

Renewable Portfolio Standard from the Perspective of Policy Network Theory for Saudi Arabia Vision 2030 Targets

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Abstract— Renewable Portfolio Standard (RPS) is one of the successful policy instruments that is used to support the augmented development of renewable energy in different countries. In vision 2030, the Kingdom of Saudi Arabia (KSA) has set the targets to deploy 58.7 GW of renewable energy (RE) with 40 GW of solar photovoltaic, 16 GW of wind and 2.7 GW other RE sources, paving the way for a low-carbon economy in the Kingdom. Renewable Portfolio Standard (RPS) could be an effective policy instrument for stimulating RE integration, consumption on a large-scale and comprehending the objectives of vision 2030. In this paper, four phases KSA RPS formulation strategy is proposed in which collaborative relationship between different stakeholders like policy and regulatory bodies, professional bodies, inter-governmental bodies, power producer and social network at different levels by using policy network theory (PNT) to analyze the interactive relationship of multiple actors is discussed. This strategy will help KSA to overcome the limitations of the stakeholder's relationship in RPS formulation and thereby offers significant success for RE deployment in KSA.

Keywords—: *Renewable Energy, Energy Policy, Energy Standards, Renewable Portfolio Standard, Policy Network Theory.*

I. INTRODUCTION

Energy plays a vital role in the development of any country and for most socio-economic activities. With looming oil prices higher per capita power-consuming countries are considering alternative energy sources to reduce the higher utilization of fossil fuel in their electricity sector and scaled up the deployment of renewable energy technologies (RETs), thereby contributing to sustainable development and climate mitigation objectives [1]. Continuously increasing demand for Renewable Energy Technologies (RETs) with high penetration of distributed energy generators is changing the structure of the conventional electric grid to a modern grid [2]. Renewable energy in the power sector added 181 GW in 2018 with a total global RE capacity of 2,378 GW and leveled off, 2017 years of growth [3]. Renewables will be leading with 29.4% of its shares to fulfill the global electricity demand until 2023 up from 24.9% in 2018.

The Kingdom of Saudi Arabia (KSA) identifies the significance of a diversified energy mix with the penetration

of renewable energy to its long-term economic prosperity. Therefore, under the country's National Transformation Program (NTP) and through the National Renewable Energy Program (NREP), the Ministry of Energy, Industry, and Mineral Resources have covenanted a commitment to encompass its leadership in promoting and deployment of renewable energy technologies to fulfill KSA electricity demand in future. The Kingdom of Saudi Arabia announced the KSA vision 2030 target of 58.7 GW till 2030 of RE projects with 40 GW of solar PV, 16 GW of wind and 2.7 GW other RE sources by 2030 [4] as shown in figure-1. For achieving this target in the 2018 Renewable Energy Project Development Office (REPDO) Saudi Arabia called the tender for 300 MW of solar PV in "Sakaka" and 400 MW of wind power plant in 'Dumat Al-Jandal'. Eleven pre-developed solar PV projects tendering are in process that was scheduled during the year 2019 with a capacity of 2.225 GW as depicted in figure-2.

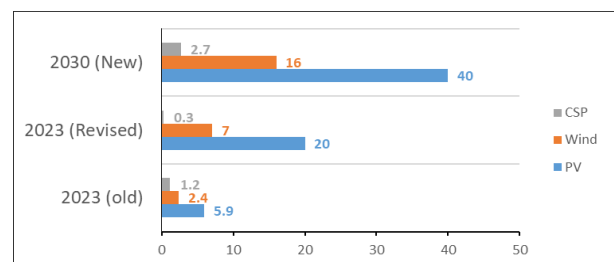


Figure 1. Revised Renewable Targets of KSA Vision 2030

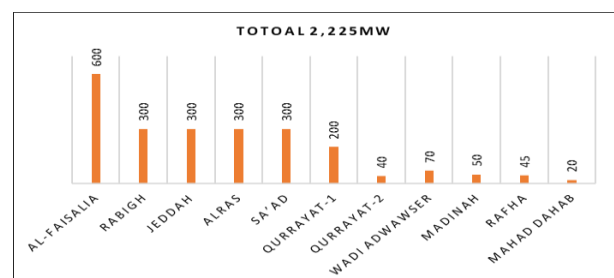


Figure 2. List of 11 new PV projects Expected to tender in 2019

For successful deployment and dissemination of renewable energy technologies, different renewable energy policy instruments are formulated and promulgated by different countries to achieve their set targets [3]. Renewables Portfolio Standard (RPS) is considered one of the successful policy instruments that are used to support the augmented development of renewable energy technology in any country as shown in table-1. The Renewable Portfolio Standard (RPS) verdicts that national electricity generation companies and independent power producers (IPPs) shall generate a specific percentage or a share of their total electricity generation by the deployment of renewable energies sources such as solar PV, wind, mini and micro hydropower, and other alternatives in their system.

RPS is one of the successful policy instruments which is being opted by USA different States [5] EU countries [6], China [7] and many other countries for successful deployment of RE in their countries for achieving their RE targets. It can be structured with any renewable energy policy, depending on a country's policy and targets/goals with the electricity industry, regulatory and enforcement capabilities, social and political context. For maximum impact and effectiveness of RPS, fundamental policy design principles are obligatory to follow.

As the Kingdom of Saudi Arabia has published its Vision 2030 targets with very high targets specifically for solar PV in which 20 GW by 2023 and overall 40 GW by 2030. However, on the other side, KSA regulatory authorities are struggling and are in the process to formulate the RE policies and other supporting instruments for successful deployment and timely implementation of vision 2030 in its true spirit. Therefore, an early assessment of the renewable energy portfolio standard is very important to investigate its impact on the KSA electricity market with its pros and cons.

II. RPS LITERATURE OVERVIEW:

Renewable Portfolio Standard has been implemented in some countries for many years. Since then scholars are investigating its benefits, costs, effectiveness, and problems & challenges encountered during the implementation of RPS. In 2003, Langniss and Wisner conducted an early assessment of RPS in Texas to investigate its impact on the deployment of renewable energy and observe the competition between RE producers [8]. After the successful implementation of RPS in employment opportunities in the RE sector with economic benefits were observed [9], furthermore, calculations prove that after the implementation of renewable portfolio standards in the US (Texas) CO₂ emissions cost per ton reduced by 11 US dollars [10]. In addition, RPS implementing cost-benefit analysis in different US states is discussed in [11].

RPS's effective implementation also depends on the country's conditions. Different in-depth research has been conducted in this area. Based on China's power generation situation RPS applicability with opportunities and challenges and adopting renewable energy policies is discussed in [12]. Furthermore, research on RPS impact on Pakistan energy sector economy and its environmental impact is conducted in [13]

For successful dissemination of vision 2030, it is very empirical for the Kingdom of Saudi Arabia to formulate and promulgate effective RE policies timely. Renewables Portfolio Standard (RPS) is considered one of the successful policy instruments that are used to support the augmented development of renewable energy technology in any country. RPS is one of the successful policy instruments which is being opted by USA different States [5] EU countries [6], China [7][14] and many other countries for successful deployment of RE in their countries for achieving their RE targets successfully as depicted in table-1.

Table 1. RE Policies in Different countries including KSA- Comparative Analysis

| Country | Renewable energy targets | Renewable energy in INDC or NDC | Regulatory Policies | | | | | | | Fiscal Incentives and Public Financing | | | |
|----------------|--------------------------|---------------------------------|---------------------------------|--|-----------------------|-------------------------------|--------------------------|--------------|-----------|--|---|---------------------------|--|
| | | | Feed-in tariff/ premium payment | Electric utility quota obligation/ RPS | Net metering/ billing | Transport obligation/ mandate | Heat obligation/ mandate | Tradable REC | Tendering | Investment or production tax credits | Reductions in sales, energy, CO ₂ , VAT or other taxes | Energy production payment | Public investment, loans, grants, capital subsidies or rebates |
| United States | P ◊ | | □ | □ ◊ | □ ◊ | ● | □ | □ | ○ | ● | ● | ● | ● ◊ |
| United Kingdom | E, P, T, HC | | ● ◊ | ● | | ● | | ● | ○ | | ● | ● | ● |
| Germany | E, P, HC, T | | ● ◊ | | | ● | ● | ● | ○ | ● | ● | | ● ◊ |
| Canada | P | ● | □ ◊ | □ | □ | ● | | | ○ | ● | ● | | ● |
| China | E ◊, P, HC | ● | ● ◊ | ● | | □ | ● | | ● | ● | ● | ● | ● |
| India | P, HC | ● | □ ◊ | ● | □ ◊ | □ ◊ | □ | ● | ○ | ● | ● | ● | ● |
| Saudi Arabia | P | ● | | | ● | | | | ○ | | | | |

E= Energy (final or primary), P= Power, HC= Heating or cooling, T= Transport, * Indicates sub-national target, ● Existing national policy or tender framework (could include sub-national), □ Existing sub-national policy or tender framework (but no national), ○ National tender held in 2017, ◊ Sub-national tender held in 2017, ◊ New

Source: 2018 Renewables Global Status Report

The Renewable Portfolio Standard (RPS) verdicts that national electricity generation companies and independent power producers (IPPs) shall produce a specific percentage or a share of their total electricity generation by increasing the production of electricity from renewable sources such as

solar PV, wind, mini and micro hydropower, and other alternatives [15].

Renewable portfolio standards (RPF) is one of those instruments which can be structured with any renewable energy policy, depending on a country's policy and targets/goals with electricity industry, regulatory and

enforcement capabilities, social and political context. For maximum impact and effectiveness of RPS, fundamental policy design principles must be followed.

As it can be observed in table-1 that almost all the leading countries have opted for RPS for successful deployment and achieving their RE targets. Likewise, the Kingdom of Saudi Arabia has only RE policy and tendering instruments in their RE portfolio. Therefore, it is very important to investigate the success stories in the world and based on lesson learned a strawman road map should be developed to opting the RPS in KSA for the successful deployment of RE technologies and achieving the VISION 2030 targets.

III. POLICY NETWORKS THEORY:

Policy networks theory was originally introduced in the 1950s in the United States [16] and became the mainstream paradigm of the modern policy environment for research on policy formulation in countries like the United Kingdom (UK), United States of America (USA), Germany and Netherland. Due to different political systems and social behavior in the EU and US, policy network theory experienced macro and micro changes in it, keeping in view of their country’s RE policies and interests. The most recent and commonly acknowledged explanation of policy networks theory is introduced by Rhodes in [17]. Rhodes exemplifies

the policy networks theory as “*bunches of professionals or multifaceted administrations interconnected with each other by means of needs and dependencies and are parted from other clusters by breaking in the structure of means and dependencies*” as depicted in figure-3A

IV. ADOPTION OF POLICY NETWORK THEORY FOR RPS

FORMULATION IN SAUDI ARABIA:

In order to investigate whether the policy network theory can be applied to formulate RPS in the Kingdom of Saudi Arabia in a meaningful way. According to policy network theory for the formulation of any policy, many stakeholders are involved in an interaction like government agencies, power producers, research and development from universities and other stakeholders. Each stakeholder has a different role and responsibilities because of their interests and different target strategies. Keeping in view of KSA structure this paper divided the RPS policy network into five types of stakeholders. Based on their numbers of actors integration and source deployment. Ranging alongside loosely to highly integrated, those five types of organizations are the intergovernmental bodies, professional bodies, policy and regulatory bodies, power producer and social networks as shown in figure-3B.

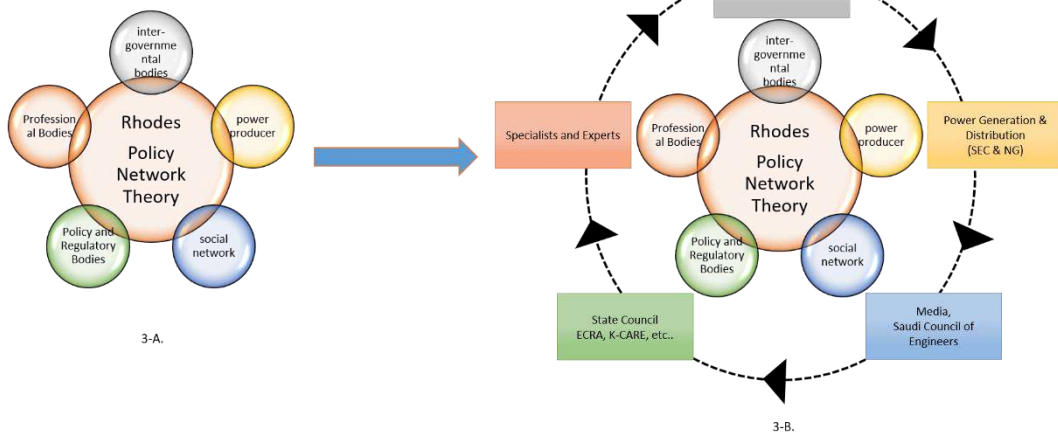


Figure 3. (A) Rhodes Policy Network Theory Model. (B) Proposed Policy Network Theory Model for KSA

V. INSTITUTIONAL INTERACTION MAPPING FOR RPS

FORMULATION IN KSA:

In order to formulate an effective RPS policy for the Kingdom of Saudi Arabia, a pentagon institutional communication strategy is proposed in this paper as depicted in figure-4. It précises the relationships between all the stakeholders who are involved in the policy formulation process in KSA. The proposed pentagon strategy is based on intergovernmental bodies and relevant shareholders who are interdependent because of mutual interests or means. Their affiliation is vigorous and diverse. During this RPS formulation process, multiple stakeholders will be interconnected in every link of the communication and implementation process. They will exchange resources, interact and have different requests.

Based on the aforementioned KSA pentagon RPS formulation strategy. This whole process is divided into four phases as the definition phase, agenda items setting phase,

action plan phase and legislation phase. The explanation of all these four phases are surmised in table-2.

Table 2. KSA RPS Formulation Phases

| RPS Setting Phases | Content(s) |
|-----------------------|--|
| Definition | The definition phase comprises thinking, charting the limitations of problems, defining the policy scope, screening the possible profit and loss, re-examining the problem expression and so on. |
| Agenda Setting | In this process, all the policy issues are combined for discussion between all the major stakeholders for the enactment by the institutions. |
| Action Plan | In this process, decision-makers articulate the solutions, measures and countermeasures policy issues to deal with, specifically determining objectives, articulating plans, projecting the significances of plans. |
| Legislation | The phase mainly comprises putting forward policy formulation proposals, deliberating legal aspects of the proposals, After voting to adopt and promulgating policies as per approved agenda items and action plans. Finally promulgation of policies after signing by the executives. |

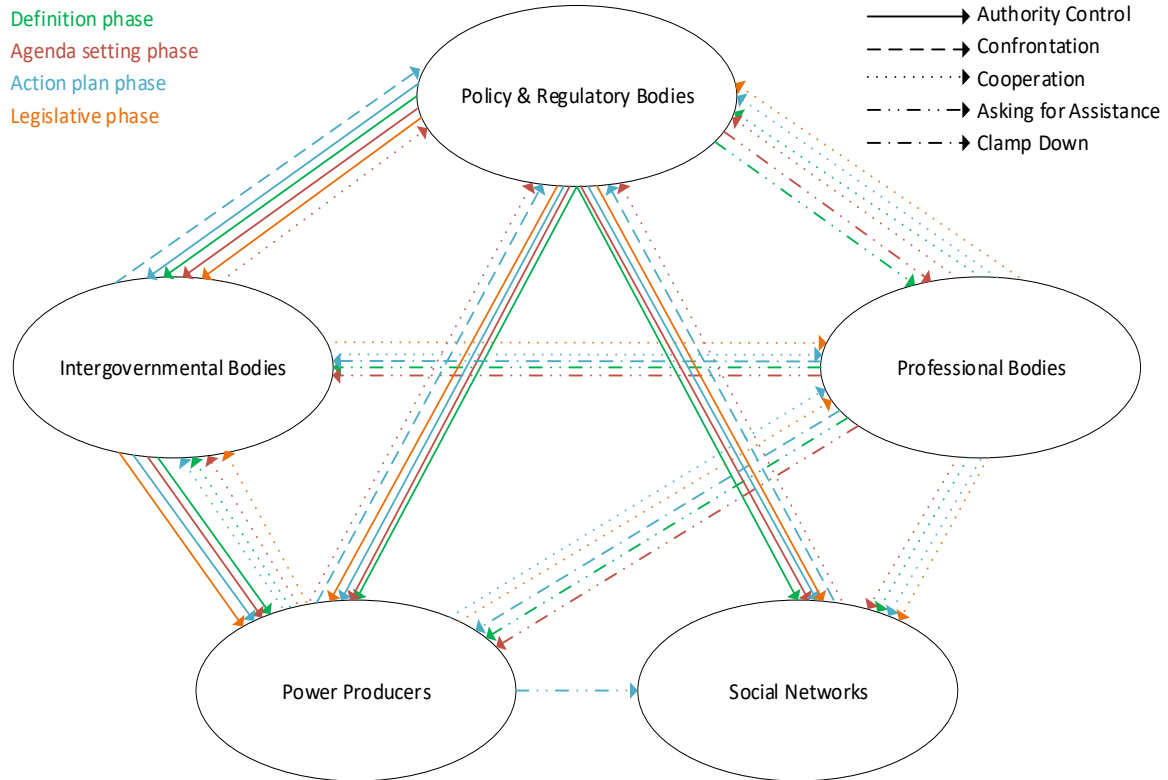


Figure 4. KSA RPS Formulation Pentagon Communication Mapping

VI. SUGGESTIONS AND RECOMMENDATIONS:

Based on the “Rhodes” policy network theory and proposed KSA RPS pentagon communication strategy a four phases renewable portfolio standard formulation task is given in

table-3. In which all the KSA stakeholders should play their roles in the formulation of RPS for successful deployment of vision-2030 RE targets in the Kingdom of Saudi Arabia as depicted in figure-4.

Table 3. KSA RPS Development Phases.

| Objectives | Phases | Tasks |
|------------|---|--|
| 1 | Phase-I: Literature review and lesson learned | Three successful RPS case studies of different US states and EU countries will be investigated for a brief RPS development and design for the Kingdom of Saudi Arabia. |
| 2 | Phase-II: Study of Design Principles | RPS design principles will be highlighted to follow and effective implementation of RPS at low-cost in KSA. |
| 3 | Phase-III: Development of RPS Standard | Based on the Phase-II discussions this section will describe the RPS design choices in detail. That will help policymakers to choose and opt for RPS with its pros and cons. |
| 4 | Phase-IV Recommendation to KSA | Strawman RPS proposal design that might be considered as an RPS approach in the Kingdom of Saudi Arabia context for successful deployment of renewable energy in the true spirit of KSA vision 2030. |

VII. CONCLUSION:

Keeping in view of economic growth and energy consumption as well as environmental concerns the Kingdom of Saudi Arabia recognizes the importance of a diversified energy mix with the dissemination of renewable energy technologies. KSA has promulgated its Vision 2030 to deploy approximately 58.7 GW of RE project with maximum penetration of 40 GW of solar photovoltaics (PV) power plants. For the successful deployment of vision-2030 RE targets, the Renewable Portfolio Standard (RPS) can play a significant role. Therefore, by following the network theory policy a pentagon communication strategy between all the five stakeholders with four phases road map is proposed in this paper. This road-map will help KSA regulatory authorities, retail electricity providers (National Grid) and

power generation companies (SEC, ARAMCO, SWCC, PCPC, etc...) to opt it and encourage them for technology development and ultimately make renewable energy specifically solar photovoltaic economical source of energy as compared to conventional electric power generation system in the Kingdom of Saudi Arabia.

AUTHOR CONTRIBUTIONS

All authors have equally contributed to this paper.

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