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Energy Performance Contracting Initiative in Malaysian Public Hospitals

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Abstract: Ministry of Health Malaysia (MOH) has integrated sustainability program in the management of its assets particularly hospital buildings in line with the national sustainability goals and the United Nation Sustainable Development Goals. The fundamental sustainability change is significant since 2015 in the public healthcare sector where green business practice is more appreciable through formation of policy and sustainability related programme. Public hospital in Malaysia are very high energy consumers, therefore various energy projects have been implemented through Energy Performance Contracting (EPC). EPC projects in MOH is intended to deliver energy expenditure savings as well as to offset hospital building carbon footprint. EPC practice in government hospitals have managed to offset about 15.7 ktonne carbon emission in 2019 or about 16% of Government building national emission reduction target. Energy project such as energy efficient chiller retrofit, LED lighting retrofit and solar thermal hot water are some of the EPC initiatives by MOH in public hospitals. The energy projects not only serve to meet the overall Hospital Facility Management Contract sustainability goals but also to complement the green building target for Malaysian Healthcare building by 2025. The aim of this paper is to review the development of the EPC projects in public healthcare sector and its impact on government energy spending as well as to the climate.

Keywords: Healthcare, sustainability, energy efficiency, energy performance contracting

1. Introduction

Why green development is important in Malaysia? Malaysia like most other countries in the world is struggling with challenges to balance between population growth with increased demand of the build environment and increasing negative strain on the natural environment in the form of spiking world extreme weather. There is a growing need to move towards green development in Malaysia thus the country has committed to a more sustainable nation development programme. The new green development trajectory targets several outcomes mainly reversing the environmental negative impact of the socioeconomic activities, preserving natural resources like the forest and biodiversity as well as responsibly managed water resources and ecosystem. Other outcome is the protection of the development outcome that would enhance and ensure the wellbeing of the people including the next generation. Also included in the green trajectory is the efficient use of energy and to increase the use of renewable energy. The new trajectory is intended to replace the conventional 'grow first, clean up later' development approach. As such,

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fundamental changes are required that would involve new policies, regulatory body, responsibility sharing and environmental awareness. The climate change mitigation should be seen as an investment in the development plan rather than a cost burden that would otherwise discourage the green development revolution. The fundamental change that is seen in Malaysia is aligned with the United Nation Sustainable Development Goals [1] and the government national sustainability goals.

Ministry of Health Malaysia (MOH) has been actively implementing the fundamental changes in the public healthcare sector by integrating sustainability program (SP) in the management of its assets particularly hospital buildings. The sustainability framework has already been put in motion since 2015 which drives the sector to adopt more sustainable and clean energy consumption to help reverse climate change impact [2]. Public hospital in Malaysia are very high energy consumers therefore various energy projects or retrofitting have been implemented in public hospitals through Energy Performance Contracting (EPC). EPC projects in MOH is intended to deliver energy expenditure savings as well as to offset hospital building carbon footprint. Experiences from other countries have shown that EPC is more economically desirable solution to implement retrofitting or energy projects as it involves minimum financial exposure, personnel and risk [3]. Countries like Germany and Austria are pioneers in EPC since the mid-90s with more than 200 and 500 EPC agreements respectively involving high tech individual building like Hospitals [4]. Economic giants such as China who are early adopters of EPC have been pursuing and made great efforts to expand the EPC market in China to encourage deep energy savings [5]. A common dilemma facing energy efficiency project is financial constraints therefore outsourcing through EPC provide means to overcome this barrier. Survey on practitioners have also showed that the guaranteed energy cost savings is the prime reason EPC is viewed favourably [6]. Many examples shows that 20-40% energy saving are possible through performance contract [7]. This paper will look into the development of EPC programme in the public healthcare sector in Malaysia and its achievements.

2. Method

Information regarding energy performance contracting initiative in Malaysian Public Hospital were gathered from several sources as listed in Table 1.

Table 1 - List of sources used for this review

No	Source
1	Concession agreement on Hospital Support Services 1996 and 2015
2	EPC agreement for selected hospitals in Malaysia
3	Discussion with experts from Ministry of Health Malaysia and other government agencies, and relevant stake holders
4	Personal work experience in the field of Facility Management in healthcare setup
5	Discussion with FM companies/ESCOs providing energy services to the Government
6	Online searches of the retrieved literature, newspaper cuttings, journal paper, government reports, statutory references
7	Technical visits to selected healthcare facilities

3. Discussion

The following discussion covers a few important points which includes manifestation of sustainability development in Malaysia, development of EPC project within Ministry of Health, EPC work flow that is being practiced in MOH and the impacts of EPC to government energy expenditure.

3.1 Manifestation of Sustainability Development in Malaysia

Sustainable development in Malaysia started to gain momentum following commitments made by Malaysia at 15th Conference of Parties (COP 15) to the United Nation Framework Convention on Climate Change in 2009. Malaysia has declared to reduce its carbon emission by 40% compared to 2005 GDP levels subject to assistance from developed countries by 2020 [8]. Malaysia has also ratified the Paris Agreement (COP 21) and further commit up to 45% Green House Gas (GHG) emission intensity reduction based on 2005 GDP level in 2030 [9]. Since then multiple new legal instrument in term of policy and regulations have been enacted to reflect Malaysian sustainability commitment in line with several United Nation Sustainable Development Goal shown in Fig. 1. Such policy and regulations are listed in Table 2 and Table 3.

Fig. 1 - Part of United Nation Sustainable Development Goal agenda supported by Malaysian SP policies

Table 2 - Policy and regulation

No	Policy and regulation	Regulatory bodies
1	Renewable Energy Act 2011,	Malaysian Energy Commission
2	Electrical Supply Act (Amendments) 2015	Malaysian Energy Commission
3	Efficient Management of Electrical Energy Regulations 2008	Malaysian Energy Commission
4	Malaysian Development Plan 2016-2020	Prime Minister Department
5	National Sustainable Consumption and Production Blueprint	Prime Minister Department
6	National Energy Efficiency Action Plan (2016-2025)	Ministry of Energy, Green technology and Water Malaysia
7	National Green Technology Master Plan (2017-2030)	Ministry of Energy, Green technology and Water Malaysia
8	Energy Efficiency & Conservation Legislation (pending for parliament approval)	Under the purview of Ministry of Energy and Natural Resources

Table 3 - List of standards, technical guide and certification tool

No	Standards and Technical Guide, Certification Tool	Owner
1	MS 1525:2014 Energy Efficiency and Use of Renewable Energy for Non-Residential Building	Department of Standards Malaysia
2	MS 2680 :2017 Energy Efficiency and Use of Renewable Energy for Residential Buildings	Department of Standards Malaysia
3	Net Energy Metering Scheme	Malaysian Energy Commission
4	Guide on Large Scale Solar PV Plant	Malaysian Energy Commission
5	Building Sector Energy Efficiency Project (BSEEP)	Environment and Energy Branch of Public Works Department Malaysia
6	Green Building Index	Malaysian Green building certification tool
7	Malaysia Carbon Reduction and Environmental Sustainability Tool (MyCREST)	Malaysian Green building certification tool
8	Minimum Energy Performance Standards (MEPS)	Malaysian Energy Commission
9	Energy Performance Contract Guide Book	Environment and Energy Branch of Public Works Department Malaysia

In the 11th Malaysian Development Plan (2016-2020), one major specified outcome is the reduction of GHG intensity up to 40% by 2030 which necessitates the wide use of energy efficiency and renewable energy. Some key strategies or mechanism to support the outcome is the creation of green market through Government Green Procurement (GGP) policy which is made mandatory to all government ministries after 2017. MOH was the first 5 ministries to carry out pilot GGP projects in 2013 [10]. Under the GGP policy, government have allocated a sum of money to finance procurement of energy services in line with MOH sustainable program goal [2].

The main goal of GGP was to create demands for green product and services and promotes industries to further raise the standard and product quality to meet the green criteria [11]. Malaysia Green Technology Corporation has publish MyHIJAU Directory that serves as an online platform for procurers, government ministries, and members of the general public to find information about all green products and services that have been recognised under the MyHIJAU Mark [12]. Under the 11th Malaysian Plan, the government has set a target of 20% green procurement by 2020 and leading by example so that the private sector would follow the government's footstep in the green procurement effort. Another step by the government in stimulating the green market is the use of green building certification scheme for new government buildings and green retrofits on existing buildings by stages to improve its

GHG footprint. Building sector is one of six key sectors stated in the Green Technology Masterplan (GTMP). The Government has implemented initiatives to realize a 5% reduction in energy consumption of ministry buildings in the federal capital by 2020 as well as the adoption of green building rating scheme. The Government is targeting between 550 and 1,750 buildings to be certified to a green building rating tool by 2020 and 2030 respectively [13]. This move is seen to help boost the growth and development of the EPC market in Malaysia. Malaysian government sustainable development framework and goal for public healthcare services can be summarised as shown in Fig. 2.

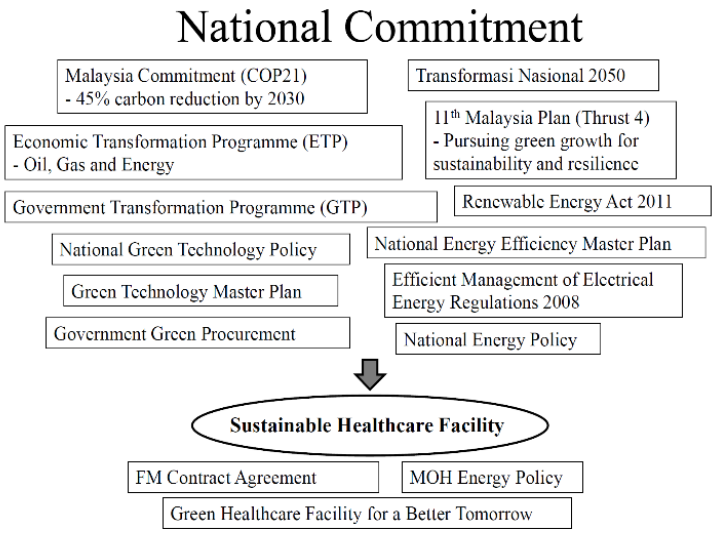

Fig. 2 - Sustainable development framework and goal for public healthcare services

3.2 Development of EPC Project in MOH

Hospital buildings have been identified as one of the highest energy users in the country [14], therefore stimulated the need to include green business practices in the facility management of all of MOH facilities especially its hospitals. The green practices are applied through the Sustainability Program (SP) which form part of the outsourced Facility Management (FM) contract of all 148 government hospitals as shown in Fig. 3. The FM contract between the Government and multiple FM companies provided the stepping stone which allow the implementation of EPC in healthcare set up.

Clause 15 and Appendix 9 in the FM contract was established to allow the FM companies (also acting as the Energy Services Company or ESCO) to implement proven and cost-effective energy saving technologies in government hospitals. It is part of a larger SP programme that is integrated in the FM contract. The EPC significant and attractive feature is that the energy projects is funded entirely by the FM companies.

Currently there are at least 18 number of EPC projects that have been implemented in various government hospitals. The existing EPC contracts varies between 5 and 7 years depending on the type of projects being implemented in the hospital building. As the FM contract last only for 10 years (starting in 2015) , the EPC project implementation would have to fit in the FM contract time frame. Table 4 shows the list of ongoing EPC projects in Malaysian government hospital provided by multiple Energy Services Companies (ESCOs). The first EPC project by MOH started in 2017 at Hospital Teluk Intan followed by several more hospitals in year 2018 and 2019.

3.3 EPC Scope, Final Proposal to Negotiation Phase

The main driver for the implementation of EPC in healthcare facility is the national climate change policy as well as potential savings that is expected from the energy projects. Some energy efficient projects are selected on the basis that it could provide upgrades to the existing aging engineering system such as chillers and boilers. The upgrades included total engineering asset replacement that capitalized on the latest technology which not only allow hospital to be more efficient but also contributes to climate change mitigation.

MOH engineers plays an important role in assisting MOH to integrate sustainable practices towards high performance healthcare building. The goal is to enable Malaysian healthcare building to be responsive to the triple bottom line of green building principle: people, planet and profit. Some of the major green practices includes continuous improvement of building energy performance through the adoption of energy management system and green building certification initiative to improve and benchmark the energy use. EPC project were strategically applied and delivered to selected hospitals that is participating the green building certification programme. EPC would improve the chances of certification by meeting the minimum building energy performance as demanded by the certification

Table 4 - List of ongoing and completed EPC projects in Malaysian Government Hospitals

No	Energy Saving Measures/Projects	Hospital	ESCO
1	Chiller and LED Lighting Retrofitting (installation complete in 2017)	Teluk Intan	Edgenta Mediserve Sdn. Bhd.
2	Chiller and LED Lighting Retrofitting (installation complete in 2018)	Ipoh	Edgenta Mediserve Sdn. Bhd.
3	Chiller and Lighting LED Retrofitting (installation complete in 2018)	Putrajaya	Radicare (M) Sdn. Bhd.
4	Solar Thermal Hot Water System (installation complete in 2019)	Keningau	Sedafiat Sdn. Bhd.
5	Chiller and LED Lighting Retrofitting (installation complete in 2019)	Kepala Batas	Edgenta Mediserve Sdn. Bhd.
6	LED Lighting Retrofitting(installation complete in 2019)	Kluang	Medivest Sdn. Bhd.
7	LED Lighting Retrofitting (installation complete in 2019)	Segamat	Medivest Sdn. Bhd.
8	LED Lighting Retrofitting (installation complete in 2019)	Batu Pahat	Medivest Sdn. Bhd.
9	Solar Thermal Hot Water System (installation complete in 2019)	HQEII	Sedafiat Sdn. Bhd.
10	Solar Thermal Hot Water System and LED Lighting Retrofitting (installation complete in 2019)	Sarikei	One Medicare Sdn. Bhd
11	LED Lighting Retrofitting (installation complete in 2019)	Port Dickson	Medivest Sdn. Bhd.
12	LED Lighting Retrofitting (installation complete in 2019)	Tuanku Ampuan Najihah	Medivest Sdn. Bhd.
13	Chiller and LED Lighting Retrofitting (installation complete in 2020)	Sultanah Fatimah	Medivest Sdn. Bhd.
14	Chiller and LED Lighting Retrofitting (installation complete in 2020)	Sultan Ismail	Medivest Sdn. Bhd.
15	Solar Thermal Hot Water System dan LED Lighting Retrofitting (installation complete in 2020)	Sibu	One Medicare Sdn. Bhd
16	Solar Thermal Hot Water System and LED Lighting Retrofitting (installation complete in 2020)	Miri	One Medicare Sdn. Bhd
17	Chiller and LED Lighting Retrofitting (installation complete in 2020)	Pulau Pinang	Edgenta Mediserve Sdn. Bhd.
18	Solar Thermal Hot Water System dan LED Lighting Retrofitting (installation complete in 2020)	Sultanah Bahiyah	Edgenta Mediserve Sdn. Bhd.

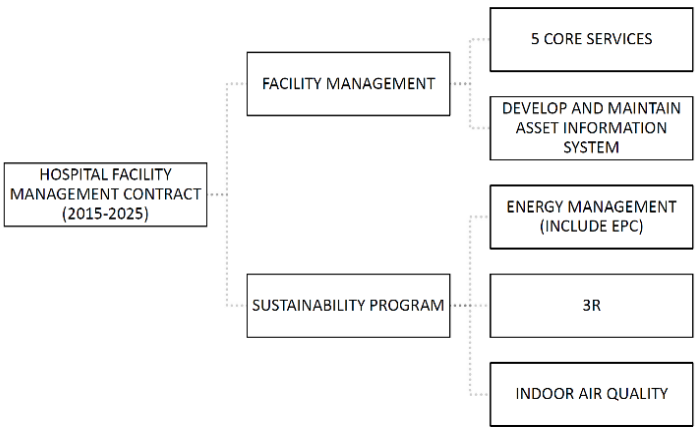

Fig. 3 - Sustainability program and Energy Performance Contracting in Government Hospital

tool. Control energy consumption and reduce energy loss have been identified as the major factor that contribute to the development of Green public hospital building [15]. Currently Hospital Langkawi is the first public hospital to achieved Gold level certification according to LEED green building certification tool. This is the first step in creating a green hospital trend that will become the new norm for MOH.

In term of scoping of the EPC project, MOH have selected few major hospitals from different zone in Malaysia with each zone has a different player acting as the ESCO providing energy service including EPC. There are in all 5 ESCOs that also plays the role of the FM companies providing engineering support services to the government hospital as shown in Table 5. MOH did not go through the normal tender process to select its ESCOs as the mandate for the EPC project is already given in the FM contract. In the EPC project initiation stage, the FM company is required to partner with a service provider to propose energy conservation measures (ECM) that has high energy savings potential. To streamline the process, all the FM companies are registered as ESCO with Malaysian Energy Commission as part of the regulatory body requirement.

Table 5 - List of ESCOs providing energy services including EPC

No	ESCO	Service Zone
1	Radicare (M) Sdn. Bhd.	West Malaysia (Central and East Cost)
2	Medivest Sdn. Bhd.	West Malaysia (Southern)
3	Edgenta Mediserve Sdn. Bhd.	West Malaysia (Northern)
4	One Medicare Sdn. Bhd.	East Malaysia (Sarawak)
5	Sedafiat Sdn. Bhd.	East Malaysia (Sabah)

Since the ESCOs themselves operates as FM in government hospitals, basic information such as historic energy consumption, drawings of the facility, operation schedule, data and energy records of major utilities such as HVAC and major equipment's are readily available to them. Nevertheless, the ESCOs are also required to do an investment grade energy audit (IGA) at their own cost in order to prepare a precise proposal. By doing so they would be able to manage and mitigate the technical and performance risk including giving guarantee to the anticipated energy savings and achieve the anticipated profit [16]. The cost of the IGA would be included in the capital cost of the EPC project. MOH would evaluate ESCOs proposal in term of several criteria which includes quality, expected target savings, performance guarantee and finance options. Other evaluation criteria may include CO2 reduction, improved building environment, equipment upgrades and reduce maintenance backlog and cost burden [17] .

EPC in public sector is still not common in Malaysia therefore still requires the development of procurement framework for EPCs. Procurement frameworks for energy services requires the making of a standardised contracts that comply with region procurement regulations and can be used with ESCOs for implementing energy efficiency projects [18]. As such it was necessary for MOH to make reference to external sources and the agreement model such as the UK EPC best practice guide to suit to MOH need.

The EPC terms and condition were negotiated between both MOH and the ESCOs in several workshops until it was finalised and ready to form part of the binding Contract Management Agreement (CMA) between the two parties. Good information gathering and laying out proper and adequate requirements is critical while ensuring government procurement regulation is being met [17].

Table 6 shows relevant schedules detailing out the technical aspects of the projects which are part of the agreement. The CMA would also include documents such as the technical energy audit report, the company's proposal, measurement and verification plan, floor plan as well as letter of appointment. Legal advice has also been sought in preparing the terms and conditions before the work is to be awarded to the ESCOs.

MOH have also specified key performance requirement in the EPC contract that prescribes the minimum performance level or operating condition of the ESM equipment as shown in Table 7. The methodology for the calculation of the performance target is described clearly in the general schedules of the CMA. Failure to comply to the set performance level would result in fee deduction based on a deduction formula to be agreed by both parties.

The minimum payback period or financial return for the EMS is not being used as a criterion for performance level as it normally would. Payback period for ESM is being used as criteria to select whichever ESM that could be implemented, operated, and transferred to the government within the timescale of the FM contract (2015-2025). The overall timescale of the EPC project is such that it will not exceed the expiry date of the FM contract. Other requirement would include maintenance of the ESM by the ESCOs for the duration of the EPC until ownership transfer. In summary, to deliver energy efficient projects in government hospitals through EPC model should meet the following prerequisite as shown in Fig. 4.

3.4 Implementation, Operation and Measure &Verification (M&V)

The general scope of work by the ESCOs as stipulated in the CMA would generally include the design, procurement, supply, delivery, installation, testing, commissioning and providing maintenance of the Equipment or

retrofit that is part of the energy saving measures. The duration of installation work may vary between 2 to 6 months depending on the scope of the ESM. The scope also includes Energy Monitoring System to be installed and maintained by the ESCO for the purposes of monitoring and measuring the performance of the ESMs. Fig. 5 shows an example of a project implementation workflow which includes the operation as well as M&V.

In general, the EPC contract varies from 2 to 6 years before the expiration and transfer of ownership to the government. The ESCOs are responsible for the both maintenance and the measurement of energy saving. The energy performance period would start immediately after the construction period. During this period, an independent third party is appointed by the ESCOs to measure and verify the Energy Savings according to the International Performance Measurement and Verification Protocol (IPMVP) every 12 months. The external verification process also includes calibration of meters to provide accurate data for energy saving calculations.

Table 6 - General schedules in MOH EPC project

Schedules	Details
Schedule A	Equipment to be installed by company
Schedule B	Details and description of premises; pre-existing equipment inventory
Schedule C	Energy savings
Schedule D	Monthly payment to company
Schedule E	Baseline energy and diesel consumption
Schedule F	Format for recording changes in operating conditions to calculate the adjusted baseline
Schedule G	Construction and installation schedule
Schedule H	Systems start-up and commissioning
Schedule I	Minimum operating conditions
Schedule J	Deduction formula
Schedule K	Calculation of net present value
Schedule L	Supporting document to substantiate data within the schedule

Table 7 - Minimum performance level or operating condition of the ESM equipment

No	ESM	Performance target
1	Chiller retrofit	Chiller water temperature between 6-9° C
2	LED lighting retrofit	50 to 500 lux depending on area
3	Solar Thermal hot water	Min hot water temperature at 60° C

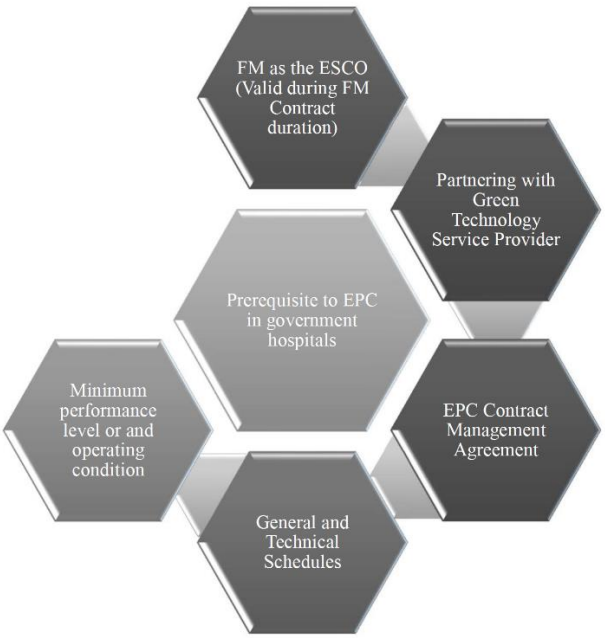

Fig. 4 - Prerequisite of EPC model for government hospitals

Table 8 shows the M&V option that is applied to MOH EPC project. Option A is typically used for lighting retrofits where measurement is done for a sample of the installations and where operating hours are stipulated. Option B is more preferred for installation such as chiller or boiler plant where the fuel or electricity consumption is measured including the production of hot or chilled water.

All the EPC projects by MOH is financed by ESCOs. MOH have set 100% energy bill savings is used as repayment of the project cost at an agreed monthly rate. Fig. 6 demonstrate the general methodology of EPC project cost repayment structure. The EPC agreement is such that the yearly remeasurement would be carried out by a third party to verify the actual savings produced from the energy project. The actual savings is then compared to the yearly offered guaranteed savings as indicated in the EPC contract. Should the actual saving fall short from the amount guaranteed, the ESCOs is required to pay the difference to the government. The government is also entitled to impose another 1% deduction from a minimum guaranteed saving value if there is underperformance by ESCOs or defect exists in the installation that lead to a poor actual savings. This is to encourage the ESCOs to carry out remedies that will improve the ESM performance. Apart from that, a service level-based deduction would also be imposed should the ESCO fail to carry out corrective maintenance within the given timeframe as explained in Table 9.

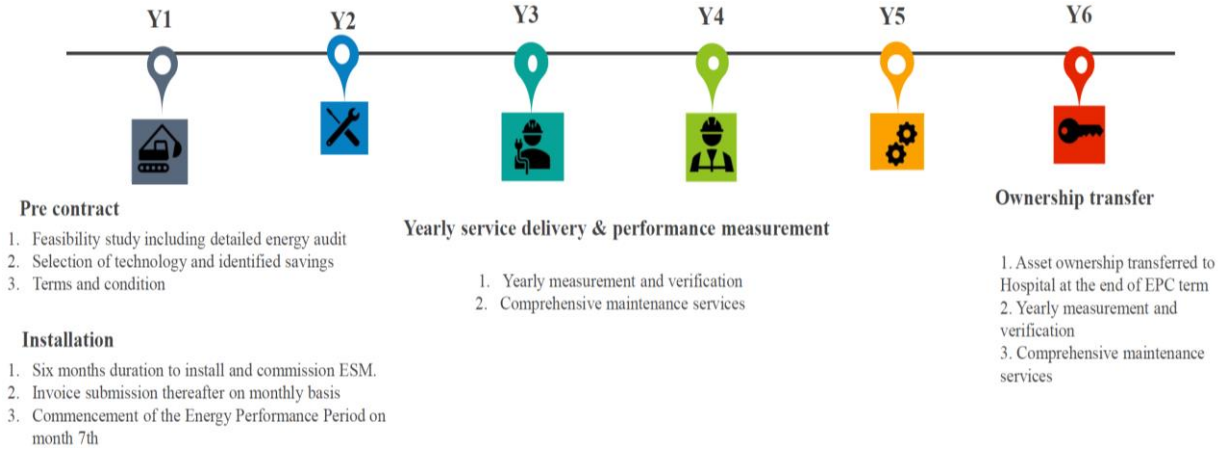

Fig. 5 - Hospital Sarikei EPC Timeline from project inception to ownership transfer

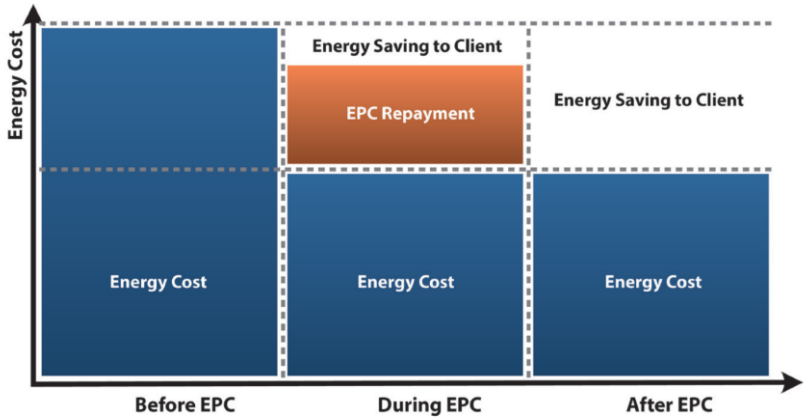

Fig. 6 - Application of EPC and project cost repayment structure. [19]

Table 8 - M&V option used in MOH EPC projects

No	ESM	ESM Description	M&V Option used	Typical minimum saving guarantee[a]
1	Lighting	Replace fluorescent lighting fixtures with LED lamp	Option A	>50 %
2	Chiller	Replace chiller plant with Energy Efficient type	Option B	> 40%
3	Solar Thermal Hot Water	Boiler Plant Room Upgrading to Solar Hybrid Hot Water System Plant	Option B	>95%

Table 9 - Service level-based deduction

ESM	Performance target	Deduction impose
Chiller retrofit	Interruption of chilled water supply or chilled water temperature out of range (6°C – 9 °C)	Fix deduction rate for water temperature range not met or supply interuption
LED lighting retrofit	50 to 500 lux depending on area	Fix daily deduction rate for any defective LED
Solar Thermal hot water	Min hot water temperature at 60 °C	Fix daily deduction rate for hot water temperature not met

3.5 Overall impacts on Government Energy Expenditure

Currently the energy project proposed by the ESCO to the government have led to three type of retrofits. The EPC retrofits include replacing old and inefficient chillers to an energy efficient chiller, replacing fuel fired boiler with solar hot water system and replacing fluorescent lamp to LED lamp. Several more energy project for other major hospitals in Malaysia is still in the pipeline. The future project would explore possibilities of adding more energy efficient technology as well as renewable energy solutions delivered by EPC such as photovoltaic system and replacing aging air handling unit to efficient ones to name a few. Fig. 7 to Fig. 9 show some of the selected ESM that has been delivered to several Malaysian public hospitals.

Fig. 7 - Solar Collector for hot water system at Hospital Sarikei Sarawak

Fig. 8 - Hospital Teluk Intan applying Centrifugal Chiller with Magnetic Bearing

Fig. 9 - LED lamp replacing fluorescent lamp

Table 10 shows the breakdown of the annual energy saving and carbon emission offset from the EPC program implemented in government hospitals.

Table 10 - Breakdown of annual energy saving and carbon emission offset from EPC projects up to 2019

ESCOs	Annual electrical energy savings (kWh)	Annual fuel energy savings (litre)	Carbon Reduction (Tonne)
Edgenta Mediserve Sdn. Bhd.	9,269,288.70	NA	6,432.00
Radicare (M) Sdn. Bhd.	3,538,121.29	NA	2,455.00
Medivest Sdn. Bhd.	7,100,537.16	NA	4,928.00
Sedafiat Sdn. Bhd.	NA	215,966.40	570.15
One Medicare Sdn. Bhd	646,678.26	342,000.00	1,355.88
Total	20,554,625.41	557,966.40	15,741.03

EPC projects in government government hospitals have managed to generate significant energy cost savings annually and off set about 15.7 kilo tonne carbon emission by the end of 2019. The emission reduction by government hospitals through EPC projects delivered so far has contributed about 16% of the national emission reduction target set for government building as shown in Fig. 10. There are several more EPC project to be delivered to major Malaysian Hospitals in the coming years. It is expected that the EPC will continue to grow and contribute another 40% increase in energy cost savings compare to 2019 achievement. Building systems such as computerized building controls, sub system metering, high efficiency active engineering systems, rainwater harvesting, on site recycling facilities, charging stations, parking for electric or low emission vehicles, renewable energy source, passive building retrofits, building envelope retrofits, green open space are several other future potential projects to be implemented in government hospitals.

The project did not require any investment or upfront cost by the Government other than commitment to pay the ESCO from energy cost savings. However, the saving will only be appreciated by the government at the end of the EPC program as the energy cost saving currently is used to pay for the ESM investment by the ESCOs. Even so, immediately after the installation of the ESM, the EPC would provide maintenance savings to the government from upgraded equipment, improving building environment through improved lighting, efficient air-cooling system and greener water heating system including meeting government CO2 reduction target. Hiring an ESCO is a proven strategy for identifying and implementing energy savings capital improvements while managing risk inherent in such projects [20]. However factors such as accurate M&V, available technology and effective coordination plays an important role for the success of EPC project [21].

Government are putting more importance to operate the healthcare buildings in an energy efficient and sustainable ways while at the same time targeting to obtain a 3rd party green building certification. Therefore, there are high hopes and expectation from the FM companies (ESCOs) to introduce more green technology to government hospitals as well in their business goals and culture. However, financial, time constraints, lack of knowledge and awareness are several barriers which need to be addressed. Future retrofitting projects for government healthcare building requires substantial amount of financing in order to achieve its energy efficiency and green building goals. Therefore, EPC is seen as a practical solution to steer hospital building towards this direction. If the EPC project challenges were to be addressed and overcome sooner the impact on the energy savings and carbon reduction would be greater as shown in Table 11. The potential for energy savings and carbon is greater as there are many more hospital buildings in Malaysia that has yet to implement energy projects. Part of the challenges is to establish an energy benchmark for various hospitals in term of sizes and functions.

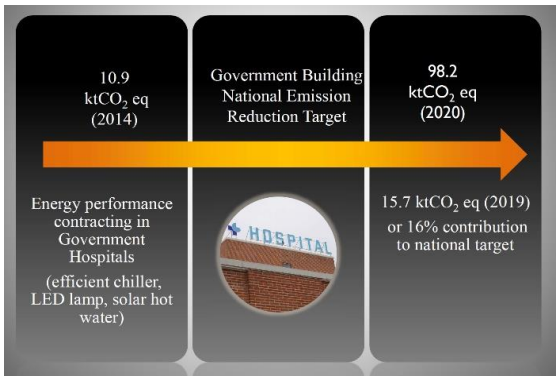

Fig. 10 - Government hospital emission reduction impact and contribution to National target

The energy consumption of a hospital building can be better managed and monitored against a target or benchmark (Building Energy Intensity, BEI) or another similar size building. MOH is still working with Malaysian Energy Commission (MEC) in an ongoing research to establish a building energy efficiency benchmark for different categories of hospitals. Initial study by MOH has shown that government hospital building energy index is 172 kWh/m2/year [16]. However, MOH will be able to predict its hospital energy usage and allow them to select hospitals that need energy project by stages to reduce its energy consumption down to acceptable level. EPC energy project allows high energy consuming hospitals to become more energy efficient, reduce energy wastage as well as its carbon footprint in its effort be greener and more sustainable.

Table 11 - Potential carbon reduction estimate from government hospital

ESCOs	Nom of hospital with EPC project	Carbon Reduction achieved (Tonne)	Total num of hospital within FM contract	Potential estimated carbon reduction (Tonne)
Edgenta Mediserve Sdn. Bhd.	5	6,432.00	32	41,164.80
Radicare (M) Sdn. Bhd.	1	2,455.00	46	112,930.00
Medivest Sdn. Bhd.	7	4,928.00	22	15,488.00
Sedafiat Sdn. Bhd.	2	570.15	26	7,411.95
One Medicare Sdn. Bhd	3	1,355.88	22	9,943.12
Total	18	15,741.03	148	186,937.87

4. Conclusion

Government mandates for sustainability already exists and is asking for its buildings to be more efficient and sustainable [22] . The Malaysian government are looking for ways to reduce its carbon footprint and is putting more emphasis to operate the healthcare buildings in an energy efficient and sustainable ways. Energy retrofit projects for the government healthcare building requires substantial amount of financing. The available grants for such green projects made available by the government is not going to last long from the time it was first introduced to spur the EE industry. Therefore, EPC projects seems to be a favorable form of funding and implementation of EE projects. In 2019 a total of 18 hospitals have benefited from the EPC project which have managed to give monetary saving and offset substantial amount of carbon emission.

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