6.3 Solar energy, fuels & plastic

Global demand for fossils will decline because there are now simpler, more efficient and cheaper alternatives available. However, for some specific usages and applications, fossils remain difficult to subsidise – in particular commercial aviation, and in the petro-chemicals, plastics and fertilizer industries. Non-fossil alternatives are emerging, however. Given the GCC's expertise with fossils, it seems manifest to capitalise on possible replacements in these areas to guarantee new income streams

- **Synthetic solar fuels:** due to low energy density and therefore high weight of batteries, liquid fuels are difficult to subsidise for aviation in the near-term. Solar fuels are made using solar energy, and carbon sequestered through industrial carbon capture or direct air sequestration. While this is still an emerging technology, it is a business field which has a large potential in the Gulf countries, thanks to abundance of sun and expertise in exporting liquid fuels.
- **Synthetic solar plastics:** synthetic plastic is another emerging technology based on the same principles: using the C element in natural available CO_2, and then synthetically produce different forms of polymers (the building blocks of plastics). This type of technology, if scaled up and proven to be efficient and cost-effective, could potentially contribute to reducing the carbon footprint of the plastic industry and offer significant business opportunities.
- **Solar electricity:** Gulf countries have sunshine days in abundance, allowing for the production of cheap solar electricity. However, in order to export electricity, continental grids would have to be built. Smart grid technology is also a market with high growth potential.

5.6.4 R & D investment – fostering new enterprises

Developing a knowledge-based economy through investments in technology, innovation, and research and development can yield significant returns. Encouraging startups and fostering an environment conducive to tech innovation could lead to the creation of new industries and income streams when available resources are aligned. Strong co-operation with universities and/or financing of labs at universities that allow students to experiment and research can facilitate the development of new technologies and start-ups. High-quality universities and research facilities also attract students and seasoned researchers alike.

5.6.5 Global Service Providers

The Gulf countries have invested heavily in modern infrastructure, and are home to some of the World's most modern cities. Combined with the geographical location between Europe, Asia, and Africa should enable GCC's to attract globally active service providers – e.g. in the financial, insurance, or IT service development industries, creating jobs and income

5.6.6 Tourism, Hospitality, and Culture

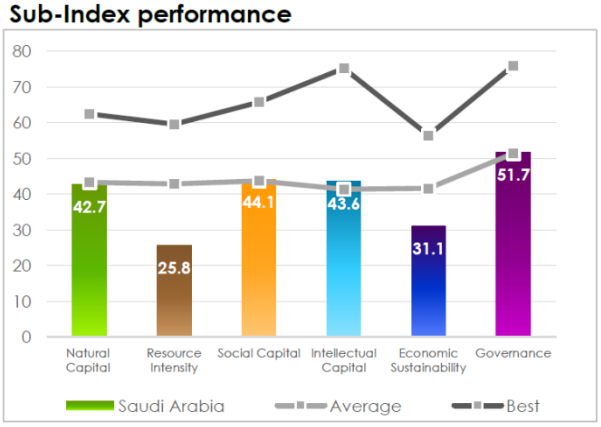
The Gulf region has tremendous potential for tourism due to its rich culture, investments in the cultural sector, its historical sites, and beautiful landscapes. By developing this sector further, Gulf countries could attract more tourists and generate revenue through hospitality, entertainment, and related services.

5.7 Country round-up

5.7.1 Saudi Arabia

Saudi Arabia is the most populated country and the largest economy amongst the Gulf corporation countries. The country has enjoyed what economists would call a "free lunch" over the past decades thanks to its richness in easily extracted oil and steady growth of global demand for the same – the country didn't need to think about alternatives for a long time, and still relies heavily on the export of fossils to support government revenues and the country's GDP. The low diversification is reflected in the comparable low ranking in the Global Sustainable Competitiveness Index (126), as well as the sub-indexes. Saudia Arabia performs along the global average in most areas, expect for resource efficiency and economic sustainability, where the country score significantly below the global average.

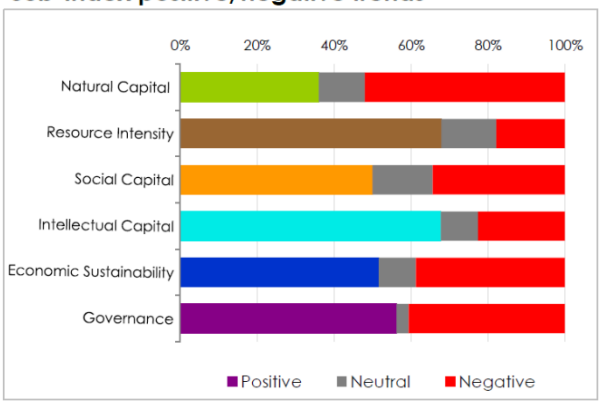
Sub-Index performance



Data source: Global Sustainable Competitiveness Index, SolAbility

Saudi Arabia is ranked 126 in the GSCI 2023, achieving 66.8% of the best scoring country

Sub-Index positive/negative trends



Data source: Global Sustainable Competitiveness Index, SolAbility

Saudi Arabia sustainable competitiveness trends

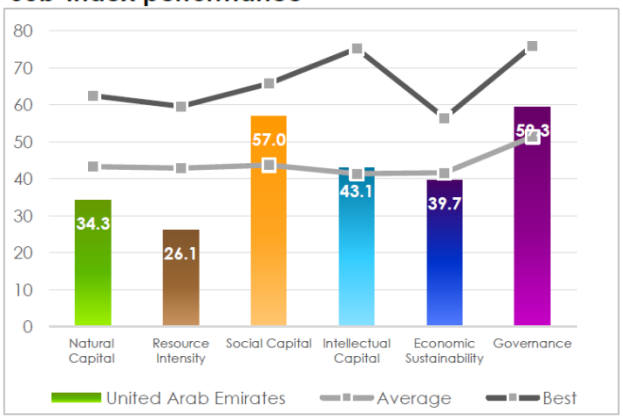
Saudia Arabia has issued the ambitious "Saudi Vision 2030" in 2016, with the aim of diversifying its revenues and income. While the Vision ticks most boxes, the individual programs seem inadequate to achieve the ambitious goals. For example, the Saudi Vision 2030 states the goal of achieving 50% of exports from non-fossil sales. However, the countries fossil exports remain hovering around 80% of total exports, 7 years after the presentation of the Saudi Vision. While Saudi Arabia maintains large wealth and financial power, its sovereign wealth fund that supports the transition is comparable small in relation to smaller GCC state wealth funds.

Given that demand for, and cost of, oik is expected to start declining soon, Saudi Arabia should redouble its efforts to diversify its income streams.

5.7.2 The United Arab Emirates (UAE)

The United Arab Emirates has followed a diversification strategy for nearly 30 years. The UEA is now a major air transport hub, a tourist destination, and is attracting highly educated individuals that form a pool for potential development. This all is reflected in the UEA's improved standing in the Global Sustainable Competitiveness Index. While the UAE performs below global averages in Natural Capital and Resource Intensity, the country is above global average in Social Capital and Governance.

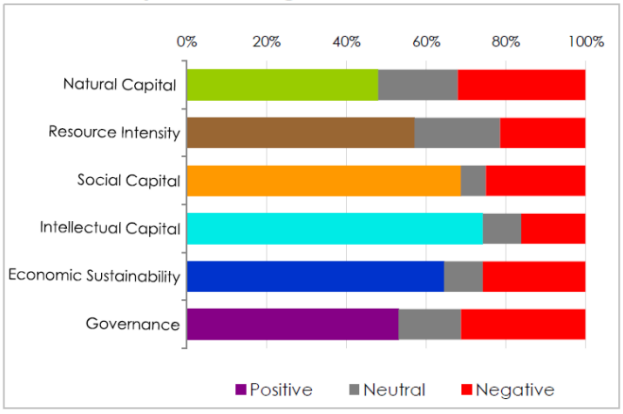
Sub-Index performance



Data source: Global Sustainable Competitiveness Index, SolAbility

The UEA is ranked 84 in the GSCI 2023, achieving 72.5% of the best scoring country

Sub-Index positive/negative trends



Data source: Global Sustainable Competitiveness Index, SolAbility

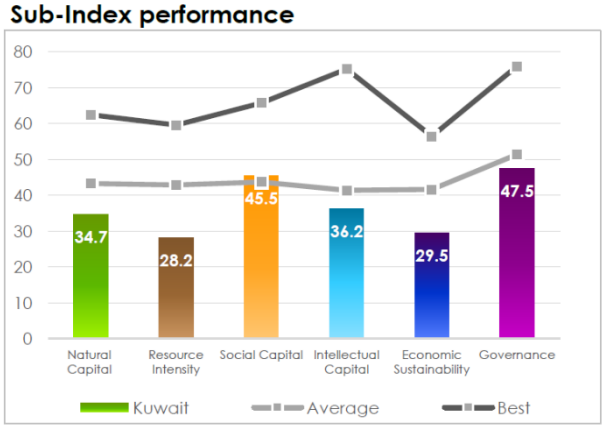
UAE sustainable competitiveness trends

The UEA's sovereign wealth funds (totalling more than 400% of current GDP, or more than U$ 1.7 trillion)) put the country in a god position to being able to finance a swift transition from fossils to renewables. However, the Countries Vision beyond 2030 is strongly focused on developing hydrogen as an alternative to fossils, which is an economic non-starter. The UAE needs to develop a more diversified and detailed Vision and implementation roadmap to capitalise on its good current standing – hopefully to be presented at COP28.

5.7.3 Kuwait

Kuwait, similar to Saudi Arabia, has somehow missed to opportunity to introduce economic diversification policies at an early stage, reflected in below average performance in the Global Sustainable Competitiveness Index. Kuwait is ranked 160, and score below average in almost all areas, in particular in Natural Capital and Resource Efficiency. Only in Social Capital does Kuwait perform above the global average.

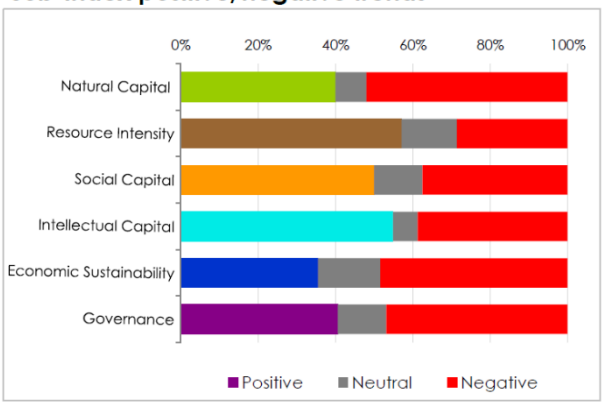
Sub-Index performance



Data source: Global Sustainable Competitiveness Index, SolAbility

Kuwait is ranked 160 in the GSCI 2023, achieving 62% of the best scoring country

Sub-Index positive/negative trends



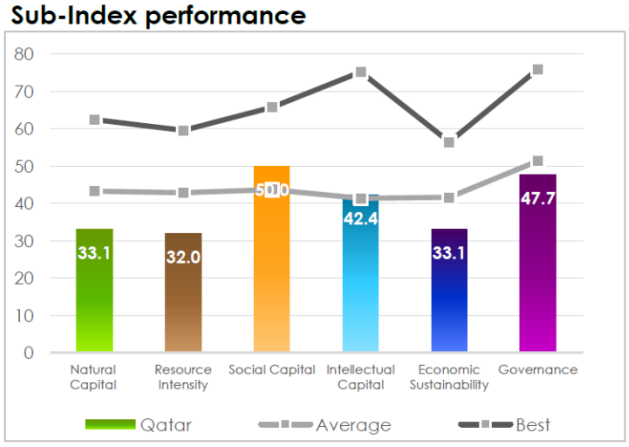
Data source: Global Sustainable Competitiveness Index, SolAbility

Kuwait performance GSCI trends

Kuwait has issued an economic vision program in 2017, outlining a vison for a "New Kuwait 2035", aiming at improving livelihoods, health, nature and diversifying the economy to become a financial hub to break the dependency on fossil exports. Kuwait possesses a large National sovereign wealth fund, allowing the country to invest in new technologies, infrastructure and other programs. However - while the focus on fostering new enterprises and education covers some of the underlying deficits, in total the "New Kuwait 2035" seems not ambitious enough in light of the rapidly changing global environment and the expected decline in oil demand.

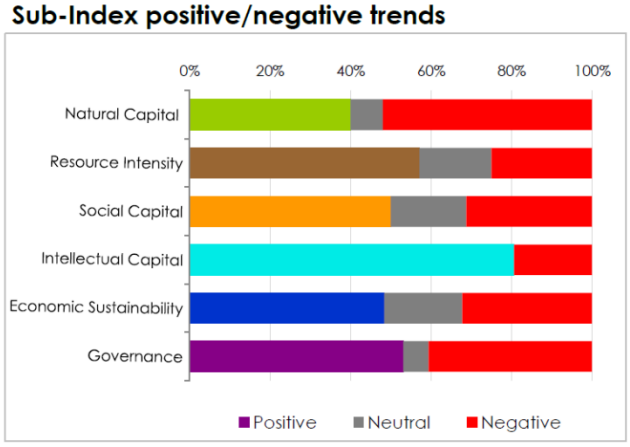
5.7.4 Qatar

Qatar boasts high income and modern infrastructure and facilities, with a comparable high population density compared to its neighbours – and also a considerable GDP per capita. The country, however, performs below global average in the Global Sustainable Competitiveness Index, ranked 129. Only in Social Capital does Qatar perform above the global average. However, trend in most areas (other than natural capital) suggests future improvements can be expected



Data source: Global Sustainable Competitiveness Index, SolAbility

Qatar is ranked 129 in the GSCI 2023, achieving 67% of the best scoring country



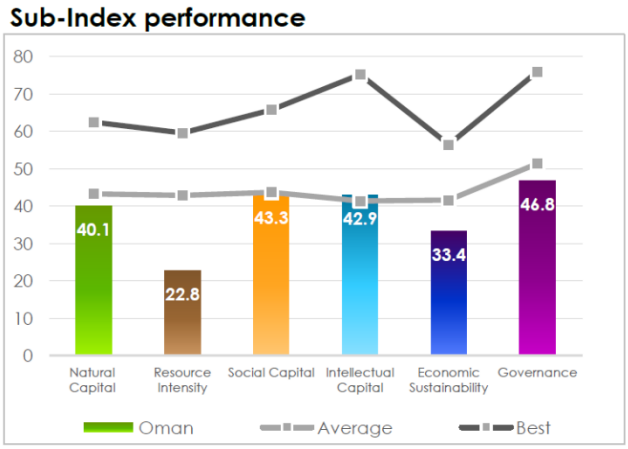
Data source: Global Sustainable Competitiveness Index, SolAbility

Qatar GSI trends

Qatar has published The National Qatar Vision 2030" in 2008, with the key aim to diversify the economy while maintain the citizens standard of life. However, the Vision is kept somewhat vague, and share of fossils as percentage of exports remain hovering around 80% - that is not sufficient in light of stalling oil revenues when global demand for fossils starts to decline. Qatar has put savings aside in the nation wealth fund. The large available capital resources indicates that a swift transition away from fossils would be possible.

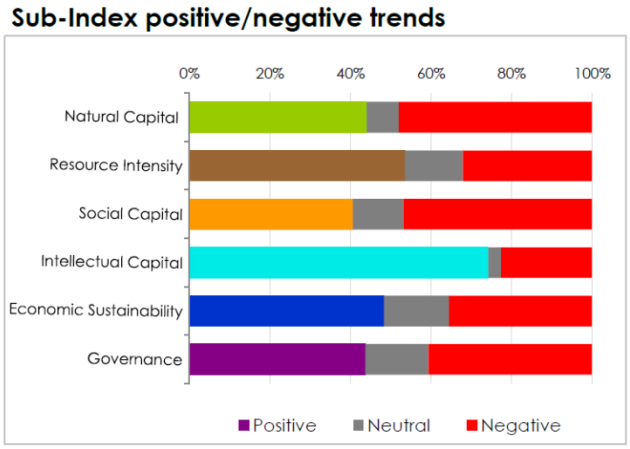
5.7.5 Oman

Oman is somewhat different from the other GCC countries in terms of oil resources, and GDP per capita.
Oman performs below the global average in the Global Sustainable Competitiveness Index in most areas, ranked 157. In Social Capital and Governance, the country is withing the global averages.



Data source: Global Sustainable Competitiveness Index, SolAbility

Oman is ranked 148 in the GSCI 2023, achieving 64.1% of the best scoring country



Data source: Global Sustainable Competitiveness Index, SolAbility

Oman GSCI trends

Oman has issued a "Vision 2040" with surprisingly detailed targets, mostly based on international indexes. However, there is insufficient clarity regarding the policies formulated, and it remains to be seen whether these targets can be achieved. Oman's sovereign wealth find is comparable small relative to other wealth funds, meaning a slight disadvantage compared to the other GC countries.

Conclusions

The Oil markets & business

- The markets for renewables and electricity-powered consumption have reached momentum that is now unstoppable. It's simple economics: Renewables are – by a large margin – more efficient and cheaper.
- Market developments flush more investments in R&D, production and installation - everything renewable and electric will become even cheaper in the near future. The outlook suggests half the cost in the next 10 years, redoubling market dynamics.
- As a consequence, fossils and fossil-powered consumption are no longer competitive. Demand for oil will peak between 2025 and 2027, and therefore start to decline, slowly at first, and faster over time. Demand, revenues and profits for and from fossils will decline in accordance.
- The renewable transition will happen faster than the "mainstream" is currently expecting.
- Demand for oil will decline after 2030, even assumed a business-as-usual scenario with no or very limited climate change-forced policies.
- Policies and targets induced by climate change (e.g. incentives and financing framework for renewables, and taxing of fossils) are likely further accelerating market dynamics. It is highly likely that the demand for fossils will be a fraction of todays, and maybe even close to zero by 2040.

Gulf Corporation Countries Sustainable Competitiveness

- GCC countries currently generate between 15 and 40% of their GDP and close to 100% of government revenues from fossil exploitation – income that is set to drastically decline after 2030 (at the latest), and might well be close to zero by 2040
- Diversification efforts so far have resulted in the development of alternative income streams, (hub functions, service centres, tourism, hospitality). The UAE and Qatar are quite advanced in diversification, with Saudi Arabia and Kuwait having made somewhat less progress in reducing the dependency on fossil income
- The transition to renewables is set to happen faster than previously anticipated. GCC countries therefore have to revise their development visions, and investment plans to accelerate the transition.
- Thanks to the financial resources (sovereign wealth funds) and past investments in new business areas, infrastructure, education and health, GCC countries are in a reasonable position to successfully manage a transition to advanced economies without fossil income.
- However, circumstances and the pace of development require acceleration of current efforts to diversify the GCC economies if decline of living standards are to be avoided. Resources and investments need to be allocated wisely in areas that promise the highest return on investment in terms of sustainable competitiveness.

About this Report

Methodology, data gathering, calculation, & report compilation by SolAbility.

About SolAbility

SolAbility is an independent sustainability think-tank with a history in sustainable management implementation in large corporations.

SolAbility is the proud publisher of the Global Sustainable Competitiveness Index and the maker of 3 DJSI Super-Sector Leaders.

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