3D Energy Framework Strategy by Balanced Scorecard

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Abstract: In this paper, the balanced scorecard has been applied to create an ideal national energy framework, which is useful for the specific overall strategic theme, objective, sub-objective and the owner of each objective. The result obtained from a case study shows that it can be used to facilitate the measurement of alternative energy development plan (AEDP 2012-2021) in Thailand and the ideal national energy framework, which can also be applied for the national energy framework creation and presented the overall strategic theme, objective, sub-objective and the owner of each objective under the strategic theme in objective measurement target initiative (OMTI) form. This method can help strategic planners for assigned measurement guideline under each strategic objective to the right owner. Originally, the company in lower chain will receive the policy from the top level organization such as ministry, regulator or country governor. Then, this policy can be used to set own vision, goal and their key performance indicator (KPI), where the problem from information can transfer from low level to top level, which can support the decision maker.
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1. Introduction

Industry has always been recognized as the main sector of the economy of all developed countries in the world society, where the electricity supply industry (ESI) acts as an important part that affects to the gross of domestic growth, which can be defined as group of partners who are responsible to generate, transmit, distribute, sale and control the electricity from production to end users. Basically, it needs to balance the level between electricity supply and demand, in which the stabilization and utilization of the industry could be controlled Kirschen and Strbac (2004). In general, the electricity industry can be separated into many functions from generating and delivering electricity to the customers by using the transmission and distribution lines in the grid, which starts with the electricity generation, then transports to distributers via transmission lines. The electricity is then distributed to the end-users by using the distribution lines in each area, in which the short-term balance, security and reliability of the system, and other associated services such as construction or maintenance can be controlled by system operator (SO).

The main business functions can be described in many parts, according to the responsibility of any business's partner Depoorter (1999) and Lai (2001). First, it is the vertically integrated utilities which generate and utilize the transmission and distribution network. Second, the generated companies (Gencos) take the responsibility for electricity generation by using generators and sell to the end- users. Meanwhile, they also sell service like regulation, voltage control and energy reserve. Third, the distribution companies (Discos) take responsibility as the operator of distribution network owner, which sell energy to all consumers who connected to the networks. Then the retailer takes responsibility of buying the electricity to wholesale market and sell to authorize user, and market operator (MO), whose responsible is to get the bid and offer the buyers and the sellers of electricity energy.

The next part is an independent system operator (ISO) which can be defined as the operation controller, who maintains the level of transportation services to ensure that the system operates constantly and maintains the electrical equilibrium. And the transmission companies (Transco) that operates after generators producing the electricity, where finally the electricity is supplied to the buyers with very high voltage via the electricity transmission lines. These are used in the interconnected network, which is shared by all end users. The transmission lines are also called upon the network externalities that benefit all interconnected parties by increasing the reliability and security, in which the cost of generation can be reduced, which results in the additional value of investment in grid augmentation being reduced by successive investment.

Then the regulator that acts as the government to ensure the fair and efficient operation of the electricity sector, who also takes responsibility for energy rule and policy management of electricity market. And the last is related services, where all of general features of

the electricity system industry, the generation, transmission, distribution, end user supply and system operations are the most important features. However, the ESI was expanded widely and has a more complex structure of functions that can reduce the cost of investment and can give way to a number of different, and more specialized, market players. In order to have many players in the market, the ESI needs to find some more functions to reduce their risk. The functions, such as financial services, can provide benefits that offer a growing number of power exchanges between countries.

While changing the structure of ESI, the monopoly structure is the first structure, which each utility is integrated by own generation, transmission and distribution system for electricity supplying to the customers in the different geographic areas Kirschen and Strbac (2004). So, it starts by running the business like monopoly structure, where the buyers need to buy the electrical energy from the specific area close to the generator. However, some economists were studied in 1980s along the electricity industry and argued that market under electricity framework had limitation in the incentive to operate efficiency and encouraged unnecessary investment. The cost of mistaken decision was passed to the customers Figge, Hahn, Schaltegger and Wagner (2002). Therefore, the government try to invite the investor to invest in all parts of electricity industry by giving the promotion such as tax reduction or investing subsidized cost. The investor can offer the lower prize to the electricity market with more benefit and advantage, freely from monopoly structure. The opening of perfect competition opportunity of the industry can enhance the electricity efficiency and freely select the technology usage, which finally makes more benefits to the customers.

When the market was opened, the private generators were called by independent power plants (IPP) via the connected network. The utility has no longer owns the whole generation capacity and needs to purchase some energy from IPPs. This affects the electricity cost because it introduces a form of competition between generators that creates the investment and cost sharing from competitive market. The latest structure development that opens the free market of ESI calls for fully competition, in which the consumers in this market are free to buy the electricity from any retailers (suppliers) Gobin and KP Subramanian (2012) ; Hogan (1993) and Holloway (2004). In this market, the retail price is no longer be regulated because consumers have their oportunity to select their retailers when they offer the better price, and energy price are set through market interaction.

When focusing on the complexity of the electricity supply industry (ESI), it separates into many layers of operation theme which focuses on the core function such as generation, transmission and distribution, and they found that electricity industry crucially affects the country's market growth because it became a vital investment cost of every industrial sector Stoft(2002) and Wolak (2009). There has been an attempt to promote private sectors to control the whole electricity supply industry (ESI) but, this can leads to the problem of strategic duplication and confliction among organizations because the strategic of each organization may not support one another to support the full key performance indicator (KPI) of the country's strategy.

With the expansion of the ESI structure, market operators such as system operators or regulator are attempts to apply the computer application to help their controller to increase their efficiency in their decision making. The applications like SCADA, EMS, and EMS was adopted and developed. However, each organization is still developing their own computer systems to support and improve their profit organization instead of sharing the infrastructure due to the differences among organizations. Based on that strategy, the difficulty is falls on the final decision maker who rely on the data from each application to generate the information to support their business decision. Therefore, this paper presents the concept of integrated data by applying balanced scorecard methodology to create the guideline in top level indicator which can be used by any computer application designer as a guideline to develop the most suitable application in their system.

2. Balanced Score Card

To solve the problem of strategic duplication among electricity provider and related business, the government should look at the top level business strategic which is the national development plan as a primary reference. The balanced scorecard theory is then applied to provide definitions for any industry indicators by matching with the national matching with strategic on that plan.

Balanced scorecard is the top theory that the decision maker uses to identify the key business drivers which can use to measure and improve the performance level of their business operation because it can establish the current organization position, their future action, and also the simulation of actions in key areas. In a traditional market most of the key measurement areas are mainly focus only on financial, profit, and return on asset because it can reflects the tangible and cause and effect results. However, focusing only on financial perspective can leads to the balance of business operation that may affects the long term business profit and customer relation because its main purpose is to perform a retrospective case studies rather than future action predictive Arora (2002). Therefore,

business gurus have presented the tools that show the balance in four distinctive perspectives to promote a more holistic view of business.

Balanced scorecards have emerged in the USA from Johnson and Kaplan, at the end of the 80's (1987), as a new management control tool to help business make gains in strategic and marketing dimensions. BSCs are most popularly used for mid-term strategies (5 years) and are composed of the following details Sarntijaree (2009):

(i) Four strategic perspectives, which are financial, customer, internal business process, learning and growth

(ii) Ten to fifteen strategic objectives distributed among the four perspectives

(iii) At least two indicators to measure each strategic objective

(iv)Targets and initiatives to reach the targets

The four perspectives are designed to balance the organization capitals that are the balancing between financial and non-financial, the internal and external, the current performance with the future performance, and end with the develop of learning and growth level of organization.

The relation between BSCs and knowledge management was shown in the parts of capital within the organizational architecture of the firm called "Intellectual Capital Scorecards" and were deployed by the Swedish insurance company Skandia. It means design and identify the measurement of each four parts in balanced scorecard can effect with the success of organization strategy Figge, Hahn, Schaltegger and Wagner (2002).

Based on the theory of balanced scorecard the methodology to transfer the strategy from top-level organizations to their partner has revealed that the sub units select some strategy from their headquarters and transform it into their own strategy and indicators, which can be a measurement of the drive to commit their goal.

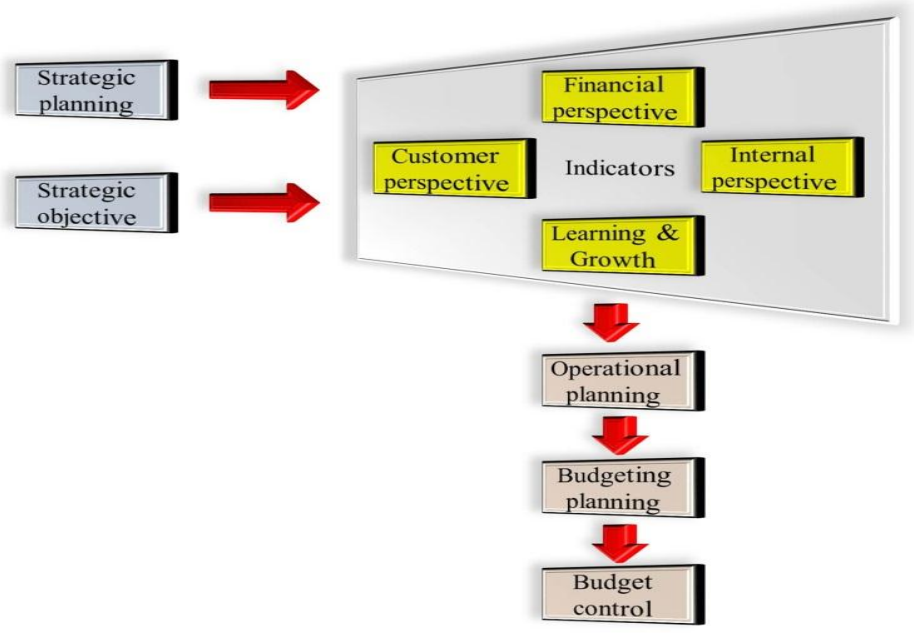

Fig. 2. Relationship between balanced scorecard and organization strategy

To apply the balanced scorecard for the electricity supply industry (ESI), firstly, it has to begin with the analysis of the industry strategy, the design of the strategic map including the strategic themes, and the relationship between the cause and effect and the themes. Therefore, the strategic theme can be presented in four main parts and the cause-effect between those parts and the strategic map can be presented in the figure below.

Figure 4 describes the relationship between four main parts of balanced scorecard. First part is finance, showing the strategic theme, objective and indicator concerning financial aspects by separating into three main aspects by increase the organization revenue, decrease organization investment costs or increase the quantity of production and organization asset utilization. The second is the theme concerning customers, focusing on the aspects concerning customer satisfaction with the market share, which directly affects the profitability of customers. The third aspect presented concerns internal business processes that analyses the strategic indicator by starting from

innovation processes and business operation processes. The last aspect presented concerns the learning and development of people, such as their attitude towards work or training, and business processes of organizations, such as adding ICT or reducing the redundancy of organization business processes Pienaar and Penzhorn (2000).

Fig. 3. Balanced scorecard perspective and strategic management activities

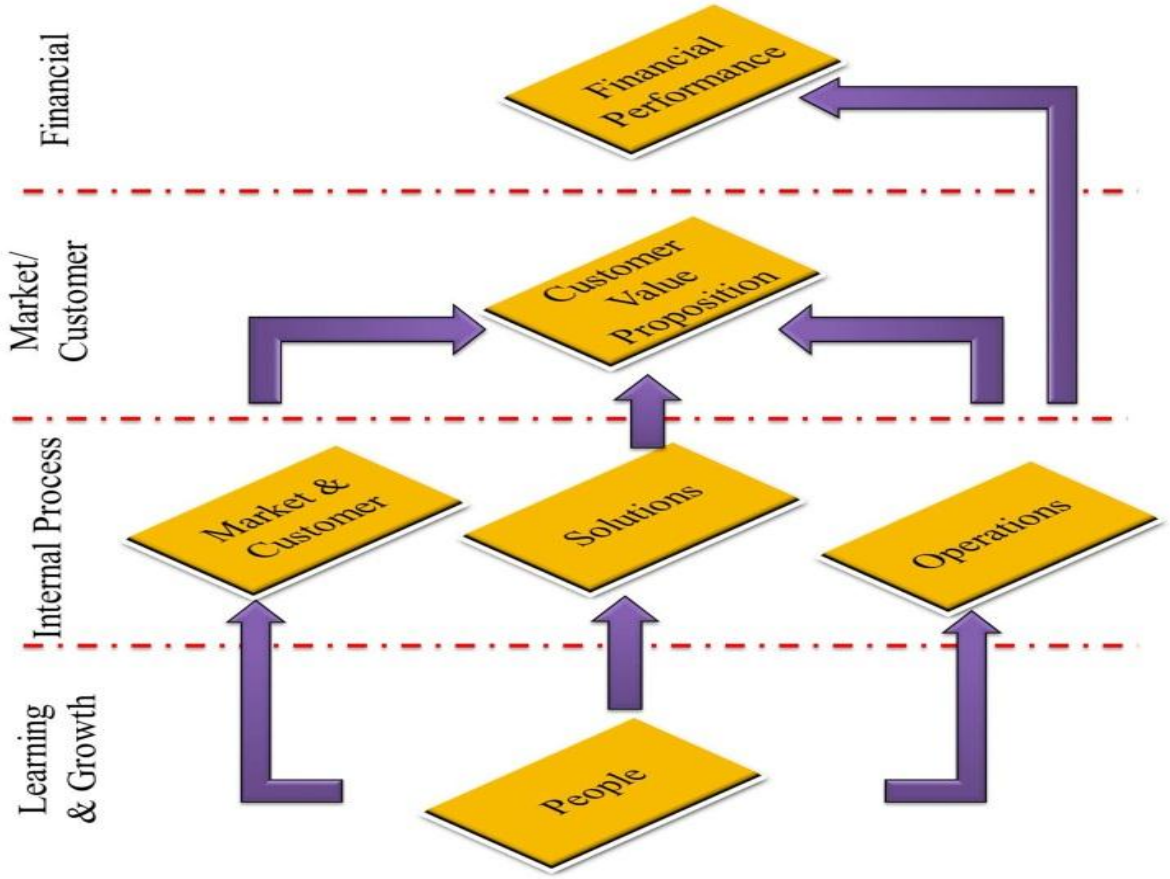

Fig.4. Balanced scorecard framework

After identify the strategic map, it follows to create the corporate balanced scorecard, which is the table to show the description of strategy by presenting the description of strategic objectives, measurements,

targets and the initiatives of all strategic themes. These tables are also called "OMTI models". Next, the organization uses their objective measurement target initiative (OMTI) to decentralize their strategic theme to sub-unit organizations, as shown in the figure below. Figure 5 shows the structure to instruct the strategic themes and measurements from the organization's headquarters to their sub business unit (SBU), and the measurement indicator of the strategic theme that is delivered to their sub business unit (SBU), which has changed to support the SBU private goal. Moreover, the success of that measurement of SBU can lead to success for the strategic theme of the organization's headquarters Simoes and Rodrigues (2013); Studer, Benjamins and Fensel (1998); Sutton and Patkar (2009). However, every sub-unit organization also needs to operate their private business to make their own profit, while needing to help achieve the organization's goal for the success of the whole group.

As presented in the balanced scorecard in Thailand's power system, we see that each company receives the national plan and develops its own indicator, and this has a structure known as the contributory model.

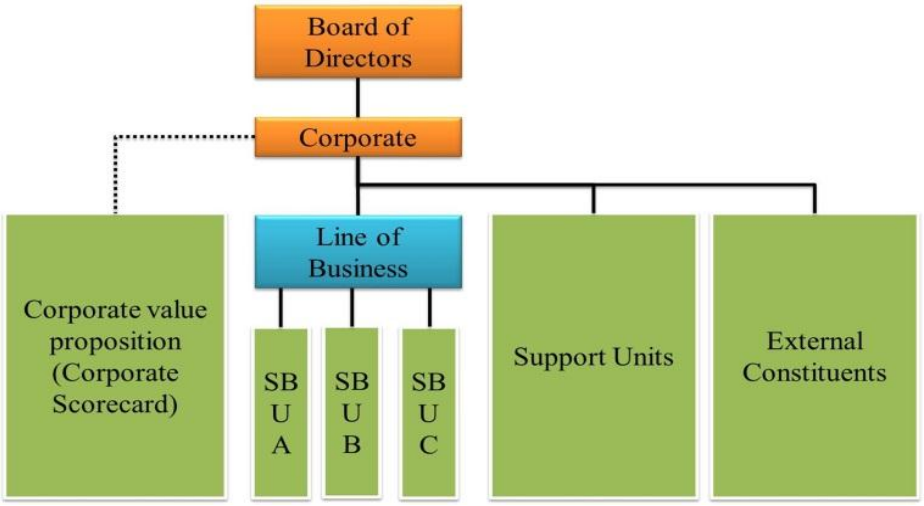

Fig. 5. Theme and measurement dissemination in balanced scorecard

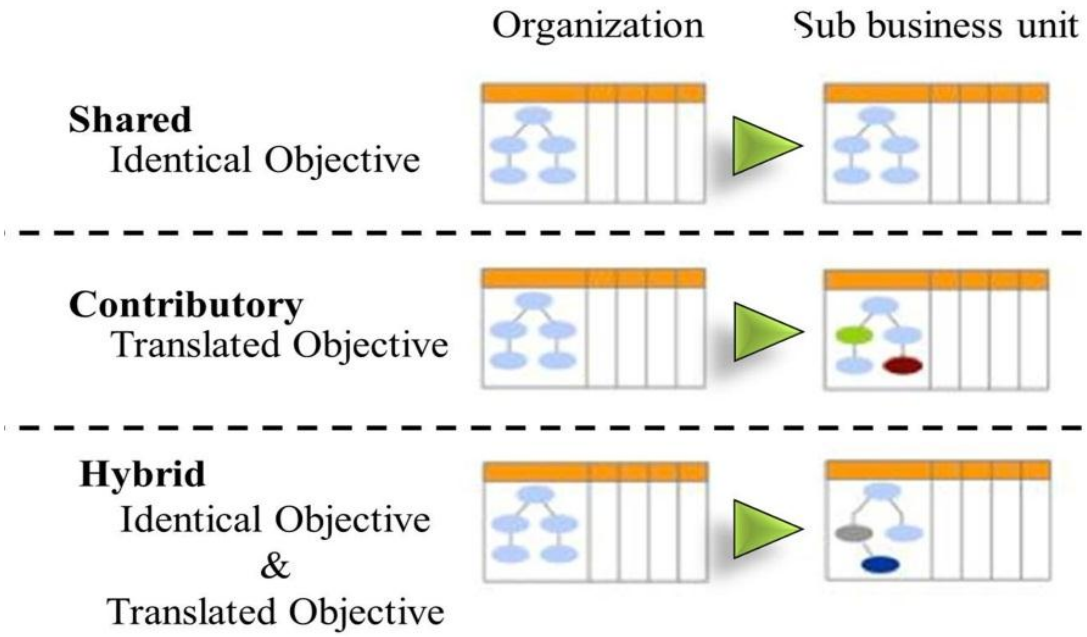

Fig. 6. Characteristics of measurement dissemination

3. Research Methodology

To prevent the issue of strategic redundancy among electricity provider industry, the ideal strategic framework that specifies the objectives and measurement of electricity market must be designed and distributed to their cooperative partners. The research idea showed in the figure below:

By designing the balanced scorecard framework in order to support electricity supply industry (ESI), it starts with define the meaning of electricity economy to find the ideal theme of each partner. After electricity theme has been identified by researchers, the theme was then separated into 4 main parts, financial, customer, internal business process and learning and growth of balanced scorecard (BSC) while researchers also looking on the current strategic plan and energy policy both overall electricity industrial sector and specific to each electricity partner. The researcher then uses that theme to create an OMTI form of electricity supply industry (ESI) applying electricity theme as the ideal theme in balanced scorecard. After the researcher gets the ideal theme of the ESI in balanced scorecard, he/she then identify the objective of each theme by study the interested issue in monopoly market to fully competition market, and list them as the objective in OMTI form.

As a result, the duplicate issue in the strategic of electricity supply industry was justify by apply the ten years energy's development plan of Thailand, call alternative energy development plan: AEDP 2012 – 2021" into OMTI form and see the difference result compare with the original plan.

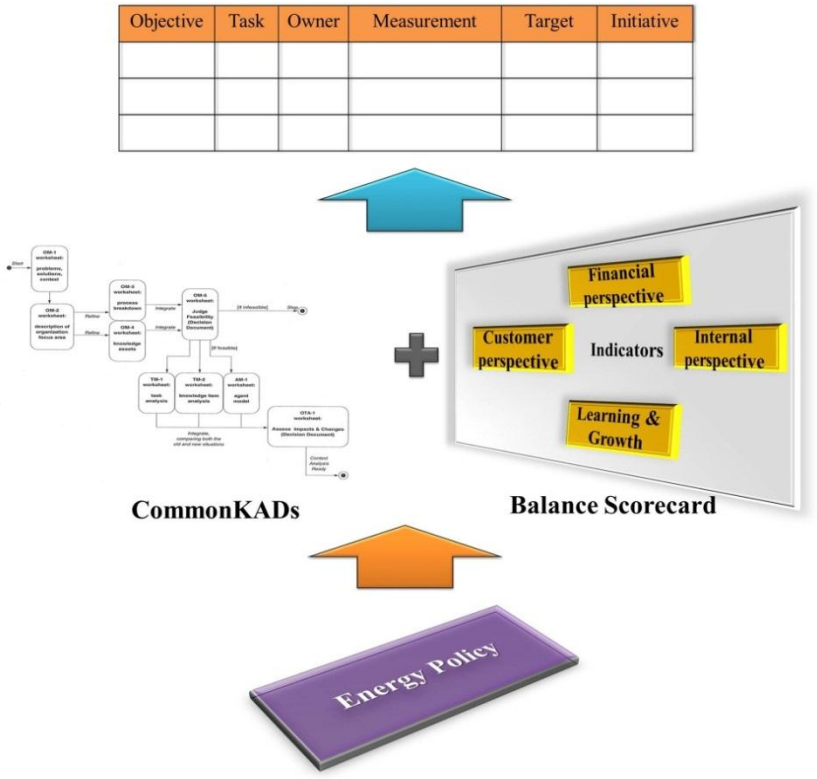

Fig.7. Research methodology

4. Case Study

To justify the ideal ~~of~~ national energy framework, the methodology has applied in alternative energy development plan: AEDP 2012-2021 and found that this plan was mainly focus on the improvement of renewable energy in Thailand electricity industrial sector. This plan presents the important cause for developing the energy plan of Thailand. It shows the energy ratio between domestic production and international imports, and the way to promote renewable energy to reduce the ratio of imported energy dependency. Moreover, this plan also focuses on the environmental problem especially global warming problem and the goal toward low cost carbon society. This plan then presents the issue of agricultural resource and some area in Thailand that have solar resource which show the latency in order to use that resource in to produce the electricity.

The second part of this plan presents the general objective for improve the renewable energy to 25 percent in 10 years, and the main point and strategic to improve to the final goal in 10 years.

The strategy in that plan can be summarized as follows;

(i) To promote the corporation of people in society in order to improve the renewable energy production and usage level in the society.

(ii) To promote the suitable standard and incentive to private investor.

(iii) To consider for changing the rule and standard that may not suitable for the current situation.in promote the renewable energy in Thailand.

(iv) To adjust the electricity infrastructure in both of transmission and distribution for improve to smart grid system.

(v) To inform and generate the knowledge to people in society

(vi) To support and promote the electricity investigation for create the tool that have benefit in order to develop electricity supply industry

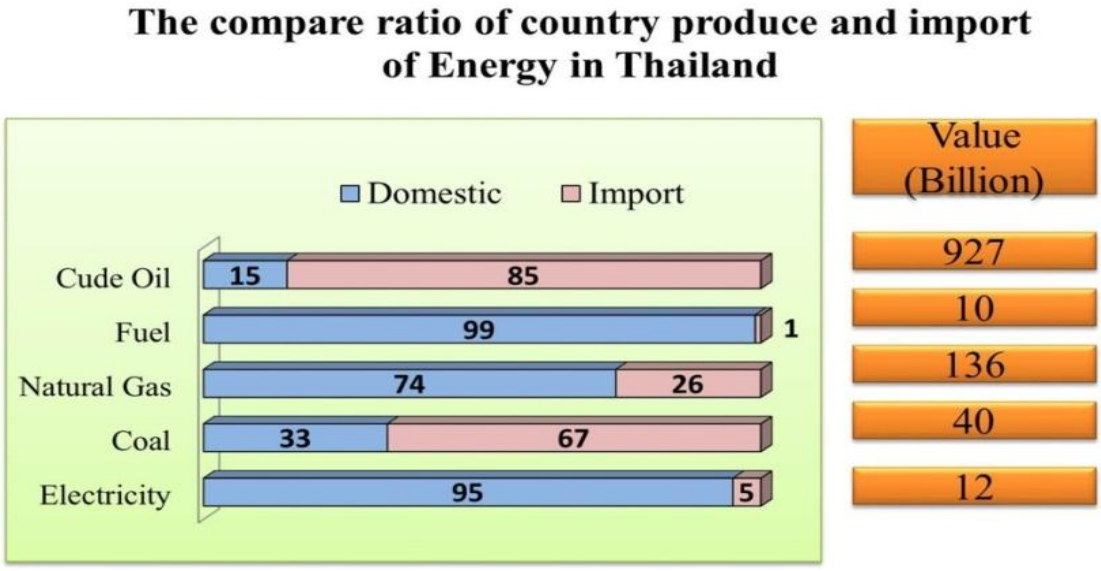

Fig.8. Energy ratio of the year 2011

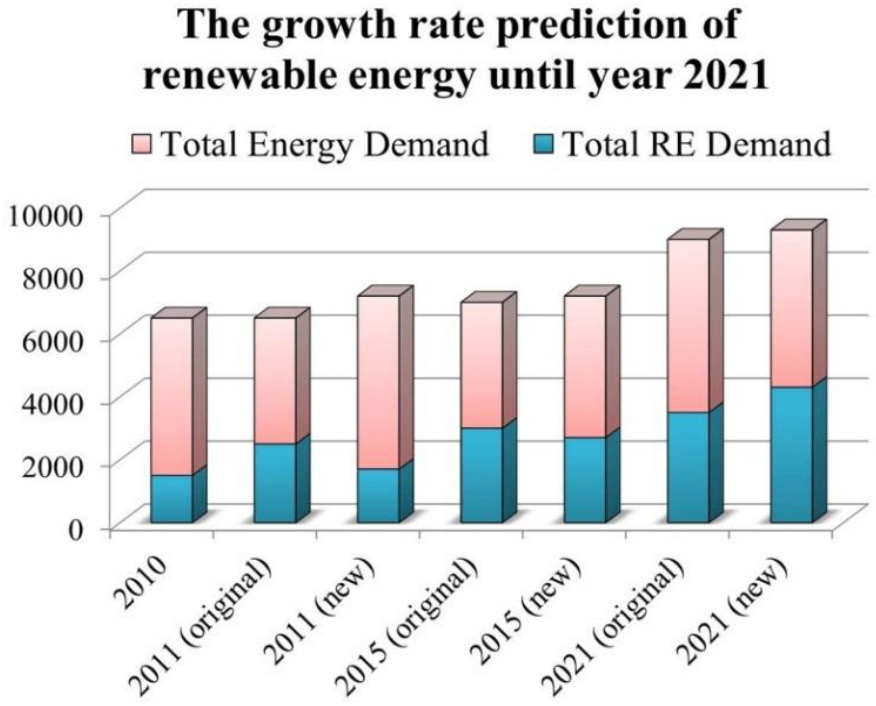

Fig.9. Renewable goal from 2012-2021

The fourth part of this plan has presented the target and initiative of renewable energy. For example the solar energy has goal to improve electricity level from 75.48 MW in the year 2011 to 2,000 MW in 10 years (2021). After that, the paper present the target based on the six strategic plan which promote the solar PV rooftop to 1,000 MW in 10 years for support the promotion the corporation of people in the society. Moreover, this plan also promote the incentive to private organization which are adjust the way to calculate adder standard from current formula to feed in tariff (FiT) standard, and also change the act of legislation on industrial sector for suitable with the current situation. The other initiative, which are keep up with the extension of electricity transmission and distribution line in Smart Grid development.

Table 1. The measurement identification and owner of AEDP in financial part

	strategic attribute	Objective	sub-objective	Owner	Measurement	target
Financial	public debt	compare the ratio of public sector electricity industrial sector with other sector	customer protection	regulator		
	Asset Utilization	worthiness of asset usage in electricity industrial sector	metering asset management and operator	retail electricity provider		
	electricity tariff	electricity license free management				
		electricity tariff reflect with manufacturing cost	Price adjustment	regulator, retail electricity provider		
			measuring generation capacity	Gencos	support CBG	
			ensuring the fair and efficient operation of the electricity sector	regulator	manage difference gap between E 20 and Gasohol 95	
			customer protection	regulator		
		management of electricity fund				
	National resource management	resource being use in the most efficient way (Balancing)	competitive equibrium	regulator, retail electricity provider	ratio between fossil fuel and renewable fuel	25,000 ktoe
					percent renewable compare with fossil fuel	0.44
					renewable fuel or diesel	25 million liter per day
	National resource management	resource being use in the most efficient way (Balancing)	competitive equibrium	regulator, retail electricity provider	renewable usage ration: wide	134 ktoe
					renewable usage ration: Solar	224 ktoe
					renewable usage ration: water	756 ktoe
					renewable usage ration: biomass	1896 ktoe
					renewable usage ration: biogas	270 ktoe
					renewable usage ration: garbage	72 ktoe
					renewable usage ration: new technology	0.86 ktoe
	investment	the ratio of private sector that invest in electricity industry	introducing competition in the retail market	retail electricity provider		
		the ratio of source of investment funds				

Table 2. Identify measurement and owner of AEDP in customer part

	strategic attribute	Objective	sub-objective	Owner	Measurement	target
Customer	Government	The constantly and vigorous growth of electricity industry	Measuring generation capacity	Gencos	Support budget for high pressure boiler	
		Thoroughly of electricity system in country	Service quality including reliability of supply, waveform quality and provision of information	ISO	Wind generator in island	
					Water generation in village	
		The adequacy of electricity usage in country	Maintain the quality and security of the electricity supply	Gencos	Cancel benzene 91	
	Investor	Policy to support the promotion of trade in electricity industry	Determines or approves the rule of electricity market	Regulator	Wide generation license	
					Water generation license	
	Industrial sector	Incentive	Price adjustment	Regulator, retail electricity provider	Adder formular	Change the Feed in Tariff (FiT)
					Renewable heat incentive (RHI)	
					Biogas safety campaign	
					Reduce tax and support producing the ECO-CAR	

Table 3. Identify measurement and owner of AEDP in internal business process part

	strategic attribute	Objective	sub-objective	Owner	Measurement	target
IBP	power quality	generation capacity	Measuring generation capacity	Gencos	Solar generation capacity	2,000 MW
					wide generation capacity	1,200 MW
					water generation capacity	1,608 MW
					garbage generation capacity	160 MW
					renewable generation capacity	3,630 MW
					biogas generation capacity	600 MW
					underground generation capacity	1 MW
					tidal and Current energy	2 MW
					generation from renewable	9,201 MW
	network operation	cover level of electricity network system	ensuring fair use of transmission network for all generator	Transco	synergize of wide user and generator	
					create distributed-green-generation	
					create Biogas network	
		improve the electricity system dispatch efficiency	controlling the dispatch of flexible plants the ensure of load match resource available to the system	SO	load forecast	99,838 ktoe
	plant scheduling and availability	load duration curve	controlling the dispatch of flexible plants the ensure of load match resource available to the system	SO	load forecast	99,838 ktoe
	asset management	the level of apply asset management framework in organisation	asset replacement analysis	Disco	EGAT, MEA, PEA prepare to network operation	
	integrated resource planning	the efficiency of managing resource based on commiting in PDP	maintain the quality and security of the electricity supply	SO and Gencos	solar PV rooftop	1,000 MW
					suitable resource for producing Hydrogen	
					improve palm oil production	5.5 million aquer
					improve clude plam oil	3.05 million ton/ year
					improve oil content	more than 18 percent

Table 4. Identify measurement and owner of AEDP in learning and growth part

	strategic attribute	Objective	sub-objective	Owner	Measurement	target
Learning & Growth	standard	improvement of standard in organization	determines or approves the rule of electricity market	regulator	change the act of legislation on industrial sector	
					change the act of ministry of natural resource	
					change the act of electricity investment	
					improve Biomass Pallet standard	
	technology	the ratio of technology source (transfer or R&D)	information technology and innovation adoption	SO	wide technology	
					micro hydro turbine	
		level of applied technology in organization	information technology and innovation adoption	SO	apply solar technology in ESI	
					gasified and gas engine technology	
					biomass-to-liquid	
					create biogas from co-digestion	
					underground heat technology	

The measurement of AEDP plan on national energy framework in the customer part which present the AEDP incentive and campaign such as change the adder formula, Biogas Safety and reduce the tax has responsible by both regulator and retail electricity provider. While policies like cancelling benzene-92 and providing the budget to support high pressure boiler was response by generating company (Gencos) and independent system operator (ISO)

The internal business process in national energy framework is one of the important parts in balanced scorecard that have many measurement owners. The table shows that track the changing ratio of renewable which effect with generation capacity has response by generating companies (Gencos), while independent system operator (ISO) response to monitor the load forecast and monitor the level of natural resource usage in the country. Moreover, the responsible for synergize the group of renewable and generator, and create the system network are under control by transmission company (Transco).

The last part of national energy framework is matching AEDP plan with learning and growth perspective as it shows that regulator is responsible to set the market rule and standard of ESI, which need to adjust unsuitable standard and update it to make most benefit to the country, in which the independent system provider (ISO) has shown the responsibility of monitoring the level of technology, and innovation, which has been adopted in the organization.

5. Conclusion

To conclude, the composition of all attributes of the electricity supply industry (ESI), it is not only resource allocation and planning generation efficiency and scheduling but also tests on transmission and distribution stability up to the demand side management and promotion. Conclusively, the result of this research shows that by applying balanced scorecard methodology to create the national energy framework, which presents the overall strategic theme, objective, sub-objective and the owner of each objective under the strategic theme can help the strategic planner to have the guideline for assign the measurement under each strategic objective to its correct owner. The future work of this research is to analyze the entire range of attributes and identified the task templates and communication models in order to map the information transfer between the ESI agents. Moreover, it wills analyses the relationship of the ESI attributes with the external factors that affect the operation of the electricity supply industry (ESI).

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