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Renewable energy support mechanisms in the Gulf Cooperation Council states: Analyzing the feasibility of feed-in tariffs and auction mechanisms

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ABSTRACT

Renewable energy will be a crucial ingredient in the transition to a more sustainable future. The renewable energy sector requires a variety of financial support mechanisms in order to further consolidate and expand. Currently, the most prominent renewable energy support mechanisms are feed-in tariffs and renewable energy auctions. Although these mechanisms have been used and analyzed extensively in Western countries and, more recently, economies in transition, they have rarely been examined in the Arab Gulf region. Yet, particularly the Gulf Cooperation Council (GCC) states have undertaken important steps towards renewable energy adoption, which could be greatly facilitated with the use of financial support mechanisms. This paper analyzes the feasibility of feed-in tariffs and renewable energy auctions adoption in GCC. Based on an extensive meta-analysis of the literature on these two mechanisms in both developed and developing countries, the paper identifies a set of conditions necessary for success and evaluates the presence of favorable these conditions in the GCC context. Our findings reveal that while conditions that would ensure political feasibility are largely absent for both types of mechanisms, auctions could be a more successful strategy at the moment.

1. Introduction

Increasing renewable energy in the national energy mix is considered a fundamental requirement for a more sustainable energy regime. It has been observed in both developed and developing countries that, provided that effective and efficient support mechanisms are embraced and applied, renewable energy resources can be utilized at significant levels. In Germany, for instance, 30% of gross electricity generation[1] came from renewable energy in the year 2015 [11]. In order to achieve such significant share of renewable energy in the national energy mix, however, effective support mechanisms are necessary. This paper discusses two sets of mechanisms that stand out most prominently: feed-in tariffs and renewable energy auctions.

The first mechanism, feed-in tariffs (FITs), is one of the most widely used renewable energy support mechanisms worldwide. FITs offer long-term pricing schemes to renewable energy producers and aim to compensate any cost and risk-related issues which can arise in such a niche area. FITs were applied in 73 countries and 35 states/provinces in the United States, China, India, Canada, and Australia as of early 2015 [81]; (p. 88).

Renewable energy auctions, on the other hand, are an alternative financial support mechanism for renewable energy production, which primarily aim at increasing deployment of renewable energy in the most cost-efficient way. Under this mechanism, following a government's call for tenders regarding the installation of a certain capacity of renewable energy-based electricity, renewable energy companies enter the auction, submitting a bid with a per unit price of electricity that they are able to produce. Subsequently, the government evaluates the offers on the basis of a number of criteria and then signs a PPA (“Power Purchasing Agreement”) with the successful bidders [56]. Depending on their aims and design, there are different types of auctions. These can be *technology-specific* (targeting a particular type of renewable energy source) and *site-specific* (regarding a certain area where electricity is generated from renewable energy sources). Furthermore, they can be *sealed-bid auctions* and *multi-round descending clock auctions*, where the former has undisclosed bids and the latter is the progressive lowering of the initially offered price [56]. As of June 2015, more than 60 countries have adopted auctions, some with great success. India, for example, has witnessed a 65% decrease in real market price of solar power compared to that of 2010 [47].

This paper analyses the feasibility of feed-in tariffs and renewable energy auctions adoption in the Arab Gulf region, where there is an

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[1] “Gross electricity generation” is defined as “the total amount of electrical energy produced by transforming other forms of energy” and it is the electricity generated in all types of power plants [25].

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Table 1
Renewable energy projects in the GCC (Source: [26] in [45]; (p. 61).

Saudi Arabia	United Arab Emirates	Kuwait	Qatar	Bahrain	Oman
• KAUST rooftop PV panels 2 MW (completed) • KAPSARC PV Phase 1 – 3.5 MW (completed) • KAPSARC PV Phase 2 – 1.8 MW (completed) • Princess Nora University solar water heating 17 MW (completed) • ARAMCO, 300 MW capacity off-grid (planned) • Saudi Aramco North Park PV Project 10.5 MW (completed) • SEC – Duba ISCC Power Plant phase 1 CSP 50 MW (planned) • Waad Al-Shamal ISCC Project 50 MW (planned) • Al-Aflaj Solar PV Park 50 MW (planned) • KACST Al Khafji PV desalination plant 10 MW (planned) • K.A.CARE, Royal Commission for Jubail and Yanbu 50 MW PV (planned) • K.A.CARE, 500 MW PV plants around the kingdom (planned) • K.A.CARE, King Salman Green Initiative, Madinah (planned) • • K.A.CARE/SWCC, Solar & Wind Desalination in north and south (planned)	• Sir Bani Yas Wind Energy Plant 30 MW (planned) • Solar power plant, Utico, RAK 40 MW (planned) • Waste to Energy, TAQA 100 MW (bids invited) • Masdar City solar PV park ADFEC 10 MW (completed) • Shams 1 CSP plant 100 MW (completed) • Mohammed bin Rashid Al Maktoum 1 – 13 MW (completed) • Mohammed bin Rashid Al Maktoum 2 – 200 MW (financial closure) • Mohammed bin Rashid Al Maktoum 3 – 800 MW (bids invited) • Waste to energy, Bee'ah 83 MW (planned) • • Noor 1 Solar PV plant 350 MW (bids invited)	• MEW/KISR-Shagaya Wind turbine 10 MW (bidder selected) • MEW/KISR-Shagaya Solar thermal 50 MW (bidder selected) • MEW/KISR-Shagaya PV 10 MW (bidder selected) • • Al-Abdaliyah ISCC project 60 MW (planned)	• KAHRAMAA-Solar Power Plant 230 MW (announced) • Mesaieed waste to energy plant 40 MW (completed) • • Al Duhail Solar PV Park 10 MW (announced)	• Waste to Energy plant 25 MW (planned) • BAPCO Bahrain PV Plant 5 MW (completed) • • Petra Solar-Manama Solar PV Park 5 MW (completed)	• Solar thermal EOR plant 1 GW (planned) • Solar thermal EOR plant 7 MW (completed) • Dhofar Wind farm 50 MW (planned)

ongoing effort to diversify the energy mix towards more renewable energy sources (See Table 1).[2] However, which mechanism can best support such efforts, both in terms of technical potential and political feasibility, is subject to debate.

While in the early 2010s FITs were advocated as the main way forward to expand the renewable energy base, the focus in the region has shifted towards auctions. While none of the Gulf Cooperation Council (GCC) states have FITs in place they are still an agenda item particularly for rooftop solar. Regarding auctions, their application is limited as they are currently mainly adopted in Dubai (for a solar power plant of 100 MW) while there are plans for their introduction in Saudi Arabia. Given the increasing emphasis on renewable energy in the region, choosing the right support policy will be key to boost the expansion of its use. This paper analyzes which of these two mechanisms is a more feasible option for the GCC states, given their political, institutional and economic characteristics.

We focus on GCC states for three main reasons. First they correspond appropriately with the prominent group of leading resource-rich rentier states[3] of the Middle East. Hence, investigating GCC states allows us to draw generalized conclusions about the rentier states of the Middle East. Secondly, GCC states are the main carbon emitters in the region. According to 2009 calculations of global CO2 emissions (metric tons per capita), Qatar ranked first, Kuwait third, the United Arab Emirates (Henceforth, UAE) fifth, Bahrain seventh, Saudi Arabia eleventh, and Oman thirteenth, among a total of 214 countries [95]. Concretely, 42% of carbon emissions of GCC states comes from generation of electricity and production of heat, followed by 36% from industrial sector, 20% from transportation, and 2.3% from residential sector [40]. Therefore, when per capita carbon emissions are considered, electricity generation of the Arab Gulf region is one of the most critical issues to be tackled with, from the perspective of the global efforts to curb greenhouse gas emissions. Thirdly, there is a growing interest in renewable energy in the region. After the 2008 financial crisis, GCC states started to pay more attention on the need to diversify their energy sectors, since over-reliance on international oil market means being much more affected by the oil price fluctuations [7].

This research presented in this article uses mostly qualitative data, based on an extensive literature review of journal articles, organizational reports, regional evaluations and institutional publications of the International Renewable Energy Agency that reveal how the support mechanisms are designed, introduced and affected the energy sector in the countries they were applied. In this respect, cases from Asia, Europe, North Africa and South America were reviewed through publications (reviewed research includes country cases on Germany, Spain, Portugal, Malaysia, China, Japan, Brazil, South Africa, and Peru) dating from 2002 to 2015 [8,14,17,29,33,39,49,53,60,62,76,82,86,87,91]. Furthermore, five in-depth interviews were carried out by the first author with senior policy experts of the International Renewable Energy Agency Headquarters in Abu Dhabi, UAE, in April 2015.

The paper is structured as follows. Part 2 identifies the conditions under which FITs and auctions have been successful or not based on developed and developing country experiences. Part 3 examines the

[2] For further information on these efforts, also see [1,4,10,22,75,70,74,79].

[3] These states are Gulf Cooperation Council member states, namely United Arab Emirates, Saudi Arabia, Kuwait, Qatar, Bahrain, and Oman. In these states, fossil resource revenues (rents) make up large shares of governmental income.

presence of these conditions for the Arab Gulf countries and tries to explain the comparative feasibility of the application of these two support policies in GCC states. Part 4 concludes the analysis.

2. Analytical framework: success conditions for the adoption of feed-in-tariffs and auctions

2.1. Feed-in Tariffs

The Renewable Energy Policy Network for the 21st Century (REN21) defines feed-in tariffs as “a renewables promotion policy that pays a guaranteed price for power generated from a renewable energy source, most commonly for each unit of electricity fed into the grid by a producer, and usually over a fixed long-term period (typically 20 years)” [80]; (p. 56). The positive effects of FITs are fostering the competition of renewable energy prices and securing certain cost and risk related issues. In support mechanisms like FITs and premiums, the difference between designated price and wholesale market price is not only a financial support for investors, but can also be seen as the internalization of environmental benefits, supply security, and diversification, as well as potential benefits like cuts in health service expenditures and increase in employment level [15]; (p. 260).

The FIT literature also deals with certain sensitive areas regarding their application. From an economic perspective, for instance, it has been argued that feed-in tariffs cannot work in a deregulated environment and they cost more to ratepayers when compared to renewable portfolio standards, which aim to foster price competition by making it obligatory for the electricity supplier to have part of their electricity generated from renewable resources. Wilson and colleagues (2007) challenge these arguments by underlining that both feed-in tariffs and renewable portfolio standards require government intervention, hence being “equally market-based”, and that the previous experiences in the European Union, the British government and others show that “investor confidence in feed-in tariffs can actually result in lower premiums for green power and thereby lower policy cost” [92]; (p. 77). Moreover, a study comparing feed-in tariffs with quota and auction mechanisms in the wind energy sector, for instance, concludes that “[German] feed-in tariff has to date managed cheaper prices paid per wind energy delivered, greater competition and more deployment” [16]; (p. 1865).

The following part sheds more light on the characteristics that explain the political feasibility of FITs as these have been identified in the literature.

2.1.1. Public awareness and consent

Public opinion on the significance and urgency of renewable energy policy is an important factor that explains the feasibility of renewable energy innovations in general and FITs in particular. This is because the economic burden of FITs is reflected on bill payers, unlike in the case of auctions where private companies pay the price. Conceptualized by some as “social acceptance”, socio-political acceptance, community acceptance, and market acceptance together affect the ease of consolidation of a given renewable energy innovation directly. The absence of such acceptance can act as a barrier at the project's implementation level [96]; (p. 2685). To illustrate, the oil crises of early 1970s and the 1986 Chernobyl disaster have been influential in triggering Germany to consider alternative energy solutions to fossil fuels and nuclear energy and shaped the German renewable energy journey [49]. Similar observations are made for developing countries. In Algeria, for instance, increasing public awareness was identified as a crucial factor for FIT success rather than simply enforcing the related legislation [86]; (p. 1181), [87]; (p. 4517). A study examining public opinion on renewable energy technologies in Portugal, also emphasized the level of knowledge regarding renewable energy costs, their impact on electricity bill and FITs as important. Indeed, lack of public acceptance is considered a “social risk” of the project evaluation phases [91]; (p. 48–49). In Malaysia as well, low level of awareness of government policies is considered as one of the major barrier for FITs and it is regarded as a problem which needs to be solved with the cooperation between the private sector and the government [62]. Overall, public awareness and consent are key success conditions for the deployment of FITs in both developing and developed countries.

2.1.2. Supplier-friendly pricing and cost-distribution

Following up on the German example, energy analysts point to certain risks which should be kept in mind regarding FITs. Firstly, feed-in tariffs have a concrete advantage of providing individual renewable energy technology developers with financial stability and a shield against future energy market volatility. However, fixed, long-term price adjustments carry the high risk of deviating from predetermined market prices over time. Secondly, if the predetermined tariff rates are too high, electricity prices will increase, and if they are too low, renewable energy technologies cannot be developed at sufficient rates [54]; (p. 983). Thus, when they are set too high, this increase is reflected in the electricity bills and it can result in public discontent. This observation is particularly important for developing countries. Indeed, one of the main reasons for these countries' reluctance to adopt feed-in tariffs is the direct reflection of the cost of the tariff scheme on public budget. When a government sets a long-term fixed price for a unit of energy which would be generated by a renewable energy resource, this price is almost always above the market price, because the very rationale behind this system is lowering the risks which may occur with price fluctuations. The difference between this fixed price and the actual market price is indirectly paid by the public, through electricity bills. Hence, feed-in tariffs put pressure over consumers. In this context, some scholars argue in favor of defining “a threshold price under which social welfare is damaged” [90]; (p. 4294). Likewise, others argue that special design options must be introduced, such as the setting of caps on renewable energy capacity in order to control the costs that apply to the final consumers and the development of national funds [58]. Furthermore, when “renewable energy efforts are directed at improving energy for the poor” [67]; (p. 340), such as the electrification of rural, off-grid areas, it is crucial that cost and risk compensation should not be at the expense of harming the poorer segments of the population.

Thirdly, FITs may also raise regulatory risks[4] which can directly affect power suppliers in the renewable energy sector. In Spain, for instance, when the electricity prices went up in 2005, the resulting increased income for renewable power producers paved the way to overcompensation in some subsectors of renewable energy, eventually turning premiums, which were then the second support mechanism in Spain, into a more desirable alternative than fixed FITs [83]; (p. 295). Consequently, FITs were gradually decreased for new plants, cancelled for new facilities, and in 2013 lowered for the already running renewable energy plants [27]; (p. 412).

Finally, hydrocarbon-related pricing reforms are also needed to prevent FITs from failing or being less effective. In this respect, not only the phase-out of subsidies, but also the internalization of externalities of hydrocarbons (such as environmental damage costs that result from combustion of fossil fuels) into the price of output electricity is of immense importance and they should be taken into account while deciding on pricing [72]; (p. 642).

2.1.3. Effective institutional structures

FITs are successful when supported by effective institutional structures. More specifically, these are structures that successfully

[4] These risks occur when regulatory agencies change policy decisions, laws, or regulations, causing a disruption of ongoing processes. Factors such as institutional structure of these agencies, their degree of autonomy from the elected government, and the nature of policies (whether they are strongly embedded in legislation, or they are set by agency or ministerial orders) may affect the level of regulatory risk [38]; (p. 654).

adjudicate the conflicting interests between the fossil fuel and renewable sectors, they are adequately supported financially and in terms of human resources, and enable dialogue and communication among different interest groups. The importance of these conditions is illustrated by the following examples.

Algeria is the first African country which adopted FITs in 2004 [32]; (p. 31). The renewable energy and energy efficiency development plan was adopted in February 2011 and aimed to increase the country's renewable energy-based electricity production to 40% [32]; (p. 31). Although it has been almost a decade since FITs were first introduced, the country's energy sector is still heavily dependent on hydrocarbon reserves and the solar PV sector is dominated by imports from foreign countries [88]. The main reasons for this underachievement are the dominance and preferential treatment of the oil sector (which is one of the outstanding export commodities), lack of qualified human resources in the renewable energy sector, and insufficiency of government funds for renewable energy projects [57]; (p. 923). Likewise, weak inter-sectoral coordination and communication, slow process in implementing Decrees of Application, lack of continuity of personnel, and lack of knowledge networks have hindered the potential of FITs [37]; (p. 1590).

Similar observations are made for Japan. Its “Basic Act on Energy Policy”, which was introduced in 2002, aimed at “securing a stable supply, environmental suitability and utilization of market mechanisms” [8]; (p. 191). Yet, four years after the first introduction of FITs in 2009, there exists a loophole which enables the interests of big energy monopolies to kick in [39]; (p. 9). Indeed, unlike the German case, where there is a balance of power among more than one institutions which enabled “intermediation between different objectives during the initial implementation”, in the Japanese case, the power is concentrated in one authority which has proven vulnerable to pressures from the fossil fuel regime [39]; (p. 8). Thus, a more decentralized distribution of power among different authorities in the energy sector may be more effective in supporting the FITs scheme.

In short, in order to have a successful FIT mechanism, public awareness and consent, supplier-friendly pricing and cost distribution, and effective institutional structures are substantial conditions.

The next section delineates the success conditions for renewable energy auctions.

2.2. Renewable energy auctions

Auctions are key elements of a renewable energy policy design fostering the growth and strength of a renewable energy market in the countries where it is applied. Auctions reduce the risks for investors since they offer guaranteed revenues for fixed periods, improve cost efficiency due to price competition, foster volume and budget control, and can increase the predictability of electricity supply from renewable energy resources, if they are well planned and applied [56]; (p. 12,13). Policy experiences from developed and developing countries present certain lessons which reveal particular conditions for the successful deployment of auctions in the renewable energy sector. These conditions are analyzed in the following sub-sections.

2.2.1. Local content requirement

This is a design element that enables the strengthening of weak parts of the sector, so that it functions as an opportunity to link the existing areas of expertise to a learning-by-doing processes and also by directing it to different segments of the value chain with the highest development potential [19]. This is illustrated very prominently by the example of Brazil. Brazil has been carrying out technology-specific auctions since 2007 in the context of its legal framework for auctions [56]; (p. 16,17). Since their first introduction, auctions yielded a number of positive developments such as greater renewable energy capacity and lower prices, and the growth of domestic wind industry, thanks to the local content requirement [56]; (p. 21). This requirement obliges project developers to use domestic equipment and services. This not only leads to local industry development and job creation, but also results in domestic economic development [56]; (p. 45). Such features can be especially useful for countries which lack already established, strong and mature renewable energy sectors. In the case of Brazil, it is expected that with the help of auctions, photovoltaics will surpass biomass and catch wind energy [14] and diversify the renewable energy sector. Other examples include South Africa where renewable energy auctions were designed to promote job creation among marginalized social groups [19]. As of today, local content requirements are widely used in other countries as well, such as wind auctions in Argentina and solar auctions in Morocco. However, it is important to note that auctions can also be part of FITs, as seen in the FIT designs of Ukraine, Turkey, Spain and Italy. The main difference between auctions and FITs in terms of how they make use of local content requirements is that in FITs, this requirement is used as a bonus mechanism for increasing the applied tariff for a specific renewable energy, once they meet the designated percentages (as seen in the cases of Italy and Turkey). That is, if the power producer manages to meet this local content percentages during the power generation process, the tariff is further increased [65]; (p. 52–53). However, local content requirements are arguably more effective when they are applied as part of auctions when compared to FITs, since in that case they are direct criteria of the auction design, in contrast to FITs where they are not obligatory.

2.2.2. Penalty and incentive mechanisms

These are important mechanisms for auctions because they prevent the problem of underbidding by encouraging more work to be done at the beginning of the project and ensuring that the contracted amounts are met, as well as deterring speculative bidding [21]; (p. 29). To illustrate, if the annual production is less than 90% of the contracted amount, the investor pays 115% of the contracted price and makes up for the deficit in the following year. Similarly, if the generated amount is more than 130% of the contracted amount, the investor receives a feed-in tariff of 70% of the contract price and the 30% surplus is reflected on the account of the following year [76]. Likewise, in Croatia, penalties are planned for companies that fail to meet the target of 60% local content requirement [51]. In the Brazilian case, penalties were introduced to ensure the meeting of established targets. Similarly, in Peru, penalties apply for delays in construction and annual under- or over-production. Penalties are regarded as one of the leading instruments to avoid failures to delivery and delays in construction, alongside financial guarantees and early warning systems [29].

2.2.3. Support by FITs

Auctions can also be supported by FITs. This can be done by setting a FIT price reference prior to auctions as a way of averting the risk of underbidding and increasing the feasibility of contracted auctions. Hence, depending on different characteristics of the renewable energy sector, such as the size of competing projects, estimated cost of project completion, and fiscal dynamics of the country –such as inflation rates-, FITs can act as a reference point for successful auctions. China's experience of renewable energy auctions demonstrates this relationship. Initially China started using auctions for its wind energy with selection criteria such as the lowest kWh price offered, share of local content that is used in the project, size and sophistication of wind turbine technology and overall financial viability of the project [53]; (p. 3886). However, underbidding was experienced. Having observed success stories in countries like Germany and Spain, manufacturers and developers in the sector soon started to look forward to the introduction of FITs in the context of the Renewable Energy Law which was adopted in 2005, expecting that they can create a feasible threshold for prices [53]; (p. 3887). In the absence of any penalty mechanism like that found in Brazil, competing bids were below workable prices. Indeed, such concerns of stakeholders in the wind energy sector were not completely addressed by the law. Even though there was a significant interest in the adoption of FITs, it was not clearly specified how they could work with auctions and portfolio standards and how the investor uncertainty could be addressed [18]. Furthermore, there are concerns that concession models, which include auctions, can bring fiscal disadvantage to government budget and this can occur when the preferential tax policy that is applied to winner bids is exploited by the project developers by the inclusion of other economic activities in wind power projects [33]; (p. 2945). These and other flaws of the already existing concession system of China were proposed to be reformed with fixed FITs for projects and the improvement of wind turbine localization policy [33]; (p. 2950). Today, China has both auctions and FITs for photovoltaics and wind energy and is trying to materialize the target of 5 GW offshore wind energy by the end of 2015 [31]. Indeed, in cases like the Jiangsu province, the inclusion of FITs to a sector that already had auctions proved to be successful [82].

Similarly, in Brazil, wind is already being auctioned at FIT levels [76]. Similarly, in Peru too, FITs are used in renewable energy auctions [17]; (p. 16). Importantly, so far, Peruvian auctions have generated substantial returns. The Ministry of Energy and Mines conducted two auctions; first one covered 173 GWh/year power, second one 43 GWh/year, with an overall attracted investment of $ 140–150 million [60]. Extensive literature review on developing and developed countries of different regions suggest that FIT schemes are not only compatible with renewable energy auctions, but they are also beneficial for overcoming the underbidding problem, standing as a condition for successful policy applications.

To sum up, the presence of local content requirement, application of penalty and incentive mechanisms, and support by FITs can be regarded as conditions which enable the successful consolidation of renewable energy auction scheme.

Table 2 summarizes the conditions necessary for the successful application of FITs and auctions and the related literature.

The following part examines the presence of these conditions for GCC countries. (Table 3).

3. Assessing the feasibility of GCC choices over renewable energy support mechanisms

When it comes to the adoption of support mechanisms there seems to be a variation in Middle East and North Africa (MENA), at large. According to the Joint Policies Database of International Energy Agency and International Renewable Energy Agency, FITs are applied in Algeria, Egypt, Iran, Israel, Jordan, Tunisia, and Turkey, while auction regulations exist only in Jordan and Iraq. Gulf countries seem to lag behind most of their MENA neighbors, with the exception of United Arab Emirates that has introduced nationwide grants and subsidies for renewable energy projects. FITs, on the other hand, remain absent in GCC states.

3.1. Feasibility of the introduction of Feed-in-tariff mechanisms in GCC countries

In the Arab Gulf region, in the early 2010's there were numerous calls by local consultants, policy and decision-makers for the adoption of FIT's, as the region started to focus more on the deployment of renewable energy. On August 15, 2011, the leading newspaper of the UAE, "The National", covered the statement of a regional energy consultant at Deloitte, arguing that "The announcement that Dubai will keep prices fixed increases pressure on the Government to introduce a feed-in tariff to help renewable energy compete with conventional power," [97]. Likewise, in 2012 Fahad bin Mohammed al-Attiya, chairman of the organizers of the climate change conference in Doha at that time, stated that in order to support the development of rooftop solar and help Qatar achieve its 16% solar electricity target in 2018, feed-in tariffs would be adopted [9]. In Saudi Arabia, FITs were included in the KA-CARE (King Abdullah City for Atomic and Renewable Energy) program, which aimed to follow two rounds of bidding for various renewable energy resources, expected to start around early 2015 [28]. Accordingly, 90% of the planned 54,000 MW renewable energy were supposed to be achieved by technology-differentiated FITs. However, in the early 2015, the capacity target of this KA-CARE program was postponed to 2040 [59].

By 2011, however, concerns regarding the introduction of FIT's in the region were raised. When asked about the status of renewable energy in Saudi Arabia, the business development manager of an energy company stated that the region needed to move away from FITs towards competitive bidding, since market dynamics of the MENA region were not suitable for FITs [12]. In a publication from 2012, a mixed policy between FITs and quota systems was recommended for the solar energy sector of the UAE [68]. According to one IRENA Official, even though around 2012 and 2013 there were discussions to introduce FITs in the region, especially at the utility scale, the inclination shifted to auctions [48]. However, the plans to introduce FITs are not completely cancelled. Abu Dhabi and Saudi Arabia still have these items on their political agendas [10], but skepticism remains.

A strategic analysis of the renewable energy sector of UAE from 2012 stated that even though FITs have the potential to be effective in the Emirates, local utility companies were concerned that because large amounts of privately generated renewable energy could have negative impacts on the grid. Thus, it made more sense for households to use the generated energy, rather than feeding the self-generated electricity back into the grid [50]. In other words, it was argued that a support mechanism that would be directed towards utility scale renewable energy, rather than the grid scale would be much more effective for such an oil-rich country. This would be possible with tariffs paid for self-generated and self-consumed electricity from renewables [50]. Furthermore, in 2013, the director general of Abu Dhabi's Regulation and Supervision Bureau, Nick Carter, stated that they were not supporting FITs, since they might put the government at a disadvantaged position in 10 years-time [20].

In the flowing sections, we examine whether the conditions necessary for a successful deployment of FITs as previously identified exist in GCC countries, thus contributing to the debate about their potential application in the future.

3.1.1. Supplier-friendly pricing and cost distribution

A competitive financial setting is a substantial requirement of a successful FIT scheme. Yet, in a set of countries where citizens are used to having free electricity and water (and in some cases, with symbolic prices if not free), in order for this target to be met, subsidies stand as

Table 2
Conditions for applying successful FITs and renewable energy auctions, and the related literature.

Feed-in Tariffs		Renewable Energy Auctions	
Conditions for Success	**Literature**	**Conditions for Success**	**Literature**
Public awareness and consent	[49,62,86,87,96,91]	Local content requirement	[19,14,56,65]
Supplier-friendly pricing and cost distribution	[54,58,67,90]	Penalty and incentive mechanisms	[21,29,51,76]
Effective institutional structures	[8,32,37,40,57]	Support by FITs	[17,18,31,33,53,60,82]

Table 3
Status of Renewable Energy Support Mechanisms in MENA (Source: [43]).

	National Renewable Energy Support Mechanism	Relevant Legislation
Algeria	Feed-in tariffs (in force)	Law 04–92 on the Diversification of Power Generation Costs (2004); Feed-in tariff for solar PV installations (2014)
Bahrain	–	–
Egypt	Feed-in tariffs (in force)	Egypt Renewable Energy Law, Decree No 203/2014 (2015)
Iran	Feed-in tariffs (in force)	Section B of Article 133 of Iran's 5-year development plan, ratified through Act no. 100/37732 by the Council of Economy (2005)
	Renewable portfolio standards (in force)	Article 139 of the 5th program ratified by Iran Islamic Consultative Council Parliament (2012)
Iraq	Auctions (in force)	First tender for a 50 MW solar PV project (June 20th, 2016)
Israel	Feed-in tariffs (in force)	Public Authority Utility decisions (2009; revised in 2011)
Jordan	Feed-in tariffs (in force)	Directive governing the sale of electrical energy from Renewable Energy Systems (2012); Renewable Energy and Efficiency Law No. 13 (2010)
	Auctions (in force)	Directive for the Costs of Connecting Renewable Energy Facility to the Distribution System for Direct Proposals and Competitive Tenders (2012)
Kuwait	–	–
Lebanon	–	–
Libya	–	–
Morocco	Net-metering (in force)	Law n°58–15 (2016)
Oman	–	–
Palestine	–	–
Qatar	–	–
Saudi Arabia	–	–
Sudan	–	–
Syria	–	–
Tunisia	Feed-in tariffs (in force)	Decree 2010/1521 (2010)
Turkey	Feed-in tariffs (in force)	Renewable Energy Law 2010 (2011)
United Arab Emirates	Grants and subsidies (in force)	Renewable Energy Deployment Strategy (2009, 2011, and last updated in 2015)
Yemen	–	–

important obstacles. Indeed, a recent study by the Oxford Institute for Energy Studies underlines that "In the presence of GCC states' existing cost-unreflective domestic energy price environment, fiscal support mechanisms would introduce a further distortion into an already distorted market," [24]; (p. 12). The most important economic obstacle for the introduction of FITs in the region[5] is the excessive natural resource subsidies, which are especially visible in the case of oil subsidies. GCC states are notorious for their extensive subsidization of fossil resources [69]. Although abundant with immense solar energy potential, in the UAE, for instance, the cost of electricity from solar power installations is higher than electricity from the grid by around the double [61]; (p. 374). Subsidies can also be implicit via low petroleum product prices and through long-term loan subsidization [44]. These subsidies, in turn, form the backbone of the rentier state system and they are entrenched in that system (See Table 4).

International organizations and institutions[6] argue in favor of phasing out fossil resource subsidies, and designed a joint report on a roadmap for implementing such a phase-out [66]. Importantly, a global subsidy phase-out by 2020 is expected to decrease global energy demand by 5.8% [42], and CO_2 emissions by 4.7% [66]; (p. 7). Yet, fossil fuel subsidies have been continuously increasing. In 2011, for instance, fossil resource subsidies increased up to 30%, when compared to 2010, and while for the year 2011, total subsidies for fossil resources were $523 billion, those for renewables were just $88 billion [73].

There are different views regarding the ways in which subsidies can be modified and/or removed. Some scholars underline the need to 'gradually' reduce subsidies [3], while others pinpoint the benefits of transferring them from fossil fuels to renewable energy sources [13]; (p. 1035); [2]; (p. 338); [5]; (p. 1966). Lack or absence of renewable energy subsidies is identified as one of the problems that lead to slow diffusion of renewable energy technologies [63]; (p. 3841); [77], hence channeling these funds from fossil resources to renewables or simply, to other public expenditures [94]; (p. 105) are alternative solutions. However, subsidizing renewables can, too, have negative implications in the long run [98]; (p. 548), by preventing the further maturation of the sector.

Currently, substantial motives exist for phasing out fossil fuel subsidies. Scholars argue that considering the current low oil prices, and downward trends in gas and coal prices, there now exists a "window of opportunity" to remove fossil fuel subsidies and internalize climate externalities [93]; (p. 1186). Furthermore, according to IEA, enabling universal access to energy by 2030 would require much fewer amounts than then annual sum of fossil fuel subsidies [30]; (p. 377). In sum, there exist solid reasons why fossil resource subsidies should be either gradually phased out and/or moved to other areas of public expenditure where they would yield much more positive results. While it is projected that an immediate removal of subsidies would generate negative macroeconomic consequences, such as a decrease in GDP or a slight rise in unemployment, financial simulations show that with carefully designed, gradual phasing out, these risks can be averted.[7]

3.1.2. Public awareness and consent

Social requirements are also fundamental for the feasibility of FITs. This characteristic is lacking in GCC countries, particularly with respect to energy issues, due to energy subsidies and low energy prices. Indeed, unlike many European countries, where public awareness and salience of renewable energy is relatively high,[8] the most important environmental threats perceived in the Arab world at large, are water scarcity, desertification, and land degradation [84]; (p. 847). A recent study examining the potential use of building-integrated photovoltaics

[5] The need to minimize resource subsidies stands as a challenge for not only GCC states, but also for North African countries, directly affecting their degree of renewable energy readiness [35]; (p. 139).

[6] These organizations and institutions are OECD, IEA, OPEC, and the World Bank.

[7] Simulation studies regarding the subsidy reform in China are indicatory in the sense that with moderate cutting rates energy price reform is achievable. For such simulations, see [71]; [58]

[8] Developing renewable energy is perceived as a main priority objective in 13 member states: Sweden 67%, Denmark 55%, Luxembourg 55%, France 50%, Finland 50%, Cyprus 50%, Belgium 47%, Austria 46%, Slovenia 45%, the Netherlands 44%, Hungary 42%, the United Kingdom 40%, Ireland 38% [25]; (p. 251).

Table 4
GCC states and fossil fuel subsidies in 2014 (Source: [41]).

	Total subsidies (billion USD)	Average subsidization rate (%)	Subsidy per capita ($/person)	Total subsidy as share of GDP (%)
United Arab Emirates	17,6	55,2	1868	4,4
Saudi Arabia	71,3	78,6	2428	9,5
Qatar	6,2	68,8	2754	3,0
Kuwait	8,8	81,4	2528	5,1
Bahrain	2,3	59,9	1697	6,7
Oman	7,0	63,6	1775	9,0

(BIPV) in GCC countries, for instance, emphasized that raising energy awareness and overall environmental consciousness is crucial for the legitimacy of BIPV [89]; (p. 1097). A recent survey further highlighted that future expectations are important in shaping public opinion towards renewables. Respondents to this survey pointed out that only fossil fuel depletion would lead to the need to diversify the energy mix and the volatility of fossil fuel prices would make renewable energy investments more attractive [55]; (p. 8273). One way to overcome such constraints is undertaken by Hossein Askari,[9] whose studies emphasize the relationship between Islam and concepts like oil-lead economic development and human development in the Middle East. Such work demonstrates that the link between religious teachings and sustainable resource management may be be a viable effort in shaping public opinion among the Islamic elite.

3.1.3. Effective institutional structures

Since the renewable energy sector is still perceived as a niche for many investors in the GCC, "energy companies, utilities, conventional power plant EPCs (engineering, procurement and construction), and equipment suppliers have entered the renewables space, left, re-entered, and often left again" [34]; (p. 12). Adequate financial support, qualified human resources, and the enabling of dialogue and communication among different interest groups, are not present in the region yet, due to the short lifespan of most of the companies in the sector. This, in turn, is triggered by "limited deployment experience and appetite for major equity, risk, and guarantee commitments" [34]; (p. 12). Furthermore, coordination between supply- and demand-side management is weak in GCC countries, as the authority over energy sectors is "highly fragmented", involving different ministries and regional bodies [52]; (p. 18). This fragmentation is mostly due to the fact that Arab Gulf economies heavily rely on the public sector, since there exist multiple state-owned utilities in the electricity sector (especially in Oman, Qatar, and United Arab Emirates). Recent years also saw the entry of private firms into the market as a result of efforts to reform the power sector (Table 5).

In addition, environmental institutions of GCC countries (Table 6) have no energy-specific focus except for ministries that focus on petroleum and mineral resources.

Moreover, the State remains the leading decision-maker in different industries, while the GCC private sector is dependent on rent recycling and is shielded from citizenry [36]; (p. 36). As mentioned earlier this increases state vulnerability to strong corporate interests from the fossil fuel industry. In the GCC, this relationship is especially hard to break as there is a mutual dependence between the private sector and the State as a result of the rentier character of the latter.

In short, conditions required for a successful FIT application in the region are largely absent. There is extensive fossil fuel subsidization, lack of public awareness and consent, and limited presence of effective institutions which could hinder the successful adoption of FITs in the region.

3.2. Feasibility of the introduction of auctions in GCC countries

Auctions have already been introduced in some GCC countries, such as in Dubai, where they have made the price of renewable energy competitive with natural gas [48]. Likewise, Saudi Arabia also has plans to introduce auctions. Other than these two, there is currently no other auction implementation in the GCC region. However, auctions can be another option as a particularly promising renewable energy mechanism for the region. Below we try to understand whether this promise holds.

3.2.1. Local content requirement

The local conditions, particularly needs and capabilities are integral in the development of auctions. In GCC countries, Saudi Arabia has proposed as of 2015 the inclusion of local content and labor requirements in the design of auctions. Accordingly, a minimum of 20% of the auctioned projects' components has to be produced locally. Within the total content, each part of the product will have different local content percentages (such as 50% for blades and towers of a wind turbine, while 100% for gearboxes) during the evaluation and decision process of the auction [46]; (p. 33–36). Encouraging the growth of domestic industry via these component requirements is especially important for GCC states which have so far been major importers.

Consolidation of local content production and fostering of local labor force are also important local content requirements. Yet, as of 2010, 85% of UAE's population were foreign workers [23], and the situation is similar in other GCC states. Although these states have very distinguished engineers and natural scientists who specialize on renewable energy technologies at the research level, the practical realm remains a niche area for them. Furthermore, 99% of total FTE (full time equivalent) researchers in the Gulf are employed in the public sector [64]; (p. 264), potentially discouraging investors favouring a market economy. Accordingly, the local content requirements are not entirely fulfilled in the region [85]; (p. 248).

3.2.2. Penalty and incentive mechanisms

The extent to which these mechanisms can apply in GCC states depends primarily on legal and institutional capabilities. In this context, the lack of a taxation system can prevent overall willingness of companies to comply by financial impositions such as auction penalties. The use of other instruments, however, can prove more promising. Dubai may act as an example for other Gulf states. Specifically, according to the Clean Energy Ministerial (CEM) and IRENA's extensive study on the design of auctions, investors' risk perception can be reduced by involving the government in the project's equity. In the auction for solar power that took place in 2014, the Dubai Electricity and Water Authority (DEWA) had a 51% equity share in the project. The winning bid was awarded at a price of USD 59.9 per MWh and with an increase of the contracted amount from 100 MW to 200 MW, a further price reduction to USD 58.4 per MWh was possible [46]; (p. 33). However, the report also warns of possible side-effects such as greater bureaucracy and limited management flexibility [46];

[9] For more information, see Mirakhor, A. Askari, H., 2010. Islam and the Path to Human and Economic Development. New York: Palgrave Macmillan; Askari, H., Nowshirvani, V., Jaber, M., 1997. Economic Development in the Countries of the GCC: The Curse and Blessing of Oil. Greenwhich: JAI Press

Table 5
Electricity market structure in Gulf Cooperation Council States (Source: [6]; (p. 179)).

	Regulator	Generation	Transmission	Distribution	Procurement
Bahrain	Electricity and Water Authority (EWA)	● Electricity and Water Authority (EWA) ● Al-Ezzel Power Company (Al-Ezzel PC) ● Hidd Power Company (HPC) ● •Al Dur Power and Water Company (Aldur)	Electricity and Water Authority (EWA)		
Kuwait	Ministry of Electricity and Water (MEW)				
Oman	Authority for Electricity Regulation (AER)	● SMN Barka Power Company ● Al Rusail Power Company ● Sohar Power Company ● •ACWA Power Barka ● United Power Company ● Al Kamil Power Company ● Al Ghubrah Power and Desalination ● Wadi Al Jizzi Power Company ● Rural Areas Electricity Company ● Ministry of Defense (generates electricity and sells it to OPWP) ● • Petroleum Development Oman (PDO)	● Oman Electricity Transmission Company ● • Rural Areas Electricity Company	● Rural Areas Electricity Company ● Muscat Electricity Distribution Company ● Mazoon Electricity Company ● • Majan Electricity Company	Oman Power and Water Procurement Company (OPWP)
Qatar	Companies are self-regulated	● Qatar Electricity and Water Company (QEWC) ● Ras Laffan Power Company (RLPC) (Ras Girtas Power Company & Q Power) ● Mesaieed Power Company	Qatar General Electricity and Water Corporation (KAHRAMAA)		
Saudi Arabia	Electricity and Cogeneration Regulatory Authority (ECRA)	Saudi Electricity Company (SEC)			Sustainable Energy Procurement Company (SEPC)
United Arab Emirates					
The Northern Emirates	Federal Electricity and Water Authority (FEWA)				
Sharjah	Sharjah Electricity and Water Authority (SEWA)				
Dubai	Dubai Electricity and Water Authority (DEWA)				
Abu Dhabi	● Abu Dhabi Water and Electricity Authority (ADWEA) ● Regulation and Supervision Bureau (RSB) ● • Federal Authority for Nuclear Regulation (FANR)	● Al Mirfa Power Company (AMPC) ● Emirates CMS Power Company ● Gulf Total Tractebel Power ● Shuweihat CMS International Power Company ● Arabian Power Company ● Taweelah Asia Power Company ● Emirates SembCorp Water and Power Company ● Fujairah Asia Power Company ● • Ruwais Power Company	Abu Dhabi Transmission and Dispatch (TRANSCO)	● Abu Dhabi Distribution Company (ADDC) ● • Al Ain Distribution Company (AADC)	Abu Dhabi Water and Electricity Company (ADWEC)

Table 6
Environmental institutions and agencies in GCC Countries (Source: [78]; (p. 9).

Countries	Policy institution	Executive agency
Bahrain	Environment and Wildlife Affairs	Public Commission for the Protection of Marine Resources, Environment and Wildlife
Kuwait	Environment Public Authority	Environment Public Authority
Oman	Council of Ministers	Ministry Environment and Climate Change
Qatar	Council of Ministers (Permanent Commission for Environment Protection)	Supreme Council for the Environment and Natural Reserves
Saudi Arabia	Ministerial Committee on Environment	Presidency of Meteorology and Environment (PME)
UAE	Council of Federation	Federal Environment Agency / Ministry of Environment and Water Resources

(p. 29). In addition, imposition of project size is also an important component of success in auctions. This characteristic of auctions creates economies of scale, which allow winning projects to have capacities close or equal to the upper limit [46]; (p. 18), thereby fostering fast and steady renewable energy uptake.

3.2.3. Support by FITs

Further strengthening auctions with a FIT framework is an important condition for success. The UAE, Saudi Arabia and Kuwait have already been devising and enforcing a variety of supplementary policy tools which aim to provide and/or improve policy support, strategic planning, grant, subsidy, and loan distribution, information and education, tax relief, research and development, and public-private sector cooperation [43]. However, FITs are still not in this picture. One opportunity that can be utilized by countries that have not introduced a FIT framework, yet, is that once they prepare their legislations and institutions for auctions, they could also prepare for FITs. The case of China, where auctions were introduced much earlier than FITs, shows that once introduced, FITs can help overcome the problem of underbidding. Hence, the feasibility of having the required conditions for one mechanism is highly related to having those of the other mechanism as they intersect with each other.

To sum up, the local content requirement calls for a substantial level of qualified human resource capacity, considering the technological intensity of the renewable energy sector. This condition is currently not satisfied in the GCC. However, regional research institutes and investment hubs that prioritize the field of renewable energy, such as Masdar Institute of Science and Technology of Abu Dhabi, King Abdulaziz City for Science, and Technology of Saudi Arabia, and Qatar Science and Technology Park of Qatar can be considered as the initial steps of filling the human resource gap of the region. Penalty and incentive mechanisms, too, are not yet fully integrated in the already existing renewable energy projects. However, the case of the Dubai solar auction presents itself as an optimistic example with respect to the applicability of impositions in such schemes. Supporting auctions by FITs, on the other hand, is a condition which can be addressed at a later stage where the conditions for both auctions and FITs are consolidated in the region.

4. Conclusion

This paper discussed the political feasibility of FITs and renewable energy auctions in GCC states. We found that conditions required for a successful FIT framework are not yet present in these countries. First, there is still little public awareness and consent regarding the importance of expanding the use of renewables while the small share of affirmative public opinion tends to be shaped by external factors, such as the international oil price fluctuations. Second, regarding supplier-friendly pricing, we observed that while currently not present it can be achieved with the gradual reformation (if not removal) of fossil resource subsidies. In this context, sovereign wealth funds can be helpful while compensating for any possible financial disadvantages that can stem from a non-fossil resource policy. Third, the absence of subject-specific institutions further impedes the feasibility of FITs. Regarding auctions our results are more promising. First, we found that although a local content requirement is currently weak initiatives in the research and development sector are currently developed which aim to address this issue. Second, regarding penalty and incentive mechanisms, the case of Dubai's solar auctions demonstrates that imposing rules in auctions and including the government in the project's equity are important requirements for success. Third, support of auctions by a FIT framework, is currently absent but can only be present when both auctions and FITs are more widely employed in the region. Except for the immediate removal of fossil fuel subsidies, suitable conditions are not difficult to achieve in the short to medium term.

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