

# RECENT REVIEW OF ENERGY CONSERVATION PLANS AND TARGETS IN THE GULF COOPERATION COUNCIL REGION: BARRIERS AND CHALLENGES

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## ABSTRACT

In some parts of the world, such as the Gulf Cooperation Council (GCC) countries, the fast growth of societies supported by rich energy resources, mainly oil and gas, has resulted in expansive urbanization and reliance on increased levels of fossil fuel to completely support new forms of excessively enhanced lifestyles. Despite the small size of their populations, they consume almost as much oil and gas as Indonesia and Japan combined and greater than Africa. Recently, some GCC governments have publicly recognized the unsustainable nature of energy consumption patterns, or at least the tremendous waste they incur. The electricity sector, industry sector and transport sector account for an average of 70%, 50%, and 30% respectively of the total of energy consumption in the countries. This research aims to discuss common and cooperative approaches that could improve energy-efficiency and reduce energy consumption as well as CO<sub>2</sub> emissions in all disciplines. The results confirm the importance of the following factors considering energy conservation: the importance of governance, the need for integration of renewable energy targets and the potential for greater effectiveness through cooperation at the regional level. This research concludes that although all of the GCC countries now have clean energy plans or targets and there are several impressive steps towards conservation but the effectiveness of these clean energy plans is still immature in terms of energy efficiency strategies and reduction of CO<sub>2</sub> emissions. Therefore, it is vital to improve clean energy plans in order to promote energy conservation in the Gulf region.

*Keywords: renewable energy, energy efficiency, transport sector, electricity sector, industry sector, Climate change, energy consumption, energy plans and targets, CO<sub>2</sub> emissions, and GCC governance.*

## 1 INTRODUCTION

Discussing the energy policy of the Gulf Cooperation Council (GCC), the GCC was established in 1981 and comprises of the six Arab states of the Persian Gulf (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and UAE). Furthermore, about 40% of the world's proven oil and 23.6% of the world proven gas are carried by GCC countries. As a result, they consume almost 100% of energy that is produced by combustion of oil and gas. Apart from that the GCC have the highest energy consumption in almost every sector – electricity and cogeneration, industry, transport, and non-energy use. CO<sub>2</sub> emissions are soaring along the energy use and contribute to international climate change.

Moreover, the Climate Change Performance Index (CCPI) [1] assessed and compared the climate protection of 57 countries, including the GCC countries, responsible for more than 90% of global energy-related CO<sub>2</sub> emissions. The CCPI ranked Saudi Arabia on the bottom of the list. In 2019, Sweidan [2] stated that the average consumption ecological footprint of the GCC countries (8.9 gha/person) is higher than the world's average consumption ecological footprint. However, the GCC government worked on proposing energy targets and standards throughout integrated energy strategy based on diversification and efficiency targets and moved away from the hydrocarbon sector, aiming energy efficiency.

Consequently, adapting targets such as the share of renewable energy targets and intensity targets could be advantageous to current energy policy and targets of GCC countries and



have the potential to work and expand beyond national targets level to regional targets level of the GCC countries as well as contribute positively to climate change.

Finally, this paper discusses first the energy consumption and energy use of the GCC countries, second evaluates the current energy targets and strategy and its limitations, and third reviews the previous studies considering the potential of adapting national and regional target level solutions.

## 2 ECONOMIC AND ENERGY OF THE GULF REGION

Since the discovery of oil in 1930s, the Gulf Cooperative Council (GCC) countries relied heavily on oil and gas as a primary source of income. As they employ oil and gas sales revenues to improve economic development, which led to unprecedented modernisation and industrialisation in both urban and rural levels [2], [3].

As result, in 2011, the GCC countries consumed as much oil and gas as Indonesia and Japan combined, with an average of 6% over last decades and it expected to be doubled by 2024 [4], [5]. The following points discuss the current energy consumption and the structure of energy usage in the gulf region.

### 2.1 The GCC countries: Energy consumption and structure of energy usage

The energy consumption of the GCC countries has been rising over the last decades. One of the main contributors of increasing the energy consumption is the population growth rate [2]. The number of populations in the GCC countries reached approximately 5.8 million inhabitants in 2019 [2]. In addition, based on United Nation data (2009), the average rate of population growth will increase 1.29% higher in (2010–2050) [6].

However, there are others energy consumptions' contributors such as, water desalination – as the GCC countries suffer from water scarcity and desertification – low energy price, and high economic growth rate [1], [2], [7].

Moreover, a comparison study was made by Sweidan [2] to display the energy use, electricity consumption (kw/h) per capita and the CO<sub>2</sub> emission per capita of the GCC countries compared to three industrial countries (Japan, France, and UK), during the period (1971–2014). The results showed that for the energy use of the GCC is 2.3 times more than the three industrial countries as shown in Table 1. Furthermore, for the electricity consumption of the GCC, as described in Table 2, is larger than the individual of industrial countries by around 1.50 times. In addition, for CO<sub>2</sub> emissions of the GCC reached 1.78% during the period (1997–2014) and expanded to 2.49% during the period (2000–2014), as shown in Table 3 [2]. Therefore, the GCC countries require a serious efficiency policy intervention. In order to ensure the appropriate design of these intervention, it is important to first explore the structure of energy usage in each country of GCC.

#### 2.1.1 The structure of energy usage

Fig. 1 illustrates a basic sectorial breakdown of energy consumption in each GCC countries representing the four main segments (electricity and cogeneration, industry, transport, and non-energy use) [4], [5]. This shows that the electricity sector is the highest energy consumption which accounts for 70% of total energy consumption in the GCC countries. Buildings represent a high portion of electricity consumption for all GCC countries. In addition, the industry sector accounts for near to 50% of total energy consumption, Qatar represents the largest portion of industry consumption in the GCC countries. Furthermore, transport sector accounts for almost 30% of total energy consumption, Saudi Arabia shares

the highest energy demand for transportation, where it is double of that of the other countries. This is due to its larger land area and size.

Based on the differing structure of energy use, the government of GCC countries have publicly noticed the unsustainable nature of energy consumption patterns and the tremendous waste of nature resources. As a result, the Gulf Cooperation Council (GCC) announced the current energy policy and strategies. Therefore, in order to address energy efficiency, it is vital to evaluate the current energy policy and targets, and its limitations.

Table 1: Energy use (kg of oil equivalent per capita) of the individual GCC and three industrial countries. (Source: World Bank Development Indicators, and a comparison study by Sweidan [2].)

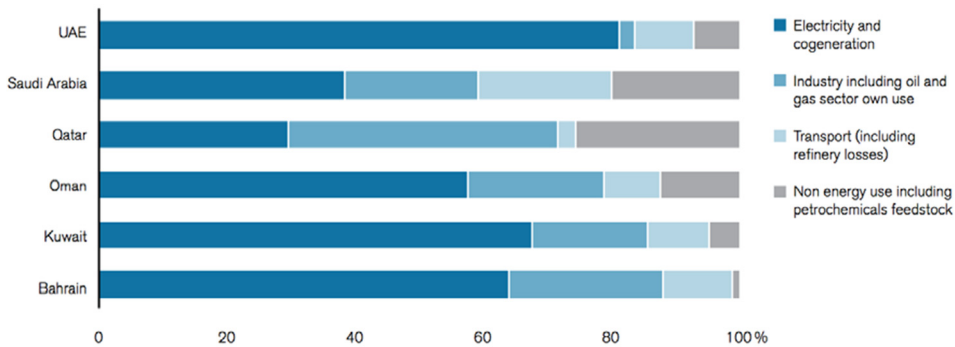
Years	Energy consumption (kg of oil equivalent per capita)								
	Bahrain	Kuwait	Oman	Qatar	KSA	UAE	Japan	France	UK
1971	6.39	7.64	0.11	7.75	1.21	3.63	2.53	3.02	3.73
1980	7.80	7.62	1.00	14.80	3.19	6.94	2.95	3.47	3.52
1985	9.92	8.07	1.41	15.22	3.49	9.86	3.01	3.59	3.55
1990	10.56	4.34	2.33	13.70	3.55	10.98	3.55	3.83	3.60
1995	11.41	9.18	2.77	15.87	4.51	11.31	3.94	3.98	3.73
2000	11.99	9.13	3.34	18.44	4.71	9.99	4.08	4.14	3.79
2005	11.68	11.54	3.94	19.27	5.13	9.72	4.06	4.29	3.69
2010	10.21	10.70	6.15	15.53	6.76	7.46	3.89	4.02	3.23
2014	10.59	8.96	6.14	18.56	6.94	7.77	3.47	3.66	2.78
<b>Avg.</b>	<b>10.07</b>	<b>8.10</b>	<b>2.77</b>	<b>15.54</b>	<b>4.12</b>	<b>8.58</b>	<b>3.45</b>	<b>3.76</b>	<b>3.57</b>

Table 2: Electricity consumption (kW/h) per capita of the individual GCC and three industrial countries (in thousand). (Source: World Bank Development Indicators, and a comparison study by Sweidan [2].)

Years	Electricity consumption (kW/h per capita)								
	Bahrain	Kuwait	Oman	Qatar	KSA	UAE	Japan	France	UK
1975	2.63	4.17	0.15	3.80	0.53	2.32	4.03	3.25	4.49
1980	4.61	6.06	0.62	9.72	1.97	5.75	4.72	4.42	4.68
1985	15.93	8.17	1.47	10.07	3.07	8.63	5.33	5.26	4.83
1990	15.62	8.22	2.19	9.59	4.02	8.50	6.81	5.97	5.36
1995	20.55	13.15	2.58	10.74	4.93	9.40	7.70	6.62	5.58
2000	20.01	14.07	3.20	14.35	5.66	12.31	8.30	7.22	6.11
2005	21.33	17.08	3.92	15.46	6.62	12.28	8.54	7.65	6.27
2014	19.60	15.59	6.45	14.78	9.40	11.09	7.82	6.94	5.13
<b>Avg.</b>	<b>15.40</b>	<b>11.57</b>	<b>2.78</b>	<b>11.53</b>	<b>4.79</b>	<b>9.04</b>	<b>6.85</b>	<b>6.19</b>	<b>5.40</b>

Table 3: CO<sub>2</sub> emissions per capita of the individual GCC and three industrial countries.  
(Source: World Bank Development Indicators, and a comparison study by Sweidan [2].)

Year	CO <sub>2</sub> emissions per capita (t)								
	Bahrain	Kuwait	Oman	Qatar	KSA	UAE	Japan	France	UK
1971	13.80	33.88	2.80	76.64	9.80	75.98	7.55	8.81	11.82
1975	21.59	16.42	8.23	66.64	11.2	56.05	7.77	8.24	10.74
1980	21.92	17.98	5.24	58.53	17.39	35.40	8.11	9.13	10.29
1985	24.31	16.77	5.78	33.43	13.09	35.89	7.58	7.06	9.90
1990	25.06	24.29	6.28	24.71	11.38	27.96	8.87	6.42	9.71
1995	26.29	34.04	7.21	61.91	12.55	28.85	9.43	5.86	9.28
2000	28.05	26.12	9.65	58.64	14.3	35.68	9.62	5.95	9.2
2005	21.60	31.43	11.90	58.92	16.63	25.36	9.70	6.10	8.98
2010	23.59	29.89	15.59	40.74	18.91	19.44	9.15	5.43	7.86
2014	23.45	25.22	15.44	45.42	19.53	23.30	9.54	4.57	6.50
2016	22.23	24.95	14.17	38.90	17.37	22.04	8.94	NA	5.78
<b>Avg.</b>	<b>23.57</b>	<b>23.76</b>	<b>9.03</b>	<b>52.29</b>	<b>14.88</b>	<b>34.46</b>	<b>8.77</b>	<b>6.85</b>	<b>9.34</b>



Source: IEA data, 2012.

Figure 1: Basic sectorial breakdown of energy consumption in the GCC countries [4], [5].

### 3 THE CURRENT ENERGY POLICY AND TARGETS IN THE GCC, AND ITS LIMITATIONS

Since the global awareness of sustainability has started to set a trend amongst decision-makers and developers in all the GCC countries. A remarkable progress has made toward clean energy targets and efficiency strategies by members of GCC. Moreover, a coordinating project made by Chatham House with regional partners of the GCC to consider energy targets and strategies [8]. Fig. 2 illustrates the basic overview of energy targets and strategies of the GCC countries made by Chatham house, where the black dots represent targets and standards set at national level, blue dots represent targets applied to a specific part of the economy, and the outlined dots show targets and standards at the study or proposal stage [8].



● Target or mandatory standard announced at official national level    ● Partial / Sector specific (in the case of Oil & Gas Sector = national oil company target)  
○ Target or standard aspirational or under proposal    ●\* Imported from Abu Dhabi

NATIONAL TARGETS & STANDARDS	GCC	SAUDI	UAE	ABU DHABI	DUBAI	OMAN	KUWAIT	QATAR	BAHRAIN
NATION-WIDE									
LOW EMISSIONS DEVELOPMENT STRATEGY									
GHG OR CO2 EMISSIONS REDUCTION TARGET									
ENERGY EFFICIENCY/CONSERVATION TARGET		○							
POWER AND WATER									
ELECTRICITY SECTOR CONSERVATION TARGET		○		●	●	●			
ELECTRICITY SECTOR PEAK DEMAND REDUCTION TARGET		○		●		○			
RENEWABLES DEPLOYMENT TARGET		●		●	●		●	○	●
NUCLEAR INTRODUCTION TARGET		●	●	●	●*				
WATER INTENSITY/CONSERVATION TARGET			○						
TRANSPORT									
TRANSPORT SECTOR ENERGY CONSERVATION TARGET									
VEHICLES EFFICIENCY STANDARDS									
APPLIANCE AND INFRASTRUCTURE									
ENERGY EFFICIENCY LABELLING		●	○	●	●				
APPLIANCE STANDARDS		●	●	●	●		●	●	●
MANDATORY EFFICIENCY CODES FOR NEW BUILDS	○	●		●	○		●	●	
NATIONAL RETROFITTING TARGETS									
INDUSTRY INTENSITY/EFFICIENCY TARGETS									
OIL AND GAS SECTOR									
EFFICIENCY/CONSERVATION TARGET		●							
FLARING REDUCTION TARGET				●		●	●	●	
OTHER SECTORAL EFFICIENCY/CONSERVATION TARGETS									

Figure 2: Targets and standards affecting energy use in the GCC countries. (Source: GCC Energy Intensity Project, 2013.)

Furthermore, Table 4 illustrates a summary of the energy targets and standards for the GCC countries. This shows the most significant efforts of GCC regarding coordinated energy targets and strategies. Dubai launched the first integrated energy strategy in the region – a plan for energy diversification and efficiency targets for 2030 in 2011 [5], and Abu Dhabi was a head as being the first region to set renewable energy targets of 7% by 2020 in 2009 [4], while Saudi Arabia have high ambitious to expect that by 2032 renewable energy with nuclear baseload will reduce fossil fuel generation to meet peak demand during the summer month [5]. Regarding building efficiency-standards, most of GCC countries are considering the issue related to reducing energy demand by pursuing innovation building standards and codes [4], [8]. The most progressive building standards in the region are in Abu Dhabi and Dubai in the UAE, and Qatar. Abu Dhabi's Estidama Pearl Rating System, which began to be applied in 2010, was the first of its kind in the region to highlight on international best practice but with adaptations to suit the local climatic conditions, the Green Building Code (GBC) in Dubai is the only established green code in the region, while Qatar has pioneered the Global Sustainability Assessment System (GSAS) in which energy and water efficiency.

On the contrary, the GCC countries have no energy targets to reduce fuel demand in transport or standards for vehicle efficiency. As for transport sector, although there is a remarkable growth in car use and sprawl urbanization, this requires to think efficiency in transport at earlier stage than in power sector [8]. However, there are several steps toward diminishing transport emissions. As municipal authorities have developed plans for public transport in the last couple of years. Each country of GCC now has plans to introduce new metro systems such as Dubai's metro system [8]. In addition, in 2003, the Gulf Standard Authority (GSA) set a mandatory vehicle exhaust emission standard for new imported

Table 4: A summary of the energy targets and standards for the GCC countries.

Energy targets in the GCC countries, mid-2013					
Country	Administrative institution dealing with energy policy	Efficiency	Renewable energy (RE)	Nuclear	Under study
KSA	Electricity load management and demand side management (ECRA, Saudi Arabia)	<ul style="list-style-type: none"><li>14% reduction of electricity peak demand planned by SEEC and 8% consumption reduction by ECRA</li></ul>	<ul style="list-style-type: none"><li>5GW of solar power by 2020.</li><li>By 2032, RES are planned to reach 54.1 GW by 23.30% from power generation capacity (PGC)</li><li>41 GW solar energy (25 GW GSP/ 16 GW PV), 9 GW from wind, 4 GW thermal + waste energy</li></ul>	<ul style="list-style-type: none"><li>17 GW Reduction 18–20% PGC by 2032</li></ul>	<ul style="list-style-type: none"><li>Bring energy intensity in line with G7 countries (SEEC).</li></ul>
Kuwait	Environment Public Authority	N/A	<ul style="list-style-type: none"><li>The share of RE is planned to reach 1% by 2020 and will be expanded up 15% by 2030</li></ul>	N/A	N/A
Qatar	Tarsheed campaign (KAHRAMAA, Qatar General Electricity and Water Authority), Qatar	<ul style="list-style-type: none"><li>20% decrease in per capita electricity consumption by 2017</li><li>35% reduction in per capita water consumption by 2011</li></ul>	<ul style="list-style-type: none"><li>RE is planned to reach 2% by 2020.</li><li>By 2030, RE share will reach 20%</li></ul>	N/A	N/A
Abu Dhabi	Comprehensive Cooling Plan (Cooling Taskforce, Executive Affairs Committee, Abu Dhabi)	<ul style="list-style-type: none"><li>Reduce electricity demand by 15% of 2010 demand by 2020 (4,500 GWh/year out of a total demand</li></ul>	<ul style="list-style-type: none"><li>800 MW of solar power by 2020, with 7% RE share</li></ul>	<ul style="list-style-type: none"><li>4 nuclear power plants (5.6 GW) planned for 2020 and will be extended 12% by 2030</li></ul>	N/A

Table 4: Continued.

Country	Administrative institution dealing with energy policy	Energy targets in the GCC countries, mid-2013			
		Efficiency	Renewable energy (RE)	Nuclear	Under study
Dubai	Dubai Supreme Council of Energy (DSCE) (est. 2009)	<ul style="list-style-type: none"> <li>Reduce BAU projected power consumption by 30%, by 2030</li> </ul>	<ul style="list-style-type: none"> <li>The share of RE reach 1% by 2020 and will be increased up to 5% by 2030</li> </ul>	<ul style="list-style-type: none"> <li>12% nuclear-powered electricity sourced from Abu Dhabi by 2030</li> </ul>	N/A
Oman	Reduction of losses in electricity transmission (AER, Oman)	<ul style="list-style-type: none"> <li>Reduce transmission and distribution losses in power sector from 14% in 2010 to 10% in 2014</li> </ul>	<ul style="list-style-type: none"> <li>The share of RE reach 10% of total electricity consumption by 2020</li> </ul>	N/A	<ul style="list-style-type: none"> <li>Electricity peak demand reduction target</li> </ul>
Bahrain	Public Commission for the Protection of Marine Resources, Environment and Wildlife	N/A	<ul style="list-style-type: none"> <li>The share of RE is planned to reach 5.7% from PGC by 2030</li> </ul>	N/A	N/A

vehicles into the GCC countries. Moreover, Abu Dhabi and Qatar have introduced legislation to curb transport emission beyond the GSA regulations. Abu Dhabi air quality established to accomplish the strategy encouraging a switch to compressed natural gas and clear diesel with an average 70% by 2013, while Qatar was the only state that has made an explicit commitment to a low carbon transport architecture which encourage road users to switch to rails and public transport [5]. Similar to industry sector, the industrial efficiency-standard is absent although the Gulf Organization Industrial Committee (GOIC) aimed at saving power in 39 factories in the GCC, and achieved saving up to 30% energy use and 80% in water use [5].

### 3.1 The limitations of current energy policy and targets

In order to improve the current energy policy and targets of the GCC countries, it is crucial to first acknowledge the limitations that can hold back the progress and fragment the current energy targets, limitations such as the following, according to Lahn et al. [5] and Lahn and Preston [8]:

- Lack of strong coordination between authorities and agencies to formulate and implement these energy targets and strategies.
- Lack of awareness of natural resources' value.
- Lack of available reliable data and centralized data sets on which to measure. Energy consumption data at the national level are often given only in aggregated form and publicly available sectoral data is partial.
- Weak enforcement of existing efficiency regulations, the challenge is to create the regulatory capacity to ensure they are followed.
- The low price of energy (fuel, electricity and water) compared to the income of consumers made no incentive investing in energy efficiency projects.

Finally, all GCC countries show various procedures towards integrated energy targets and strategies in almost all fields, especially in efficiency-standards for buildings and renewable energy development. However, there is urgent need for establishing transport and industry energy targets, and efficiency-standards for vehicle and industrial in all countries of GCC. Otherwise, the GCC countries now have a long strategic clean energy targets and plans. Although these targets are addressing only energy savings not CO<sub>2</sub> emission reduction targets except for Abu Dhabi – the only state that set a strategic approach to reduce CO<sub>2</sub> emissions by 7% by 2020. Therefore, in order to improve the current energy targets that could also address the reduction of CO<sub>2</sub> emission in the GCC countries, it is important to review and discuss the previous studies that consider intensity targets and renewable energy targets in GCC countries.

## 4 THE POTENTIAL OF ADAPTING NATIONAL AND REGIONAL TARGETS LEVELS SOLUTIONS

This section reviews the previous studies that have investigated the efficiency of energy targets and standards and the potential of having intensity targets and renewable energy targets in the GCC countries, aiming for energy-efficiency and reduction of CO<sub>2</sub> emissions. One of these studies is Lahn and Preston's study [8] that investigated the main types of energy targets being pursued internationally and evaluated the benefits and drawbacks that might be taken into consideration for GCC countries. The results of study outlined that the government of China committed to a 20% energy intensity reduction targets by 2010 and with a 40–45% carbon intensity reduction targets by 2020. Hence, the targets related to CO<sub>2</sub> intensity may



offer several advantages such as energy efficiency and saving at national level and contribute to international climate agenda. The study concluded that the CO<sub>2</sub> per capita intensity targets would be more effective for countries with large population and significant absorption of energy production such as Saudi Arabia, UAE, and Oman than countries with smaller population (Kuwait and Qatar). In addition, it highlighted several drivers may help toward lower energy or CO<sub>2</sub> intensity targets, such as: the share of renewable energy, efficient-standard for building and vehicles, and energy-efficient of heavy industry. Moreover, the study of Nanduri [8] revealed that energy intensity is very useful for measuring energy efficiency although that CO<sub>2</sub> intensity indicators are likely to be more useful as a climate policy tool.

More study from The Chatham House report by Lahn et al. [5], the report highlighted the main aspects to manage energy in the GCC countries. Such as, policy coordination, where all countries have authorities responsible for each field and integrate them together. Targets, which include setting targets in promoting efficiency investment and now each GCC countries have announced several official and clean energy target and strategies. Improving infrastructure efficiency, which includes adapting building efficient standard, in order to work with rather than against the gulf's harsh climate. Raising the efficiency of appliances, which involve efficiency-standards for vehicle. Energy price reform, which include raising the electricity tariffs to force efficiency investment. Behavioural changes, which consider providing awareness to citizens on how to use energy and value the importance of natural resources. Measurement performance, which discuss the mechanism of measurement tool to evaluate the targets, to collect the adequate data for this evaluation process, and to ensure strong enforcement regulation for implementation.

Another study by Abdmouleh et al. [9], the study investigated regional targets and decision-makers, in order to formulate a set of recommendations on renewable energy in the GCC countries. The study began with investigating the potential of renewable energy in the GCC countries as the solar energy, wind energy and biofuel have constituted the largest potential in the region and then discussing the specific challenges that faced the GCC countries in developing alternative energy, such as the effect of high temperature and dust, the lack of detailed studies about the region potential and the lack of understanding the cost and benefits of biofuel. Furthermore, exploring the status of GCC countries to transform the energy system in order to achieve an efficient use of renewable energy including list of existing renewable energy project, policies considering target setting, improving industrial efficiency, energy price reform, and behavioural change. The results showed that there are first steps regards establishing new policies promoting renewable energy development. However, there are some gaps regarding market distortions targets, policy mechanisms, climate policy and institutional regulatory framework. Moreover, the study suggested recommendations that classified into first financial support, which consists of removing subsidies and adapting new subsidies in order to create a competitive market including renewable energy projects. Second, legislative support, which is adapting legislative mechanisms such RPS which mandates a certain fraction of using energy should come from a basket of specific technologies, such as wind and solar, or renewables in general in order to develop renewable energy development. Third, political support, which is changing the government's regulatory into an independent regulatory authority helps to encourage renewable energy development. environmental support, which is allowing renewable energy project which assist in reducing emissions such as the 10 MW PV plant in Masdar city and suggesting a strong infrastructure for transmission grid will be needed in order to transport electricity. The study concluded that the importance of governance in adapting national and



regional policies that play a key role in supporting renewable energy development and implementation.

Similar to the study by Reiche [1], the study is about transforming oil wealth of GCC countries into funding for renewable energy development and energy-efficiency. The study evaluated the governance of GCC countries and what obstacles faces the governance in transforming process of integrating renewable energy. Lastly, the study concluded that integrating renewable energy targets and strategies through the role of adapting national level targets and regional level targets, as well as international level targets can have a major impact in improving the current energy policy and targets of GCC countries by fostering the opportunity to the contribution of international climate change protection agencies.

Therefore, from reviewing the previous studies, the effectiveness of adapting appropriate national and regional target levels with emphasising the role of renewable energy targets and intensity targets can improve the current energy policy and targets in the GCC countries.

#### 4.1 GCC on the national targets level

Setting appropriate national targets for energy conservation, there are some issues must be considered, such as the following [1], [5], [8]–[10]:

1. To establish CO<sub>2</sub> intensity targets, by ensuring the design of infrastructure grid, including power and water utilities and distribution industries, housing stock, and transportation, that is working with the harsh climate conditions of the Gulf region rather than against it
2. To provide energy-efficiency standards for all sectors, note that there no energy-efficiency standards for vehicle yet.
3. To integrate renewable energy targets by working on renewable energy development. One of main project in renewable energy development is Masdar city in Abu Dhabi.
4. To ensure the collection of available reliable data for each national target, in order to assist in reporting correctly data to target-makers, which could help in improving these targets.
5. To provide training and expertise in creating a mechanism that allow regular evaluation on the energy target to give feedback to the policy-making process, in order to allow maximizing progress towards meeting the energy policy target.
6. To increase the price of energy, by forcing the investors and designers to choose efficiency design.
7. To create strong enforcement of regulation, in order to ensure the implementation of energy targets.

#### 4.2 GCC on the regional target level

The aim of GCC is to enhance the coordination, cooperation, and integration between all sectors. As the GCC Supreme Council highlighted the importance of joint environmental action for converging policies, unify environment laws and legislation, improving national and regional capacity, training of labour force, raising environmental awareness among citizen and conservation of natural resources. furthermore, the efforts made by GCC members of supreme council in planning integrated energy targets and strategies on regional level gained several advantages to GCC countries [1]. However, these energy targets and strategies needs to properly work on the expanding of national targets level (CO<sub>2</sub> emissions reduction targets, energy-efficiency standards, renewable energy targets, measurement of the

Table 5: A summary on main setting for national and regional targets levels.

Ref	Targets	Recommendations for energy targets in the GCC countries	
		National level	Regional level
[8]	CO <sub>2</sub> intensity targets	To ensure the design of infrastructure grid, including all involvement sectors inside this guide, must be energy-efficiency	To extend the design of infrastructure grid to reach all of GCC countries and share energy on regional level, to provide the grid of GCC connectivity and flexibility to send electricity and create transmission grid for transport
[5]	Efficiency-standards targets	Based on pervious target, providing energy-efficiency standards for all involvement sectors in the grid, for example: building and appliances, transportation and industrial	
[9]	Renewable energy targets	To work on the renewable energy development, for example, 10 MV PV plant in Masdar city	To extend the renewable energy development not just individual dynamic project but to work on coordinated integrated renewable energy projects for regional level
[5], [8]	Reporting data	To ensure the collection of complete adequate data for each national target in order to aid in reporting and the evaluation process	To ensure of clarity of data to help in improvement of regional level
[5], [8]	Measurement of performance of target	To create a mechanism that allow regular evaluation on the energy target to give feedback to target-makers, in order to improve the target	To extend this mechanism of regular evaluation on regional targets
[5], [8]	Strong enforcement regulation	To provide strong enforcement regulations to make sure all of investors and designers are following targets of national level	To extend this enforcement regulations on regional targets level
[5], [8]	Increasing energy price	To force investors and designers to choose energy-efficiency design to save more energy	To work on common price of energy in all of GCC on regional level



performance of target, strong enforcement regulations and increase of energy price) to a higher regional targets level and also international targets level, in order to provide energy conservation at a higher level as possible. Finally, Table 5 shows a summary on main setting for national and regional targets level.

## 5 CONCLUSION

Regarding energy conservation, the GCC countries have recently adopted integrated-energy targets and strategies that addresses environmental issues. Such as, energy saving targets, renewable energy targets, efficiency-standards for buildings and appliance – note that there is an urgent need for efficiency standards in transport and industry in all countries. However, the government of GCC showed significant effort considering energy saving targets rather than CO<sub>2</sub> emission reduction targets.

Briefly, this paper discusses first the energy consumption and usage of GCC, second the status of efforts provided by the GCC government in managing energy, which included establishing of the current energy policy and target and exploring the limitations of these targets, and finally the potential of adapting national and regional solutions to improve the efficiency of energy targets and strategies and to reduce CO<sub>2</sub> emissions. As a result, this paper reveals the significance of main drivers considering managing energy. Such as, the importance of GCC governance, by pursuing innovative pilots in efficiency, clean energy plans, energy efficiency-standards and pricing reform. Moreover, the need for integration of renewable energy strategy, by implementing renewable energy targets that can enhance the efficiency of current energy policy and targets. Furthermore, the potential for greater effectiveness through cooperation at regional level, by extending of national targets to a higher regional level in order to increase efficiency to a higher level.

Bring all together, this paper provides an overall comprehensive review of cooperative approach of GCC in order to enhance energy conservation. However, there is need for a greater focus on the current energy policy and targets, especially on CO<sub>2</sub> emission reduction targets instead of energy saving targets, integrated renewable energy targets which have a high potential to impact on energy policy and targets. Therefore, it is crucial to work on targets that could have the potential to expand to a higher regional level and contribute to international climate change protection.

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