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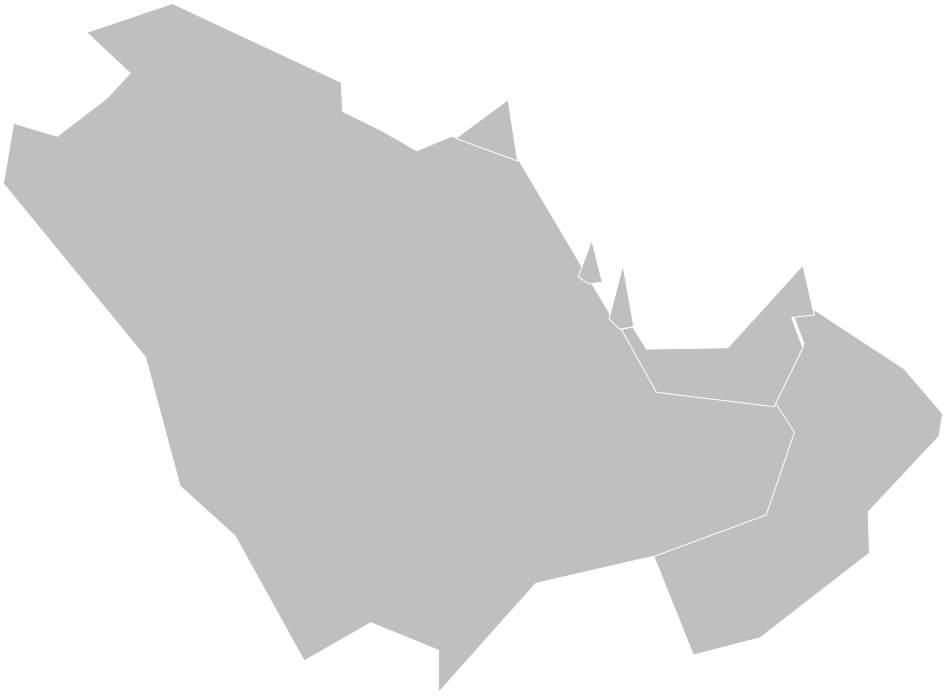
New Frontiers of Energy Sustainability in the GCC Region

Whitepaper



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1 Executive Summary

Energy efficiency and renewable energy are young industries in the GCC region, established in earnest a little more than a decade ago. Initial deployment of comprehensive and long-term sustainable energy strategies started in the UAE and Saudi Arabia. Following success of these initiatives, various governments in the region have established strategies and organisations to guide and support the development of sustainable energy in their jurisdictions.

This paper has been developed with the purpose to stimulate reflection on the current trajectory for development of sustainable energy in the GCC region, on the level of aspirations that territories in the region should have, and on barriers and game changers that can determine success in capturing existing and new major areas of opportunity.

Despite substantial progress over the last decade, the sustainable energy industry in the region is still far from reaching its full potential. The sustainability ambitions of the GCC countries are expected to grow, given the local priorities for economic development and the evolution of international commitments towards climate change mitigation. The COVID-19 pandemic and its expected aftermath may support higher ambitions in sustainable energy programmes, for their benefits in terms of health, well-being and cost-competitiveness. We recommend the adoption of aspirational targets as opposed to incremental ones, supported by independent top-down assessments and the use of recognised standards in sustainability reporting.

In support of the coming growth of the regional sustainable energy industry, in this paper, we identify and examine barriers currently affecting its growth in the GCC, and suggest game-changers that may remove these barriers. The barriers are:

1) Misaligned incentives between utilities and energy users, which pose obstacles to some types of user intervention, such as distributed renewables;
2) Split incentives between building owners and tenants, that hinder energy efficiency interventions in tenanted buildings;
3) Tariff subsidies, which affect the sustainable energy business case;
4) Limited infrastructure readiness for future energy transition;
5) Lack of financing mechanisms, which prevents deeper penetration of sustainable energy solutions; and
6) Shortage of local supply, which has imposed higher costs and technical inefficiencies on the local industry.

We present in the paper 10 “game changers” that can remove or reduce these barriers, across four different themes:

Allowing participation of end-consumers in the sustainable energy market

Game changer 1. Attractive business models for distributed renewables and energy storage

Game changer 2. Open access to the grid

Incentivising participation of end-consumers

Game changer 3. Addressing subsidised consumer segments

Game changer 4. Addressing split incentives

Game changer 5. Developing financing mechanisms

Ensuring future-readiness of energy infrastructure

Game changer 6. Supporting EV readiness

Game changer 7. Supporting distributed solar PV readiness

Game changer 8. Considering green hydrogen readiness

Developing local supply capabilities and energy champions

Game changer 9. Localising technology value chains

Game changer 10. Creating energy champions able to operate at a global scale

These game changers are expected to unlock a number of sustainable energy opportunities in the GCC that will benefit the government, utilities, as well as private players. Examples of those opportunities are provided in the last section of this paper and range across major global trends, such as nearly-zero energy buildings, next-generation energy solutions, energy storage, green mobility.

The Emirate of Ras Al Khaimah in the UAE is a territory where opportunities for sustainable energy are extensive, and the topics discussed in this document are therefore particularly relevant for the development of the local economy. The ideas presented here are largely the result of the foresight planning process of Ras Al Khaimah Municipality, which informs the continuous update of Ras Al Khaimah Energy Efficiency and Renewables Strategy 2040.

Ras Al Khaimah Municipality hopes that sharing these reflections will help stimulate positive debate in the industry, and welcomes any feedback from the government and private sector on the ideas that are expressed in this paper.

As a last remark, the development of this document benefitted greatly from the contribution of recognised regional experts from the government and private sector, whom the authors thank for their invaluable support.

2 Context

Energy efficiency and renewable energy are young industries in the GCC region. The regional energy efficiency industry germinated a little more than a decade ago, with the UAE and Saudi Arabia taking the first important steps, followed by other countries such as Oman and Bahrain within a few years. The adoption of the first broad conservation measures was in building codes (e.g., Saudi Building Code Conservation Requirements of 2007, Trakhees EHS Green Building Regulations of 2008). This was followed by the emergence of more comprehensive energy efficiency strategies (e.g., Dubai Demand-Side Management Strategy 2030, Saudi Arabia's National Energy Efficiency Program), and the establishment of government facilitators to kick-start the industry (e.g., Dubai Supreme Council of Energy, Saudi Energy Efficiency Center). The first notable efforts in renewable energy were made over the same period, following many years of studies and experimental projects, with the launch of the first utility-scale projects in the early 2010s (e.g., phase 1 of Dubai's Mohammed bin Rashid Al Maktoum Solar Park in 2013) followed by the first adoption of regulations supporting distributed renewables in Dubai (Net-metering regulation of 2015). After these initial successes, various governments in the region have established strategies and organisations to guide and support the development of energy efficiency and renewables in their jurisdictions, as illustrated in the map below.

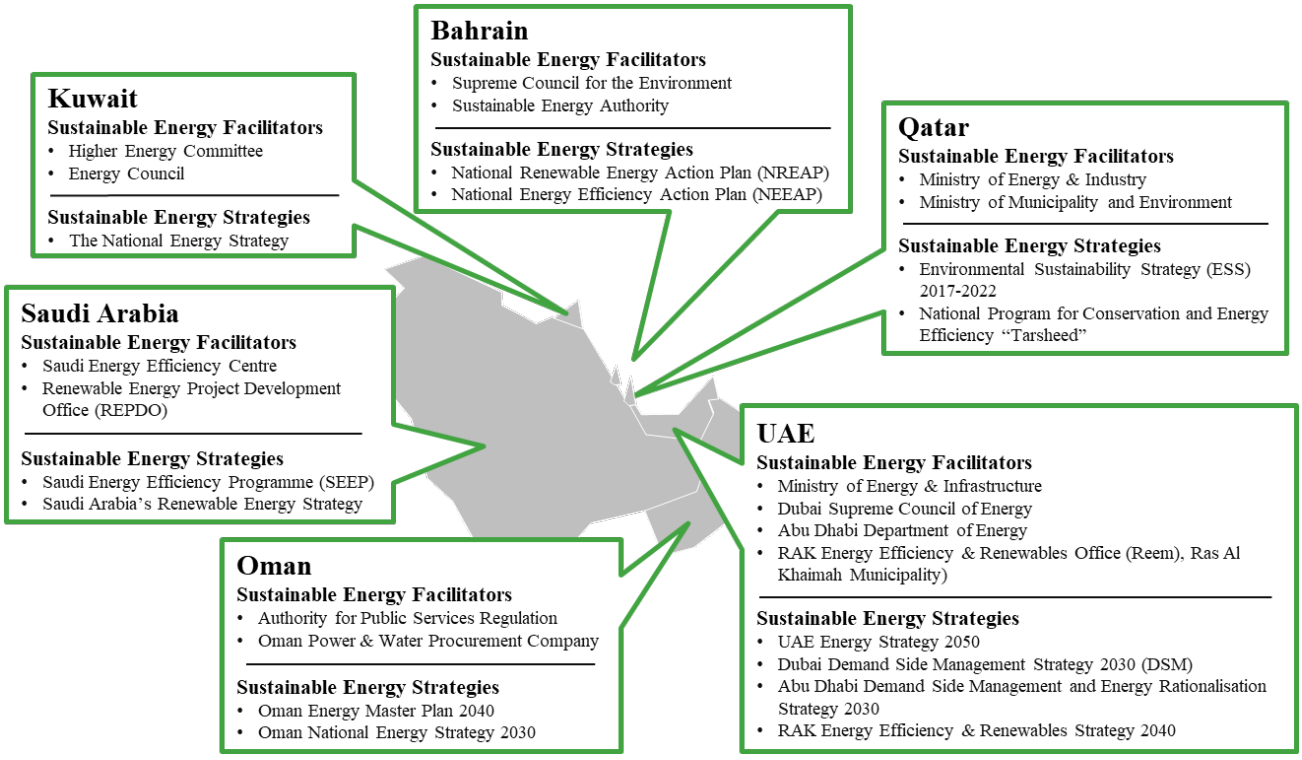

Figure 1: Sustainable energy facilitators and strategies across the GCC region (examples, not exhaustive)

Growth in the sector over the last decade has created the sense of a maturing sustainable energy industry in the region. However, with some notable exceptions (e.g., recent solar mega-projects, major water reuse networks), comparison with other mature markets reveals that the sustainable energy industry in the GCC region is still far from reaching its potential. Overall, energy efficiency standards in buildings are still modest, retrofit programmes only address a small fraction of the building stock,

access to distributed renewable energy in many territories is limited and waste-to-energy conversion is still nascent.

The current economic situation, marked by the COVID-19 pandemic and its expected aftermath, may offer a favourable setting for the sustainable energy industry. The traditionally recognised benefits of sustainable energy in support of strategic goals of the GCC countries, such as energy security, reduced dependence on fossil fuels and diversification of the economy, are today being complemented by the recognition of more fundamental benefits for individuals and businesses. Impacts of sustainability measures on health and well-being (e.g., indoor air quality, outdoor comfort and air pollution), on cost competitiveness of businesses, and the multiplier effects of these benefits are today becoming mainstream in public policy discussions.

3 Aspirations

Over the last decade, as the GCC countries have developed their energy sustainability strategies, their plans and actions were shaped by two primary drivers:

1) **Energy competitiveness:** The GCC countries aimed to reduce final energy costs to consumers and/or reduce energy subsidies, allowing for a more competitive commercial and industrial sector and improved public finances. This supported national strategic goals including economic diversification and increasing the availability of crude oil and natural gas for export.
2) **Climate change mitigation:** As partners in the fight against climate change, the GCC countries joined the Paris Agreement to limit their GHG emissions. The countries of the GCC, as developing countries, had previously made initial commitments in the first round of the Paris Agreement, as illustrated below.

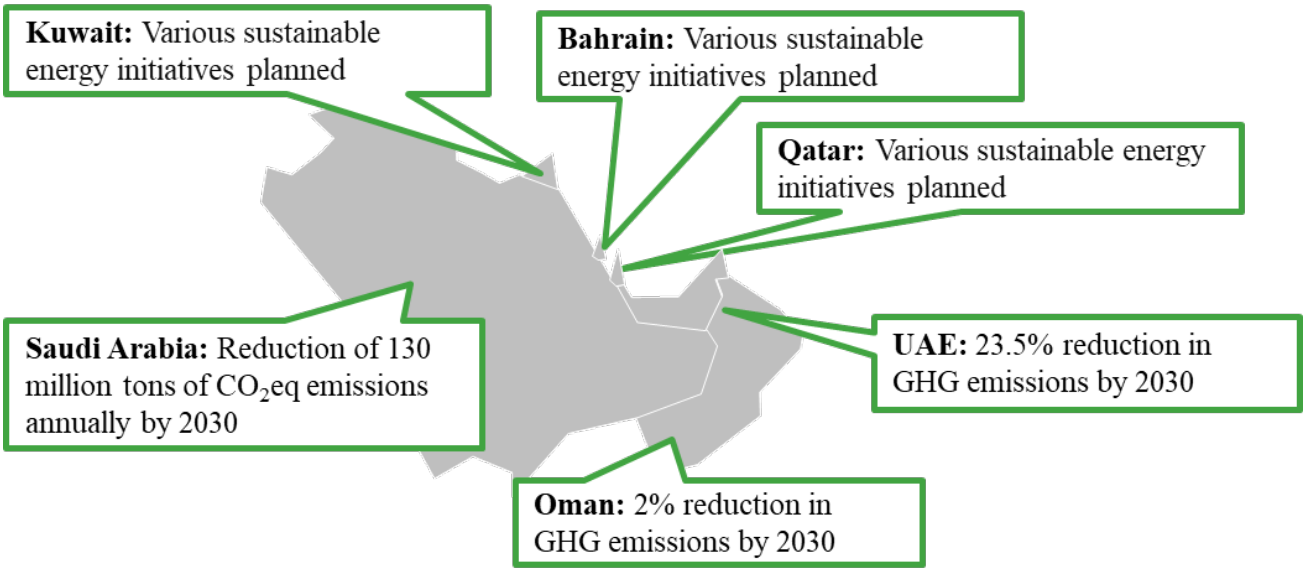

Figure 2: Nationally determined contributions of GCC countries under the Paris Agreement

As the world gears itself for a critical decade of climate action until 2030, countries and local governments around the world are drawing up new plans and targets for the first update of their voluntary commitments under the Paris Agreement. Several countries and local governments have already pledged ambitious targets, including commitments for net-zero emissions by or before 2050 by the UK, France, Denmark, Sweden, New Zealand, Japan and South Korea among others. According to a press release by the UNFCCC, the number of commitments to net-zero carbon emissions by 2100 from local governments and companies have also ballooned[1].

Given the strong pace of technological improvement and the growth of policy and implementation capabilities in the GCC region, we expect higher targets from the region in its second round of commitments. The UAE is the first GCC country to update its commitments in December 2020, targeting a 23.5% reduction in GHG emissions by 2030.

[1] https://unfccc.int/news/commitments-to-net-zero-double-in-less-than-a-year

While commitments to climate change mitigation contribute to raising ambitions in the GCC region for sustainable energy, cost competitiveness remains a key driver for action. Regional strategies are therefore expected to favour energy sustainability measures that have a strong economic rationale.

When determining their commitments and strategic targets going forward, countries of the GCC can now rely on a more robust base of strategies, institutions, and programme experience. However, past experiences in energy target setting have been mixed. In the following points, we provide some pragmatic considerations for the target-setting process, based on our and our peers' experiences in government energy policy:

1) **Medium to long-term targets should be aspirational**, as opposed to incremental. The fast-moving character of the sustainable energy industry tends to offer much more opportunity than is planned for with typical incremental target-setting methods. Furthermore, ambitious government targets increase the likelihood of their achievement as the private sector mobilises in response to a business opportunity. With this in mind, aspirational targets should address achievement of universal imperatives (such as health, safety and climate change mitigation). This would stimulate a culture of positive ambition where hunger for new opportunities is encouraged, while risk of failure is actively de-emphasised. A key step in moving towards aspirational targets is ensuring that the strategic planning process is started with independent evaluations, adding top-down approaches to the bottom-up methods that are typically used by implementing entities driving the process.
2) Metrics and calculations used in **target-setting should follow internationally recognised methodologies**, such as those outlined in ISO 17742, ISO 50049, or the GHG Protocol, allowing benchmarking across countries and stimulating competition on the targets themselves.

Given the global trend towards stronger climate change mitigation action, we hope that higher, more aspirational targets with internationally comparable metrics will soon be widespread in all the GCC countries. The sustainable energy industry in the GCC is expected to grow rapidly to fulfil existing targets and future aspirations. In this paper, we identify and examine some barriers currently affecting growth of the sustainable energy sector in the GCC region, and suggest game-changers that may remove these barriers.

4 Barriers

As mentioned previously, the sustainable energy sector in the GCC region has grown tremendously over the last decade. There is now a robust set of ESCOs, energy auditors, advisory firms, and certification bodies in the region. Involvement of governments in shaping long-term strategies ensured that programmes were broad in scope and enjoyed significant stakeholder alignment. Looking at the UAE as an example, Ras Al Khaimah Energy Efficiency & Renewables Strategy 2040, Dubai Clean Energy Strategy 2050, and Abu Dhabi Demand Side Management and Energy Rationalization Strategy 2030, all comprise a range of initiatives addressing a broad spectrum of opportunity areas. Not all territories in the GCC region have strategies of similar breadth, however success of the first cases suggests that more territories may gradually follow this example.

While the breadth of some sustainable energy programmes is remarkable, the depth of intervention is still limited. To name some key examples; minimum sustainability standards for new buildings are still far from those adopted in other developed markets; retrofit programmes are addressing a small fraction of the building stock, leaving significant opportunity in important building types (e.g., residential) largely unaddressed; adoption of distributed renewable energy, with the notable exception of the Shams Dubai programme, is minimal; key levers of system efficiency, such as demand response, are only marginally adopted; and transport efficiency is addressed only in selected areas.

A study of the regional sustainable energy market in the context of the evolution observed in other mature markets reveals some key barriers. These barriers should be addressed in order for existing strategies to achieve their desired outcomes. We have identified the following main market barriers in the GCC region:

1) **Misaligned incentives between utilities and end-consumers:** The electricity sector in the GCC region has been driven by investments by power and water corporations typically owned and managed by the state. Frequently these utilities enjoy exclusivity in large parts of their business (e.g., sales to certain or all customer groups) and have a relevant influence on industry regulation. This type of competitive structure seems to favour centralised interventions to sustainable energy, as opposed to market-driven approaches. For example, utility-scale solar PV installations are being widely adopted, as they represent a way for utilities to reduce their generation costs; while on the other hand, distributed solar PV installations, have only been marginally adopted (Dubai being an exception), as they inherently pass on part of the utility margin to end-consumers. In such a setup, additional incentives or government / regulatory mandates may be required, in order to incentivise capital investments from potential market participants, where those investments result in system benefits.
2) **Split Incentives between building owners and tenants:** A significant share of real estate in the region is owned by investors and leased to residential or commercial tenants. This has often resulted in a divergence of incentives between owners and tenants (known as the split incentive problem), preventing implementation of energy efficiency measures in the concerned properties. Apart from some development models (e.g., buildings with centralised cooling, where cooling charges are borne by owners), building owners who rent their property get no direct benefit from energy efficiency improvements, as the energy savings are captured by tenants occupying the building. On the other hand, tenants rarely invest in those same measures,

since their payback period is much longer than the typical term of the tenants' lease contracts. As a result, energy efficiency measures in tenanted buildings are rarely implemented after a building is developed.

3) **Tariff Subsidies:** Electricity and water tariffs for local citizen homes and farms are subsidised to varying degrees in many countries of the GCC region. Although these subsidies were largely phased out in Saudi Arabia and Bahrain after the oil price crisis of 2016, and Oman announced plans for their gradual elimination, they remain significant in other GCC countries. These subsidies distribute the total cost of energy and water between the consumer and the utility. As a result, the benefit of any potential efficiency measures is also distributed in the same proportion. This has led to drastic underinvestment in energy and water efficiency in the homes of these subsidised customers, as neither the customer, the utility, nor the state has a strong business case for such investments. This is illustrated in the graphic below[2].

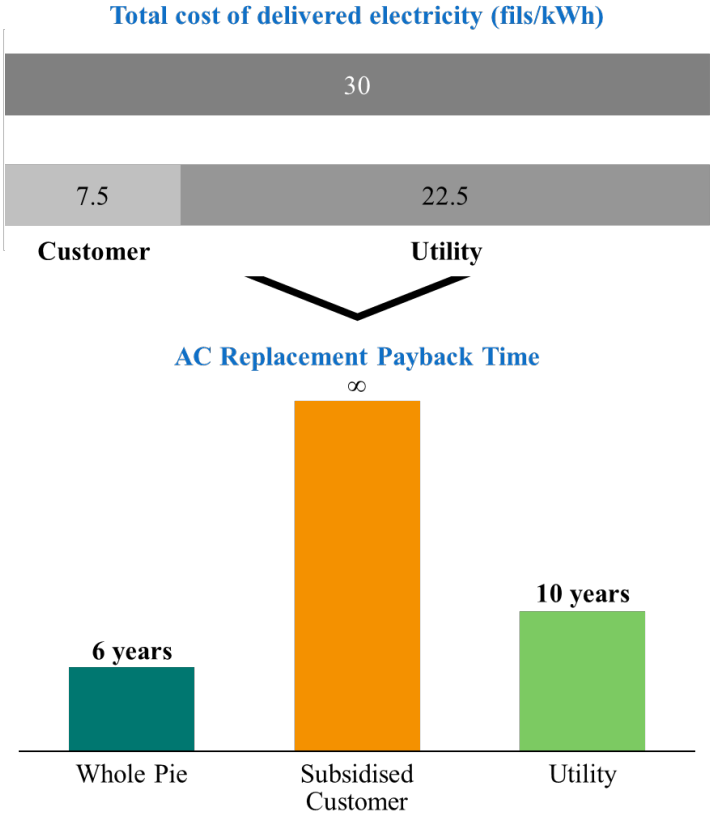

Figure 3: Effect of subsidies on the business case for AC replacement with a more efficient type (illustrative figures, based on examples, disguised vs. specific market situations)

In those cases where subsidies are provided by the utility itself, this typically happens by recovering subsidy costs from other customer groups (e.g., industrial, commercial), whose utility costs may end up being uncompetitive. This ultimately affects or distorts industrial and commercial investment decisions in local markets.

4) **Infrastructure readiness for future energy transitions:** There are several global "transitions" currently underway, in the way that energy is produced, stored, delivered and

[2] Payback time calculations are for replacement of a 1.5-ton ESMA 1-star split AC with an ESMA 5-star split AC of the same capacity, costing AED 2,800. A discounting rate of 5% was also considered.

used. Some examples include the gradual electrification of transport and industry, the blending or replacement of natural gas with hydrogen, and the proliferation of distributed renewable generation. The countries of the GCC are participating in some of these transitions – notably the UAE has several programmes and incentives in place to promote electric vehicles. Many of these transitions require major changes or upgrades to existing energy infrastructure. For example, widespread adoption of electric vehicles (EVs) requires the development of public EV charging station networks and availability of private charging facilities at residences and offices. Deploying such a network would require expensive upgrades of electricity grid connections and buildings, extending well beyond key urban centres and taking a country-level approach as a minimum.

5) **Lack of financing mechanisms:** Energy efficiency and renewable energy projects are typically capital intensive, requiring easy and affordable access to capital. Small-scale and accessible green financing for sustainability projects remains largely unavailable in the region. Only recently in the region have some banks started to offer green finance solutions to large corporate customers, while those types of financial products remain largely unavailable for SMEs and individuals.

6) **Shortage of local supply:** Exploitation of new technologies or business models requires sufficient market opportunity to encourage the private sector to deploy capital and expertise. In the GCC region, government strategies have supported the development of such markets through mandates and programmes for sustainable energy adoption, not typically accompanied by support for local businesses. The consequences of this are three-fold: solutions are typically imported and not always suitable for local conditions, costs are higher than they would be if products and services were locally created and some of the benefits of new markets are lost - employment opportunities in particular.

There are certainly other barriers to be addressed when pursuing high ambitions in sustainable energy. Lack of awareness and local capacity limitations in terms of skills are typically pointed at as barriers to deployment. However, we believe that lack of awareness and capacity are to a large extent by-products of the above mentioned key barriers. Once those barriers are removed, the improved business case of sustainable energy investments is likely to result in higher demand for solutions, which should support the development of local skills, with minimal need for government intervention. In an environment where these barriers are removed, we expect the market to move from a situation where the sustainability agenda is promoted by the government as a strategic priority, to a situation where sustainability is demanded by individuals and businesses to improve cost-effectiveness and create competitive advantage.

5 Game Changers

In this section, we present some ideas that can remove or reduce the barriers identified above. These are presented in four categories – those that allow participation in the sustainable energy industry, others that incentivise such participation, some future-readiness actions and finally ideas to seed centres of excellence in sustainable energy. In some cases, the socio-economic changes caused by the COVID-19 pandemic may also present certain other advantages to removing these barriers, which we elaborate on in the next chapter.

5.1 Allowing Participation

We believe that end-consumers should be free to participate in renewable energy deployment and benefit from its adoption (in terms of reduced energy costs). This can be ensured either by the utility companies themselves or by the relevant regulatory bodies through two particular policies:

Game Changer 1. Attractive business models for distributed renewables and energy storage

Under a net-metering or net-billing policy, end-consumers of electricity can install small-scale renewable energy systems like solar PV at their premises, and be charged by the utility only for the net energy they draw from the grid. Distributed renewables deployment should be encouraged also because it is known to create a higher number of skilled jobs compared to other initiatives in the energy sector, including equivalent utility-scale renewables deployments[3]. The existing net-metering policy framework in Dubai has led to the development of a substantial local renewables industry. Other leading net-metering frameworks around the world set worthy examples, such as those from California[4] or Delhi[5], or net-billing frameworks from Singapore[6], Arizona or New York[7]. Further options supporting distributed energy storage (i.e. fixed storage at consumer premises as well as vehicle to grid protocols) may also be explored to enhance system value and grid resilience.

In some cases, net-metering may impose a financial burden on utilities, as they are forced to remunerate distributed generation at many times their own marginal generation cost. Feed-in tariffs based on the marginal cost of energy can solve this problem, while also supporting grid stability by discouraging consumers from producing more energy than their own needs. Examples of countries that have adopted innovative feed-in tariff models include Germany[8] and Indonesia[9].

Game Changer 2. Open access to the grid

In the dense community developments that are typical in the urban areas of the GCC (e.g., high-rise urban areas, industrial areas), open space limitations do not allow onsite renewable energy installations that fulfil a relevant share of the energy needs of individual energy users or of the community. Medium-sized renewable energy plants situated in nearby empty land or distributed across public spaces in the community could benefit these communities by supplying relatively low-cost energy to

[3] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jun/IRENA_RE_Jobs_2019-report.pdf
[4] https://www.cpuc.ca.gov/general.aspx?id=3800
[5] http://www.derc.gov.in/sites/default/files/DERC%28Group%20Net%20Metering%20and%20Virtual%20Net%20Metering%20for%20Renewable%20Energy%29%20Guidelines%2C%202019.pdf
[6] https://www.ema.gov.sg/cmsmedia/Enhanced%20Central%20Intermediary%20Scheme%20%20Final%20Determination.pdf
[7] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Net_billing_2019.pdf
[8] https://www.futurepolicy.org/climate-stability/renewable-energies/the-german-feed-in-tariff/
[9] https://www.nrel.gov/docs/fy16osti/65503.pdf

them. Master community developers and free zone operators are best positioned to take advantage of such opportunities, given their control of public areas in their developments. The regulatory set-up needed to enable this is an "open access" policy, where large power consumers above a certain threshold can connect their renewable energy plants to nearby grid access points (substations) and supply their own consumption under specified and transparent regulations. The network utility can also benefit from such arrangements by being compensated for use of its assets (For example, "common carriage" systems were introduced in the UK water sector in the 1990s[10]). Such a system can be implemented first for the low-voltage distribution networks, where it can be based on simple rules similar to net-metering, and later be extended to transmission networks, for which additional regulatory controls are required. Open access policies have been very successful in both developed and developing economies. The example of Singapore[11] is prominent, as a city-state with a newly developed open electricity market. India is another developing region where an open access policy resulted in close to 3 GW of solar PV developments by 2018[12].

5.2 Incentivising Participation

We believe that participation of end-consumers of electricity and water is the best way to make deep and lasting progress in energy efficiency. For consumers to take initiative and participate in energy-saving measures, they need to have sufficient incentives.

It is clear, from the experience of past decades in a number of geographies, that clear economic incentives generate the highest degree of participation. The availability and consumer perception of a positive business case for sustainable energy is a necessary condition for broad participation.

Our approach consists of the following solutions to improve the system of financial and other incentives presented to the end-consumer.

Game Changer 3. Addressing Subsidised Consumer Segments

A seemingly obvious step towards improving the business case of end-consumers for energy efficiency measures is the removal of utility subsidies. Global economic impacts on government finances (e.g., the oil price crash of 2014) have induced some GCC countries, notably Saudi Arabia and Bahrain, to reduce utility subsidies in the past, while Oman has recently laid out plans for their progressive elimination.

The progressive reduction of utility subsidies, or their provision through different methods with a less direct link to actual energy and water consumption, are options to be evaluated. Another area of improvement, while subsidies continue, is the source of funds. As mentioned earlier in this paper, in some parts of the GCC region, utility companies directly provide subsidies and recover subsidy costs through higher tariffs for other customer segments. This set-up makes utilities resistant to sustainable energy initiatives even for unsubsidised customer segments, as such initiatives would reduce their profitable revenue streams, and upset the balance required for cross-subsidies. Thus, ensuring that utilities can *channel* the subsidies without *providing* the subsidies, would ultimately unlock opportunities also for unsubsidised energy consumers.

[10] https://www.ofwat.gov.uk/wp-content/uploads/2015/10/pap_con_wslacccodesguid.doc
[11] https://www.ema.gov.sg/cmsmedia/Handbook/NEMS_111010.pdf
[12] https://bridgetoindia.com/report/india-open-access-report-i-june-2018/

There are also alternatives that policy-makers may consider if a reduction of subsidies is deemed infeasible. As GCC governments ultimately bear the cost of electricity and water supply to subsidised consumers, they have a financial incentive to directly invest in reducing the energy and water consumption of subsidised end-consumers. Some initiatives of this type are already taking place. Dubai Electricity and Water Authority has invested in replacing lighting fixtures with efficient LED lights in 2,000 homes and has now extended the project to include installation of solar PV systems and efficient water fixtures in 5,000 homes[13]. In the northern emirates of the UAE, the Federal Electricity and Water Authority (now Etihad Water and Electricity Company) has invested in efficient water fixtures and fittings for more than 30,000 homes[14].

Accelerating such initiatives requires two types of interventions. First is securing medium-term financing for such energy efficiency investments. Various options exist for such financing, such as a small surcharge on utility tariffs, direct allocation from the government budget, or issuance of long-term green sukuks. Once established, such a fund may be the right vehicle to broaden such initiatives into wider energy efficiency programmes that could be managed by local governments.

Other options may exist for incentivising energy efficiency in subsidised segments. Many governments in the region already have systems in place to support home construction and improvement projects for deserving citizens. Financial support for energy and water efficiency improvements may be channelled through such existing systems, based on fulfilment of pre-defined technical and economic criteria.

Another way to improve usage and purchase behaviours may be to demonstrate the true cost of energy and water to subsidised consumers. Abu Dhabi has implemented a policy of showing the full cost of energy and water, along with the subsidised amount, in customer bills. This may encourage customers to adopt conservation measures. Oman has also announced implementation of a similar idea from 2021 – that of separating the utility tariffs from the subsidy payments[15]. Progress of this pioneering exercise is expected to inform policy-making in other parts of the GCC region in the coming years.

Game Changer 4. Addressing split incentives

Different solutions exist to address different parts of the split-incentive problem. Green building regulations, for example, induce developers and building owners to invest in energy efficiency measures in buildings, even when some of the benefits are passed on to end-users of the buildings. Energy performance ratings for buildings are sometimes introduced to ensure those investors find appropriate returns. Retrofit mandates and incentives stimulate similar investments in existing buildings.

In developed markets, many combinations of these solutions have been adopted to address split incentives. However, no silver bullet has been found against this problem. Given the fragmented nature of building regulations and the real estate industry, solutions to split incentives are also expected to be tailor-made at a local level, by local governments. Recent progress being made in green building

[13] https://www.smart4power.com/smart4power-completes-etihad-esco-mbrhe-lighting-replacement-project-in-record-time/; https://www.emaratalyoum.com/local-section/other/2019-06-15-1.1223202

[14] https://fewa.gov.ae/conservation/en/index.aspx

[15] https://www.arabianbusiness.com/politics-economics/456185-oman-to-start-removing-utility-subsidies-from-january-2021

regulations and retrofit mandates in the UAE may guide other GCC governments in this regard. However, continuous updates to green building regulations as well as the introduction of building energy performance rating systems are both necessary for an all-round approach covering both new and old building stock.

Game Changer 5. Development of financing mechanisms

Appropriate financing mechanisms improve access to sustainable energy technologies and also make sustainable energy more attractive. For example, a low-interest green mortgage for an energy-efficient building can, by itself, provide immediate cost savings to developers and homeowners, further encouraging more developers and owners to adopt efficient building technologies.

Governments could act as facilitators for financing, by introducing standards and enablers that address the typical barriers faced in developing green finance products, namely:

- Credit risk, as energy efficiency-related equipment does not usually constitute sufficient collateral for credit and
- Customer eligibility, as application of green finance products is typically conditional to certain technical features of the project, which the bank may not be ready to evaluate.

Effective enablers include standards for the provision of green mortgages or soft loans and requirements for utilities to provide on-bill financing services. Many types of energy efficiency financing mechanisms require the active participation of the government or utilities. These include for example green mortgages, soft loans, on-bill financing, grants, discounts and rebates for efficient equipment, all of which are proven to encourage clean energy deployment across several developed and developing countries.

Only some types of financing mechanisms may require direct government investments. Examples of these types include grants for retrofit projects or rebates for efficient appliances. The UAE has begun to explore some such mechanisms for promoting efficient appliances in the separate local energy efficiency strategies of Dubai, Abu Dhabi and Ras Al Khaimah, but there isn't yet a history of successful initiatives of this type in the GCC region. These types of government intervention do not always require significant budget allocations for the government. California's planned allocation for all its state energy efficiency financing programmes is only about $1 bn[16] per year, from 2018 through to 2025. This covers state grants and loans for a wide variety of measures including renewable energy, building cooling efficiency, efficient appliances, and efficient vehicles. Modest but well-managed public service funds in the GCC region, at a national or province level, which finance proven energy efficiency measures and technologies can generate strong economic returns for both recipients of funds and supply chain participants.

Large energy efficiency and renewable energy projects can benefit also from private sources of funds. In 2017, Dubai's Green Fund has already raised a significant tranche of capital through green bonds. The issuance of green bonds or green sukuks is an increasingly popular option - Green sukuks have been successfully used in Indonesia, where government entities have used transparent and well-managed green sukuks to finance several renewable energy and energy efficiency infrastructure

[16] https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Annual_Reports/CPUC%20Annual%20Report%20-%20Draft%201-31-19%20-%20page%20view%20and%20spread%20-%20red%20sz.pdf

projects[17]. Private financing can also be tapped by encouraging and gradually mandating ESG criteria in privately managed funds.

5.3 Ensuring future-readiness of energy infrastructure

Infrastructure improvements are necessary to enable certain key technologies that are expected to dominate the energy landscape of the future.

Game Changer 6. Supporting EV readiness

As previously mentioned, deeper penetration of EVs in the market would require electricity infrastructure improvements to support the ubiquitous deployment of EV charging stations. Electricity utilities may take the lead in driving these upgrades, as they would directly benefit from access to a new market for electricity sales. Readiness within master developments and individual buildings may also be encouraged through appropriate development guidelines and building codes, as well as innovative financing mechanisms or incentives driven by utilities.

Game Changer 7. Supporting distributed solar PV readiness

Distributed renewable energy, especially distributed solar PV, continues to be more and more cost-effective, as the PV technology matures and deployment techniques improve. Combined with upcoming energy storage technologies, such as lithium-ion batteries, distributed solar PV will be able to provide acceptable service levels at costs comparable to or less than conventional utility supply. To take advantage of this transition, buildings need to be ready for solar PV installations. Basic measures to ensure such readiness (such as minimum structural strength of the roof, cable pathways from the roof to the electrical cabinets, and space for inverters at the electrical cabinets) usually have negligible costs in the context of building construction. Municipal bodies may support these measures, by encouraging or mandating rooftop solar PV readiness and building-integrated PV through building regulations.

Game Changer 8. Considering green hydrogen readiness

Green hydrogen, produced using renewable energy, is expected to play an increasingly larger role as a carbon-neutral fuel for industry and transportation, in particular those applications that may be hard to electrify. To participate in this long-term transition towards green hydrogen, a holistic approach extending across the value-chain should be considered, e.g. hydrogen-readiness of new and existing natural gas infrastructure and demand-side preparation in industry, mobility and domestic uses. Availability of cheap renewable energy in the region may support broader strategies that extend beyond the region, for hydrogen production and export (potentially in the form of ammonia).

5.4 Developing local supply capabilities and energy champions

A robust supply market, consisting of research and development centres, manufacturers, distributors, and solution providers; is necessary to obtain the full potential value of energy efficiency and renewables. An augmented local supply of innovative products and services will spur the creation of its own demand. We suggest some ideas to develop local supply capabilities below:

Game Changer 9. Localising technology value chains

[17] https://www.djppr.kemenkeu.go.id/page/loadViewer?idViewer=9468

Active and deliberate government initiatives are needed to encourage and guide technology localisation in the energy sector in the GCC, which will eventually create or adapt solutions specific to the GCC region. Experiences from other regions, however, suggest the need for targeted government involvement in local industrial development. For example; in India, the local development and manufacturing of LED lights and ACs only matured after the government invested in bulk procurement of efficient equipment through its super-ESCO, EESL. When a local base of technology development and manufacturing exists, competitive pressures between local and imported products will result in development of cost-effective solutions to suit regional conditions (e.g. climate conditions) and the needs of regional investors and end-users.

Looking beyond existing technology, new sustainable energy solutions are being developed today by both established companies and technology entrepreneurs in other geographies. Some examples of early successes include Phononics (USA) and Airbitat (Singapore) in refrigeration and outdoor cooling, Opower (USA), Nest (USA), and MyHeat (Canada) in energy management using big data, Dandelion Energy (USA) in ground-source heat pumps, Energy Vault (Switzerland) in medium-term energy storage, and Ciel et Terre (France) and Scotra (Korea) in floating solar solutions.

The GCC countries should support local development of such new technologies in addition to localisation of existing technologies. Initiatives such as start-up incubators, technology accelerators and venture capital funds are already available in many parts of the GCC region. More such initiatives are needed, with a particular focus on new energy and sustainability start-ups and technologies. There may also be a strong case for utilities and research institutions of the GCC region to form partnerships with developers of promising new technologies, to develop locally adapted solutions.

Game Changer 10. Creating global energy champions

Some important institutions have been built in some niches of the sustainable energy sector in the GCC region. Examples include Masdar in sustainability research and renewable energy development, ACWA Power in renewable energy and desalination, and Bee'ah in waste management and recycling. Such institutions are vital to the growth of local capabilities, as they preserve and continuously polish the knowledge, expertise, skills and other physical and intellectual capital of the GCC in sustainable energy. The GCC region serves as a natural initial market for such institutions, where, with support from the GCC governments, they can acquire scale, expertise, and develop competitive advantages. At a critical scale, such institutions can become global energy champions, driving exports and international influence for the region in the future, and competing with western energy giants like EDF (Électricité de France) or ENGIE.

6 Opportunities

Implementation of the game changers unlocks a plethora of opportunities in the GCC region's sustainable energy industry.

The introduction of attractive revenue models for distributed renewables, as well as the definition of policies for open access to the grid, would open the way to opportunities such as the adoption of multiple renewable energy sources, grid efficiency through storage, system efficiencies in electric mobility. Addressing subsidised consumer segments and split incentives would unlock major opportunity in buildings, such as energy efficiency retrofits, adoption of modern home automation and smart home solutions. The adoption of dedicated financing mechanisms would allow the introduction of facilitators, such as rebate programmes, soft loans, grants, which have been very successful in promoting sustainable energy in other regions. The development of local capabilities through localisation and growth of market champions would support a more competitive industry, resulting in deeper adoption of technology locally and sustained competitive advantage for the region.

A few examples of opportunities resulting from the game changers are mapped in the illustration below. The map is not intended to be comprehensive, but just illustrative of the broad space that can be opened up for the growth of sustainable energy in the region.

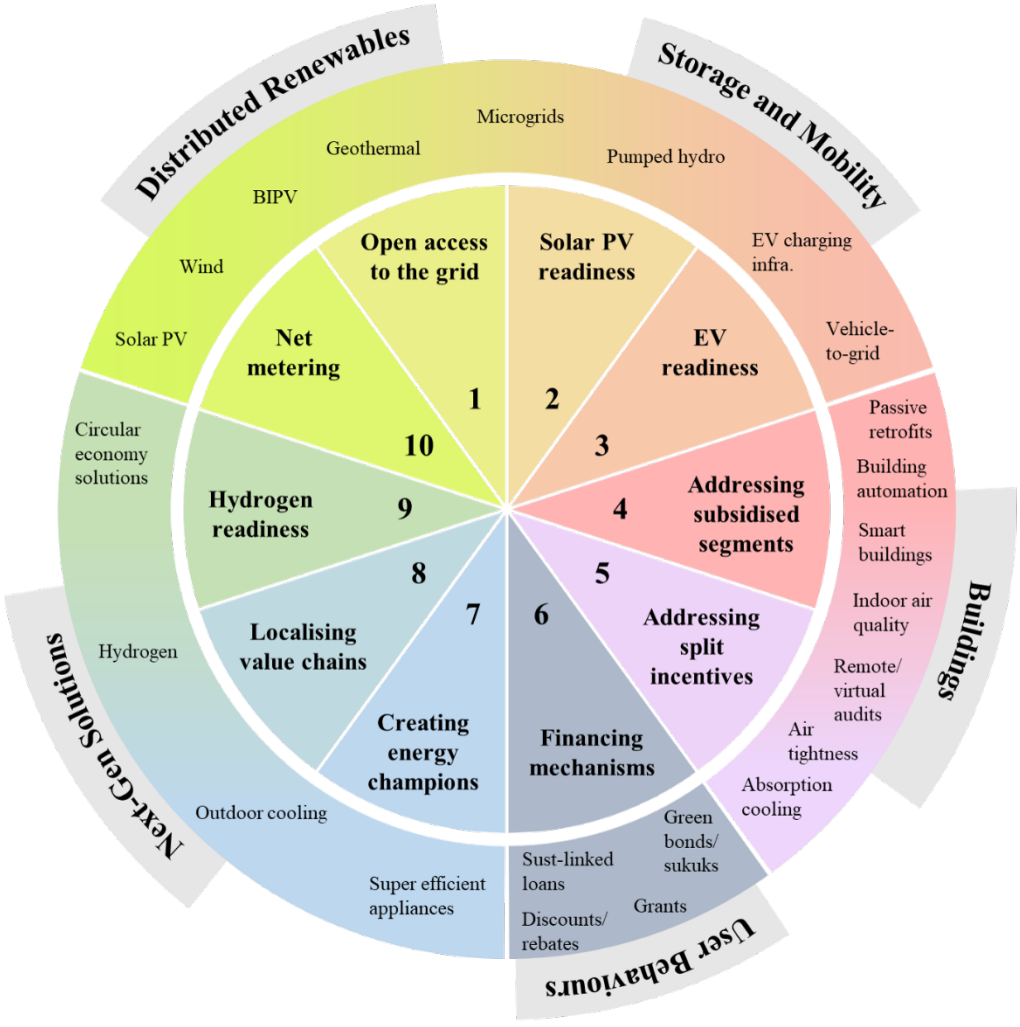

Figure 4: Examples of sustainable energy opportunities resulting from the identified game changers

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