Global Green Growth Institute

Green Public-Private Partnerships for Public Infrastructure in Mongolia

PPP Model and Technical Guidelines for Green Education Buildings

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List of Abbreviations

ADB	Asian Development Bank
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BESTD	Building Energy Software Tools Directory
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BLT	Build-Lease-Transfer
BOT	Build-Operate-Transfer
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Methodology
BT	Build-Transfer
BTO	Build-Transfer-Operate
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
CBSE	Central Board of Secondary Education
CHP	Combined Heat and Power
DfEE	Department for Education and Employment
DHW	Domestic Hot Water
EPS	Expanded Polystyrene/Styrene
FICCI	Federation of Indian Chambers of Commerce and Industry
GCF	Green Climate Fund
GDP	Gross Domestic Product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GoM	Government of Mongolia
G-SEED	Green Standard for Energy and Environmental Design
GSHP	Ground Source Heat Pump
GTC	Green Technology Center
HOBs	Heat Only Boilers
IAQ	Indoor Air Quality
ICT	Information and Communication Technology
IEA	International Energy Agency
IES	Integrated Environmental Solutions
IES-VE	Virtual Environment by Integrated Environmental Solutions
IFC	International Finance Corporation
IMA	Invest Mongolia Agency
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contribution
KDI	Korea Development Institute
KEDI	Korean Educational Development Institute
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
MDB	Multilateral Development Bank
MECS	Ministry of Education, Culture and Science of Mongolia
MEST	Ministry of Education, Science and Technology of Korea
MoF	Ministry of Finance
NGDP	National Green Development Policy of Mongolia
Non-EBBs	Non-Educationally Backward Blocks
O&M	Operation and Maintenance
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PAGE	Partnership for Action on Green Economy
PE	Performance Evaluation
PFI	Private Finance Initiative
PPP	Public-Private Partnership

PSC	Public Sector Comparator
PV	Photovoltaic
SC	Shading Coefficient
SPC	Special Purpose Company
TRV	Thermostatic Radiator Valves
TVOC	Total Volatile Organic Compounds
TL	Transfer-Lease
UAE	United Arab Emirates
UB	Ulaanbaatar
UMEIs	Children's Education Municipal Units (Unidades Municipais de Educação Infantil)
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USGBC	United States Green Building Council
VFM	Value for Money
VOCs	Volatile Organic Compounds
WB	World Bank

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This report was prepared by Seung-yeon Stella Lee, Senior Green Investment Specialist (GGGI) and Bolormaa Chimednamjil, Green Investment Specialist, and a team of consultants led by the Green Technology Center in Korea (GTC). The GTC, in collaboration with the Korea Research Institute of Eco-Environment Architecture (KRIEA), the University of Seoul, and the Huree University of Mongolia, provided both theoretical and technical input and conducted the research, analysis, and simulation.

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Executive Summary

Mongolia's unique geographical and climate situation and its specific socioeconomic conditions based on a traditional nomadic way of life and associated economic activities make it one of the countries most vulnerable to the impacts of climate change. In Mongolia the risk of climate change and extreme climatic events could have dramatic impacts on the economy and natural systems. The economic sectors most at risk are the agriculture, livestock, land use, water resources, energy, tourism and residential sectors. Based on a series of consultations, GGGI and the Government of Mongolia (GoM), have identified the prioritization of green infrastructure as a potential strategy for Mongolia in its efforts to reduce its vulnerability to climate change, beginning with a focus on Mongolia's education sector. Considering the capacity of green growth strategy to improve social, as well as, environmental conditions, and following the green growth principles of pro-poor inclusivity, the GoM and GGGI recognized the education sector as one having an urgent need for improvement. In particular, the greening of education buildings has been proposed as a practical step towards achieving pro-poor inclusive green growth.

Facing constraints on public resources and fiscal space, while recognizing the importance of investment in infrastructure to help their economic growth, governments are increasingly turning to the private sector as an alternative additional source of funding to meet the funding gap. The current state of infrastructure in Mongolia is inadequate to meet the country's economic needs. The GoM places a high priority on the use of public-private partnerships (PPPs) to improve the delivery of public services. PPPs have the ability to deliver a greater number of services, faster, at a lower cost and with a higher level of quality than their public counterparts.

This report aims to offer a feasible, green PPP model for Mongolia's public education sector and to establish technical guidelines for the greening of its education buildings. Moreover, it provides the economic rationale for promoting private investment in the educational sector and a reference for green education buildings and technologies with accompanying output specifications. The report is divided into two components; (1) the development of feasible and applicable PPP models and (2) the development of the Technical Guidelines (TGs).

Component 1. Public-Private Partnership Model for Education Buildings in Mongolia

According to the Ministry of Education, Culture, and Science (MECS), 38% of young children and 12% of primary and secondary school-aged children do not have access to education due to a lack of school facilities. In response to the fast growing demand for school facilities, the GoM needs to expand its investment in education infrastructure. Introducing PPPs into the education sector will help enhance the quality of education service delivery by coupling public-sector infrastructure with private-sector innovation. Additionally, the introduction of the private sector into the educational space will stimulate competition, resulting in higher quality products and services at lower prices. Thus, the inclusion of the private sector in the projects in question is likely to result in improvements in the cost and quality of education services while allowing for more flexibility and creativity in the achievement of predetermined goals.

The greening of the new education buildings can further increase the quality of educational service delivery by enhancing the performance of both students and teachers. Through improvements in acoustics, lighting, temperature, and air quality, green buildings provide a more conducive teaching and learning environment. Additionally, the money saved on reduced operational costs can be invested in supplementary educational resources. Moreover, by engaging and inspiring students, green buildings can educate students about the benefits of green buildings and their role in conserving resources and reducing waste.

However, even though the MECS had planned to increase its investment in the greening of education buildings, only a small number of the projects in this area have progressed. Most of the projects implemented so far have followed a Build-Transfer (BT) model. The BT model is not considered to be a genuine PPP model because it engages private partners only in the design and construction phases, not in the operational phase. Because the private partners leave after construction is completed, they have no incentive to take a life-cycle approach to design and construction. Further, these models do not benefit from private-sector efficiency in the operational phase and they often result in greater fiscal pressure, with the private partner borrowing at commercial rates to finance the project in the short term.

The key challenges for educational PPPs in Mongolia include: inconsistency and low credibility in government plans, strategies, and policies; lack of institutional capacity at the central and local government levels; lack of coordination among relevant ministries and government agencies; a weak legal and regulatory environment; uncertainty in project preparation and the implementation process; high project and non-project risks; and a lack of financing sources, government incentives, and support measures.

GGGI conducted extensive literature reviews on global PPP standards for the education sector in order to best apply them to Mongolia's specific context, including governance system and legal, institutional, and policy framework. In so doing, GGGI analyzed available models, relevant risks relating to education service delivery in global practices, and Education PPP case studies in Korea, the UK, and Brazil. This report outlines the challenges inherent in the adoption of Educational PPP models and offers solutions to meet each of these.

Taking into account Mongolia's specific context, GGGI concluded that a performance-based PPP model, such as those employed in Korea and the UK, would be most appropriate for the projects in question. These models impose no demand risk on the private sector, as the private partners are paid by the government based on service performance rather than demand. Compared to the BT model, which is widely used in Mongolia, the recommended PPP model reduces direct fiscal pressure on the GoM in the immediate term by ensuring a long term, sustainable, performance-based partnership between the public and private sectors.

Based on various research activities and stakeholder consultations through workshops and a study tour, a feasible PPP model for Mongolia's education sector was developed and policy recommendations to achieve the successful application of the model were provided. Local conditions such as government capacity, financial market, and potential contractors were considered in the development of the model. In addition, various government payment structures such as front-loaded, constant payment, and stepped payment systems were explored, considering both the fiscal burden on the government and the revenue risk of the private sector.

The characteristics of the recommended PPP model are outlined in the following table.

Table ES.A — Comparison of possible PPP models for education buildings in Mongolia

	BT Model (Currently used in Mongolia)	Recommended Model (Simplified PPP model)	Service Contract Model
Feasibility Study	No	Pre-feasibility Study	Yes
VFM Test	No	Checklist in the early stage	Yes
Advisory Service	No	PPP unit supported by technical advisor (ex. Multilateral Development Banks (MDBs), Global consulting firm)	PPP unit in Mongolia (Independent)
Tender	Competitive bidding	Competitive bidding Limited invitation	Competitive bidding
Private Partner	Competitive bidding	SPC Construction company	SPC (Special purpose company)
Contract Period	2-3 years	10-15 years	20-30 years
Main Financial Resources	Corporate finance	Construction subsidy Corporate finance Project finance	Project finance Equity fund Self-revenue
Building Type	School/kindergarten	School/kindergarten	School + ancillary facilities (School + theater + sport facility)
Green Technology (Green Building)	No consideration	Yes (ex. linked with energy performance)	Yes
Core Service Provider (Education: Teaching)	GoM	GoM	GoM
Design	GoM	Private partner	Private partner
Facility Operate & Maintenance	GoM	Private partner	Private partner
Government Payment	Installment payment within construction period and/or early operational period	Unitary payment based on service performance / flexible availability payment during the contract period	Unitary payment based on service performance

Component 2. The TGs for Greening Education Buildings

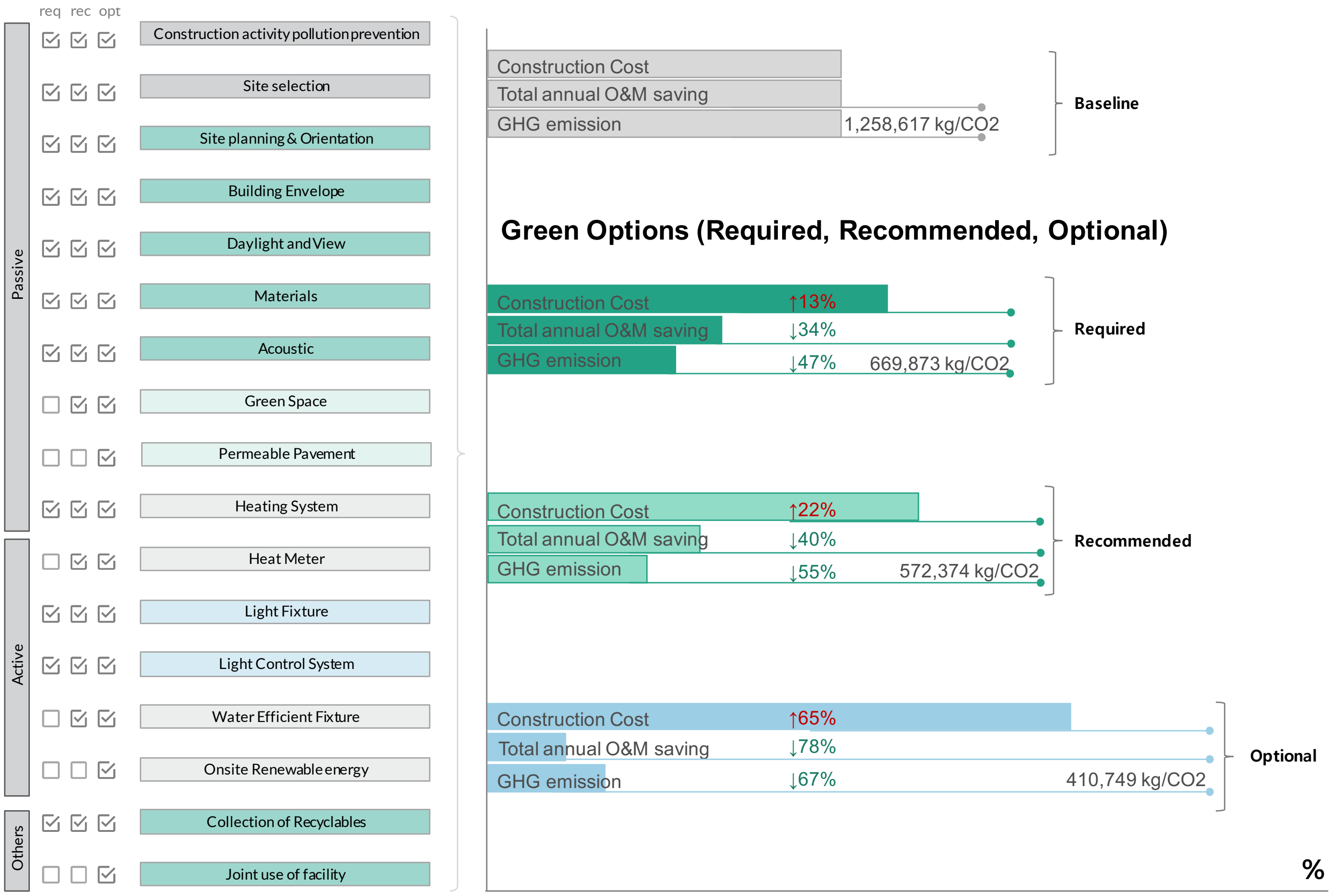
The evaluation of the current status of Mongolian education buildings was based upon local data on the standard floor plans of Mongolian schools and kindergartens. Based on the analysis of the standard floor plan developed by the MECS and several consultations with local experts, a baseline model with green options was constructed and the impacts of the various green options on energy performance and costs were analyzed. The baseline model selection procedure consisted of three steps: data collection, desktop review, and stakeholder consultations. After considering data collected through workshops and focus group interviews with key stakeholders, including government officials and local experts, school buildings built in the 1980s were selected as a baseline model. The guidelines drew upon desktop research of international rating systems, such as Leadership in Energy and Environmental Design (LEED), technical PPP literature, and Mongolia-specific references.

The framework for the TGs was divided into the three categories of design, construction, and operation and maintenance (O&M). Each of these components was further classified as 'passive', 'active' or 'other'. General output specifications were developed together with strategies for achievement to provide guidance for each component.

The TGs were developed to provide initial guidance to the GoM, the MECS, and other stakeholders in the education sector who are engaged in the construction of green educational facilities. The output specifications for green education buildings were developed as part of the TGs. In a PPP project, a private sector partner designs, builds, and maintains facilities over a contract term of approximately 10 years. PPP projects focus on the service outcomes for which private partners are responsible, such as integrating design, construction, service delivery, and long term maintenance. As such, PPP project output specifications should be tailored to achieve the objectives of public authorities as they relate to these facilities—particularly, their effective operation over the long term.

In the second component of establishing guidelines for greening PPP projects, the work procedure was divided into the following phases: precedent study, framework design, technical guideline development, baseline model selection, and validation. In the validation phase, the components and technologies were categorized as 'required' when designed and structured in accordance with current Mongolian building codes and standards. In an effort to improve building performance over the required model, different levels of green options were proposed by implementing additional green technologies such as geothermal, PV or solar thermal, etc. These have been categorized as 'recommended' or 'optional' based on their added environmental values. Each option was tested through computer simulation and compared to the baseline model. Through the validation process (building energy performance assessments), performance improvements of green options (required, recommended, and optional) proposed in the TG framework were verified. Compared to the baseline model (education buildings built before 1990s), the adoption of green options for new education buildings is expected to result in an energy savings of more than 40%. O&M costs can also be reduced if the building design complies with required output specifications (perceived reduction rate: 34% and above) or recommended (perceived reduction rate: 40% and above) standards. If the optional green technologies indicated in the TGs are additionally implemented, approximately up to 70% of O&M costs can be saved. Although the adoption of green technologies involves increased capital costs initially, incremental costs can be recovered from lower operating costs that will continue over the life of the building.

Figure ES.1 — Implication of Green Technologies and their Validation Results – School



Conclusion

The report analyzes Mongolia's current legal, policy, and regulatory conditions and assesses the country's current design and technology standards for education buildings. Based on this analysis, it puts forth a locally feasible PPP model and the TGs for green education buildings, and suggested complimentary policy measures to ensure maximum effectiveness. Various policy measures are suggested in the legal/institutional, operational, and financial aspects in order to better facilitate the use of PPP schemes in the construction of green education buildings (see "Policy Recommendations). As the GoM has a great interest in greening its public education buildings under a PPP scheme, the suggested models in this paper could be considered as a reference.

Policy Recommendations

This report was prepared to support the GoM in developing locally appropriate PPP models for the deployment of education buildings and services and to provide technical guidelines for relevant green approaches and structural components in the design, construction, and operation of education buildings. Given the GoM's limited budget, the PPP model could be a useful method for accelerating investment in green education buildings, while making urgently needed educational services available to the public. Considering the high intensity of greenhouse gas (GHG) emissions in the Mongolian building sector and the shortage of educational facilities in Mongolia, the diffusion of green education buildings could be an optimal solution for the GoM in responding to both issues simultaneously. On the economic front, green buildings will reduce O&M and energy costs and will achieve lower life-cycle costs (LCC) than conventional buildings over the long term. Furthermore, the use of a PPP model for this purpose will have the effect of including private-sector innovation and efficiency in the design and operation of the education buildings, while the suggested TGs and output specifications will help guide both public officials and private developers and investors in developing and preparing potential projects. Also, the proposed green PPP models and TGs can provide foundations for developing similar models for other public buildings.

Despite the clear advantages, there are risks and challenges that will have to be addressed in order to effectively introduce the suggested green PPP model into Mongolia's education sector. The key risks and challenges are divided into three categories in the table below: legal/institution, operational, and financial.

Table PR.1 — Main risks and challenges for greening PPP education buildings

Area	Key Risks and Challenges
Legal/ institutional	Weak legal framework for PPPs (the Concession Law, other associated laws)
	Lack of coordination among government stakeholders (between the central PPP authority and line ministries and between the central and local governments, etc.)
	Lack of contract enforcement power
	Change in government policies on PPP/concessions and the focal agency affecting investor confidence
	Lack of planning/screening and rigorous project assessment in project preparation
	Underdeveloped procurement system
	Lack of government emphasis on environmental sustainability in concession projects
Operational	Lack of technical guidelines for project preparation and procurement
	Lack of competition in bidding
	No mechanism for performance evaluation for performance-based model PPP projects
	Technical risk of inappropriate/immature technical schemes or poor technical design for green education building projects
	Lack of incentives for green technologies
	Weak government capacity to manage complex PPP deals
	Lack of qualified private companies to undertake large-scale infrastructure projects
Financial	Lack of long term finance in the local financial market
	Financial risk relating to interest rate and foreign exchange rate fluctuation
	Limited state budget to meet long term payment obligations and/or to fill viability gap
	Lack of incentives for green technologies

In order to address key risks and challenges identified above, relevant policy measures and implementation tools should be introduced.

Legal/institutional Aspect

The Mongolian Law on Concession has been the basis for the preparation and implementation of PPP projects in Mongolia. It has the fundamental elements necessary for a PPP law, such as a definition of the scope of the law, the definition of the various concession types, an outline of the procurement process, a list of concession items to be approved by the government, and the definition of the rights and powers of the associated parties. However, there are a range of areas in which the current Law needs to be improved in order to bring it to the level of a modern PPP law.

- **There needs a link between the Law on Concession (PPP law) and other relevant laws** such as laws on budget, fiscal stability, public procurement, and debt management. This is necessary because PPP projects may have both short term and long term budgetary and fiscal impacts. Therefore, systemic assessment and monitoring processes should be put in place by the relevant laws governing the project preparation and approval process.

- **The Law has to provide a clear definition of PPP**. Although PPP arrangements can take various forms, as seen in the international cases discussed later herein, it is necessary to develop a basic definition for the PPP concept in the context of Mongolia. For example, in many countries the term "concession" as it appears in legislation, is intended to refer to specific forms of PPPs which do not cover the service contract or performance-based payment PPP models. Also, it is recommended that the Build-Transfer (BT) model be removed from the PPP definition, both because this type of arrangement it is not generally considered to be a PPP and, because this model is not an appropriate solution for the Mongolian context. This is so because the BT model does not engage the private sector in the operational phase for the delivery public services, and because it can impose considerable short term fiscal risk on the government.[1]

- **The performance-based payment or service contract PPP model should be clearly regulated as a form of PPPs** and its government payment mechanism should be clearly defined by the Law.

- **The Law has to clarify roles and responsibilities of concerned parties**. In the current Concession Law, the project implementation process is heavily centralized within the PPP authority from the project screening stage to the signing of the concession contract, and the roles and responsibilities of line ministries and local governments (e.g. the Municipality and the Provinces) are not well defined. There should be a formal consultation and coordination process between the central PPP authority and line ministries and local governments for major decisions regarding PPP programs and projects (ex. PPP project prioritization, selection, assessment, and procurement). As the PPP program matures, it is recommended that the roles of the line ministries and local governments be strengthened in the PPP project preparation and implementation process (ex. contract signing) to strengthen their ownership and ensure project-cycle management and monitoring.

- **PPP project planning has to be in accordance with mid- to long-term infrastructure plans of the government and national investment priorities.** On the government side, it is not advisable to pursue PPP projects solely for commercial reasons. PPP models are options for public service delivery, and, as such, they should be planned and implemented in the context of public interests. Therefore, a more rigorous assessment process (ex. VFM study) will be needed for unsolicited project proposals.

- **The Ministry of Finance should be involved in the early stage of project development and approval, especially for service contract type PPP projects.** Future government payments to PPP projects should be included in budget plans and these plans should include a mechanism which prohibits Parliament from being able to cancel them after PPP projects have been approved and contracts awarded. This is critical for the reduction of risk for private partners and to ensure the sustainability of PPP programs. Also, failure in agreed government payments may cause legal disputes between the government and private partners for breach of its payment obligations.

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1 The Law on Budget specifies that PPPs are prohibited for the purpose of avoiding contribution to the budget deficit or for postponing budgetary payment.

- In accordance with the National Green Development Policy, **the Law has to emphasize environmental sustainability and green development in planning, preparation, and implementation of PPP projects.** This principle can be highlighted in the section on the "Principles of Public-Private Partnership" and relevant criteria and requirements in line with this principle should be added to the bid evaluation and selection process.

- **It is critical to set up a consistent and transparent procurement process by law, supporting regulations and guidelines** drafted to enhance its predictability and efficiency. Project preparation costs and time will be considerably reduced, not only for the private sector, but also, for the public sector if there are clear rules and guidelines for project assessment and procurement. Because the Law cannot cover all the details of the implementation procedure, regulations, and government support measures, and because it is not easy to amend the Law once it is enacted, it is desirable to regulate the details of implementation in subordinate ordinances or in implementation guidelines (ex. details regarding (pre-) feasibility studies, VFM tests, RPF preparation, bid evaluation, contract drafting, etc.)

- **A dedicated PPP organization should be established and strengthened with strong supports from core ministries.** In order to meet Mongolia's urgent need for infrastructure, including education buildings, clear coordination among stakeholders, the simplification of the administrative process for PPP projects, and appropriate and timely management are critical. In this regard, it is recommended that a well-organized institutional framework be established, either by creating a dedicated PPP organization (in a focal ministry or as an independent agency) or by strengthening the current organization with clear roles and functions under the law, and simplifying the PPP process. The establishment of an inter-ministerial PPP committee will be effective in facilitating coordination and decision making among government agencies.

The Operational Aspect

- **The project preparation process should be strengthened by developing assessment guidelines and methodologies.** Lack of appropriate preliminary research and assessment lead to weak project feasibility, low demand, and lack of market appetite and competition. Guidelines and methodologies for project assessment, such as the inclusion of (pre-) feasibility studies and VFM tests, should be developed with the support of external experts and development partners. In the early stages when market and project data is lacking, simpler forms of assessment can be used until sufficient data is collected and project experience is accumulated.

- **Considering the urgent need for public education buildings, it is recommended that a clear institutional framework be developed which simplifies the PPP procurement process through the introduction of a pre-qualification system,** at least for pilot projects. A fully open competitive bidding process is often the best way to secure VFM, however, for early stage frameworks, it is recommended that the bidding period be combined in a two-step bidding and evaluation system, which includes pre-qualification and requests for proposals to qualified bidders. According to the Asian Development Bank (ADB), recommendation of modified direct negotiation, participation in bid submissions can be limited to invitation and a strict screening pre-qualification system to reduce the bidding period (ADB 2014, 3).

- **Direct contracting should be avoided** to increase market competition and ensure VFM.

- **It is necessary to promote participation of foreign companies and investors** in infrastructure investment due to lack of qualified local companies to undertake large-scale infrastructure projects. However, it is desirable to recommend or even obligate bidders to engage local companies in order to not only fully reflect local conditions but also to build the capacity of local companies through the learning-by-doing approach.

- **It is necessary to establish a performance evaluation (PE) system for performance-based model PPP projects** as suggested for the Mongolian education sector. In particular, O&M is important for "green" PPP education buildings to achieve the pre-established energy performance targets. A system should be established for measuring performance management in an objective manner, and the PE should be directly linked to the government payment scheme.[2]

2 The case for performance evaluation (PE) mechanism in Korea is described in the Appendix C.

- **The government needs to consider incentive systems to promote green buildings and technologies**. For example, giving preference in the evaluation process to construction and design companies engaging in green building projects could be an incentive.[3] The incentives must be designed to reduce LCC for private-sector players, while increasing the demand for green technologies, in order to stimulate the green technologies and the green building market. Examples include tax deduction programs for energy efficient products, subsidies, and rebate programs. The government can also offer financial support to socially and environmentally preferred energy options through investment incentives, low-cost loans, and special funding for green educational building programs.

- **It is recommended for the GoM to utilize the suggested TGs and output specifications for greening education buildings**, which have been developed in accordance with the current energy policy and building codes of Mongolia, **for the greening of its education buildings**. Three construction models are proposed herein. They are as follows: (1) the "required model", which proposes technologies aimed at achieving maximized value by improving the educational environment and achieving higher energy efficiency at minimum additional cost, while reflecting the standards set out in Mongolia's existing building codes; (2) the "recommended model", which suggests the use of more environmentally friendly technologies that would improve energy efficiency beyond the level obtainable by the required model; and (3) the future-oriented "optional model", which incorporates the utilization of renewable energies such as photovoltaic, solar thermal, and geothermal energies. Considering the lack of experience that Mongolia has with respect to green education buildings, strategies and technology recommendations for each model are provided in the TGs. By referring to the TGs, the private sector could be guided in the design and construction of green PPP education buildings.

- **It is necessary to improve the professional skills and expertise of government officials.** A dedicated PPP organization could be effective in recruiting and retaining PPP experts, as there have been issues with the turnover rate of public officers who are in charge of PPP programs and projects. The government must work with and be supported by external advisors and consultants for technical issues in the short term, as it builds internal capacity for project design, implementation, and monitoring.

Financial Aspect

- **It is recommended that the GoM provide financial support to those projects which best meet the urgent needs and interest of the public.** The Concession Law includes provisions on financial support from the state such as guarantees, partial financing, and tax incentives and waivers. However, it lacks detailed process, scope, and implementation arrangements. These should be clearly defined within the Law and/or within a subordinate ordinance.[4]

- **The utilization of international climate finance resources should be highly considered to diversify funding sources and decrease financing burden of the government.** Climate financing in Mongolia needs to move from the per project level – to a more systematic and scaled-up approach characterized by new access and delivery and a robust structure across government actors and entities. As Mongolia is among the countries having ratified the Paris Agreement on Climate Change as of September 2016, it has increased opportunities for accessing the climate financing funds available for low-emission and climate-resilient development in the public sector. The GoM should collaborate with international partner organizations to develop bankable green PPP projects and seek low-cost, long term climate funding which can be effectively blended with other funding sources such as concessional loans, Official Development Assistance (ODA), and government budgets. There are a number of national and international funds, with each with different access modalities and diverse target projects, making climate finance complex and difficult to understand. Key decision-makers in the country now recognize that there are further opportunities for Mongolia for accessing international funds, particularly within the Green Climate Fund (GCF) framework. In addition to the GCF, other suggested climate finance opportunities that should be assessed further by the GoM are listed below:
  - Multilateral funds, within United Nations Framework Convention on Climate Change (UNFCC): Adaptation fund; Special climate change fund; GEF trust funds

3 Examples of various incentive schemes are described in the Appendix G.

4 Case of Government Support for PPP Projects in Korea are described in the Appendix B.

- Multilateral funds, Climate Investment Fund (CIF) World Bank (WB): Pilot program for Climate Resilient (PPCR); Clean Technology Fund (CTF); Scaling–Up Renewable Energy Program for Low Income countries (SREP)
- Multilateral funds, EU: Global Energy Efficient and Renewable Energy Fund (GEEREF); Global Climate Change Alliance
- Bilateral funds: UK's International Climate Fund; Japan's Fast Start Finance; Germany's International Climate Initiative; Norway's International Climate and Forest's initiative

• In addition, **various traditional development agencies and bilateral donors have a programmatic focus on climate change and environmental issues**, which indicates there are increasing opportunities to access development funds for green public building and infrastructure projects. Engaging development funds or banks can reduce the financial burden of the private investors while mitigating financial instability and risk during the long PPP contract period.

• **The GoM will be able to access low-cost financing for energy efficient public building projects** by working with international development partners **in designing a financing structure that is most beneficial for the GoM in the long term and enhancing capital flows into the PPP program.**

Figure PR.1 — Use of concessional loans and grants to cover government affordability risk in PPP projects

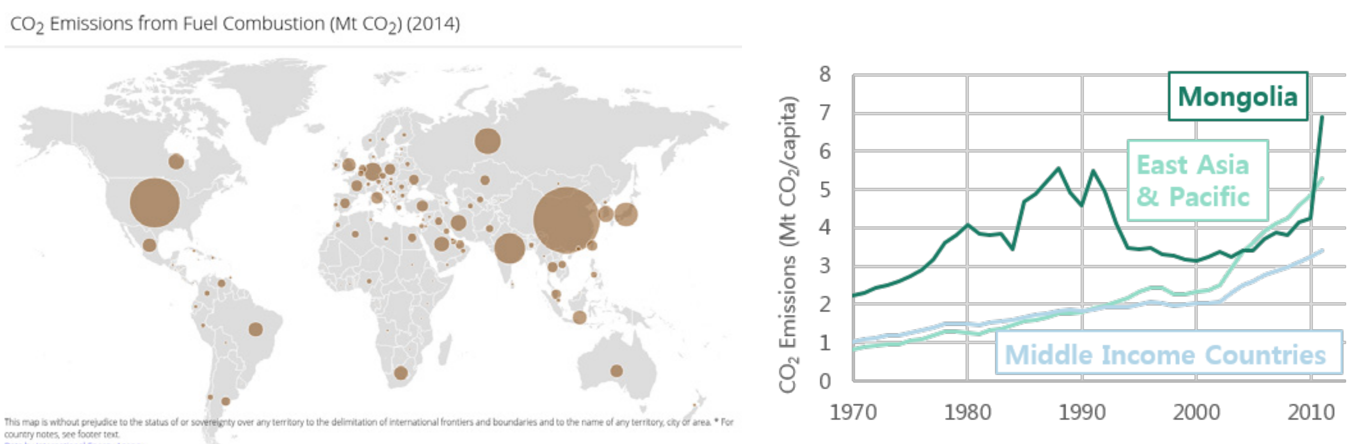
1 Introduction

1.1 Background

Mongolia is a landlocked country in Northern Asia, characterized by boreal forest in the North, steppe and grassland in the Central region, and the Gobi Desert to the South. Despite its rich mineral resources and vast territory, Mongolia is one of the most vulnerable countries to climate change due to its geographic location and severe weather conditions. The winter climate in Mongolia is extremely severe with a monthly average temperature in January of -25.4°C and temperatures dropping below to -40°C at night. According to Mongolia's Intended Nationally Determined Contribution (INDC) submitted to the UNFCCC, factors such as fragile ecosystems, a reliance on pastoral animal husbandry and rain-fed agriculture, and a growing, urbanizing population all combine to render Mongolia's socio-economic development vulnerable to climate change.

Its severe weather conditions, paired with large coal reserves, have resulted in a heavy dependence on fossil fuels, with less than 5% of the country's electricity being derived from renewable sources. Currently, approximately 95% of Mongolian energy production is fossil fuel based. Furthermore, energy in Mongolia is expected to quadruple by 2030 due to population growth, rural to urban migration, and economic growth. According to International Energy Agency (IEA) Energy Atlas statistics from 2013, Mongolia has the world's highest emission intensity in terms of CO_2 emissions / GDP (kg CO_2 /2005 USD) (IEA Energy Atlas 2016)m with far higher emissions than other countries with similar geography and income levels, as shown in Figure 1 (WB 2016). These statistics indicate Mongolia's urgent need for green transformation. In recognition of the need to pursue a green economy in order to achieve economic growth and social inclusiveness while maintaining environmental sustainability, the GoM has developed the National Green Development Policy of Mongolia (NGDP), which was approved by Parliament in August of 2014. Mongolia developed its INDC based on the NGDP and committed to reducing total national GHG emissions by 14%, excluding land use, land usage change, and forestry (LULUCF) by 2030, compared to BAU.

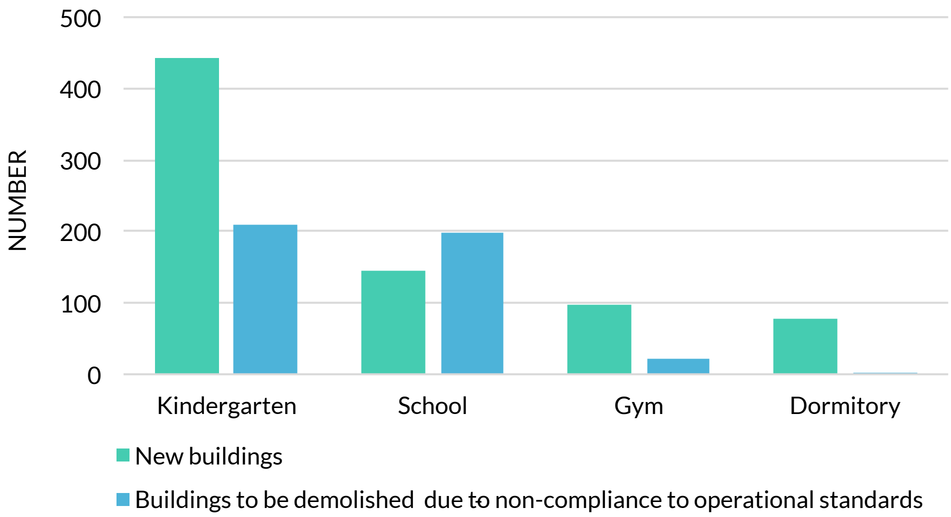
Figure 1.1 — Map of CO_2 emissions from fuel combustion - 2013 (left) and comparison of CO_2 emissions (right)



(Left) IEA Energy Atlas (2016); (right) WB (2016)

Along with green economic development, overcoming poverty and achieving economic growth in Mongolia will require urgent attention to the education sector as it will provide sustainable and qualified human capacity to the country in the long term. As a result of extensive urban migration and the deterioration of education infrastructures in urban areas, schools and kindergartens are operating in poor conditions with limited capacities. According to the MECS, there are too few school buildings to accommodate the increasing number of students. Moreover, 198 school buildings capable of serving 83,763 students, and a further 210 kindergartens need to be demolished and reconstructed due to their failure to meet current building standards, as shown in Figure 1.2 (MECS 2013, 5). More than 70% of schools and kindergartens in Ulaanbaatar were constructed before 1990 and need to be demolished or retrofitted (GIZ 2014, 26-33). A total of approximately 1,197 new educational facilities are required nationwide. The GoM planned to reach the target by utilizing funding sources including state budget, PPP, loans, and grants. Even though they prepared a list of concession projects consisting of 84 kindergartens and 40 schools in 2014, only 4 of these projects have been initiated for implementation with private investment. According to data from the MECS and the National Statistics Office, 27 public schools and 7 kindergartens were built between 2012 and 2014. However, the gaps between supply and demand for kindergartens and schools are still about 38% and 12%, respectively. As a result, many schools operate in double or triple shifts each day to manage overcapacity. Therefore, considering the needs for national green development, together with school shortages, increasing the number of green education buildings should be encouraged.

Figure 1.2 — Number and capacity of required new buildings and buildings to be demolished



Source: MECS (2013)

A "green building" can be generally defined as one for which the planning, design, construction, and operations give central and foremost consideration to air quality, energy and water use, human health, waste reduction, pollution, and environmental degradation (Larsen et al. 2011, A-1). Mongolia's NGDP defines a "green building" as a structure that constitutes a comfortable living and working environment that is energy efficient, having heating systems with low carbon emissions and rainwater collection technologies with sewage or wastewater treatment, and is built with materials that do not cause negative impacts on human health and environment (Cover Mongolia 2014). Numerous research papers show the measurable benefits of green buildings on worker productivity, which is relevant to staff and teachers. It is shown that buildings with overall high environmental quality, including effective ventilation, natural or proper levels of lighting, indoor air quality (IAQ), and good acoustics can increase worker productivity by 6-16% (Abraham et al. 1996, 21). Similarly, research has shown that increased daylight and air quality improvement in green education buildings enhances student performance (Olson and Kellum 2003, 7). Given that the GoM is seeking to meet its educational infrastructure needs by leveraging private expertise and capital, this report recommends the employment of PPP best practices, adapted to the Mongolian context, which incorporate a full life-cycle approach from design to operation. Moreover, the PPP approach would better facilitate the adoption of new technologies and innovative construction practices, while relaxing the budget constraints associated with the traditional public procurement process.

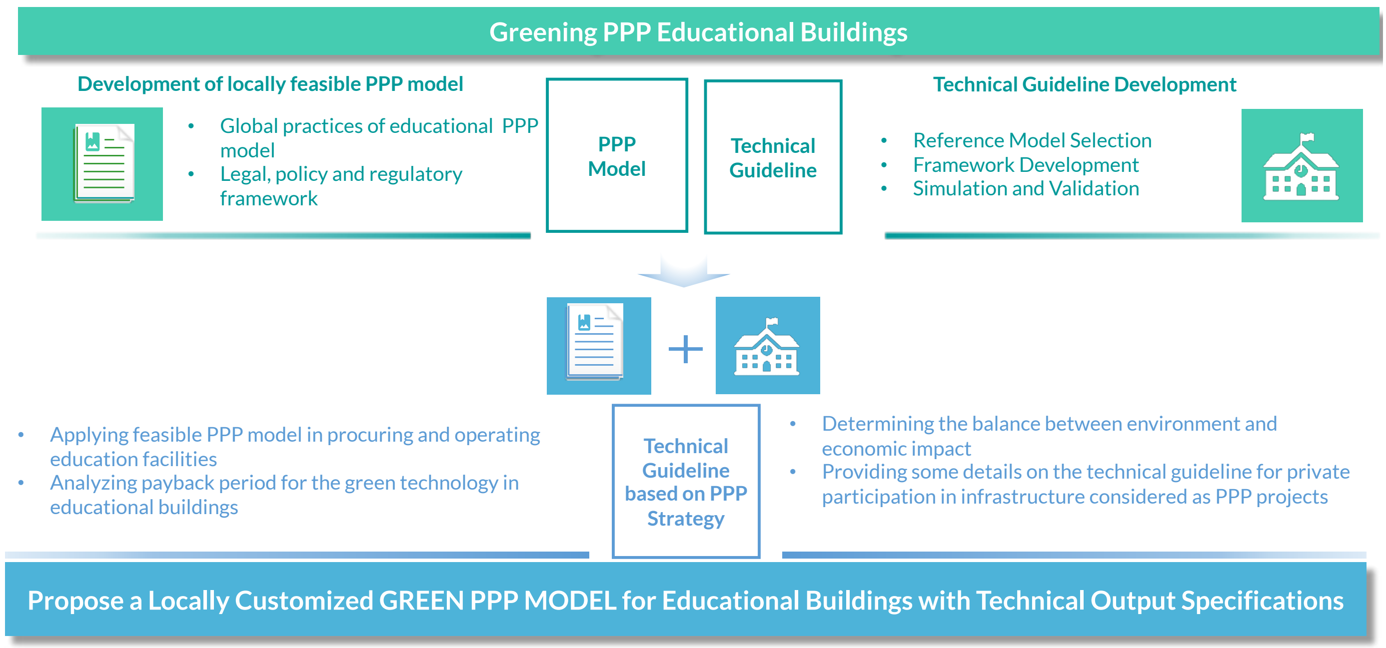
1.2 Methodology of the Study

The objective of this study is to support the GoM by developing a feasible green PPP model for its public education sector and to establish technical guidelines for greening potential PPP projects. The suggested PPP models and TGs in this report will provide the economic rationale for promoting private investment in the education sector as well as a reference for green education buildings. The TGs will provide output specifications for private partners in the operation and maintenance of facilities by capturing the characteristics of PPP models.

This study has 2 main components:

- The analysis and recommendation of feasible and applicable PPP models promoting large-scale private investment in educational facilities (schools, kindergartens, etc.) in Mongolia.
- The assessment of current design and technology standards of education buildings in Mongolia and development of guidelines for greening PPP projects in the education sector.

Figure 1.3 — Project overview

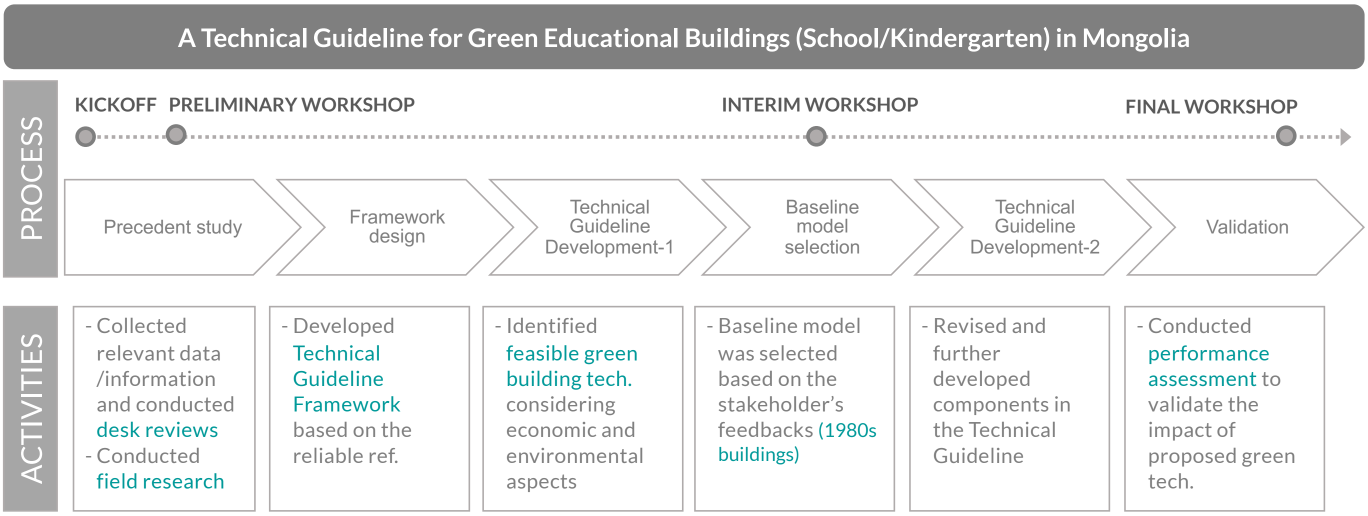


In the first component of PPP model development, extensive literature reviews were conducted on global standards for PPPs in education and PPP governance in order to compare them with Mongolia's specific context including its governance system and legal framework. Available models and relevant risks relating to global practices in educational service delivery were analyzed, and various applications of PPP types were covered in the education sector. PPP projects have been implemented in the education sectors of various countries such as Korea, the UK, and Brazil. Drawing from reviews of these case studies and their implications, this report identifies the challenges associated with these projects and offers suggestions for their solution.

Based on various research activities and stakeholder consultations through workshops and study tours, a feasible PPP model for Mongolia's education sector was developed along with complimentary policy recommendations for the successful application of the model.

The work procedure involved in the second component—that of establishing the TGs for greening PPP projects—is described in the following figure.

Figure 1.4 — Work procedure for the TGs for green education buildings



During the preliminary visit to Mongolia, data on the current status of Mongolian schools and kindergartens and a standard floor plan were collected to evaluate the current system. Based on the analysis of the standard floor plan and consultations with several local experts, a baseline model was constructed with green options. The cost the various green options and their impact on energy performance were then analyzed. The guidelines draw upon desktop research of international rating systems, such as Leadership in Energy and Environmental Design (LEED), technical PPP literature, and Mongolia-specific references. The green school handbook for Mongolia developed by United Nations Environment Programme (UNEP) Partnership for Action on Green Economy (PAGE) was thoroughly reviewed to avoid redundancy or conflict.

The framework for the TGs was divided into three categories of design, construction and O&M (operation and maintenance) for ease of navigation. Each of the components were further classified as 'passive', 'active', or 'other'. General output specifications were developed, together with strategies for achievement, providing guidance for each component.

In the validation phase, the components and technologies that were designed in compliance with current building codes and standards were categorized as 'required'. In an effort to improve building performance over the required model, different levels of green options were proposed by implementing additional green technologies such as geothermal, photovoltaic (PV) or solar thermal, etc. These have been categorized as 'recommended' and 'optional' based on their added environmental values. Each phase was tested through computer simulation and compared to the baseline model. Additionally, policy recommendations were provided to support the implementation of these projects.

1.3 The Concept of Greening Education Buildings as PPP Projects

Mongolia is facing increasing pressure to respond to climate change due to the country's high greenhouse gas emissions from the utilization of fossil fuels. The building sector contributes largely to energy consumption and GHG emissions. This being so, building sector improvements should be included in government strategies for long term environmental sustainability. In particular, the INDC submitted by Mongolia sets the goal to "reduce building heat loss by 20% by 2020 and by 40% by 2030, compared to 2014 levels" based on the state policy on energy (Parliament resolution No. 63, 2015), Green Development Policy, 2014.

Nowadays, there are a great number of building design approaches for reducing energy consumption that are readily available in Mongolia. The GoM has developed enhanced standards and building codes for public buildings with improved energy saving capabilities. Despite the country's efforts to begin the shift toward green buildings, green building projects face many constraints including a shortage of financial resources and technical limitations. Private-sector participation in green building construction and operation can be encouraged as one option to overcome such challenges. In order to effectively address and avoid environmental crises, it is necessary for the GoM to move toward the development of energy efficient buildings by adopting green technologies. An effective way of accomplishing this, given the constraints Mongolia's state budget would be by including the private sector through PPPs. PPP models are well suited to the concept of green building construction as they take a whole life-cycle approach from design to construction and operation. In other words, under a PPP model, the project company has a strong incentive to invest more in the design and construction stage in order to reduce long term operational costs over the remainder of the PPP contract term (normally more than 10 years). Therefore, the project company would be willing to accept the higher upfront costs of green design and technologies inasmuch as they can lead to reduced lifecycle costs for operation and maintenance. This report develops locally applicable PPP models for green buildings, green education buildings in particular, and validates the long term impacts of these buildings in terms of energy performance and lifecycle costs.

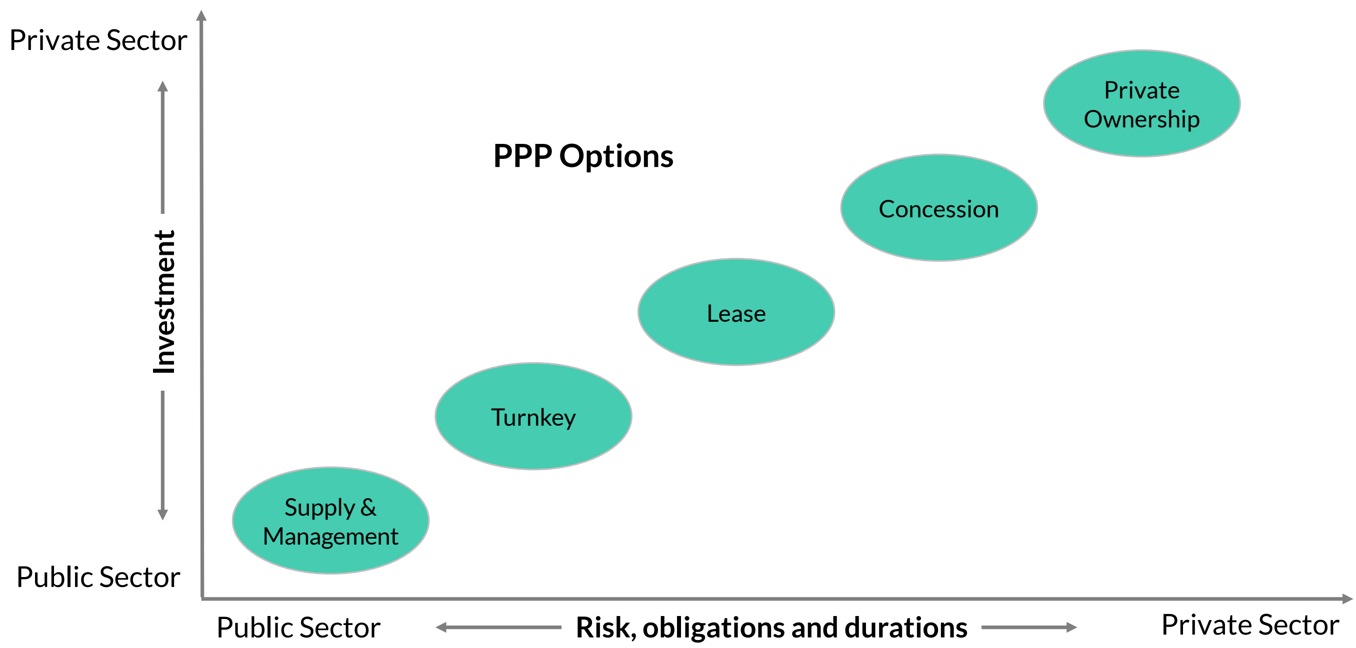
The concept of PPPs and green education buildings are described below.

There is no single, internationally accepted definition for the term "Public-Private Partnership" or "PPP"; however, the World Bank PPP reference guidebook offers the following description (WB et al. 2015, 14):

> *A long term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance.*

There are various PPP models based on contract type and degree of responsibility and risks borne by the private and public sectors. According to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), PPP options and descriptions are as follows (UNESCAP 2011, 4-10):

Figure 1.5 — PPP models



Source: UNESCAP (2011)

- **Supply and management contracts:** A contractual arrangement for the management of all or a part of a public enterprise by the private sector.
  - The public sector retains ownership of the facility and equipment, while the private sector is assigned specified responsibilities concerning a service and is generally not asked to assume commercial risk.
  - The private contractor is paid a fee to manage and operate services, normally performance-based.

- **Turnkey:** A traditional public sector procurement model for infrastructure facilities.
  - The private contractor designs and builds a facility for a fixed fee, rate, or total cost. This type of private-sector participation is also known as Design-Build.

- **Lease:** A type of PPP in which the operator (leaseholder) is responsible for operating and maintaining an existing facility and associated services, but generally is not required to make any large investment.
  - The operator takes lease of both infrastructure and equipment from the government for an agreed period of time.
  - Generally, the government undertakes responsibility for the investment and bears investment risk while operational risks are transferred to the operator.

- **Concession**: The government defines and grants specific rights to an entity to build and operate a facility for a fixed period of time
  - The government may retain ultimate ownership of the facility and/or right to supply the service.
  - In a BOT concession, the concessionaire makes investments and operates the facility for a fixed period of time after the ownership reverts back to the public sector. Operational and investment risks can be substantially transferred to the concessionaire.

- **Private Ownership, Private Finance Initiative (PFI):** The private sector remains responsible for the design, construction and operation of an infrastructure facility
  - The public sector purchases infrastructure services from the private sector through a long term agreement.
  - Asset ownership at the end of the contract period is generally transferred to the public sector.

Green Education Buildings: The holistic concept of green education buildings or schools originated with the understanding that the constructed environment can have profound effects on the natural environment, as well as on the students who inhabit it every day. The concept of green schools is increasing in importance, driven by greater environmental awareness, as well as rising energy and operation costs of traditional education buildings.

A green school is a high-performing, energy efficient, socially inclusive building that can be environmentally beneficial and offer improved learning environments while maintaining economically viable planning, construction, operation, and maintenance. There are several criteria that provide economic and environmental benefits while also positively impacting student health and learning. These include (Olson and Kellum 2003, 6):

- sustainable site planning and landscape design for outdoor student activities and the reduction of pesticide usage;
- efficient building envelope designs for windows to improve insulation and comfort levels;
- adequate IAQ from air filtration and exchange systems;
- the eradication of inadequate transportation, and the use of green supplies and materials to minimize possible sources of toxins, allergens, and other harmful pollutants;
- proper design and maintenance of heating, cooling, and ventilation systems;
- onsite renewable energy sources; and
- facilities and services that are accessible to low-income families, people with disabilities, and marginalized communities.

There are several principles that frequently recur in green school definitions: protecting the environment, lowering operating costs, improving the health and quality of the learning environment, and integrating learning opportunities with the built environment (Government of Ontario 2010, 15).

2 Public-Private Partnership Model for Education Buildings in Mongolia

2.1 Overview of Education PPPs

2.1.1 Definition and Features

According to the Organization of Economic Co-operation and Development (OECD)[5], a PPP can be defined as an arrangement under which the private sector offers infrastructure, assets, and services that have traditionally been provided by government (OECD 2007). Many countries have implemented PPPs in diverse sectors to improve their infrastructure such as roads and plants or for economic and social development. Education is another sector where interest in implementing PPPs has increased.

PPPs for education are usually referred to as "School PPPs" or "Education PPPs" and can be described as follows.

> *"…the pooling and managing of resources as well as the mobilization of competencies and commitments by public, business and civil society partners to contribute to expansion and quality of education. They are founded on the principles of international rights, ethical principles and organizational agreements underlying education sector development and management; consultant with other stakeholders; and on shared decision-making, risk, benefit and accountability" – Institute for Educational Planning (Latham 2009, 2)*

There are several differences between School PPPs and PPPs in other sectors. Some of the unique characteristics of Education PPPs include (Federation of Indian Chambers of Commerce and Industry (FICCI) 2014, 12):

- a focus on providing services to the poor without opportunity to cross-subsidize;
- no potential to earn revenues or return on investment, as schools can only charge fees in limited circumstances;
- complex monitoring structures with results that may take time to emerge, e.g. improved learning outcomes; and
- high operating and maintenance costs in relation to capital expenditure, as teacher salaries make up a large part of education costs.

There are key partners in Education PPPs as in other sectors: the public sector, the private sector, and civil society. The public sector is usually defined as government, whereas the private sector is defined as non-public sector, including for profit and non-profit businesses. Finally, civil society is the community involved in PPP projects. The participation of the private sector in education service delivery does not represent the withdrawal of government from the provision of educational services. Rather, it represents a transition in the role of the government from being administrator to facilitator and regulator. Well-executed Education PPPs are able to induce positive disruption in the government system that could lead to the following results:

- creating models of excellence;
- addressing residual gaps in access, especially in secondary education; and
- triggering competition between different public and private providers.

2.1.2 Pros and Cons

School PPPs help to enhance the quality of education service delivery by offering both the reach of the government system along with private sector innovation, increasing the quality of the system as a whole; thus, executing PPPs in education enables the government to offer quality education services to the public, efficiently and effectively. In addition,

5 OECD Glossary of Statistical Terms-Public-Private Partnership (PPP) Definition (Created on July, 2007).

there are other advantages to implementing Education PPPs:

- PPPs can induce competition in the market for education, prompting the public sector to improve the quality of public education.
- PPP contracts allow more flexibility than most public sector arrangements, and a flexible contract can better align education supply and demand. In other words, private contracts are likely to be less exposed to strict regulation related to public procurement and budget management.
- Private providers involved in PPP contracts are usually chosen through an open bidding process, with such selectivity helping to improve the quality of education.
- PPP contracts can achieve an optimal level of risk-sharing between the government and the private sector; consequently, these may attract more resources and result in higher quality service delivery.
- The private sector can have higher standards in the delivery of education services by reflecting specific standards and quality targets; therefore, performance during the life of the contract can lead to improvements to education.
- A PPP model that combines the strengths of government, the private sector, and civil society stakeholders to advance education can create new, sustainable education reform initiatives.

According to the World Bank, private-sector participation in education has increased dramatically over the last two decades around the world (Patrinos et al. 2009, 2). Table 2–A illustrates the increase in private education enrollment rates from 1990 to 2005. In primary schools, Benin experienced the greatest increase (300%), followed by India and South Africa, (each at 100%). As for secondary schools, Benin also experienced the greatest change in private enrollment with a rate increase of 213%, followed by Jordan and India (167% and 130% respectively). FromTable 2.1, we find that developing country interest in School PPPs has sharply increased.

Table 2.1 — Growing private education enrollment rate, 1990 and 2005, selected countries

Country	Primary %			Secondary %		
	1990	2005	% Change	1990	2005	% Change
Benin	3	12	300	8	25	213
Brazil	14	10	-29	35	12	-66
Bulgaria	0	0	0	0	1	100
Chile	39	51	31	49	52	6
Colombia	15	19	27	39	24	-38
India	10	20	100	10	23	130
Indonesia	18	17	-6	49	44	-10
Jordan	23	30	30	6	16	167
Netherlands	69	69	0	83	83	0
Pakistan	25	27	8	24	25	4
Peru	13	16	23	15	22	47
South Africa	1	2	100	2	3	50
Thailand	10	16	60	16	13	-19
Togo	25	42	68	17	28	65
Tunisia	1	1	0	12	5	-58
Ukraine	0	0	0	0	0	0
United States	10	10	0	10	2	-10

Source: Patrinos et al. (2009)

Governments have several reasons for considering the private-sector provision of education services, such as efficient project implementation and properness of financing. However, some questions remain over the effectiveness of Education PPPs.

The following table represents the reasons for and against PPPs in education.

Table 2.2 — Reasons for and against PPPs in education

Focus area		Reasons For and Against PPPs in Education
Access	For	Supplementing the limited capacity of government schools to absorb the growing numbers of children, thereby expanding access and helping to reduce class sizes in government schools.
	Against	Private-sector contribution is small in relative terms, with little evidence that this will change substantially.
Quality	For	Allowing government education authorities to focus on core functions such as policy and planning, curriculum development, and quality assurance.
	Against	Poorly designed contracts that have inappropriate incentives may not lead to significant performance gains.
Finance	For	Increasing the level of financial resources. Sharpening competitive pressures in the education sector, thus generating efficiency gains and spurring greater innovation in education delivery.
	Against	The benefits of choice and competition are not evenly dispersed and can lead to widening inequalities between rich and poor. Poorly designed contracts may expose the government to significant financial and performance risks.
Capacity building and governance	For	Increasing the level of public sector knowledge, skills, and innovation. Enabling participation among all stakeholders in decision-making and responsibility for results is crucial to the success of any innovation or reform.
	Against	PPPs represent a loss of control for education authorities and result in a loss of accountability to the public. PPPs generally involve more complex arrangements that require detailed policy design, as well as financial and contract management capabilities.
Flexibility and innovation	For	Allowing for much greater innovation in the delivery of education by focusing on the outputs and outcomes desired from an educational provider. Allowing governments to circumvent restrictive employment laws and outdated government payment scales.
	Against	The development of policy, as well as the formulation and specification of provider contracts, can be complex and time-consuming – particularly for bureaucracies unfamiliar with an external, output-based contracting model.
Sustainability	For	Where governments are weak and personnel change is frequent, PPPs provide continuity and stability in a project.
	Against	Non-government partners drop out once the focus of their institution or staff change. PPPs typically incur high transaction costs.

Source: Latham (2009)

2.1.3 Types

According to Latham, M (2009), there are seven types of PPPs in the education sector. Each one has different characteristics in terms of its purpose for partnerships, design, and the roles that are played by the public and private sectors. The table below lists and briefly describes these common types of Education PPPs.

Table 2.3 — Main types of Education PPPs

Type	Description
Adopt-a-school program	The main feature of an Adopt-a-School Program is that the private sector provides cash and in-kind resources to complement the government's financial support for the public school. The purpose of this program is to improve the quality, accessibility, and infrastructure within public schools while boosting community participation.
Private-sector philanthropy	Private-Sector Philanthropy aims to increase poor children's access to quality education by improving system efficiency and increasing the scale of social contributions. The purpose of this program is to provide a sustainable education reform model for developing countries through PPPs, ranging from the philanthropic to profit-based business cases.
Capacity building programs	In Capacity-Building Programs the private sector provides varied support such as curriculum support, pedagogical support, management and administrative training, textbooks, and teacher training with the costs covered by the government. The government retains full control over the schools with the private sector offering educational inputs.
Outsourcing of school management	The main feature of the Outsourcing of School Management is that public sector authorities establish contracts directly with private providers to operate public schools or to manage certain aspects of public school operations. These schools are operated by the private sector, but financed by the government, which retains ownership of them. A common characteristic of these programs is their flexibility where details such as performance targets, accountabilities, timelines, and arbitration procedures are easily adjustable.
Government purchasing programs	Government Purchasing Programs are contractual arrangements whereby the government contracts with private schools to deliver education at public expense. In this case, the expense is in the form of a subsidy for each student enrolled in an accredited or eligible private school.
Voucher programs	Voucher Programs involve government funding for students to attend private schools through a voucher that is essentially a certificate or entitlement that the parent may use to pay for their children's education. This voucher can be used to purchase education from either a public or private school.
School infrastructure partnerships	In School Infrastructure Partnerships the private sector builds, owns,[6] and operates the educational facilities, in exchange for which the private partner is paid a fee over the contract period, while the government uses these facilities to run the school and provides the core educational services. The contract period is generally between 20 to 30 years and payment is based on the schools meeting strict performance criteria. The ownership and asset at the end of the contract period may be transferred to the government or be retained by the private sector depending on the terms in the contract.

Source: Author rewrite based on Latham (2009) and FICCI (2014)

6 Ownership or exclusive right to use the asset is endowed during the contract periods.

2.1.4 Challenges and Limitations

There are various challenges for successful PPPs in the education sector, which limit the design scope and reduce the incentives for the private sector to invest in education.

First, many countries have a low capacity for implementing education sector PPPs, which makes it challenging to progress and accomplish a successful PPPs. Second, there can be significant differences in the power that each partner can wield. This possibility may lead to an imbalance among the partners, causing conflicts in the PPP process. Third, the contract costs of involving the private sector are higher, depending on the scope and size of the potential partnership project. It augments uncertainty so that the private sector is likely to be reluctant to make an investment in PPPs, which makes it difficult to implement the projects ultimately. Fourth, all partners have different purposes, constituencies and working methods, making it difficult to meet each partner's expectations and requirements for working with each other. Fifth, measuring school performance is challenging due to the many factors that influence school performance. Sixth, the public and private sectors have different, sometimes conflicting interests. For example the public sector views education as a "non-commercial activity" and is often apprehensive of making education commercial, while, the private sector is concerned that policy changes would reduce the benefits of such partnership arrangements. Lastly, because PPPs generally last for a long time, without a proper management system, the financial burden that PPPs place on the government may cause fiscal risk in the long run.

In addition, although PPPs are advantageous in many ways in terms of providing new infrastructure, they have also been criticized given the inflexibility, lack of capacity and expertise of the public sector, and lack of market competition as explained below:

- **Inflexibility during contract periods:** Once signed, it is very cumbersome to adjust the terms over the contract period. In the school case, designers face difficulties in improving the learning environment due to the poor participation of key stakeholders—including teachers, pupils, and the community—in the learning design process.
- **Lack of public sector capacity and expertise:** It was recognized in UK cases that both the private and public sectors lacked necessary experience and skills relating to PPPs. In such cases, the success of the PPP is largely dependent on the capacity and expertise of external consultants, triggering higher transaction costs in the form of consultation fees.
- **Lack of market competition:** Competition is generally required to reduce costs and enhance the value for money (VFM) associated with these types of projects. In fact, lack of competition is the main cause of high project costs in the PPP market. In long term complex ventures such as PPPs, such high costs limit the appetite of private actors who might otherwise bid for these projects.

2.2 Education PPPs in Mongolia

2.2.1 Legal and Institutional Framework for PPPs in Mongolia

After a long period of under-investment, the infrastructure challenges facing Mongolia have been detrimental to economic development and social welfare. Traditionally, the key objective of the GoM in infrastructure development has been focused on promoting mining and industrialization. However, this focus has been widened to investments in economic infrastructure facilities including roads, railways, water, and energy, as well as social infrastructure facilities such as school, kindergartens, and healthcare facilities to improve the quality of people's lives, increase economic competitiveness, and eradicate poverty.

2.2.1.1 Legal and Policy Framework for PPPs

This section will discuss key elements of Mongolia's legal and policy framework for private investment in public infrastructure.

The National Development Strategy of Mongolia:

Until very recently, the GoM had no specific policy to promote private sector development. Some of the gaps between government policy and institutional framework were narrowed in 2008 when Mongolia adopted its Private Sector Development Strategy (PSD), which is linked to its National Development Strategy (NDS) based on Millennium Development Goals (MDGs).

The NDS sets medium-term objectives for achieving the MDGs during the first phase of implementation (2007-2015), and a long term goal of transforming Mongolia into a dynamic, knowledge- and high technology-based economy during the second phase (2016-2021). The NDS foresees the gradual reduction of GoM involvement, making room for the rise of a strong private sector. In this regard, it identifies foreign direct investment (FDI) as playing a key role in improving the country's competitiveness and includes broad FDI-related objectives, such as using FDI to introduce advanced technologies and to develop human capital. The strategy defines particular targets such as increasing private-sector participation and promoting industrial growth, which, while they appear to be moving in the right direction certainly seem counter to the current and growing trends of public-sector expansion an increasing state participation in Mongolia's mining and energy sectors. Other parts of the strategy include increasing labor productivity and flexibility through skills and technology policy for the private sector; improving the business environment and investment climate and stimulating private sector competitiveness by promoting macro-stability and financial market development; promoting the PSD regionally by encouraging agro industries, tourism, and mining services; and building all types of PPP's by improving the legal environment, infrastructure, and consultation mechanisms, including those with external partners.

Mongolian Investment Law

In October of 2013, the Mongolian Parliament passed the Investment Law of Mongolia (IL). Entering into effect on November 1, the IL replaced the controversial 2012 Strategic Entities Foreign Investment Law (SEFIL).

The IL sets down the legal rights and obligations of investors in Mongolia, stabilizes the tax environment, establishes the powers and responsibilities of the agency that regulates investment, and provides incentives to encourage investment. Unlike SEFIL, what distinguishes a foreign from a domestic investor in the IL is not the investor's nationality, but rather, where the investor resides. Accordingly, investments made by private individuals or firms are no longer subject to special approval other than registration with the State Registration Office, which simplifies the procedures for doing business, unless sector specific legislation mandates additional requirements.

A central feature of IL, and one widely promoted by the GoM, is its tax incentive structure where these incentives take the form of tax stabilization certificates. Old and new projects meeting the necessary requirements can qualify for favorable tax treatment for periods up to 27 years. Affected taxes may include corporate income tax, customs duties, value-added tax, and mineral resource royalties. The determining criteria for participation in the tax stabilization incentive program are the amount of the investment and the sector and geographical area involved.

The Invest Mongolia Agency

The IL created a new investment promotion entity, the IMA, which reports to the Office of the Prime Minister, to replace the Foreign Investment Regulation and Registration Department. IMA is responsible for issuing the tax stabilization certificates. In addition, IMA has the PPP and concession division, which manages the selection, tendering and contracting processes for concessions/PPP projects. Also, IMA has the mandate to assist investors – both foreign and domestic in planning their investments and to protect their interest and rights.

There have been three major, politically-driven, institutional upheavals since 2012. Responsibility over PPPs shifted from the State Property Committee to the Ministry of Economic Development (MED) in 2012, and then to the Ministry of Industry after the MED was dissolved in 2014. The IMA was dissolved in 2016 and its PPP/concession division has been transferred to the newly established National Development Agency (NDA).

The Concession Law

Progress in attracting private investment into infrastructure is facing challenges but the potential payoff is large, both in terms of eliminating the bottlenecks facing the economy and in improving foreign investor attitudes towards Mongolia as a place to invest. Well-structured and competitively implemented PPP projects are an effective and efficient means for operating, maintaining, and financing the construction of public facilities in Mongolia.

An appropriate legal framework for concessions is crucial for stimulating PPPs. The legal structure for concessions in Mongolia began in 2009 when the Mongolian Parliament adopted a State Policy promoting private-sector participation in all areas of the national economy. The following year, the Parliament adopted the Concession Law, setting forth the rules governing all aspects of PPP implementation. The goal of this law is to regulate the processes associated with tenders and concessions related to government owned property, including their conclusion, revision, termination, and the settlement of disputes. The concessions law provides a strong, flexible basis for PPP project development at the central and local government levels, and across a range of PPP models and sectors.

According to the Law, concession types and the preparation of lists of concession items are to be approved by the government. Matters related to the granting of concession rights, the powers of central and local government in concessions, concession agreements, direct negotiations with private partners, competitive tendering, the powers of the concessionaire and the concession financier, government support, guarantees for the implementation of concessions, and dispute settlement are included in the Law. Despite its comprehensive nature, however, the Law does not provide for risk allocation, links to public investment planning, public financial management, or the assessment of fiscal risk.

Political commitment to PPPs remains strong, but wider systemic challenges represent stumbling blocks to attracting foreign investment. Since the change of government in November of 2014 there have been concerns over the level of commitment to the budgetary discipline. While MDBs and donor agencies have provided technical support and capacity development for evaluating the suitability of proposed PPP projects, pre-feasibility studies have not been commonly used in these assessments. Instead, selection by way of political haggling followed by post-selection justifications for the chosen projects have been more the norm. Moreover, though cost benefit analyses are legally required, their implementation has been limited due to lack of capacity and resources.

Overall, the legal framework for PPPs in Mongolia is well-designed and progress on projects signed so far has been encouraging. Nonetheless, implementation of project selection and monitoring requirements have been hampered by lack of expertise, human resources, and cross-ministerial coordination, as well as, frequent institutional changes.

The following table shows major roles and responsibilities of public- and private-sector parties regulated in the Law on Concession.

Table 2.4 — Roles and responsibilities of public- and private-sector parties

Associated Parties	Role/Responsibilities
Regulatory authority: State authorities/ Local administrative and self-governing authorities A state authority with functions to grant permission and licenses required for the implementation of the concession, determine prices and tariffs, and adopt and enforce rules and regulations pertaining to the concession item or services rendered by it; In the case of a state-owned property that is a concession item, the state administrative authority in charge of state property, and, in the case of a local property that is a concession item, the governor of the aimag or the capital city.	**The Government shall have the following powers:** To approve and revise the list of concession items for the state-owned property; To decide on granting a concession and to authorize the authority to enter into a concession agreement; To report annually to the Economic Standing Committee of the Parliament on the implementation of the legislation on concession. **The state administrative authority managing economic development policy shall have the following responsibilities:** To prepare and submit to the Government a draft list of concession items for state-owned property; To research and prepare proposals for inclusion in the list of concession items for state-owned property; To inform the public about the list of concession items; To provide methodological and expert assistance to other relevant authorities on matters related to granting and implementing concessions; To evaluate and oversee the implementation of the concession agreement and implement the legislation on concession; To establish and maintain the national centralized registry and database on concessions; To adopt legally binding norms when specifically authorized to do so by legislation; To prepare tender documents together with the relevant state administrative authority, and announce, organize and evaluate the tender; To enter, with the concessionaire and other entities, into a concession and such other related agreements as contracts of the concessionaire to obtain financing. In the case of a concession that is a state-owned property, the state central administrative authority in charge of economic development policies, and, in the case of a concession involving a locally-owned property, the governor of the aimag or the capital city. State and regulatory authorities shall have responsibilities for (i) financial support for the implementation of the concession agreement, (ii) support to the concessionaire in obtaining the permits, licenses, land, and land use rights necessary for the implementation of the concession. The following entities shall monitor the implementation of the concession agreement: (i) The state administrative authority in charge of economic development policy and state and local administrative authorities in charge of state and local property; (ii) The state administrative authority in charge of the particular concession item; (iii) Other authorities and officials authorized to monitor as specified in the laws.

	Granting licenses and permits If the works and services to be rendered by the concessionaire require a license, the relevant license shall be granted to the concessionaire as soon as possible upon the conclusion of the concession agreement. If a concession item is a facility that is inseparable from the land, the regulatory authority shall have a duty to resolve the land use issue in accordance with the relevant procedures as soon as possible upon the conclusion of the concession agreement. If the implementation of the concession will require transit through the land possessed, used, or owned by a third party, or if works, maintenance, and services need to be performed on any equipment and facilities that are related to the concession item and located on such land, the authorized entity and the regulatory authority shall resolve these matters in accordance with the relevant laws before granting the concession. **Financial support from the State** **The State may provide the following financial support to the concessionaire:** Loan guarantee; Portion of the financing for the concession; Tax exemptions and waivers in accordance with the relevant laws; Insurance; Guarantee for the minimum amount of the concessionaire's revenues under the concession agreement; and Compensations specified in this law and the concession agreement. Fiscal support specified in the concession agreement, and source of payment shall be reflected in the state budget. If the concession agreement requires repayment from the state budget, the Debt Management Law of Mongolia shall guide the terms of repayment.

Concessionaire Mongolian or foreign legal entity or their consortium that has obtained a concession under the procedures specified in the Concession Law.	Depending on concessions type, a concessionaire shall design the concession item, build it by using its own funds it has raised, may operate it within the period specified in the agreement, and may transfer it to the state or local ownership upon the expiration of the agreement in accordance with the conditions specified in the agreement. **Following responsibilities are specified in regard to concessionaire:** To provide services under essentially the same conditions for the users of the same category; To report and inform; Quality guarantees for the concession item after its transfer upon expiration of the concession agreement; To conduct activities specified in the legislation and the concession agreement; To pay the concession fee in accordance with the relevant procedures, if the concession agreement provides so; To ensure that the quality, quantity, and volume of the works and services rendered do not go below the level of specified in the concession agreement; To possess, operate, repair, and maintain the concession item for the purposes specified in the concession agreement; To pay taxes and fees imposed by the legislation; To insure the concession item against accidents if the concession agreement provides so; A concessionaire shall be responsible for the quality and performance of a sub-contractor's works and services; and Other obligations specified in the law.
Concession financier An entity which renders financial services to the concessionaire such as providing loans or issuing guarantees.	**A concession financier shall have the following rights:** To monitor the activities of the concessionaire; To access the concession item and related facilities to exercise its rights; and To take over the pledged assets and the rights of the concessionaire subject to the relevant legislation and agreements. In the event of non-performance or failure by the concessionaire to properly perform under the concession agreement or if the concessionaire is bankrupt or liquidated, submit a proposal to the authorized entity to manage the concession item or transfer it to others with the consent of the authorized entity in accordance with the procedures specified in the concession agreement.

Tender of Concession Provision

The Concession Law contains provisions relating to tendering which might be better structured by placing the principles and aims of the tendering process in the Law but the specific details in regulations and procedures should be adopted. The Concession Law should be supported by the regulations, procedures, and guidelines to make the law and institutional arrangements operational in a coherent, consistent, efficient, and effective manner.

Procedures on the selection of the PPP private partner are contained in the Regulation on the Tender of Concession Provision, Resolution No. 103, dated April 4, 2012. Following this regulation, the Model Prequalification Document on Granting Concessions, the Model Request for Proposal Documents for Tender and the Tender Evaluation Guidelines were adopted as Annexes to the Resolution of No 103.

PPPs by Local Administrative and Self-governing Authorities

The Concession Law authorizes sub-national PPP arrangements in provinces and in the capital city of Ulaanbaatar as the Budget Law gives more authority to local government. The sectors over which Ulaanbaatar (UB) City and local governments have authority are broad including, basic education, primary healthcare, urban planning and construction, social welfare services, water supply and sewerage, public transport, urban roads and bridges, street lighting, and waste collection and disposal. These functions are to be financed through local taxes and fiscal transfers of shared taxes from the central government. The transfer formula in this case is based on population, population density, remoteness, size of the local government, and level of local development. There is a conditional performance element to the transfers that is linked to local tax efforts. Only UB City, with the approval of the MoF, is allowed, to borrow from capital markets to finance public investment projects. The debt is limited to the previous year's revenue and debt service is limited to 15% of the previous year's revenue.

UB City is a particularly important potential source for PPP projects. With 45% of the total population of Mongolia residing here, there are economies of scale for significant economic and social infrastructure to be provided through PPP arrangements. UB City has its own list of concessions including education facilities, water supply, municipal roads, public transport, heating, electricity, solid waste management, health, and other public services.

In spite of its importance as a growth pole for Mongolia, UB City does not receive the level of resources that it should for infrastructure development. However, the new municipal tax law, approved by the Mongolian Parliament, which went into effect in October 1, 2015, imposes a capital city tax on pubs, restaurants, hotels, and resorts, as well as all alcoholic beverage and cigarette retailers. Proceeds from this tax will be invested in\ the development of city infrastructure and tourism.

The World Bank (2010) emphasized a number of priority investment areas for UB city (Kamata et al. 2010, 82-83):
- Construction of access roads within Ger areas;
- Better heating systems to improve efficiency and reduce air pollution;
- Investments in solid waste management and community infrastructure;
- Affordable collective housing for mid-tier areas; and
- Expansion of the city's electricity, heating, and water utilities.

The 2011 Asian Development Bank (ADB) report on the Mongolian roads sector recommended focusing new construction where demand is the highest (ADB 2011, ES 14):
- UB ity trunk and feeder roads (in Ger areas), international transit corridors, and roads serving mining areas.

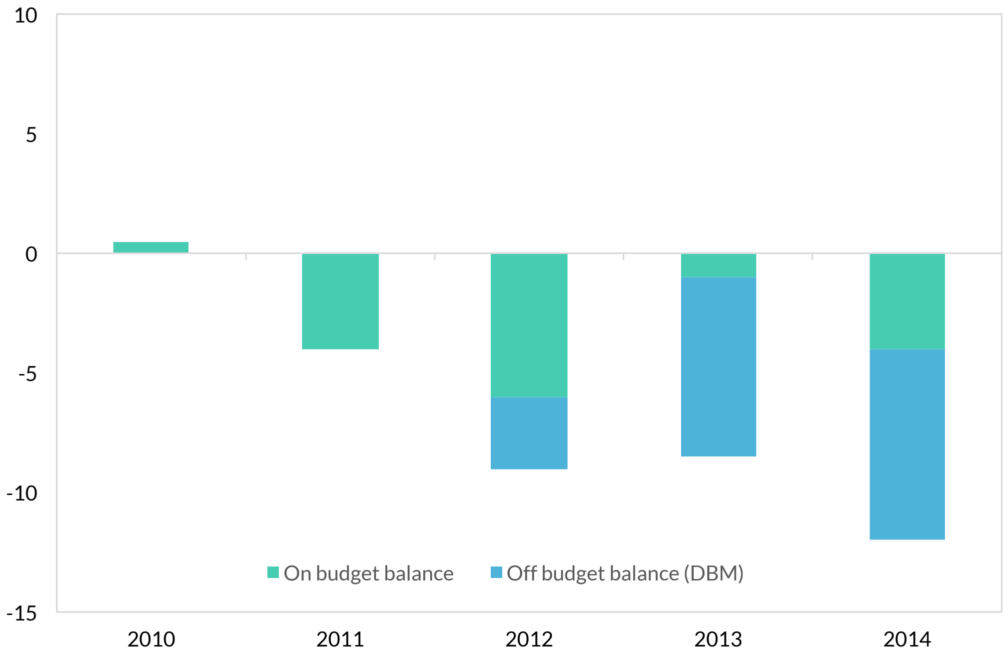
Laws on Budget and Fiscal Discipline

Mongolia has adopted the Integrated Budget Law, the Fiscal Stability Law, and reforms to the Public Procurement Law in order to improve the country's framework for macroeconomic decision-making and public financial management. These laws on budget and fiscal discipline affect the planning and implementation of PPP projects, as some PPP projects require long term fiscal supports or guarantees. These laws should be closely linked to the Concession Law to ensure fiscal sustainability and soundness in implementing PPP projects. The World Bank report (2013) states that "these laws however, are yet to be effectively implemented and face significant opposition from vested interests. One major difficulty is that other laws, such as the Law on the Development Bank of Mongolia and the Concession Law, are undermining these legislative reforms" (WB 2013, 27).

According to an International Monetary Fund (IMF) country report, Mongolia's current account deficit declined in 2014. Nevertheless, Mongolia experienced a substantial deficit in payment balances due to service account outflows that same year. Mongolia did not reach its revenue targets and structural fiscal deficits reached 4.25% of the GDP in 2014, exceeding the limit proposed by the Fiscal Stability Law. Furthermore, the Development Bank of Mongolia (DBM) depleted its budget for fiscal activities such as spending on public social infrastructure projects, increasing total deficits by 11% of GDP.

Setting a goal to reduce total deficits by 5% of the GDP in 2015, the GoM executed supplementary budgets, with most spent by DBM. However, their goal could not be accomplished due to several unrealistic assumptions, including failing to take into account DBM spending accounting for 2.5% of the GDP. The IMF estimated that total deficits had decreased from 11% of the GDP in 2014 to 10% of the GDP in 2015.

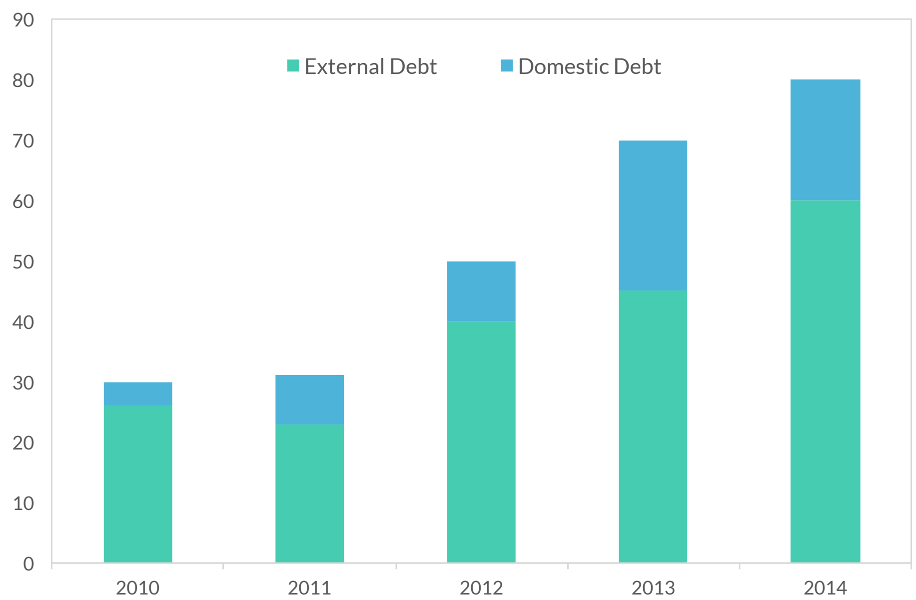
Figure 2.1 — Mongolia's fiscal balance (In percent of GDP)



Note: DBM = Development Bank of Mongolia
Source: IMF (2015)

The IMF also reported that public debt for Mongolia's entire public sector, including Mongolian state enterprises, had risen rapidly to a high of 76.5% of the GDP at the end of 2014 (in nominal terms, and including the People's Bank of China swap). Considering the continuous deficits, they expect that public debt will represent 92.5% of the GDP by 2017 before declining rapidly as mining growth picks up. Though the IMF has evaluated Mongolia's high debt risk, it has also found that this debt could be reduced if mining improves, as the debt level is relatively low compared to Mongolia's natural resource wealth.

Figure 2.2 — External and domestic debt (In percent of GDP)



Source: IMF (2015)

Integrated Budget Law (2011)

In 2011, Mongolia's Integrated Budget Law (IBL) replaced the Public Sector Management and Finance Law with provisions coming into force in 2012. Article 1.1 of the IBL states that the purpose of the Budget Law is "to establish principles, systems, compositions and classifications of budget, to implement special fiscal requirements, to define authorities, roles and responsibilities of the bodies that participate in the budget process, and to regulate the relations that arise in connection with budget preparation, budget approval, spending, accounting, reporting and auditing".

The IBL has strengthened the PPP framework by requiring concession projects to be listed on the budget, along with information on government guarantees and contingent liabilities. It also assigns responsibility for decisions on financing mechanisms and assessment of fiscal risks related to PPPs to the MoF. However, these requirements have not been consistently implemented, and PPP selection is not fully integrated into public investment planning.

The IBL uses the term "PPP", not "concession". Article 30 of the IBL provides that public services may be executed by the private sector and through concession contracts. In the following circumstances PPPs shall be used:

- to introduce private-sector technology, equipment, and management tools to the public sector;
- to implement projects or activities that require mandatory government support but which cannot be implemented solely by private sector; and
- to implement projects and activities with proven benefits as shown in feasibility studies.

Additionally, Article 30 states that:

- PPPs are prohibited for the purpose of avoiding contribution to the budget deficit or for postponing budgetary payment;
- projects and activities implemented through concession contracts shall be part of the budget; and
- relations on concession contracts shall be regulated by relevant laws.

Article 6.4 of the IBL states that the principles of ensuring effective fiscal management should be followed through various means, which include two items that are particularly relevant to PPP arrangements, namely:

- the possibility of using citizens, entities, or non-government organizations in the delivery of programs or activities shall be considered if these programs or activities can be carried out by them and
- unless otherwise specified in law, the selection of a body to delivery any goods, works, or services shall be conducted through an open and competitive procedure.

Public Investment Planning

Two important changes introduced by the IBL are program budgeting and public investment program (PIP) planning regulations. Article 27 of the IBL dictates that the budget will be prepared by programs and that the MoF should provide the instruction for the preparation of the program budget. The IBL introduces comprehensive regulations regarding PIP planning (article 28) and investment budgeting (article 29). PIP planning should include development and infrastructure projects that support long term economic growth with total values higher than MNT 30 billion, and article 28.3 defines the criteria for prioritizing investment projects. A feasibility studies for investment projects with total values of more than MNT 30 billion must be undertaken by National Development and Innovation Committee (NDIC). For projects with total values under MNT 30 billion, these feasibility studies are performed by line ministries and submitted to the MoF.

Guarantees for Debt: Article 51 of the IBL gives the GoM the power to issue debt guarantees, dictating specific circumstances in which it is permitted to do so. For example, the GoM may issue such guarantees if they are approved by a particular year's budget law as a part of the budget. Thus, guarantees issued by the GoM in the context of PPP arrangements must be verified against provisions in the IBL and Concession Law.

Contingent Liabilities: Article 52 of the IBL states that information on the GoM's contingent liabilities is to be disclosed to the Parliament and to the public. Records of contingent liabilities are to be reflected in annual and supplementary budget proposals, and in semi-annual and annual budget execution reports. The State Central Audit Office is to monitor and issue an opinion on contingent liabilities, debt guarantees, and related records. Disclosure of estimations on contingent liabilities, loan guarantees, and possible risks do not mean that these are accepted or that the liabilities have been incurred. Contingent liabilities may arise in PPP arrangements and how these are approved and recorded awaits discussion.

Fiscal Stability Law (2010)

The Fiscal Stability Law of 2010 (FSL) came into force in January 2013. Article 1 of the Law provides that its purpose is to establish fiscal management principles and special fiscal requirements for the purpose of ensuring fiscal stability.

The World Bank report states that the FSL is by-passed through off-budget infrastructure financing which avoids the FSL's structural balance and expenditure growth rules. The report gives the following two examples: (i) BT projects for roads and energy financed by the construction companies themselves, usually through commercial borrowing, on the condition of repayment from government budget at a later date and (ii) excessive lending by the DBM for non-revenue generating public infrastructure projects. DBM is not subject to Mongolia's Public Procurement Law. As a result, a number of roads projects have been implemented through direct contracting, rather than competitive tendering. These BT projects ended up being an expensive financing option as construction companies were required to pay commercial interest rates to finance them, rendering the projects an estimated 25% to 30% more expensive than the equivalent budget-budget projects. These schemes also involve very little transfer of risk from the government to the private-sector partner. Moreover, the high financing costs are ultimately passed back to the budget without compensating efficiency gains in the operational phase.

In order to mitigate the fiscal risk associated with PPP projects and to strengthen government capacity to manage these risks, the World Bank (2013) advises that "while in the longer term, it may be preferable to incorporate PPP commitments into the fiscal rules set out in the Fiscal Stability Law, in the immediate term, introduction of a financial cap would be advisable."

Public Procurement Law (amended in 2011)

The Public Procurement Law of Mongolia (PPL) was amended in 2011 and the changes came into effect in October of 2012. Additionally, in August of 2012, Government Resolution No. 6 established the Government Procurement Agency (GPA) as part of Mongolia's government for Change Reform Policy. The PPL applies to the public procurement of goods, works and services, and, unless otherwise provided in the international agreements to which Mongolia is a party, the Law also applies to the procurement of goods, works, and services funded by foreign grants or loans.

The PPL provides for open tendering, defining three types of "exceptional procurement" (procurement where tendering is not required) in which tender, namely: (i) limited tendering, (ii) comparison and direct contracting, and (iii) the procurement of consulting services. Direct contracting may be used only under limited conditions set out in Article 34. Moreover, unless the PPL provides otherwise, procurement contracts must comply with the Mongolian Civil Code.

The World Bank report states that the difference between the use of concessions in the Concession Law and PPPs in the IBL "is significant in that the emphasis in the Concession Law is on providing business opportunities to the private sector rather than protecting the government from fiscal risk".

In its report titled, "Government of Mongolia: Developing a Conducive Environment for Public Private Partnerships", the ADB states that Mongolia needs a clear and certain legal definition for the term "PPP" and that the term "concession" should be further defined as a specific form of PPP. The ADB report sets out detailed definitions for both the terms "PPP" and "concessions".

2.2.1.2 Issues with the Concession Law and Areas for Improvement

The GoM has established a legal and policy framework for the promotion and management of PPPs, achieving meaningful performance in diverse sectors, as shown in Table 2.5 below. However, there are increasing needs for improvement of the procedures for project preparation and implementation. Currently, the GoM is preparing a new PPP Act, recognizing that need. Some of the issues with the current Concession Law and associated recommendations for its improvement are as follows:

1. **PPP Legal and Administrative Framework:** The GoM has introduced a special law – the Concession Law – to promote PPPs, but still has not developed a subordinate ordinances or practical guidelines to support the implementation of the Law. Subordinate ordinance, regulations, and implementation guidelines are necessary to reduce uncertainty and to enhance transparency and efficiency for both public and private partners. They will regulate detailed steps for preparation and PPP implementation, the roles and responsibilities of public and private partners, government support mechanisms, and other necessary measures. The new PPP Act should be accompanied with necessary subordinate regulations and implementation guidelines to translate the Law into project implementation. Related ordinances or guidelines could be as follows:
   - PPP Act Enforcement Decree
   - General PPP plan and policy direction (annual/bi-annual update)
   - PPP Implementation guidelines - (feasibility and VFM tests, standard contracts, tender preparation and evaluation guidelines, financing & refinancing guidelines, etc.)

   The new PPP Act shall be in alignment with other laws such as the Procurement Law and the Public Budget Law. Some countries made the PPP act a special Act that precedes other related laws in order to promote PPP projects and expedite the implementation process. This may exempt PPP projects from the management inflexibility associated with national property and public procurement processes.

2. **Types of PPPs / Concept of PPPs**: The present concept of concession in Mongolian Law is not clear, and there is no clear differentiation between BOT, Build-Own-Operate-Transfer (BOOT), and Concession.[7] The Build-Transfer-Lease (BTL) model can also be a good alternative model for PPPs, as this may mitigate risk related to property ownership[8].

3. **Government Support**: It is desirable to offer diverse and effective support measures to promote private investment and mitigate risks. Some recommended incentives and support measures that are not currently specified in the Law, but that could increase its effectiveness are as follows:
   - a construction subsidy,
   - a buyout option (force majeure, etc.),
   - an incentive for early completion, and
   - compensation for bid preparation costs

7 Article 4 of Mongolia's Concession Law defines the following PPP types:

"4.1.1. "Build-Operate-Transfer" – a concessionaire builds the concession item by using its own funds or funds it has raised, operates it within the period specified in the agreement and transfers the concession item upon the expiration of the agreement to the state or local ownership in accordance with the conditions specified in the agreement;

4.1.2. "Build-Transfer" – a concessionaire builds the concession item by using its own funds or funds it has raised, and transfers the concession item to the state or local ownership in accordance with the conditions specified in the agreement;

4.1.3. "Build-Own-Operate" – a concessionaire builds the concession item by using its own funds or funds it has raised, and owns and operates the concession item in accordance with the conditions specified in the agreement;

4.1.4. "Build-Own-Operate-Transfer" – a concessionaire builds the concession item by using its own funds or funds it has raised, owns and operates it within the period specified in the agreement, and transfers it upon expiration of the agreement to the state or local ownership in accordance with the conditions specified in the agreement;

4.1.5. "Build-Lease-Transfer" – a concessionaire builds the concession item by using its own funds or funds it has raised, transfers the possession of the concession item to the authorized entity under a financial lease arrangement as specified in the agreement, and transfers it to the state or local ownership upon the expiration of the lease."

8 Under the BTL model, property ownership is transferred right after finishing the construction of a building, while in the case of a BLT, the property ownership transfer happens at the end of contract period. In Korean legal system, national property cannot be transferred without a standardized public procurement process which cannot be applied to PPPs scheme.

Most of the clauses regarding guarantees and tax incentives in the Law only declare the 'possibility' of use and application. It is necessary to clarify definitions, financial resources, and specific tax incentive with baselines.

4. **Dispute Arbitration Mechanism**: It is advisable that the GoM establish a special dispute arbitration mechanism preferably under the national committee or line ministry in charge of PPPs. It may resolve PPP-related disputes more quickly than through international arbitration or lawsuits in Mongolia.

2.2.2 Performance of PPPs in Mongolia

Since the Concession Law was introduced, Mongolia's PPP unit at the IMA has expanded the regulatory framework and gained significant project experience. Several PPP projects are underway or are being considered for roads, power plants, airports, public facilities, and social infrastructure.

In 2010, the GoM approved the List of Concessions, which is comprised of 121 concession projects. The Cabinet made amendments to the list of Concession projects in 2013. As of the end of 2015, 80 projects are on the list, 19 of which have been signed (6 projects in 2014, 13 projects in 2015).

Table 2.5 — Concession projects

Sectors	Signed agreements	Built-Transfer (BT)	Build-Operate-Transfer (BOT) and other
Infrastructure	5	2	3
Road and Transportation	6	5	1
Energy	4	0	4
Health	1	0	1
Education	1	1	0
Sports and Culture	1	0	1
Railway	1	0	1
Total	19	8	11

Source: IMA (2016)

2.2.3 Investment Need in the Education Sector and Promoting PPPs

2.2.3.1 Demand for PPPs in the Education Sector and Government Response

Investment in the education sector is essential for Mongolia to improve human capital as a driver for long term growth. According to the MECS, the supply and demand gaps in early childhood education and primary & secondary education have reached about 38% and 12%, respectively. In the case of UB, there are many primary and secondary schools operating on a three-shift system. In addition, UB citizens have severe difficulties in finding available kindergartens and must pay high fees for private daycare services.

Table 2.6 — Supply and demand gap (primary/secondary schools and kindergartens)

Year			2012	2013	2014
Kindergartens	Total number of children (ages 1-5)		293,016	308,843	336,823
	Capacity	Total number of kindergartens	945 total (750 public)	1,067 total (764 public)	1,171 total (777 public)
		Number of children	180,969	193,672	206,636
	Gap		-112,047	-115,171	-130,187
	%		-38.2	-37.2	-38.6
Primary/ Secondary Schools	Total number of children		567,138	569,940	573,365
	Capacity	Total number of schools	755 total (621 public)	756 total (628 public)	762 total (628 public)
		Number of children	496,123	497,022	505,816
	Gap		-71,015	-72,918	-67,549
	%		-12.5	-12.7	-11.8

Source: MECS and National Statistics Office

In response to the fast growing demand for school facilities, the GoM needs to expand its investment in education infrastructure. According to the MECS (2013), the GoM planned to construct up to a maximum 1,197 new schools from 2013 to 2016 with diverse funding resources, including state budget, PPPs, loans, and grants (MECS 2013, 5). The details of the planned new education facilities and estimated financial needs are shown in the tables below.

Table 2.7 — Required investment in education facilities

	New construction buildings			Reconstruction of new buildings after demolishing			Total necessary buildings required buildings		
	Quantity	Capacity	Expenditure (mln MNT)	Qty	Capacity	Expenditure (mln MNT)	Qty	Capacity	Expenditure (mln MNT)
Kindergartens	443	44,393	368,464.9	210	22,678	188,227.4	653	67,071	556,692.3
Schools	144	112,546	619,003.0	198	83,763	460,696.0	342	196,309	1,079,699.5
Sub total	**587**	**156,939**	**987,467.9**	**408**	**106,441**	**648,923.4**	**995**	**263,380**	**1,636,391.8**
Dormitories	97	7,900	61,620.0	23	1,945	15,171.0	120	9,845	76,791.0
Gyms	79		43,450.0	3		1,650.0	82		45,100.0
Total	**763**		**1,092,537.9**	**434**		**665,744.4**	**1197**		**1,758,282.8**

Source: MECS (2013)

Table 2.8 — Annual investment needs and sources of capital (2013-2016)

	2013		2014		2015		2016	
	Quantity	Expenditure (mln MNT)	Quantity	Expenditure (mln MNT)	Quantity	Expenditure (mln MNT)	Quantity	Expenditure (mln MNT)
Kindergartens	92	47,062	187	169,877	187	169,877	187	169,877
Schools	75	109,529	89	323,390	89	323,390	89	323,390
Sub total	**167**	**156,591**	**276**	**493,267**	**276**	**493,267**	**276**	**493,267**
Dormitories	24	12,439	32	21,451	32	21,451	32	21,451
Gyms	19	7,804	21	12,432	21	12,432	21	12,432
Total	**210**	**176,834**	**329**	**527,150**	**329**	**527,150**	**329**	**527,150**
State budget	155	N/A	164	263,575	164	263,575	164	263,575
Concession Agreements	36	82,000	148	237,217	148	237,217	148	237,217
Loans/grants	19	14,000	16	26,357	16	26,357	16	26,357

Source: MECS (2013)

PPP procurement is one of the available policy options for the provision of education buildings. According to the MECS, the main driving forces for PPP models in the education sector are:

- state budget pressure,
- moving from building individual facilities to implementing package deals involving multiple buildings, and
- developing alternative options to the BT scheme.

Additionally, the MECS has the following criteria to consider for selecting educational facility sites:

- standard capacity: 640 students per school, 250 students per kindergarten building,
- demand analysis,
- population, and
- economic situation and prospects of selected areas.

Currently, there are four education sector projects on the List of Concessions. However, only two package projects are in process. These are the construction of 72 elementary school and kindergarten complexes under a BT scheme and the construction and renovation of 4 secondary schools and 3 kindergartens under DBT (Design-Build-Transfer) and BT schemes. These projects are expected to be signed soon with respective concessionaires.

Under the BT model, the private sector builds facilities with its own funds, transferring ownership to the government immediately after the completion of construction, recovering the construction cost over a short period of time - around 2-3 years. The government recognizes this payment as a national debt. As such, it is difficult to progress such project contracts when national debt is at very high levels. Also, the level of government payments in the first couple of years are considerably high, leading to budget pressure. Therefore, although there is an urgent need to increase government investment in social infrastructure, including in schools and kindergartens, it is difficult for the GoM to respond to this need given its already high debt level and budget constraints.

For the next step, the MECS has selected 35 concessions projects under BT schemes for educational facilities which include schools, kindergartens, cultural centers, and sport complexes. Invest Mongolia has submitted these to the Cabinet for approval. The buildings will be constructed in urban and rural areas. In the future, the MECS aims to separate the management responsibilities associated with these facilities such that maintenance management will be carried out by the private sector and school management will be carried out by the public sector.

Table 2.9 — Ongoing and potential concession projects in the education sector

No	Project name	Concession type	Current Status
1.	72 schools and kindergarten complexes in Ulaanbaatar city	Build-Transfer	Concession has been granted through direct contracting; Contract signing delayed due to legal issues
2.	7 school and kindergarten buildings in Ulaanbaatar city	Demolish-Build-Transfer, Build-Transfer	Concession has been granted through direct contracting; 2 contracts signed; 3 pending
3.	Baganuur Science and Technology Center	Design-Build-Operate	Project analysis stage
4.	Educational Technology College	Design-Build-Operate	Not in progress
5.	35 schools, kindergartens and sport complex in Ulaanbaatar and rural areas	Build-Transfer	Procurement in process

Source: IMA (2015)

Table 2.10 — Education PPPs in Progress

No	Project name	Concessionaire	Total Cost
1.	72 schools and kindergarten complexes in Ulaanbaatar city	Top International Engineering Mongolia LLC	USD 142.6 million
2.	7 schools and kindergartens	5 private companies (BMTX LLC, Monkon construction LLC, Altanbulag Trade LLC, etc)	USD 30.2 million
3.	35 schools, kindergartens and sport complexes	To be selected	N/A

Source: IMA (2016)

2.2.3.2 Key Challenges for Promoting PPPs in Mongolia

Even though the MECS planned to increase its investment in schools, a relatively small number of projects have progressed. This is because there are some key challenges for Education PPPs in Mongolia.

First, the GoM's plans, strategies, and policies are inconsistent and have low credibility. These kind of contradictions create confusion for both domestic and foreign participants, making them hesitant to join in PPPs. Second, key players in the public sector lack the capacity to manage complex PPP projects. In other words, institutional capacity at the ministerial and PPP-unit level is not sufficient to process PPP projects efficiently. Third, cooperation among relevant ministries and government agencies is lacking, which prevents the PPP progress especially in terms of administration. This may result in unnecessarily increased costs. Fourth, the legal environment is inadequate, leading to lack of clarity regarding the rights of participants during the process of PPP implementation. Fifth, direct and indirect project risks are very high for PPP projects in Mongolia. For example, political instability and an underdeveloped financial market make these projects vulnerable. Sixth, there already exists a shortage in private investment. This is likely because Mongolia lacks traditional government incentives promoting private-sector participation such as tax guarantees, minimum revenue guarantees, etc., which might otherwise attract the private sector to invest in Education PPPs.

However, the most significant barriers to implementing new School PPP projects are budget constraints and debt ceiling issues. According to the MoF, concession projects under the BT school model, are expected to increase Mongolia's debt level. The MoF periodically analyzes its debt ceiling based on the Debt Management Law, which highly influences whether concession projects are included in the state budget.

Currently, the MoF prepares a midterm budget plan (3-years), which includes the GoM's obligation for the repayment of concession projects. The MoF is not primarily concerned with what type of project is selected as a PPP or the individual contract value. Rather, it is primarily concerned with combined annual budget payments and direct impacts to the debt ceiling.

If other types of PPP models (BTL, BOT etc.) are considered feasible for school or kindergarten projects, these are likely to have a less direct impact on the fiscal budget, given the fact that these models typically run over the longer term with less periodic budget allocation compared to the BT model.

2.3 Case Study

2.3.1 Brazil: Belo Horizonte School[9]

2.3.1.1 Overview

Belo Horizonte, the third largest city in Brazil, has made education its top priority due to the strong need for better education for the more than 11,000 children on the school enrollment waiting list.

However, technical and financial limitations hindered the municipality's efforts. It only had resources to meet approximately 35% of the demand for new school buildings. For this reason, Belo Horizonte made decided to attract private-sector cooperation and investment to expand and reinforce its existing education infrastructure.

Education PPPs in the municipality of Belo Horizonte were Brazil's first public-private partnerships. These were led by The Educar Consortium, a leading Brazilian construction company. The PPP scope not only included five primary schools and 32 preschool facilities, but also, the operation of non-pedagogical (non-core) services such as maintenance and security. The contract was signed on July 25, 2012, and the concession is to run for 20 years, with a total private-sector investment of USD 95 million.

Figure 2.3 — Infant-school (left) and elementary school (right)

Source: BNDES (2014)

9 Referred to World Bank, IFC, "Public-Private Partnership Stories Brazil: Belo Horizonte Schools," 2012 and BNDES, "Project Development Division – Concessions and PPPs" (PPT presented at, June, 2014). http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=38843104.

2.3.1.2 Governance

1. **IFC (International Finance Corporation)**: Belo Horizonte received support for this process from the IFC, as it had no previous experience with School PPPs. It appointed IFC, a member of the World Bank Group for private-sector financing, as lead advisor to investigate how private-sector participation could help improve its existing education system and what mechanisms could be used for this purpose.

   After conducting an exact feasibility study, the IFC recommended that the municipality execute PPPs with a private-sector participant to relieve the shortage of preschools and primary schools.

   Considering that Brazil had never implemented an Education PPP, the IFC referred to examples from other countries to create a detailed model and to demonstrate how well-designed PPPs could be useful in accomplishing its education objectives. Furthermore, IFC organized stakeholder consultations giving them a forum for sharing their diverse concerns.

2. **Public- and Private-Sector Roles:** Under the terms of the concession, Belo Horizonte was required to offer sites for the facilities while the private sector took responsibility for both the construction and operation of non-pedagogical services, such as cleaning, surveillance, laundry, maintenance, and utility management.

   This approach developed overall administrative efficiency for managing early educational facilities by incorporating these services under the management of a single provider. In addition, this enabled school directors to concentrate on teaching rather than managing multiple vendors. The private-sector operator was evaluated according to a set of performance and availability indicators.

2.3.1.3 Issues in Project Preparation and Implementation

Expert consultants managed by the IFC designed solutions to financial, technical, and legal issues. These solutions were reflected in a transaction structure and made available for public comment and inputs from potential investors. The IFC helped draft tender documents, organize public hearings, and manage the bidding process.

1. **Bidding:** Through a competitive bidding process, Belo Horizonte received two qualified bids from Andrade Gutierrez and Odebrecht, respectively. Bids were evaluated on a cost basis once they met minimum technical requirements in order to provide education services with a lower budget. The Educar Consortium operated by Odebrecht won the concession bid.

2. **Operation:** The IFC proposed a 20-year concession to finance, build, equip, and operate the non-pedagogical services of 37 schools (32 new kindergartens and 5 elementary schools). Compared to the former procurement process, private-sector involvement was to significantly reduce the time needed to establish and launch these new schools. The new units were delivered within two years, which was a record in government construction procurement. The primary schools became operational within about a year.

2.3.1.4 Impact in a Later Period[10]

Through these Education PPPs, about 18,000 additional children from low-income areas of Belo Horizonte will be able to attend kindergartens and elementary schools. This success has tremendous potential as model for replication in other states and municipalities of Brazil.

As of 2014, the contract for the Education PPP in Belo Horizonte, Brazil's first PPP, has been amended. In order to considerably increase the number of school openings and to ensure quality infrastructure for students, the first PPP, which initially provided for the construction and operation of 37 schools, has been increased to 51. In addition, the number of students has risen from 18,000 to 25,000.

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10 Referred to "Odebrecht Homepage," last updated in 2014, http://odebrecht.com/en/communication/releases/public-private-partnership-education-started-belo-horizonte-expanded-another.

Overall, 46 Children's Education Municipal Units (UMEIs) and five Municipal Elementary Schools (EMEFs) will be built. The new schools are being built by Odebrecht Infrastructure using the same architectural model used for the project's other 37 UMEIs. These constitute 1,100m² of built area, with classrooms, a kitchen, cafeteria, library, multi-use room, nursery area, and diaper changing.

The operation of all the PPP schools remains the responsibility of Odebrecht Properties, which offers administrative services such as reception personnel, cleaning, gardening, laundry services, and maintenance. Teaching staff, educational monitoring, and school cafeterias continue to fall under the responsibility of the Belo Horizonte City Government and the Municipal Department of Education. Furthermore, the National Education Plan, aims to open classes for 4th and 5th grade students by 2016.

The PPP was developed by the Municipal Department of Development and Education, and INOVA BH[11], which is a partnership between the City of Belo Horizonte and Odebrecht Properties will be responsible for services such as building maintenance, security, cleaning, environmental, and real estate sustainability (Nogueira 2014, 19).

INOVA BH will be compensated and evaluated for the quality of the services based on criteria established by the Belo Horizonte city government, with the support of the IFC and with monitoring by an independent evaluator. The units will also respect the regulations of the Brazilian Ministry of Education, the Brazilian Association of Technical Standards, and the Belo Horizonte Municipal Department of Education.

2.3.2 Korea: Anhwa High School (BTL Project for School Facilities)

2.3.2.1 Overview

Located in Hwaseong-si, Gyeonggi-do in Korea, Anhwa High School was constructed and is being operated as a BTL project. The school has cultural facilities including a multipurpose auditorium, an outdoor deck, and an indoor exhibition space. The total project cost was KRW 9,550 million, and it was selected by the MEST as the "School of 2007" for its new facilities.

2.3.2.2 Governance

Under the Korean PPP BTL scheme, the project company, an SPC (special purpose company), is in charge of design, construction, operation, and the financing of the project. This SPC structures the project model to enhance the VFM during the entire project lifecycle. The project company specializes in facility management and takes exclusive responsibility for construction, as well as, post-construction management.

Core services, such as education, are provided by the public sector, including managing and hiring teachers and operating educational curriculum. In terms of school buildings, the role of government agencies is limited to overall planning and monitoring.

2.3.2.3 Issues in Project Preparation and Implementation

1. **Bidding:** The main issue in the planning stage was to maintain harmony between the school building and other existing structures near the school by constructing the school on an appropriate site. In addition, an environmentally friendly architectural planning technique was selected, allowing the school to become a small, urban ecological hub. Table 2.11 summarizes the architectural points.

11 INOVA BH, which is a partnership between the City of Belo Horizonte and Odebrecht Properties, will be responsible for services such as building maintenance, security, cleaning, and environmental and real estate sustainability.

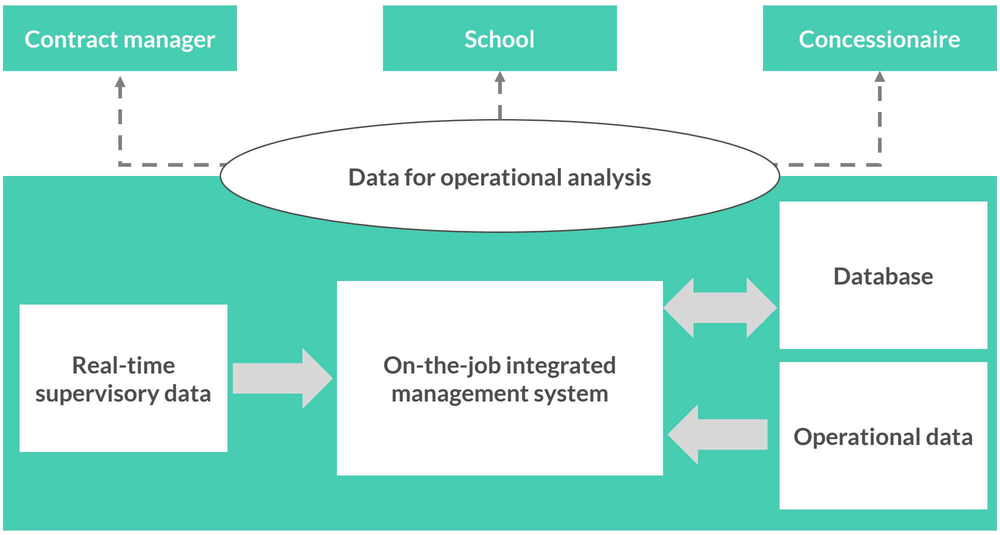
Table 2.11 — Environmental-friendly architectural techniques for Anhwa High School buildings

Technique	Technical Factors	Design Adoption
Land use and layout	Climate-conscious layout Utilization of topology and terrain	Arrangement of wards to face south
		Plan to pilot zoned parking with different lot levels
	Separation of traffic lanes from sidewalk	Separation of vehicle and pedestrian flow
	Maximization of open space	Composition of exterior space through open space
Creation of environmentally-friendly exterior space	Ecological planting	Use of special pavers or clay bricks
	Induction of rainwater permeation	Native plants and roof planting
	Creation of waterfront	Creation of waterfront in exterior space
Determination of morphology and building detail	Induction of day lighting and ventilation	Induction of daylight and ventilation via an outer wall corridor
	Minimization of gross floor area and/or building envelope	Enhancement of energy efficiency with minimum building envelope
	Use of natural solar energy	Security of maximum building pitches
Creation of comfortable interiors	Ventilation induction system	Induction of natural ventilation system
	Soundproofing and sound insulation techniques	Utilization of buffer green space and location of noise source on playground
	Use of safe interior materials	Use of wood fiber board and natural paints

Source: Educational Facilities Research and Management Center of Korea.

2. **Operation**: The competent authority, the school administrator, and the concessionaire coordinated with each other to enable the integrated operation systems. Analysis of real-time operational information and supervisory data enabled effective operations.

Figure 2.4 — Integrated facility management for the Anhwa High School project

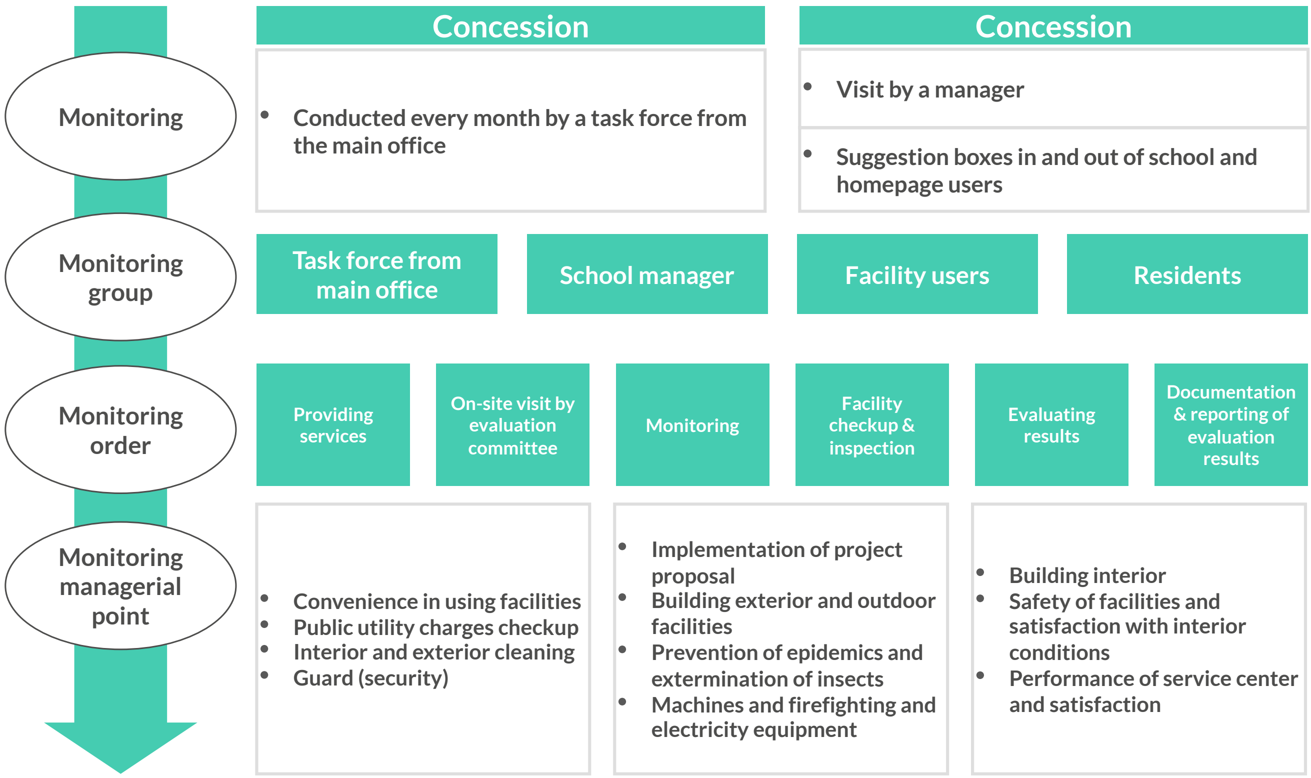


Source: Educational Facilities Research and Management Center of Korea

3. **Monitoring.** The mechanisms monitoring the facility operation and maintenance are divided into two types:
- regular monitoring conducted every month by a task force team from the main office and
- occasional monitoring conducted during visits by an evaluation committee

Members of the evaluation committee inspect facility conditions and report performance results to the competent authority. Figure 2-E below describes the monitoring process.

Figure 2.5 — Monitoring of operations at Anhwa High School



Source: Educational Facilities Research and Management Center of Korea

2.3.3 UK: Barnhill Community High School (PFI for School Facilities)

2.3.3.1 Overview

Barnhill Community High School (Barnhill) was the first PFI school constructed on an existing school site in the London Borough of Hillingdon. With a floor area of 12,000 square meters and a capacity of 1,450 pupils, it was built under the PFI through an agreement between Hillingdon Borough Council and a consortium led by Jarvis Construction (UK) Ltd. and had been in operation for about two years. Its contract is worth approximately GBP 15 million. The design concept consists of five linked faculty buildings forming a series of enclosed private and semi-private courtyard spaces. Important functional relationships between departments were established from the outset, leading to the links and interconnections, which are vital for the delivery of the school curriculum.

2.3.3.2 Governance

The PFI was used as the procurement option in line with the government policy direction for public procurement to achieve better VFM over the life of the project and to ensure environmental, economic, and social sustainability. The Department for Education and Employment (DfEE), (now the Department for Education and Skills) performed the full client role, meaning that the DfEE was able to take an entirely independent approach to the requirements of its output specifications. The DfEE guidelines were applied for the design and construction of new schools.

The consortium, led by Jarvis Construction, was responsible for finance, design, construction, and facilities management over the 25-year contract period. The output specifications of the construction were to be enhanced at an increase in construction cost but at lower facilities management costs. During construction, strong management ensured a high level of building quality, minimizing potential defects or repairs during the facilities management phase. Under the PFI contract, the project company was required to provide the following facilities:

- an assembly hall;
- a dining hall;

- catering facilities;
- a library;
- a special needs unit;
- an information technology suite;
- a large sports hall;
- teaching areas for humanities, math, science, English, modern languages, art, and technology;
- facilities suitable for breakfast club and after school clubs for pupils, starting at 7am and ending in the evening;
- an indoor environment that was stimulating and exciting, rather than "institutional-looking";
- circulation areas to provide ease of movement; and
- an outdoor environment to create stimulating external spaces for pupils to learn, play, and relax in safely, while also enabling supervision.

2.3.3.3 Issues in Project Preparation and Implementation

Since time was the most significant constraint for procurement, the bidding process was processed swiftly. During the procurement process, bidders were required to respond within twelve weeks and short-list of 4 bidders were selected out of twenty bidders on the list. It was announced in June 2000, with the financial close due in October 2000. The consortium went on site on 21st of October 2000.

The key features of Barnhill in construction and operation for preserving the environment and health of users are described below. As a unique feature, the project company was allowed to earn revenues by running evening sports activities and conferences.

Table 2.12 — Key features of Barnhill School's construction and operation

Category	Features
Ecology	Existing habitat developed
	New ecology area designed
	Ecologist on project team to advise on habitats
Energy	Heating can be provided to selected areas used outside core hours
	Energy consumption is monitored for each zone
	Electricity supplied using a green tariff
	Use of natural ventilation
	All zones have automatic temperature controls for easier management
	Use of solar ventilation
Water	Double pitch roof is used to collect rainwater for use of recycled greywater in school
	Porous car parks were built with interceptor connections
Waste and Materials	Select materials with a low environmental impact and low emissions
	Use of natural ash timber and solid ash doors and architraves, water based emulsion
	External walls used local bricks and mineral wool insulation in the cavity
Transport	Car parks were limited and cycle racks installed
	Well-lit pedestrian routes were built
Health and Safety	A full risk assessment was carried out
Economic	Revenues can be made from evening sports activities and conferences

Source: BRE (2013)

2.3.4 Lessons Learnt from the Case Studies

The key features of three cases in different countries are summarized in Table 2.13.

Table 2.13 — Key features of each case study

	Brazil (Belo Horizonte School)	Korea (Anhwa High School)	U.K. (Barnhill School)
PPP Type	PFI	BTL	PFI
Period	20 years	20 years	25 years
Cost	USD 95 million	KRW 9,550 million	GBP 15 million
Administrator	IFC/SPC	SPC	SPC
Bidding	Yes	Yes	Yes
Education Service	Government	Government	Government
Distinct Features	Active support of IFC Successful pilot project led to expansion of project scope	Participation of diverse stakeholders, realizing long term Value For Money Use of environmental-friendly architectural technology Real-time supervisory and operation analysis Property ownership is transferred to the gov't when the construction is completed	Rapid bidding process (Maximum 12 weeks) User-friendly construction and operation

Overall, the PPP models of these three cases are similar in that, based on long term PPP contracts, the private partner is in charge of non-core services (the design, build, finance and operation or DBFO of school buildings), while the public partner is responsible for core services, as well as the planning for and monitoring of the PPP contracts. Each case has its unique characteristics reflecting local circumstances and service demands. Below are some of the key features of the case studies which draw useful implications for the execution of PPP projects in Mongolia.

1. **Support of Experienced Advisor over the Whole Life Cycle of the Project:** The active cooperation and support of an international advisor such as IFC would be critical for developing countries lacking in PPP expertise. The Brazilian case is a good example. Although Brazil did not have any prior experience with PFI type projects, its first pilot project, the Belo Horizonte School project, was successfully implemented, resulting in the expansion of the project scope. IFC played a key role in the overall project preparation and management.

2. **Stakeholder Involvement to Ensure VFM**: To identify and mitigate potential risks throughout project preparation and implementation, it is key to involve diverse stakeholders (including local communities) in the planning and monitoring phases. While long term VFM can be achieved by minimizing potential risk, failure to consult with stakeholders in the preparation stage can cause higher social and financial costs in the later stages of the project, resulting in poor VFM.

3. **Supervision and Monitoring of Operation:** The success of PPPs depends upon the adequate supervision and monitoring of their operation, as exemplified in the case in Korea. The Anhwa High School PPP project has established a systematic operational mechanism and is jointly managed by the competent authority, the school administrator, and the concessionaire. In addition, the operation of school buildings is monitored in real-time and reported to the competent authority. This operation mechanism is an important success factor as it prevents the operators from neglecting their duties and encourages them to operate the facility more efficiently in the long run.

2.4 Suggested Education PPP Models for Mongolia

2.4.1 PPP Model Selection Criteria

2.4.1.1 PPP Models for Infrastructure investment

The GoM is exploring a new procurement option for the education sector, which is mainly focused on the acquisition of education buildings and facilities, rather than core services such as education services, for improved student performance. The GoM has a strong and urgent need to deliver the education buildings and facilities as soon as possible in order to respond to the country's fast-growing demand for new buildings and services.

As introduced in the Table 2.3, there are various types of school PPPs. Among them, the type of PPP that best corresponds Mongolia's specific needs is the 'School Infrastructure Partnership', where the private sector builds, owns [12], and operates the infrastructure facilities, and the government uses these facilities for running the school, in exchange for which the private partner is paid a fee over the contract period.

Under the 'School Infrastructure Partnership' framework, two typical PPP models can be considered which have been successfully adopted for procuring social infrastructure in other countries. One is a concession type model, and the other is a service contract type model such as a BTL or PFI.[13]

2.4.1.2 Comparison of Concession Type and Service Contract Type Models

There are a couple of characteristics that differentiate these two models.

First, the concession model is more suitable for projects that generate operational revenue through the direct collection of user fees, such as toll roads, ports, and railways (economic infrastructure), while service contract PPPs target facilities where private partners cannot recover their investment from user fees alone (social infrastructure).

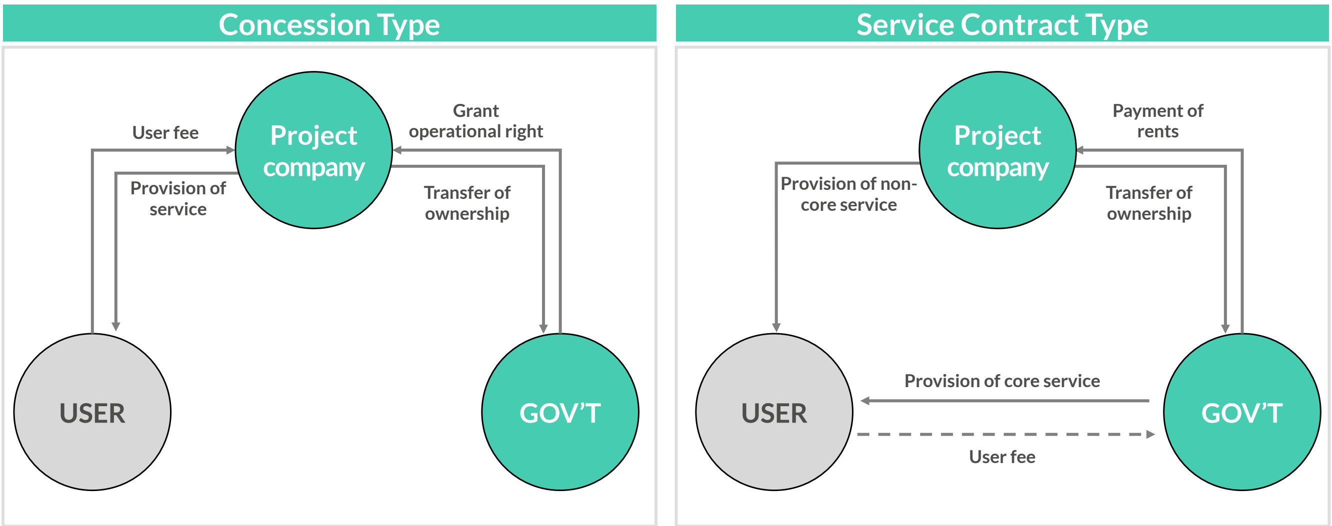
Second, in relation to the first point above, user fees should be paid by end users under the concessional model, while the public partner makes regular payments over the contract period under the service contract model.

Third, in the concession model, the private partner bears demand risks which can affect project returns. However, in the service contract model, the government takes on demand risks, and the private partner bears availability or performance risks which are much lower and more controllable than demand risks.

12 Ownership or exclusive right to use the asset is endowed during the contract periods.

13 The concession model requires user fees in order to compensate for the cost of the project. In the case of Mongolia, it is impossible to charge user fees for schools. The BLT model, which is similar to BTL or PFI, is also not an ideal model for Mongolia due to the possibility that the transfer of ownership will not happen immediately after the termination of the contract period. Thus, either the BTL or PFI model are recommended in this instance.

Figure 2.6 — Structure of major PPP models (concession type vs. service contract type)



Note: GOV'T = Government

Table 2.14 — Comparison of PPP models

Implementation Methods	Concession Model	Service Contract Model
Basic Characteristics	Possible to charge use fees	Difficult to charge use fees
Return on investment	User fee paid by end users	Government payment
Project risk	Private sector bears demand risk.	Demand risk of the private sector is eliminated. Private sector bears performance/availability risks.
Example model	BOT, BTO	BTL/PFI, BLT

Source: Ministry of Strategy and Finance, Republic of Korea

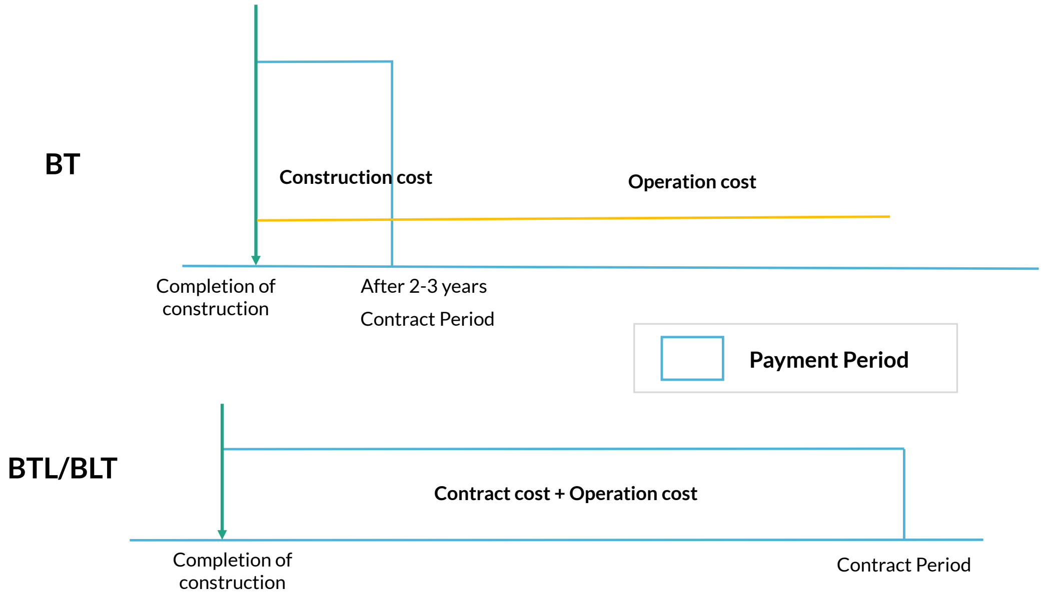
The GoM has signed concession agreements with private partners for procuring education buildings under the BT model. The typical service contract models (ex. BTL, BLT, PFI) introduced above are different from the BT model currently used by Mongolia in various aspects as follows.

Table 2.15 — Comparison of BT and service contract PPP models

Item	BT	BTL/BLT
Payment mechanism	Project costs, mainly construction costs, are paid to the private partner by the government within 2 to 3 years of after construction completion.	Project costs, both construction and operation costs combined, are paid to the private partner during the contract period (over 15-20 years).
Fiscal efficiency	The government has a high level of annual financial commitment, which limit the flexibility in government's budget allocation.	The government can mitigate its annual budget ceiling and use its budget more efficiently and flexibly.
Operation and management (O&M) costs	O&M is basically managed by the government and reduction in total lifecycle cost cannot be expected.	O&M costs will be reduced because the private partner will take total lifecycle cost approach. Also economies of scale are expected if multiple buildings are bundled in a single project.

The cash flow of the government payment will be as below in the BT and typical service contract PPP model.

Figure 2.7 — Payment flow of BT vs. Service contract PPP model



2.4.1.3 Model Selection Criteria and Evaluation

Key criteria for selecting the most suitable PPP model for Mongolia's education buildings are as follows.

First, there is the issue of whether or not the private partner provides the core education services and is guaranteed autonomy over education from the government. The GoM has clarified that government authorities will be in charge of providing education services, and private partner will be delivering only education facilities and operation and maintenance services. In this respect, the service contract model is more suitable.

Second, there is the issue of whether the private partner will directly collect a fee from users (students and parents) after construction. Because the facilities in question are public schools, the private partner will not be collecting fees or tuition from students or parents. In this regard, the service contract model is more suitable for Mongolia.

Third, there is the issue of whether the private partner can make sufficient profits from facility operation. In the case of School PPPs in Mongolia, the private partner may be able to utilize the facilities to obtain some supplementary revenue, but this would not be enough to recover its investment. In addition, the service price cannot be decided by the private partner. Therefore, the private partner will likely prefer the service contract model to secure a stable and controllable income stream.

Fourth, there is the question of who will bear demand risks, such as number of students enrolled. Demand risk is relevant to an investment decision in that the higher the demand risk, the less attractive the investment will be. The key principle of optimal risk allocation provides that the risk should be retained by the party that can best control the relevant risk. In the case of education buildings, it is hard for the private sector to forecast demand, as it depends on various economic, social, and policy factors over which the private partner has no control. Therefore, it is more realistic for the private partner to bear risks related to facility availability and operational performance. In this regard, the service contract model is more suitable for optimal risk allocation between the public and the private sectors.

Fifth, if a large-scale budget investment is not affordable for the GoM in the short run, the long term service contract model will be an appropriate option as opposed to the BT model, because it would relieve the financial burden on state budget by allowing for a longer payment period, while providing the necessary facilities in time needed.

In conclusion, the service contract PPP model is the more feasible option for Education PPPs in Mongolia.

2.4.2 Suggested PPP Model for Education Buildings in Mongolia

Mongolia's socioeconomic conditions for PPPs are different from those of both developed and other developing countries where Education PPP projects have already been successfully implemented.

The challenges for Education PPPs in Mongolia and key corresponding policy measures are as follows:

First, considering Mongolia's relatively small population, the PPP market in Mongolia is not large enough to attract many investors. In other words, it is difficult for the GoM to attract qualified private firms to competitive bidding, leading to insufficient competition in PPP tendering. To resolve this problem, it is desirable for the GoM to ease the bidding criteria and simplify the PPP process. It can also consider directly inviting qualified international players, because sufficient and fair competition among bidders decreases the final contract value and encourages the adoption of new technologies and innovations. In addition, to minimize the possibility of increased costs caused by lack of competition among bidders, the GoM should endeavor to properly evaluate the suggested bid price and adjust the differences. These efforts can make the tendering process more transparent and successful.

Second, there are not many experienced PPP experts in the GoM and the PPP unit in Mongolia lacks the capacity to structure and manage a service contract type Education PPP project. Therefore, at least in the initial stage, the GoM should work with outside agencies with specialized PPP experience as a lead advisor. The lead agency would prepare, monitor and manage the entire processes of procurement and project implementation, together with the GoM. It could also contribute to improving the PPP structure in the process.

Third, cost and funding is an issue. Mongolia's energy challenges are compounded by severe weather conditions paired with environmental pollution. Therefore, there is a strong need for green school buildings in Mongolia. However, educational facilities with green technologies may be more expensive. To relieve this additional financial burden, the GoM will need to diversify funding sources for green Education PPPs. Official Development Assistance from donor countries and financial support from MDBs and other international institutions could be good potential funding options for the GoM.

Forth, government officers lose confidence in PPP procurement because there have been substantial delays in some concession projects due to various problems, including unexpected cost increases, exchange rate risks, high project advisory costs, changes in relevant government policies, etc. A new approach is needed to resolve such challenges. For example, a simplified PPP procurement process may lead to cost reduction and shorten the project preparation period. It is recommended that the GoM seek advisory and financial support for its Education PPPs from donor agencies and MDBs.

2.4.2.1 PPP Model for Education Buildings in Mongolia

1. **Concept.** The service contract model is a new form of PPP in Mongolia. Under this PPP model, the private partner finances, designs, builds, and operates the school facilities during the contract period. It leases the facilities to the government and recovers total investment costs by collecting government payments over the contract term. In other words, the government provides public services by purchasing both infrastructure facilities and O&M services from the private sector.

2. **Main Characteristics of Education Building PPPs in Mongolia.** The suggested PPP model for education buildings features the following main characteristics:
   - The private partner is in charge of design, building, and operating the education buildings, which allows it to introduce green and eco-friendly technologies and innovative building design.
   - In principle, the government provides education services including hiring teachers, teaching students, and managing curriculum.
   - The private partner does not collect user fees from students or parents. Instead, it is paid in installments over the contract period by the government.
   - In order to reduce long term risks and financing costs, a 10-year contract period is preferable for private partners,

rather than a 20- to 30-year contract.

- The government bears demand risk. In other words, the number of registered students does not affect the level of government payment.
- The government payment is provided to the private partner based on the service performance evaluation.
- Private partners may use school facilities (ex: classrooms, cafeterias, gymnasiums) for profit-making business purposes, unless this either inhibits the main functions of the school facilities or the customer's rights.
- While multipurpose school buildings (complexes) have been popular in some countries, such as Korea and the UK, for purposes of project feasibility and simplicity, it is recommended that Education PPPs in Mongolia have a standard green building design which is mainly focused on the school's main function and energy savings.

Table 2.16 — Comparison of possible PPP models for education buildings in Mongolia

	BT Model (Currently used in Mongolia)	Recommended Model (Simplified PPP model)	Service Contract Model
Feasibility Study	No	Pre-feasibility Study	Yes
VFM Test	No	Checklist in the early stage	Yes
Advisory Service	No	PPP unit supported by technical advisor (ex. MDBs, Global consulting firm)	PPP unit in Mongolia (Independent)
Tender	Competitive bidding	Competitive bidding Limited invitation	Competitive bidding
Private Partner	Competitive bidding	SPC Construction company	SPC
Contract Period	2-3 years	10-15 years	20-30 years
Main Financial Resources	Corporate Finance	Construction subsidy Corporate finance Project finance	Project finance Equity fund Self-revenue
Building Type	School/kindergarten	School/kindergarten	School + ancillary facilities (School + theater + sport facility)
Green Technology (Green Building)	No consideration	Yes (ex. linked with energy performance)	Yes
Core Service Provider (Education: Teaching)	GoM	GoM	GoM
Design	GoM	Private partner	Private partner
Facility Operate & Maintenance	GoM	Private partner	Private partner
Government Payment	Installment payment within construction period and/or early operational period	Unitary payment based on service performance / flexible availability payment during the contract period	Unitary payment based on service performance

3. **Public Financial Support Measures.** To minimize the fiscal burden on the GoM and to mitigate government affordability risk, the GoM could seek various funding sources, such as concessional loans and grants from MDBs and ODAs from donor agencies. In addition, it can provide risk mitigation measures and financial incentives, which can decrease project costs and attract more investment. However, there is no standard rule as to how the government should provide specific financing instruments or incentives to promote private investment. Each project has different risks and participants with various interests. Therefore, each project requires a negotiation process to determine which incentive instruments are most appropriate to implement. Most importantly, the government should provide customized support measures which mitigate the related risks most effectively.

The table below shows types of public financial support for the suggested School PPPs in Mongolia.

Table 2.17 — Examples of public financial support for PPP projects

Financing Composition	Sources	
Construction subsidy (Grant)	ODA (Official Development Assistant) from donor agencies Grant from global/regional climate/infrastructure funds GoM (Budget, concessional loans from MDB)	
Fee waivers (tax, tariff, etc.)	GoM	
Risk mitigation instruments (ex. insurance, guarantee)	MDB GoM	Political risk Exchange risk, etc.
Concessional loans	MDB, ODA, ECA, climate/infrastructure funds	
Payments in kind (Land)	GoM	
Right to generate supplementary revenue from facilities	Private operator	

Subsidy: Construction subsidies can significantly decrease project costs and risk for the private partner. They can also promote competitive bidding, thus, reducing total project costs and improving service quality. By providing construction subsidies, the GoM can reduce long term government commitment and shorten the contract period.

The GoM can offer construction subsidies using its own budget. It can also consider external funding sources to complement financing needs. As Mongolia is one of the largest ODA recipients in East Asia, ODA can be a useful option for providing construction subsidies and relieving budget constraints. Various donor countries including Japan, Korea, and Germany contribute a significant amount of funding to developing countries, including Mongolia, for enhancing human capital development and educational environment. Therefore, ODA for the education sector could be a good resource for Educational PPP projects in developing countries. Funding secured from international and regional climate funds and environmental protection funds can be utilized as subsidy resources for the expansion of green public buildings. For example, the GoM can obtain concessional loans and/or grants from the GCF for green public buildings and infrastructure as these contribute to climate change mitigation and adaptation, and thus, low carbon climate-resilient development in Mongolia. The subsidy can be utilized to compensate for the incremental costs of applying green technologies.

Fee waivers, tax incentives: The GoM can attract more private investors by lowering total project costs through various tax exemptions, and by cutting administrative charges and tariffs which a project company otherwise has to pay in such construction projects. Such fee waivers are typical policy tools used to attract international private investors for PPP projects in developing countries.

Risk mitigation instruments: In developing countries, a private partner faces higher risks, such as political risk and exchange rate risk, in implementing PPP projects compared to those in advanced countries. These additional risks increase funding costs, making these projects less attractive to qualified private investors. Therefore, MDBs and the GoM should consider providing risk mitigation instruments such as risk guarantees and insurances to private partners.

Concessional loans: MDBs and donors can provide long term low-interest loans directly to private partners, or provide infrastructure project loans to the GoM. This will help to decrease project risk and would help the private partner to raise funds at a low cost.

Right to generate supplementary revenue: The GoM can grant the private partner a special right to utilize part of the education facilities to make additional revenue in exchange for reduced government payments. For instance, the private partner could rent meeting rooms and sport facilities on weekends and collect fees from users. This could be an efficient way to maximize the utilization of facilities and provide community services near school areas.

Payment in-kind: The GoM can provide state-owned land to the private partner or purchase land for the project. This is very helpful in reducing total project costs, and shortening the project preparation period for the acquisition of land and the required approvals and permits.

4. **Private Partner**

In the UK and Korea, generally the SPC is a private contractor for the PPP project, invested by various business entities, including construction firms, financial institutions, and facility operators.

Setting up an SPC has the advantage of engaging diverse investors and project-related agents through equity investment. However, it has also the disadvantage of requiring the time consuming processes of identifying and coordinating different interests.

Therefore, it may be more efficient to give priority to leading construction companies for the management of the project, which will simplify the project process and reduce the preparation period.

5. **Project Advisor**

It is advisable for the GoM to work closely with external advisors in preparing and managing the entire PPP process in Mongolia, with the project advisor being an active player rather than a consultant.

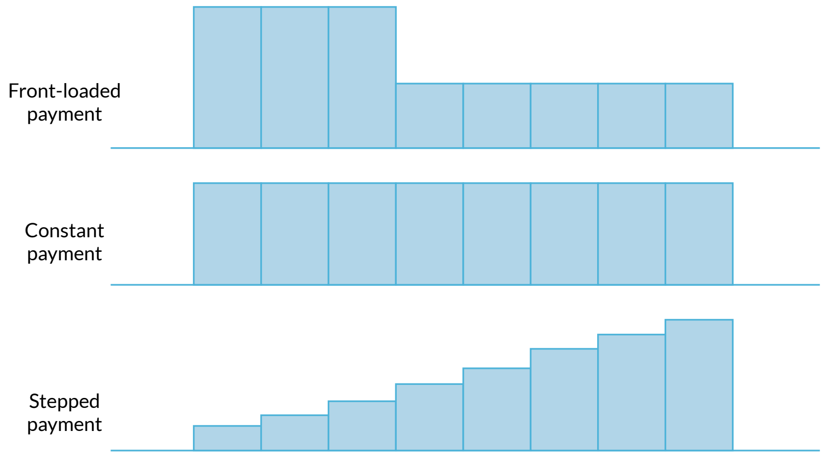
In order to run a project successfully, the project advisor should be involved in the entire project cycle, including the business case development and feasibility studies phase through to the bidding process, follow-up management, and performance evaluation & feedback phases. In this regard, it is desirable that MDBs or development agencies play a leading role so as to enhance the stability of the project and to provide professional support. It may be advisable to organize a temporary special task force to monitor the entire project procedure.

Possible candidates for this role would be MDBs/IOs (ex. ADB, the World Bank, GGGI, etc.), PPP units of developed countries (ex. Infrastructure UK, Korea Development Institute (KDI), Public and Public and Private Infrastructure Investment Management Center (PIMAC), etc.), or private consulting firms.

6. **Government Payment Structure**

The BT model, which the GoM has introduced for the first education buildings concessions, has a repayment structure under which 100% of the total costs (or government lease payments) are paid off within 1-3 years. Under the suggested PPP model, different types of payment structures can be applied based on project scale, costs, fiscal conditions, and operational period, etc. While, a unitary payment structure is widely applied under PFI models in many countries, the GoM could consider other payment structures such as front-loaded, stepped (increasing), or decreasing payment structures. The front-loaded payment structure may be most suitable in the initial stage of introducing the new PPP model, as it can reduce the long term revenue risk for the private sector as in the case of the BT model, but still giving the private partner an incentive to manage and operate the facility properly by keeping the private capital at risk over the operational period. This structure will also reduce financing costs by reducing interest costs for expensive private loans.

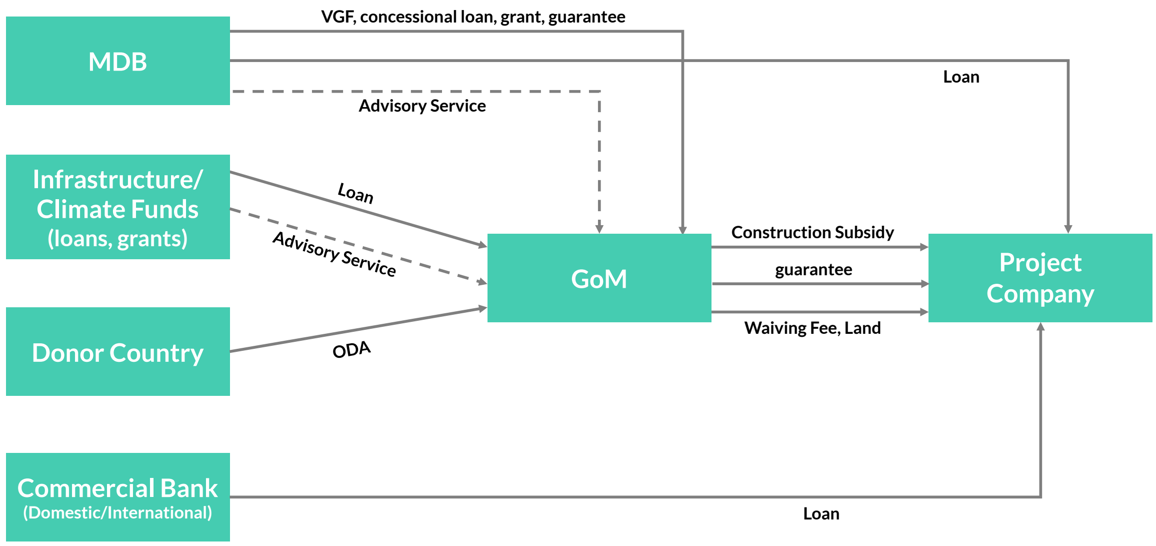
Figure 2.8 — Example of government payment structure



2.4.3 Key Public Sector Stakeholders for PPPs

The following figure shows the major roles of key stakeholders for education buildings PPPs and financial flows.

Figure 2.9 — Governance of school PPPs in Mongolia



Note: VGF=Viability Gap funding

Key public sector stakeholders for PPPs, such as the GoM, MDBs, donor agencies, and IOs, can perform various functions throughout the PPP process whether acting as project owner or advisor as shown in the following table.

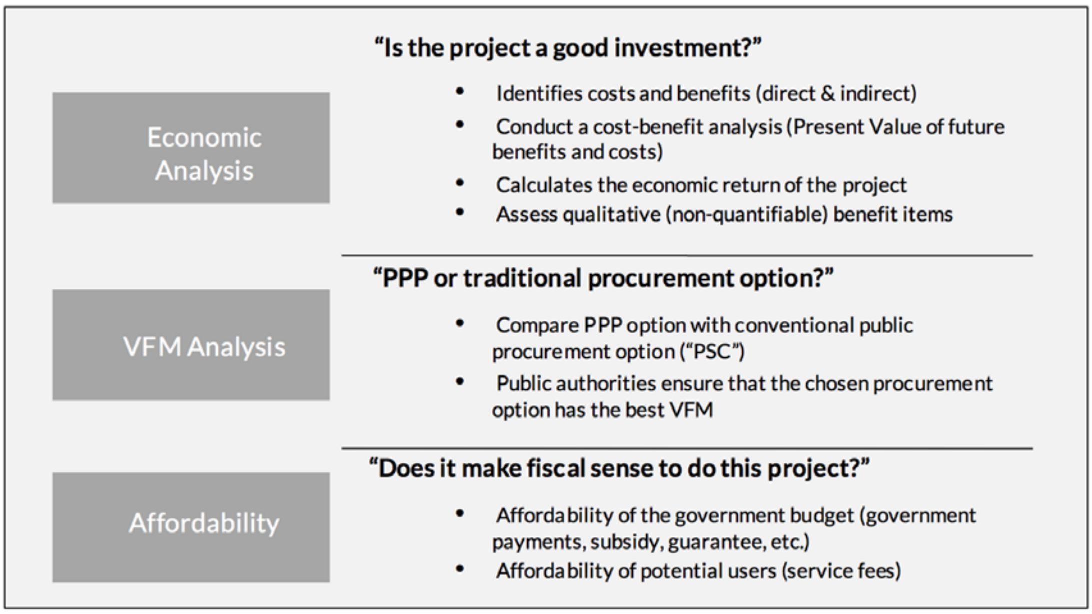
Table 2.18 — Roles of public-sector stakeholders

Participants	Role
GoM	Legal system for service contract type PPPs
	PPP support/incentive system (construction subsidy, waiving fee, insurance, guarantee, etc.)
	Land provision
	Coordination of ODA resources for PPPs
	Performance monitoring
	Stable payment to the private partner
MDBs Foreign PPP agencies	Lead project advisor
	Project management guidelines
	Standard contract
	VFM test guidelines (set up a public-sector comparator)
	Tendering guidelines
	Financial support (loan, equity, guarantee, etc.)
GGGI	Project advisor
	Green education building standard design/output specifications
	Capacity building

2.4.4 Value for Money Test

In some countries, the Value for Money Test is conducted to assess whether a PPP option will generate more VFM compared to traditional procurement options (e.g. public investment). This is different from a feasibility analysis, which assesses whether a potential project is feasible from a technical, economic, and financial perspective. Ideally, the GoM should conduct a project assessment in terms of project feasibility, VFM, and affordability, as shown in the figure below.

Figure 2.10 — PPP Project Assessment



In practice, the quantitative VFM test requires various types of data (macroeconomic, sector, project, engineering, financial, procurement, etc.) and rigorous methodologies, and cannot be implemented without detailed data and experts. Therefore, it is recommended that the GoM use a checklist rather than a full-scale VFM test until it develops methodologies and accumulates sufficient amount PPP data and experience. Table 2.19 below represents an example of checklist for the VFM used in Korea. The Korean Government uses this checklist for the purpose of screening in the preliminary stages prior to conducting a full-scale VFM analysis.

Table 2.19 — Preliminary feasibility study checklist to evaluate potential for private investment (Korea)

Step	Evaluation Items	Evaluation Details	How to Score	Remarks
Step 1	Feasibility in terms of law and policy	Legal feasibility assessment of the concerned project including whether it belongs to one of the 48 types of facilities applicable for PPP as defined in Article 2 of the Act on Public-Private Partnerships in Infrastructure Whether it is aligned with government's mid- and long-term plans for infrastructure investment, and is aligned with investment policies and priorities of the government or competent authority	Pass or Fail	The project can move to the next step only if it passes.
	PPP project implementation method	What type of PPP model is applicable: BTO or BTL depending on whether users are willing to pay higher user fees and whether the project is profitable, which are two of the principles of PPP project selection		
Step 2	Economic feasibility	To determine PPP project feasibility, the possibility to secure VFM in total project costs and economic feasibility should be confirmed first	Scoring survey results	The higher the items score, the higher potential for project implementation
	Ease of management	Whether the service in question can be independently provided at the required level of performance		
	Creativity & efficiency	Whether private-sector knowhow can be used to increase efficiency in infrastructure construction and operation and whether competition with other facilities can be facilitated to improve service quality		
	Risk allocation	Whether risks can be appropriately allocated between the public and the private sectors, and whether the scale and facilities of the project impose any restriction on the provision of services from the government's perspective		
	Public interest	Whether the participation of a private party can generate the ripple effects of improvement in public-sector technology, management skills, etc.		

Source: KDI

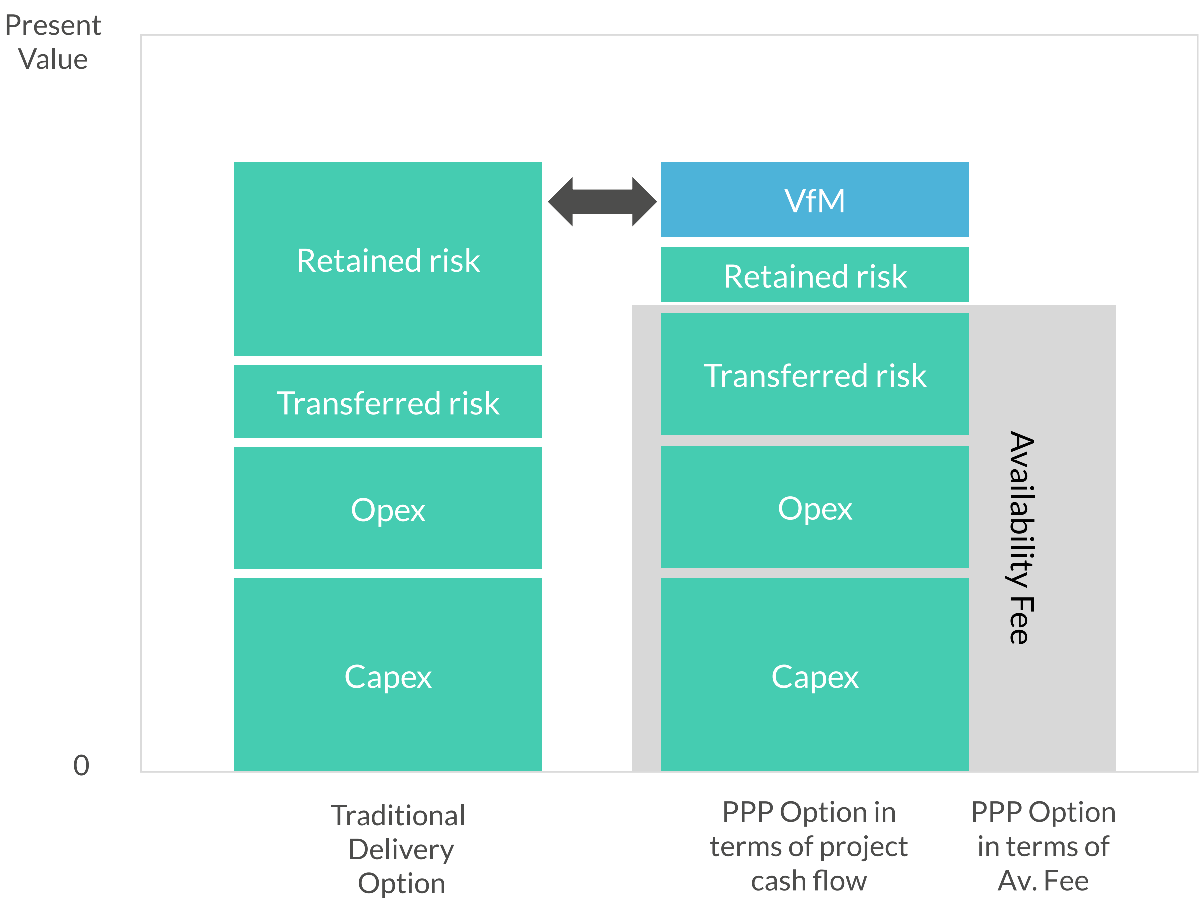
The VFM test is conducted for potential PPP projects to assess which procurement option is more appropriate between the PSC (Public-Sector Comparator) and the PFI. For a fair evaluation, the government calculates and compares the total costs of each procurement option for the same level and quality of services. In other words, the government assumes that both the PSC and the PFI can provide the same level of services. Projects that provide the same level of services are regarded as "reference projects". When estimating costs, the items below should also be taken into account, together with construction and operation costs:

- revenue from facility operation,
- tax payments,
- compensation costs,
- government monitoring costs,
- insurance fees, and
- risk quantification.

The PSC is a hypothetically constructed benchmark used to assess the VFM of conventionally financed procurement in order to compare it with privately financed schemes for delivering publicly funded services (Grimsey 2004, Glossary 14). As PSC is essential for providing the quantitative justification for engaging in a PPP project, constructing the PSC requires a comprehensive understanding of LCC and risk allocation. Understanding the LCC, which can ensure that initial investments and costs are recovered over the lifetime of the project, requires taking into account all the costs associated with the project, including initial investment costs, operation and maintenance costs, energy and water costs, capital replacement costs, and residual values and financing costs (Bidne et al. 2012, 4-10). As robust data, which may not be initially available, is needed in order to complete the quantitative LCC analysis and VFM tests, it is recommended that the GoM develop a relatively simple assessment method which can be used as a checklist in the beginning. Until sufficient data and information is collected, a simplified checklist could be applicable in the short term through qualitative analysis, while rigorous quantitative VFM tests are suggested over the in the long term.

VFM test guidelines should be developed with the support of external experts. Alternatively, a qualitative analysis should be considered in areas where quantification is not suitable, such as service improvement, technological innovation and transfer, etc.

Figure 2.11 — VFM assessment



Source: EPEC (2015)

3 Green Education Buildings Technical Guideline

3.1 Introduction

3.1.1 Current Conditions

1. **Climate Situation.** Mongolia is located in the Northern Hemisphere temperate zone and has an extreme continental climate. It is situated at an average altitude of 1,500 m above the sea level, is landlocked, and is surrounded by high mountain chains block wet winds. Known as "the Land of Blue Sky", Mongolia is a very sunny country and usually has about 250 clear days a year. Ulaanbaatar is known as the coldest capital city in the world, with a monthly average temperature in January of -25.4°C and 17.1°C in July.

Figure 3.1 — Average air temperature and precipitation in Ulaanbaatar

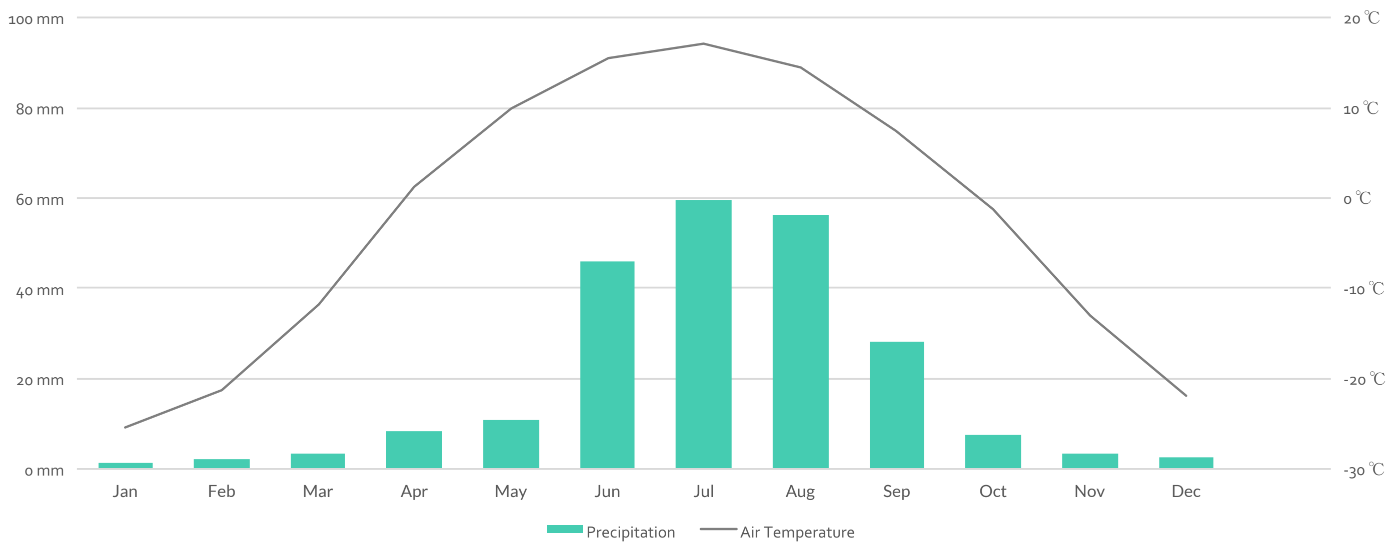


Table 3.1 — Climate data (Ulaanbaatar)

		Unit	Location and climate information
Location	Latitude	°N	47.908
	Longitude	°E	106.883
	Elevation	m	1397
Climate information	Earth temperature amplitude	°C	30.97
	Frost days at site	day	219

Monthly climate data								
Month	Air Temp-erature	Relative humidity	Daily solar radiation – horizontal	Atmo-spheric pressure	Wind speed	Earth temperature	Heating degree-days	Cooling degree-days
	°C	%	kWh/m2/d	kPa	m/s	°C	°C-d	°C-d
January	-25.4	81.8%	1.83	86.3	5.2	-25.1	1350	0
February	-21.2	83.4%	2.88	86.2	4.9	-20.8	1110	0
March	-11.7	74.9%	4.24	86.0	4.8	-11.1	922	0
April	1.2	47.3%	5.56	85.7	5.5	3.1	503	1
May	10.0	39.6%	6.38	85.6	5.0	13.1	264	53
June	15.4	47.9%	6.39	85.4	4.7	18.4	110	152
July	17.1	58.9%	5.80	85.3	4.2	19.2	63	212
August	14.5	63.8%	5.21	85.7	4.3	15.8	115	146
September	7.5	60.8%	4.42	86.0	4.6	8.6	304	26
October	-1.2	64.2%	3.06	86.3	4.8	-0.3	587	0
November	-13.0	76.6%	1.95	86.3	5.3	-12.7	935	0
December	-21.8	80.8%	1.48	86.3	5.3	-21.6	1237	0
Annual	-2.4	65.0%	4.10	85.9	4.9	-1.1	7500	590
Measured at (m)					10.0	0.0		

2. Conditions of Education Buildings

The population of Mongolia reached 3,057,778 in 2015 with an annual average growth rate of about 2% (National Statistical Office). According to statistics from the MECS (2014), there are insufficient buildings to accommodate Mongolia's increasing number of students. There are a total of 1,933 education buildings (including schools and kindergartens) in Mongolia. Approximately, 23% of the total population (712,452 children) spend most of their time in the education buildings. Unfortunately, the majority of these buildings are outdated and fail to comply with current building codes and standards. Therefore, the MECS is planning to make improvements to these buildings and construct new ones to meet growing demand. (Refer to section 2.2, Table 2.6)

Most school and kindergarten buildings in Mongolia were built between the 1960s and the early 1990s, using a uniform design developed in the USSR (Union of Soviet Socialist Republics) and the Central Construction Design Institute of Mongolia. These education buildings have masonry walls without any insulation layer. Due to poor insulation, most of the education buildings in Mongolia spend approximately 60% of their fixed costs (costs including heating, electricity, water, and sewage) on heating each year. According to the United States Agency for International Development (USAID), these education buildings that are not connected to the district heating system rely on inefficient, coal-fired, HOBs (heat-only-boilers) for heating, and the pipes and radiators attached to the boilers are often inadequately maintained (USAID 2013, 9). Fossil fuel combustion is the largest source of CO_2 emissions in Mongolia, accounting for about 60% of all emissions. Annual per capita GHG emissions are relatively high compared to other countries. This is explained by the fact that, although the country has a small population, heating is used 24 hours a day for nearly 9 months out of the year due to the severe climate (USAID 2013, 33). As a result of these emissions, Ulaanbaatar is the world's most polluted capital with regard to particulate matter during the winter months (The World Bank 2012, 1).

Figure 3.2 — Physical condition of educational building in Mongolia - Building envelope

Figure 3.3 — Physical condition of educational building in Mongolia - Radiators

3.1.2 Benefits of Green Education Buildings

The building industry is responsible for a large part of the world's environmental degradation as buildings converge in themselves major indexes of energy and water consumption, raw material employment and usage of land in order to deliver the services they provide, such as lighting, water, and climate control. Buildings also generate considerable amounts of greenhouse and ozone-depleting gases throughout their life cycles, which will have enormous impacts on nature (Tambovceva et al 2012, 1).

As heat loss is major issue for old buildings in Mongolia, in its NGDP, which was approved by Parliament in 2014, the GoM set the target of reducing building heat losses by 20% in 2020, and by 40% in 2030, through "the introduction of green solutions such as energy efficient and advanced technologies and standards, green building rating systems, energy audits, and the introduction of an incentives mechanism." This target for reducing building heat loss is also included in Mongolia's INDC. Other key policies such as the Energy Regulatory Framework, Energy Conservation Law, the draft of a green building rating system, revised building codes and standards were also established to promote green buildings.

In addition to resource savings and GHG emissions reduction, greening education buildings provides other benefits. Examples of these are as follows:

- **Environmental Sustainability:** Mongolia expects public buildings to contribute to the country's climate change mitigation responsibilities and other factors affecting the environment. The implementation of green practices in education buildings is a tangible way for the GoM to demonstrate what can be and is being done with respect to energy conservation, reducing GHG and smog emissions, reducing water use, improving water quality, diverting materials from landfills, saving topsoil and native species' habitats, supporting student achievements, etc.
- **Financial Benefits:** In developed countries, the construction of a green educational building (depending on the green technologies pursued) can add 1% to 10% to the initial cost (Choi 2014, 11). This scale of incremental cost can be recovered from lower operating costs that will continue over the life of the building.
- **Educational Performance:** Green education buildings can promote student educational performance in various ways. They can provide a more conducive learning environment - through improvements in acoustics, lighting, temperature, and air quality. Savings in operation costs can be used to invest in other educational purposes in schools and kindergartens. By engaging and inspiring students, green buildings can educate students about the benefits of green buildings and their role in conserving resources and reducing waste.
- **Green Industry Development:** Promoting green public buildings, including green education buildings, can support the emerging green building industry and green technologies, enhancing awareness of sustainable design in all sectors of the economy.

3.1.3 Purpose of the TGs for Green Education Buildings

The main purpose of these TGs is to provide initial guidance to the GoM, the MESC, UB City, and other stakeholders in the process of designing and procuring Education PPP projects. The TGs provide general output specifications to be used to develop project-specific output specifications to be attached to bidding documents for potential PPP projects, which will ultimately guide private bidders in creating their own green building designs and project proposals.

The TGs aim to promote the design, construction, and operation of green education buildings that are proven, practical, reliable, cost-effective, and beneficial to the environment. Strategically planned, green education buildings are less expensive to operate than conventional buildings. Furthermore, they help ensure healthy, safe, and high quality learning environments for all users.

3.2 Technical Guidelines

3.2.1 Overview

3.2.1.1 Output Specifications

Output specifications for green education buildings are developed as part of the TGs. PPP projects are designed to achieve performance targets over the 10-year contract term. Under the PPP contract, which details long term service requirements, private partners are in charge of the design, building, and operation of PPP facilities, while the government authority monitors and evaluates the operational performance of the private partners. The government authority prepares comprehensive output specifications, which are closely linked to the performance-based payments provided by the government authority. Thereby, the output specifications of PPP projects should be designed to achieve the objectives of public authorities in effectively operating these public facilities over the long term.

The output specifications are an important part of bidding documents for service contract type PPP projects. They define the local authority's requirements for the design, construction, and operation of green education buildings, including acceptable operational performance and energy performance levels. The output specifications, as set out below, are used as the basis for bidders to prepare their proposals. .

- When delivering the services required by the PPP contract, the private partner shall meet the output specifications set out in the TGs. Planners can pursue different levels of green options (required, recommended, and optional) by adopting combinations of all available green technologies based on site-specific conditions and budget considerations.
- Output specifications cover the continual expected performance of the green education buildings.
- Buildings and outdoor environments are to be designed, constructed, and maintained in accordance with relevant government policies and regulations.
- The building and its related systems (envelope, thermal insulation, green space, lighting, plumbing, drainage, mechanical and electrical systems, etc.) shall be suitable for their intended purpose.
- The guidelines for output specifications are described in section 3.2.2 and 3.2.3. The government authorities shall develop output specifications tailored to their specific projects.

The output specifications in the TGs are designed to achieve energy performance targets for green education buildings. Expected performance outcomes are described in section 3.3.

3.2.1.2 Framework Development

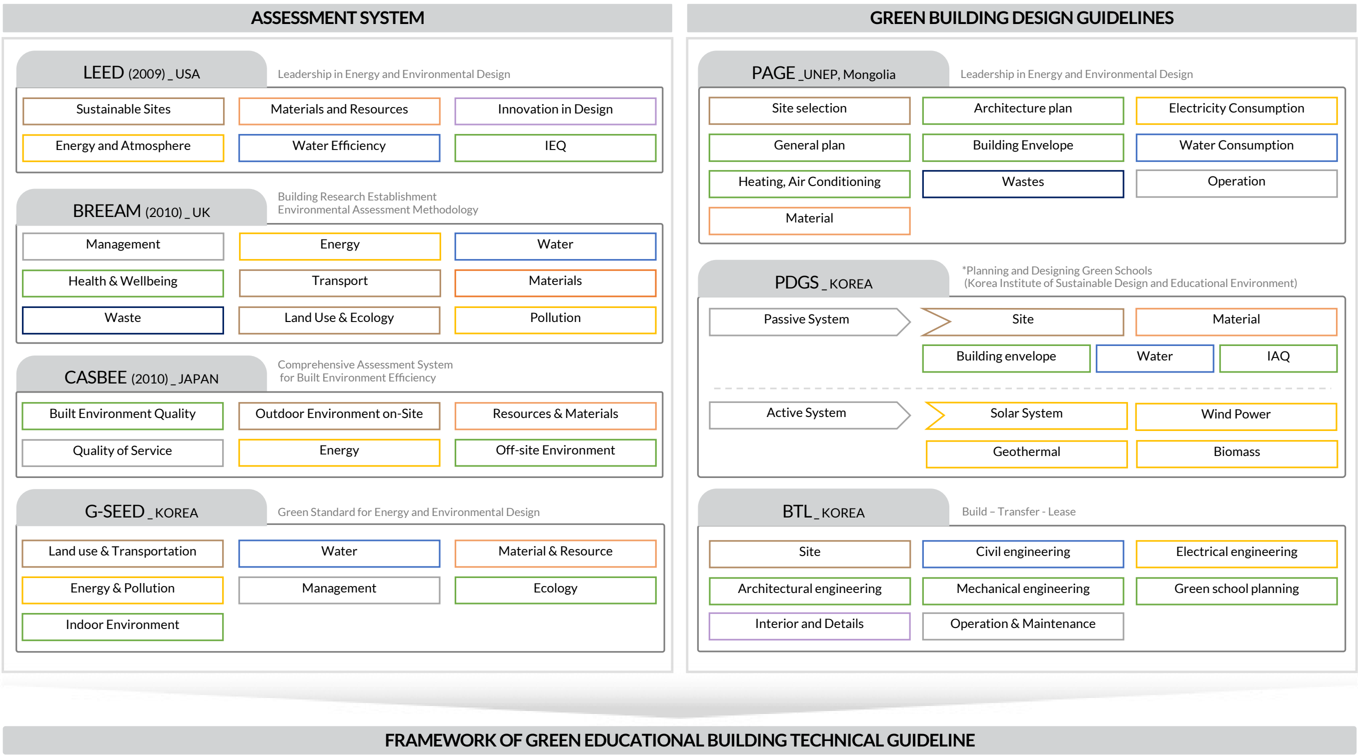
Desktop reviews and stakeholder consultations provided the informational basis for the preparation of the TGs. The desktop review included reliable references such as the LEED, Building Research Establishment Environmental Assessment Methodology (BREEAM), Comprehensive Assessment System for Built Environment Efficiency (CASBEE) and Green Standard for Energy and Environmental Design (G-SEED) assessment systems; green building design guidelines; and a previous research study--all of which contributed to the outline of green building technology options. The stakeholder consultations helped with the identification of which green technologies were most feasible for the Mongolian context, based on local needs and conditions.

1. **Green Building Guidelines and Assessment Systems**. In the past several years, environmental assessment systems and guidelines (e.g. LEED, BREEAM, CASBEE, G-SEED, etc.) for green buildings have been developed and subsequently implemented in many countries as part of their green development policies. Some of these systems have been developed for assessment purposes while others are used for guidance only. The purpose of these systems is to help drive improvements in building performance.

   The GoM also recognizes the importance of green development and has started to promote green buildings by developing a reference entitled the "Green Building Design Handbook" (The Partnership for Action on Green Economy, or PAGE, handbook), with the help of UNEP in 2015. This handbook includes general information on green buildings. While the PAGE handbook was developed to capture the overall concept of a green building and its technology, the TGs have been further developed with a focus on the green technologies which are most feasible given Mongolia's local conditions.

   The technologies employed in green buildings are constantly evolving and vary by country and region. Therefore, the TG framework has been developed in three steps to fulfill local needs. First, existing references such as the Green Building Design Handbook by UNEP and the assessment systems developed in other countries were reviewed to ensure the inclusion of the fundamental principles associated with green education buildings. In this stage, design criteria and green technology classification systems were primarily analyzed. Second, these references were compared to form a preliminary framework. Based on the initially developed framework, the importance of green items and technologies were analyzed. Finally, the TG framework was modified to meet the specific circumstances and needs of Mongolia.

Figure 3.4 — Components of green building design guidelines and assessment systems



2. **Selection of Green Technologies in the TGs**: Based on findings from the desktop review, site analyses, and stakeholder consultations were conducted and the importance of technologies were analyzed and identified. The green technology prioritization was then partially modified from the previous study (GTC 2014, 26-28). The criteria used to prioritize each option included the following four elements: local need, technological advancement, cost, and regional supply.

Table 3.2 — Prioritization of green technologies (modified version)

		Technologies			Local Need	Technological Advancement	Cost	Regional Supply	Remark
Passive Design	Building Envelope	Air tightness		Caulking/sealant	●	●	○	●	
		Shading devices		Louver	◐	●	◐	◐	
				Photovoltaic louver	●	●	◐		
				Curtain	●	○	●		
				Blinds	●	○	●		
				Roller	●	○	◐		
				Light shelf	●	◐	○		
		Thermal Insulation	Wall	EPS (expanded polystyrene/styrene)	●	●	○	○	
				Rockwool	●	◐	●	●	
				Mineral wool	○	◐	●	○	
				Poly urethane	○	○	●	○	
				Sheep wool	●	○	○	◐	
				Perlite	◐	●	●	◐	
				Ceramsite	●	●	●	○	
			Floor	Cemented layer	●	●	○	●	
				Insulation board	●	●	○	●	
			Roof	EPS	●	●	○	●	
				Sheep wool	●	○	○	◐	
				Bitumen	●	●	○	●	Vapor Resistance
			Window	Double glass	●	●	◐	○	Vary by window type
				Triple glass	●	●	◐	○	Vary by window type
				BIPV	○	◐	●	○	
			Door	Wooden door	●	●	○	●	
				Metal door	◐	●	◐	◐	
	Daylight and view	Atrium			○	●	●	◐	
		Skylight			◐	●	◐	◐	
	Green materials				●	●	◐	◐	Vary by material
	Acoustic				●	●	◐	◐	Vary by type
	Green space				●	●	◐	○	
	Pervious pavement				●	●	◐	○	

		Technologies	Local Need	Technological Advancement	Cost	Regional Supply	Remark
Active Design	Heating System	Central/district heating	●	●	●	●	
		HOB	●	●	○	◐	
		Radiator	●	●	○	●	
		Radiant floor heating	●	●	◐	○	
		Heat meter	◐	●	○	○	
	Cooling System	Chiller-heater unit	○	●	◐	○	
		Ice thermal storage cooling system	○	●	●	○	
	Indoor Lighting	Light emitting diode (LED)	●	●	◐	○	
		Fluorescent light	●	●	○	●	
		Light control system	●	●	◐	○	
	Water Efficient Fixture		●	●	◐	◐	
	On-site Renewable Energy	Geothermal	●	●	●	◐	
		PV	●	●	●	◐	
		Solar thermal	●	●	●	◐	
		Wind power	●	●	◐	◐	
		Biomass	●	◐	◐	◐	
Others	Rainwater Collecting System		●	●	●	◐	
	Greywater Recycling System		●	●	●	○	

Symbol Legend

	Local Need	Technological Advancement	Cost	Regional Supply
●	Very Important	High	High cost	Abundant
◐	Average	Average	Average	Average
○	Not important	Low	Low cost	None exist

3. **TG Framework:** After selecting the appropriate green technologies, the TG framework was structured as shown in Figure 3.5. Available green technologies and targeted energy savings are stated within the TGs. Through workshops with key stakeholders, including government officials and local experts, education buildings built in the 1980s were selected as a baseline model. Most school and kindergarten buildings in Mongolia were built between the 1960s and the early 1990s, using a uniform design. The target of 40% energy saving is set for the “required” option compared to baseline, as previous report estimated that the thermal-technical retrofits to existing building will reduce annual heat loss by an average of approximately 40% per year (USAID 2013, 4). The framework also proposes improvements (recommended and optional) in building performance over the required model.

Figure 3.5 — TG framework

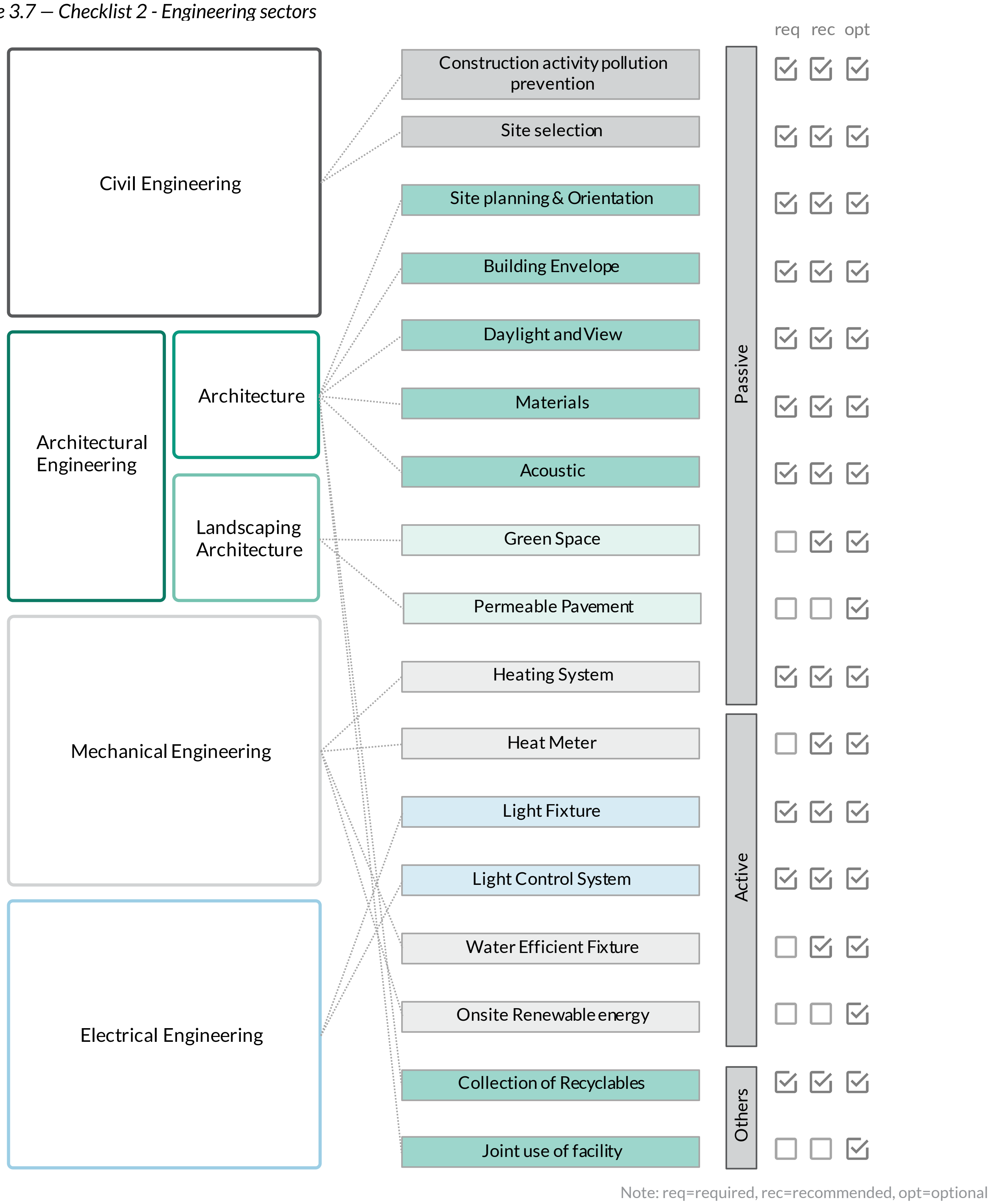
Framework of Green Educational Building Technical Guideline	PASSIVE DESIGN	ACTIVE DESIGN	RENEWABLE ENERGY
BASELINE	School buildings built in 1980s		
REQUIRED Energy consumption 40% < reduction	Site Selection Orientation Building Envelope	Radiator Indoor Lighting	
RECOMMENDED Energy consumption 50% < reduction	Site Selection Site Plan & Orientation Building Envelope Green Space	Radiator Indoor Lighting Boiler Heat Meter	
OPTIONAL Energy consumption 65% < reduction	Site Selection Orientation Building Envelope Green Space Permeable Pavement	Radiant Floor Heating Indoor Lighting Boiler Heat Meter Light Control System	Geothermal Photovoltaic Solar Thermal

In PPP projects, the design, construction, and operation and maintenance (O&M) of education buildings are typically the private partner's responsibility. Therefore, as part of the TGs, checklists are provided to assist PPP project participants in easily reconciling appropriate green technologies with the relevant output specifications. Throughout the design process (see checklist 1), different private partners, such as civil engineers, architects, mechanical engineers, and electrical engineers (see checklist 2) can utilize these checklists to find the local authority's requirements regarding the design and construction of green education buildings in Mongolia.

Figure 3.6 — Checklist 1 - Design process

Design Process	Passive									Active					Others	
	Construction activity pollution prevention	Site selection	Site planning & Building orientation	Building Envelope	Daylight and View	Materials	Acoustic	Green Space	Permeable Pavement	Heating System	Heat Meter	Indoor Lighting	Water Efficient Fixture	Onsite Renewable energy	Collection of Recyclables	Joint use of facility
Design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construction	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		
Operation & Maintenance				✓		✓		✓		✓	✓	✓	✓	✓	✓	✓

Figure 3.7 — Checklist 2 - Engineering sectors



For example, in Checklist 1, "Material" is marked as one of the technologies that needs to be considered throughout the entire design process (through design, construction, and operation and maintenance). During the design and construction phase, responsible partners (refer to Checklist 2) must select construction materials with low or zero Volatile Organic Compounds (VOCs) and develop an indoor air quality (IAQ) management plan to minimize off-gassing in the classroom. Once construction is completed (during the O&M phase), the Total Volatile Organic Compounds (TVOC) levels are examined annually to ensure good IAQ.

When bidders submit their proposals, the GoM is able to discern whether the design proposal and its performance fulfill the requirements.

3.2.2 Design and Construction

As stated in Section 3.2.1.2 Framework Development, the following green building technologies are selected as a menu of options to consider in developing bidding documents for a PPP project. Output specifications for given options are provided in this section.

Table 3.3 — List of green building items/technologies in the TG

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<tr><td rowspan="16">A. Passive Design</td><td colspan="3">A-1 Construction activity pollution prevention</td></tr>
<tr><td colspan="3">A-2 Site selection</td></tr>
<tr><td colspan="3">A-3 Site planning & building orientation</td></tr>
<tr><td rowspan="8">A-4 Building envelope</td><td colspan="2">A-4-1 Air tightness</td></tr>
<tr><td rowspan="2">A-4-2 Shading device</td><td>Louvers / blinds</td></tr>
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<tr><td colspan="3">A-8 Green space</td></tr>
<tr><td colspan="4" style="display:none"></td></tr>
</table>

<table>
<tr><td></td><td colspan="3">A-9 Pervious pavement</td></tr>
<tr><td rowspan="11">B. Active Design</td><td rowspan="4">B-1 Heating system</td><td colspan="2">B-1-1 Centralized district heating</td></tr>
<tr><td colspan="2">B-1-2 HOB</td></tr>
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<tr><td colspan="2">B-1-4 Radiant floor heating</td></tr>
<tr><td colspan="3">B-2 Heat meter</td></tr>
<tr><td rowspan="2">B-3 Indoor lighting</td><td colspan="2">B-3-1 Light fixture</td></tr>
<tr><td colspan="2">B-3-2 Light control system</td></tr>
<tr><td colspan="3">B-4 Water efficient fixture</td></tr>
<tr><td rowspan="3">B-5 On-site renewable energy</td><td colspan="2">B-5-1 Geothermal</td></tr>
<tr><td colspan="2">B-5-2 PV</td></tr>
<tr><td colspan="2">B-5-3 Solar thermal</td></tr>
<tr><td rowspan="2">C. Others</td><td colspan="3">C-1 Collection of recyclables</td></tr>
<tr><td colspan="3">C-2 Joint use of facility</td></tr>
</table>

A. Passive Design	A-1 Construction Activity Pollution Prevention

Description

Erosion and sediment controls are required on construction sites to reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust generation in Mongolia. An effective plan for the implementation of such practices is key to ensuring timely construction, minimizing erosion and subsequent pollution by sediments, and keeping construction costs down by minimizing erosion damage—which damage would otherwise require additional work to correct.

Output specifications ■ required ■ recommended ■ optional

Develop an effective and affordable erosion and sedimentation control plan in respect to the site conditions and implement the plan for all construction activities associated with the project during the construction phase.

Mongolian building codes and standards

None exist

Strategies

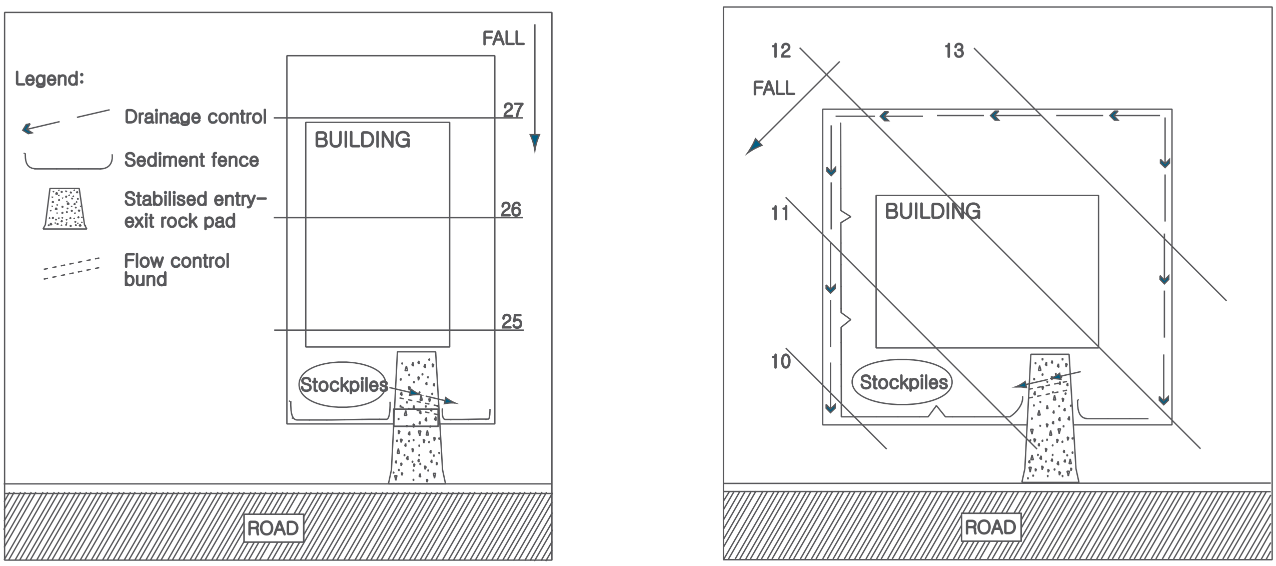
All ground cover vegetation outside the immediate building area to be preserved during construction.

All erosion and sediment control measures to be installed prior to commencement of major earthworks.

Stockpiles of clay material to be covered with an impervious sheet, roof water downpipes to be connected to the permanent underground, and storm water drainage system as soon as practical after roof is laid.

Minimize importation of non-native soils and exportation of native soils. Optimize Cut and Fill (ideally in 1:1 proportions) during clearing and excavation.

Figure 3.8 — Sample drawings of erosion and sedimentation control plan



NARROW LOT PROPERTY FALLS TOWARDS ROAD

Reference Materials

Toronto and Region Conservation Authority (TRCA). 2006. *Erosion & Sediment Control Guideline for Urban Construction.*

Healthy Waterways. 2016. *"Healthy Waterways Report Card" Accessed January 23.* http://www.healthywaterways.org

A. Passive Design	A-2 Site selection

Description

Site selection for education buildings is affected by many factors, including health, safety, location, size, and cost. Select sites that protect students and staff from outdoor pollution and have minimal environmental impact.

Output specifications ■ required ■ recommended ■ optional

If possible, select building sites in areas of existing development where infrastructure (road, water and power supply, sewage system, etc.) already exist to protect greenfield sites, minimize transportation requirements, and preserve habitat and natural resources.

Mongolian building codes and standards

None exist

Strategies

Utilize existing infrastructure (bike paths, roads, water and power supply, sewage system, etc.) as much as possible.

Create physical connections among adjacent buildings.

Enhance outdoor learning opportunities by selecting educational sites that link to natural features that enable joint use of outdoor facilities or large native planting areas. (See 'Green Space' for related information.)

Surrounding site and environmental conditions should be considered (e.g. adjacent buildings, wind speed, temperature, humidity, air quality).

Maximize opportunities for on-site renewable energy generation. For example, preserve or ensure space for a geothermal system, photovoltaic panels, wood chip storage facilities for biomass heating, or other renewable energy sources.

Provide space for on-site recreational facilities (outdoor playground, swimming pool, green space, etc.)

Reference Materials

United States Green Building Council (USGBC). 2009. *LEED 2009 for Schools New Construction and Major Renovations.*

HKGBC. 2010. *Hong Kong Green School Guide.*

NYSED. 2007. *High Performance Schools Guidelines.*

A. Passive Design	A-3 Site planning & Building orientation

Description

When designing a green educational building, orientation should be the first point of consideration. This is a process of obtaining the benefits of the sun and wind when they are valuable, and controlling them passively when not. Variables including site constraints and the building program make it impossible to predict both the cost premium for optimizing orientation and the resultant energy savings.

Output specifications ■ required ■ recommended ■ optional

Orientate the building to take full advantage of the microclimate (solar orientation, prevailing wind direction, topography, and tree species) within which it will be built.

Mongolian building codes and standards

BNbD 23-02-08, 5.12

Strategies

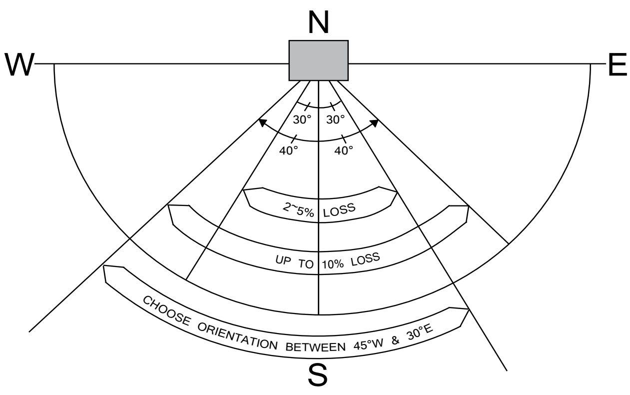
Orient the building(s) to take advantage of maximum natural light (refer to 'Daylight and View' for more information); or plot shadow patterns from surrounding buildings and place buildings to optimize access to daylight (for urban-infill sites).

Consider prevailing winds (refer to 'Natural Ventilation' for more information) when determining the site and building layout. For example, consider how the shape of the building itself can create wind-sheltered spaces, and consider prevailing winds when designing operable windows (windows that may be opened and shut to accommodate ventilation needs, as opposed to a fixed light or fixed sash) and parking lots/driveways to help blow exhaust fumes away from the educational building.

Take advantage of existing buildings, environment conditions, land formations, and vegetation to provide shelter from extreme weather or to deflect unwanted noise. Plant or protect existing deciduous trees (birch or poplar trees) to block summer sun and allow winter solar gain.

Design the floor plan in accordance with classroom use (operation) schedule.

Figure 3.9 — Building orientation strategies



Reference Materials

USGBC. 2009. *LEED 2009 for Schools New Construction and Major Renovations.*

HKGBC. 2010. *Hong Kong Green School Guide.*

NYSED. 2007. *High Performance Schools Guidelines.*

A. Passive Design	A-4 Building Envelope	A-4-1 Air tightness

Description

Air tightness (also called air leakage or air permeability) is important from a variety of perspectives, but most relate to the fact that air tightness is the fundamental building property that impacts infiltration. In Mongolia, infiltration is considered to be one of the main factors causing condensation and heat loss in buildings. There are a variety of definitions of infiltration, but fundamentally infiltration is the movement of air through leaks, cracks, or other adventitious openings in the building envelope.

Output specifications ■ required ■ recommended ■ optional

Design air permeability of 7 m³/ (h/m²) @ 50 Pa.

Mongolian building codes and standards

None exist

Strategies

Airtightness must be thoroughly considered at all stages of design and construction.

Table 3.4 — Design and construction strategies of building airtightness

Design Stage	Construction Stage
Simplify built form where possible. Define the line of the air barrier as early as possible. Consider and rationalize construction sequencing. Redefine the air barrier route and insulation strategy. • Insulate and seal doors and windows (refer to 'Thermal Insulation' for more information). • Seal the junctions between plane building elements (e.g. at wall/roof and wall/floor junctions), where the continuity of the insulation is interrupted. Decide and specify which materials will form the air barrier. Consider junction details between air barrier materials. Highlight air barrier critical elements and junctions on construction drawings.	Appoint a site "air barrier manager" to coordinate and inspect the overall formation of the air barrier. Inform the team of the air barrier line, and the materials that will form the barrier and the critical junctions. Air barrier management to undertake: • coordination of the formation of the air barrier • site quality assurance • check and sign off all "hidden" air barrier elements before covering up. Review the construction as work proceeds to identify any weaknesses in the air barrier strategy / areas not previously considered and feed this information back to the design team. Establish solutions to any problems identified. Undertake airtightness testing at the earliest possible opportunity. Apply caulk to a window frame to prevent air leakage.

Table 3.5 — Air permeability of educational building in m3/(h.m2) at 50 Pa

Best Practice	Normal Practice
3	9

Reference Materials

ATTMA. 2010. *Technical Standard L1: Measuring Air Permeability of Building Envelopes (Non-Dwellings).*

Government of Ireland. 2015. Limiting Thermal Bridging and Air Infiltration Acceptable Construction Details Introduction.

A. Passive Design	A-4 Building Envelope	A-4-2 Shading device (Louvers/Blinds)

Description

Sunlight admitted into a building impacts the building energy consumption in different ways. The design and position of shading devices depend on the daily and yearly variation of solar position. Well-designed shading devices in Mongolia can avoid glare and provide solar heating through sunlight reaching the south-facing facade in winter.

Output specifications ■ required ■ recommended ■ optional

Considering clear sky conditions dominate around the year (250 clear days), properly install shading devices to void direct sunlight.

Mongolian building codes and standards

None exist

Strategies

Properly installed shading devices can provide thermal and visual comfort to building users.

Provide natural landscaping such as deciduous trees to shade external windows, or install building elements such as overhangs (louvers), fins, and egg-crates to void direct sunlight.

Install adjustable internal shading devices (curtain, blinds, roller shades, etc.) and allow building users to regulate the amount of direct sunlight entering their space.

Recommended items are marked in bold below:
- External shading device: overhang horizontal louver (snow or wind load is small)
- Internal shading device: curtain (thick fabric can block heat transfer during the night time)

Table 3.6 — Types of shading devices

External shading devices (Louvers)			
	Descriptive Name	Best Orientation	Shading Coefficients (SC)
	Overhang Horizontal Panel	South, East, West	0.1-0.6
	Overhang Horizontal Louver	South, East, West	0.1-0.6
	Vertical Fin	East, West, North	0.1-0.6
	Egg-crate	East West	0.1-0.3

Internal shading devices (Blinds)		
	Descriptive Name	SCs
	Curtain	0.4-0.8
	Roller	0.2-0.6
	Blinds (Venetian)	0.4-0.7

Reference Materials

Lechner, N. 2008. *Heating Cooling Lighting: Sustainable Design Methods for Architects. Wiley.*

A. Passive Design	A-4 Building Envelope	A-4-2 Shading device (Light shelf)

Description

A light shelf is a horizontal light-reflecting overhang that allows daylight to penetrate deep into a building. It is placed above eye-level and has a high reflectant upper surface. It can also shade near the windows and help reduce window glare and contrast luminance ratios of building interior.

Output specifications ■ required ■ recommended ■ optional

Install light shelves to maximize daylight penetration.

Mongolian building codes and standards

Hardly any light shelf practice in Mongolia. Most construction materials are imported from China.

Strategies

Light shelves should be mounted at a height above the ground that does not interfere with passers-by (see images below).

Maximum light shelf projection is about 760mm from the back of the glazed wall system.

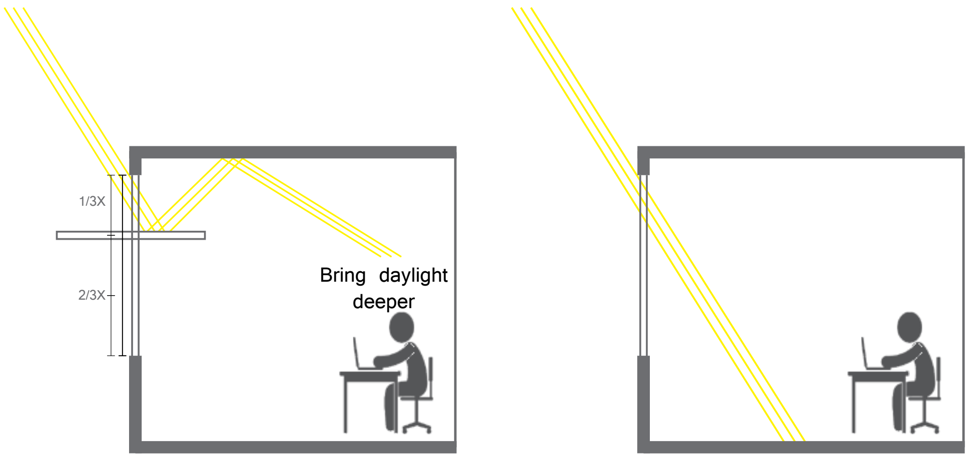
It is suggested that a white finish be used for the upper surface of a light shelf to maximize the reflection of daylight in the classroom. (Refer to 'Daylight and View' for related information.)

The ratio of maximum-to-average luminance does not exceed 3:1 (refer to 'Indoor lighting' for related information).

Consult with local building and fire codes for applications with light shelves and fire sprinkler systems.

Some light shelves can be integrated with certain types of sun control systems. Check the compatibility before installation.

Figure 3.10 — Maximizing daylight penetration with light shelves



Reference Materials

Lechner, N. 2008. *Heating Cooling Lighting: Sustainable Design Methods for Architects.* Wiley.

A. Passive Design	A-4 Building Envelope	A-4-3 Thermal insulation (Wall)

Description

The thermal resistance of the building envelope has a major effect on the energy use as most of an uninsulated building's heat is lost through its walls. If all other energy aspects are optimized but the thermal resistance is low, the ultimate energy efficiency will be poor. The external wall consists of a variety of materials including exterior surfaces (e.g. concrete, brick, or masonry), insulation (e.g. expand, mineral wool, polyurethane foam, or phenolic foam) and interior dry wall or plaster walls.

Output specifications ■ required ■ recommended ■ optional

Comply with minimum U-value requirement : 0.25 W/m²K

Mongolian building codes and standards

BNbD 23-02-09

Strategies

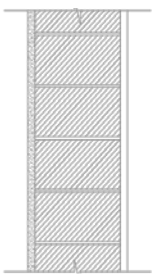
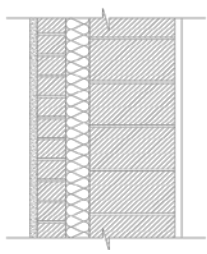
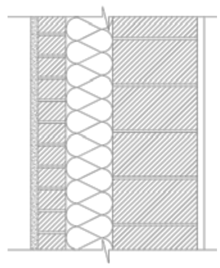
Provide calculation of thermal transmittance of building envelope and install proper thermal insulation.

Implement water barrier and vapor resistance strategy.

Types of insulation materials:
- EPS foam
- Rockwool
- Mineral wool
- Polyurethane
- Sheep wool
- Perlite
- Ceramsite

The U-value of the external wall can vary widely depending on the type and thickness of the material used.

Table 3.7 — U-Value comparison of exterior walls (examples of wall sections)

Baseline	Required	Recommended
Exterior  Interior		
1.60 W/m²K (No Insulation)	0.25 W/m²K (Insulation : EPS THK 150mm)	0.19 W/m²K (Insulation : EPS THK 200mm)

* THK: Thickness

Reference Materials

Pitts, G. 1989. *Energy Efficient Housing: A Timber Frame Approach.* TRADA.

USAID. 2013. *Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.*

MESC 2014. *Mongolia's Standard Floor Plan.*

A. Passive Design	A-4 Building Envelope	A-4-3 Thermal insulation (Floor)

Description

There are a number of different floor construction systems for education buildings. An appropriate form of the ground floor slab can be selected considering cost, ground conditions, and insulation.

Output specifications ■ required ■ recommended ■ optional

Comply with minimum U-value requirement : 0.19 W/m²K

Mongolian building codes and standards

BNbD 23-02-09

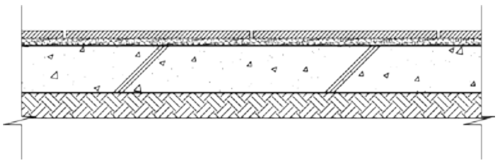
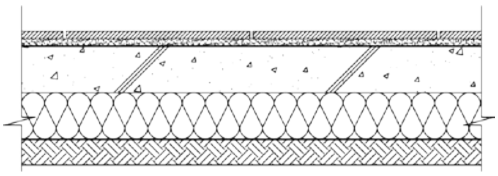
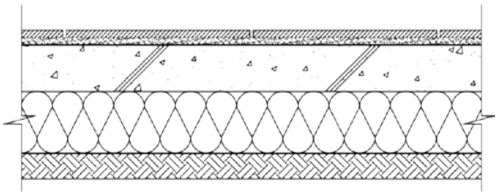
Strategies

Provide calculation of thermal transmittance of building envelope and install proper thermal insulation.

Implement water barrier and vapor resistance strategy.

U-value of the ground floor slab can vary widely depending on the type and thickness of material used.

Table 3.8 — U-Value comparison of ground floor slabs (examples of floor sections)

Baseline		1.40 W/m²K (No Insulation)
Required		0.19 W/m²K (Insulation : EPS THK 150mm)
Recommended		0.14 W/m (Insulation : EPS THK 200mm)

* THK: Thickness

Reference Materials

Pitts, G. 1989. *Energy Efficient Housing: A Timber Frame Approach*. TRADA.

USAID. 2013. *Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.*

MESC 2014. *Mongolia's Standard Floor Plan.*

A. Passive Design	A-4 Building Envelope	A-4-3 Thermal insulation (Roof)

Description

Having a well-insulated roof space will not only save significant amounts on heating costs, but it will also provide a more pleasant and indoor environment.

Output specifications ■ required ■ recommended ■ optional

Comply with minimum U-value requirement : 0.18 W/m²K

Mongolian building codes and standards

BNbD 23-02-09

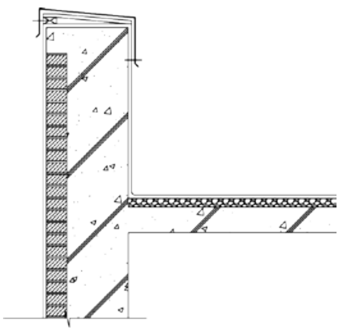
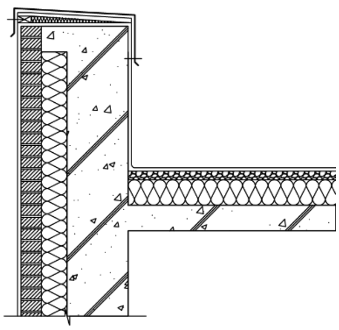
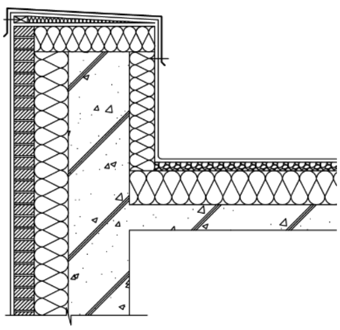
Strategies

Provide calculation of thermal transmittance of building envelope and install proper thermal insulation.

Implement water barrier and vapor resistance strategy.

U-value of the roof can vary widely depending on its shape and thickness.

Table 3.9 — U-Value comparison of roof (examples of roof sections)

Baseline	Required	Recommended
		
1.38 W/m²K (No Insulation)	0.18 W/m²K (Insulation : EPS THK 150mm)	0.14 W/m (Insulation : EPS THK 200mm)

* THK: Thickness

Reference Materials

Pitts, G. 1989. Energy Efficient Housing: A Timber Frame Approach. TRADA.

USAID. 2013. Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.

MESC 2014. Mongolia's Standard Floor Plan.

A. Passive Design	A-4 Building Envelope	A-4-3 Thermal insulation (Window)

Description

Window systems consist of two components, the frame and the glazing that sits inside in the frame. Improving window systems of education buildings can significantly reduce energy consumption and pollution sources in Mongolia. The energy-efficient windows have lower heat loss, less air leakage, and warmer window surfaces that improve comfort and minimize condensation.

Output specifications ■ required ■ recommended ■ optional

Comply with minimum U-value requirements: 2.2 W/m²K

Mongolian building codes and standards

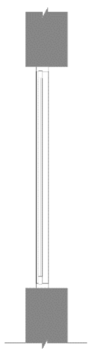
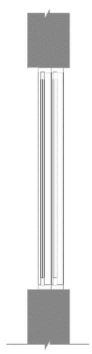
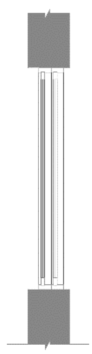
BNbD 23-02-09

Strategies

Provide calculation of thermal transmittance of building envelope and install proper thermal insulation.

Specify window systems in the construction drawings.
- Window U-value
- Window Solar Heat Gain Coefficient (SHGC), or SC
- Visual light normal transmittance

Table 3.10 — U-Value comparison of windows (examples of window sections)

Baseline	Required	Recommended
		
5.3 W/m²K (Single glazing)	2.2 W/m²K (Double glazing)	1.5 W/m²K (Double glazing, Low-E)

Reference Materials

Pitts, G. 1989. *Energy Efficient Housing: A Timber Frame Approach.* TRADA.

USAID. 2013. *Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.*

MESC 2014. *Mongolia's Standard Floor Plan.*

A. Passive Design	A-4 Building Envelope	A-4-3 Thermal insulation (Door)

Description

Ease of access to any building is essential. However, open doors can allow uncontrolled quantities of air into a building, reducing comfort and wasting energy. There are a number of opportunities to reduce heat loss through doors, and most are low-cost and can be implemented immediately. The intent of the double entry vestibule system is to reduce the infiltration of air into a space, thereby addressing energy conservation and comfort issues for building users located near primary entrance doors.

Output specifications ■ required ■ recommended ■ optional

Install vestibule/double entry systems.

Mongolian building codes and standards

None exist

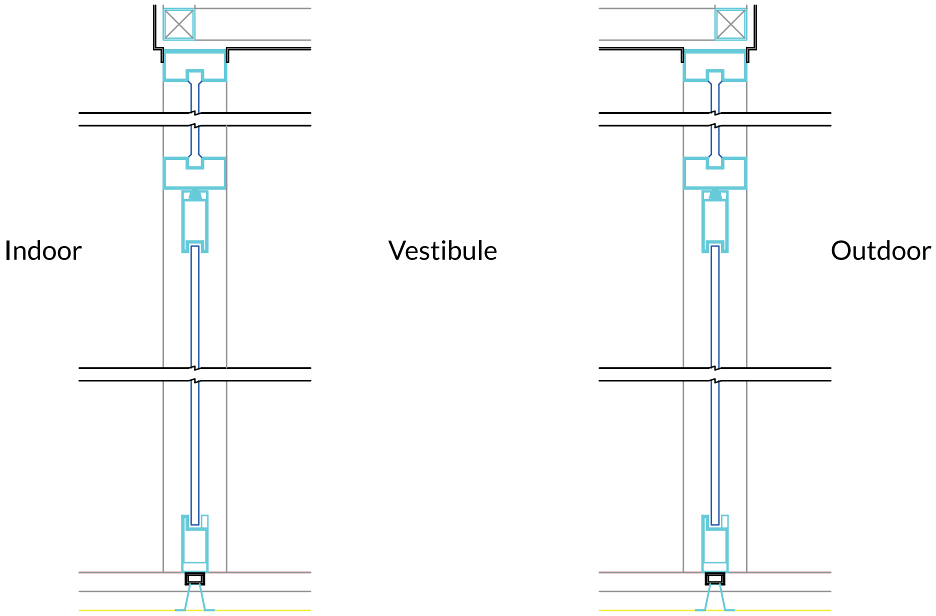
Strategies

Provide calculation of thermal transmittance of building envelope and install proper thermal insulation.

Create a wind barrier at entrance to minimize infiltration of outdoor air into a space.

Caulk and seal around the exterior doors.

Figure 3.11 — Vestibule/Double entry system



Reference Materials

U.S Department of Energy. 2010. Energy *Saving Impact of ASHRAE 90.1 Vestibule Requirements: Modeling of Air Infiltration through Door Openings.*

A. Passive Design	A-5 Daylight and View

Description

As indicated in the section on thermal insulation for windows, energy used for heating load can be reduced by installing energy-efficient window systems. In addition to its influence on energy consumption, the building envelope also plays other roles. For instance, the glazed area affects building users' satisfaction with the availability of daylight and view.

Output specifications ■ required ■ recommended ■ optional

Implement design strategies to optimize use of daylight.

Mongolian building codes and standards

None exists

Strategies

Glazing area (window size and shape): Maximize daylight within a space by increasing the glazing area. Provide exterior glazed openings with an area not less than one-tenth (1/10) of the total floor area. Three glass characteristics need to be understood in order to optimize a fenestration system: U-value, SC, and Visible Transmittance. (Refer to 'Thermal Insulation' for related information.)

Aperture Location (Window orientation): Simple side lighting strategies allow daylight to enter a space and can also serve to facilitate views and ventilation. A rule-of-thumb is that the depth of daylight penetration is about two and one-half (2.5) times the distance between the top of a window and the sill.

Reflectance of Room Surfaces: Reflectance values for room surfaces will significantly impact daylight performance and should be kept as high as possible. It is desirable to keep ceiling reflectance over 80%, walls over 50%, and floors around 20%. Of the various room surfaces, floor reflectance has the least impact on daylight penetration.

Light shelf: Install light shelf that allows daylight to penetrate deep into a building. A properly designed light shelf has the potential to increase room brightness and decrease window brightness. (Refer to 'Building Envelope, Light shelf' for related information.)

Integration with Electric Lighting Controls: A successful daylight design not only optimizes architectural features, but also integrates with the electric lighting system. (Refer to 'Indoor Lighting' for related information.)

Reference Materials

Lechner, N. 2008. *Heating Cooling Lighting: Sustainable Design Methods for Architects.* Wiley.

A. Passive Design	A-6 Materials	A-6-1 Low-carbon materials

Description

Buildings consume great quantities of materials, energy, and other resources, generating significant GHG emissions and other environmental impacts during their life-cycle. The use of low-carbon materials (e.g. recycled materials, regional materials, rapidly renewable materials, etc.) in green building design can reduce these emissions and impacts significantly.

Output specifications ■ required ■ recommended ■ optional

Select materials that are more sustainably produced (than conventional materials), recycled and/or reclaimed low-carbon materials.

Mongolian building codes and standards

None exist

Strategies

Use building materials and products that can be recycled to minimize waste generation.
- Aggregate
- Asphalt
- EPS
- etc.

Use building materials and products that are extracted and manufactured within the region, thereby supporting the use of local resources and reducing the environmental impacts resulting from transportation.

Use building materials and products that are durable, thereby require less maintenance.

Use rapidly renewable building materials and products (made from plants that are typically harvested within a ten-year cycle or shorter).

Use timber from sustainably managed plantations and avoidance of rainforest species.

Reference Materials

HKGBC. 2010. *Hong Kong Green School Guide.*

A. Passive Design	A-6 Materials	A-6-2 Low-emitting materials

Description

Materials (e.g. construction materials, textiles, furnishings, finishes, etc.) used in education buildings frequently have organic compounds as part of their composition. As many as 100 to 1,000 different VOCs may be in the indoor air at any one time where both children and adults can easily inhale them.

Output specifications ■ required ■ recommended ■ optional

Select materials that are non-toxic in nature.

Mongolian building codes and standards

None exist

Strategies

Use construction materials with low or zero VOCs to minimize off-gassing, which leads to a healthier indoor environment. Most standards and guidelines consider 200 µg/m3 to 500 µg/m3 TVOC as acceptable. Levels higher than this may result in irritation to some building users.

Provide a checklist for interior finishes used in the school buildings (Adhesive, sealant, paints, flooring systems, composite wood, furniture, ceiling, wall systems, etc.).

Table 3.11 — Checklist of low emitting finishes

		Product name/ model	Applied surface area (m^2, %)	VOCs ($mg.m^2h$)	HCHO ($mg.m^2h$) Y	Compliant with requirement	
						N	Y
Classroom	Adhesive		(m^2, %)				
	Flooring		(m^2, %)				
			(m^2, %)				
	Wall		(m^2, %)				
			(m^2, %)				
	Celling		(m^2, %)				
			(m^2, %)				

Reference Materials

HKGBC. 2010. *Hong Kong Green School Guide.*

Air Quality Sciences, Inc. *Reviewing and Refocusing on IAQ in Schools.*

A. Passive Design	A-7 Acoustic

Description

Up to 60% of classroom activities involve speech between teachers and students or between students, indicating the importance of environments that support clear communication.

Output specifications ■ required ■ recommended ■ optional

Classroom maximum noise level of 50dB.

Mongolian building codes and standards

BNbD 23-05-10, 6

Strategies

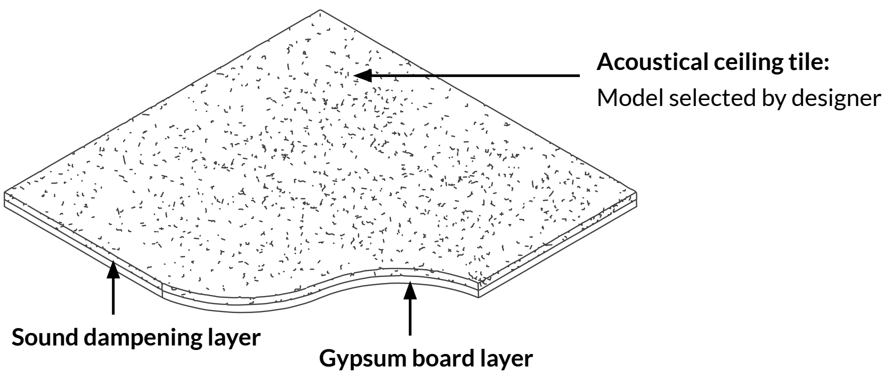
Avoid school sites in close proximity to noise generators (e.g. busy roads, rail lines, industrial facilities, and airports).

Provide sound isolating features in the building envelope (e.g. sound barrier walls and sound proofing windows) if the school site is near exterior noise generators.

Lower ambient noise by acoustically isolating teaching spaces from mechanical equipment and other noise generators.

Reduce reverberation times in large spaces, such as auditoriums and indoor gymnasiums, by installing sound absorbing materials on ceilings or walls.

Figure 3.12 — Example of sound absorbing material



Reference Materials

ANSI. 2002. *Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools.*

A. Passive Design	A-8 Green Space

Description

Green space (land that is partly or completely covered with grass, trees, shrubs, or other vegetation) helps reduce environmental impacts, enhances biodiversity, and provides a positive learning environment for students. Considering the high level of GHG emissions in Mongolia, maximizing on-site green space would be one way to reduce air pollution. Each healthy tree can reduce air borne dust particles by as much as 7,000 particles per liter of air. Thus, having green space on school premises would be analogous to having a freestanding air purifier.

Output specifications ☐ required ■ recommended ■ optional

Provide vegetated open space equal to 50% of the project site area.

Mongolian building codes and standards

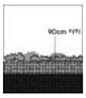
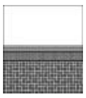
BD 31-113-11 (No less than 50% tenure land area should be green. If the building is located in park surroundings, the amount of green areas will be reduced by 30%).

Strategies

Select native, hardy, and drought-tolerant plant species that require low maintenance.

Select feasible green space design features.

Table 3.12 — Examples of different types of green space

Design features		Description
	Greening natural soil	Install green area on natural soil
	Greening artificial ground	Install green area on artificial ground (soil depth above 90cm)
	Green wall	Greening wall, retaining wall, or fence
	Permeable pavement	Install permeable pavement (see next page for more details)

Reference Materials

HKGBC. 2010. *Hong Kong Green School Guide.*

Morgan, T., Riley, K., Tannebring, R., and Veldhuis, L. 2010. *Evaluating the Impacts of Small-Scale Greenspace: A Case Study of Harlem Place in Downtown Loa Angeles*. Published by University of California.

A. Passive Design	A-9 Permeable Pavement

Description

As the average annual precipitation is low (200-220 mm) in Mongolia, water efficient landscaping is needed. Pervious paving (also known as permeable and porous paving) presents a unique opportunity to harvest and store storm water that would otherwise contribute to excessive overland runoff into the conventional storm water pipe and channel network.

Output specifications ☐ required ☐ recommended ■ optional

If possible, cover part of green space with a permeable pavement system to enhance functionality of green space and reduce overall footprint of building.

Mongolian building codes and standards

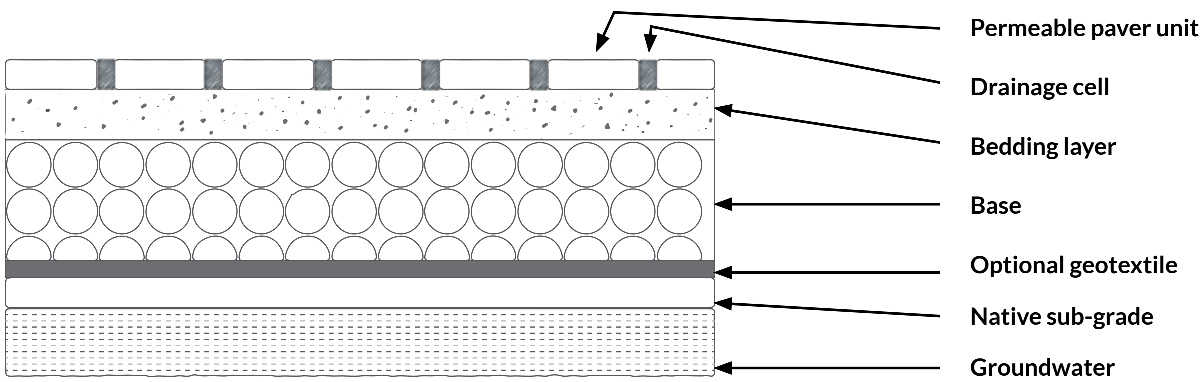
None exist

Strategies

Any system comprised of a load bearing surface that allows for movement of water through the load bearing surface into an underlying storage layer that can infiltrate or attenuate storm water runoff.

The load bearing surface can be made of porous concrete, unit pavers or turf blocks separated by spaces and joints, through which water can drain.

Figure 3.13 — Schematic outline of the permeable pavement system



Reference Materials

HKGBC. 2010. *Hong Kong Green School Guide.*
Morgan, T., Riley, K., Tannebring, R., and Veldhuis, L. 2010. *Evaluating the Impacts of Small-Scale Greenspace: A Case Study of Harlem Place in Downtown Loa Angeles.* Published by University of California.

B. Active Design	B-1 Heating System	B-1-1 Centralized district heating

Description

Mongolia's heating systems can be can be divided into the following categories; a) centralized district heating systems with combined heat and power (CHP) in larger towns, b) centralized district heating systems with heating plants in aimag centers, c) centralized small building heating systems in locations with grid connection using HOBs (heat only boilers), d) individual building heating systems in locations without grid connection using HOBs, and e) stoves in a Ger. Educational buildings use CHP, HP, and HOB as heating sources.

Output specifications ☐ required ■ recommended ■ optional

Connect to CHP systems when available.

Decrease heat loss from pipelines.

Mongolian building codes and standards

None exist

Strategies

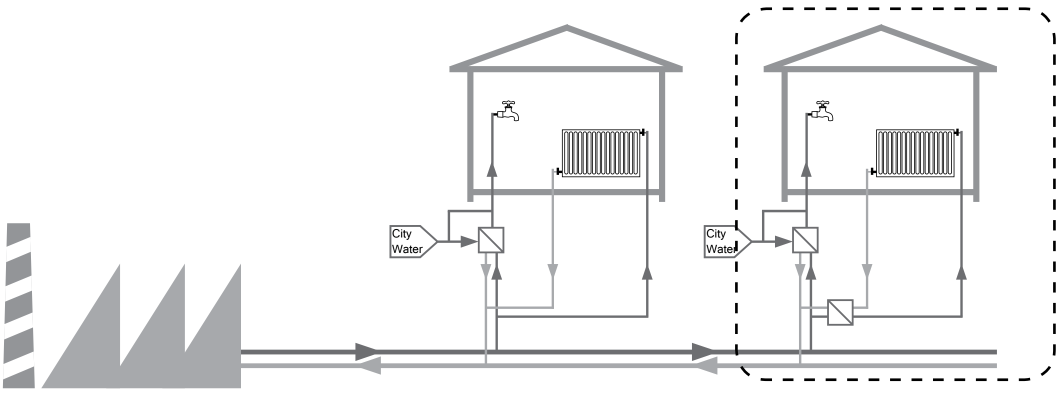
Connect to a centralized district heating system when available. These systems are more convenient and sustainable because they eliminate the need to operate and maintain a conventional boiler plant. The system has three main elements: the heat source, the distribution system (hot water pipeline), and the customer interface (heat exchanger).

Decrease heat loss from the distribution system (hot water pipeline), improve heating substation efficiency (heat exchanger), and balance the heating network by installing primary control valves.

Table 3.13 — Examples of temperatures used for the design of district heating systems

Country	Supply temperature	Return temperature	Hot water
Denmark	70	40	<60
Finland	70	40	55
Korea	70	50	55
Russia	95	75	50
Germany	80	60	55

Figure 3.14 — Centralized district heating system



Reference Materials

USAID. 2013. *Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.*

Skagestad, B., Mildenstein, P. 2011. *District Heating and Cooling Connection Handbook*. IEA.

B. Active Design	B-1 Heating System	B-1-2 Heat Only Boiler

Description

The primary purpose of the boiler is to supply energy to operate education buildings (e.g. heat and hot water). Some areas in Mongolia rely on inefficient HOBs for heating that are not connected to the centralized district heating system. To reduce air pollution, it is important to select a high-efficiency boiler that is well-suited to the application. When selecting a boiler to meet application needs, certain criteria (building codes and standards, boiler load, number of boilers, performance considerations, etc.) should be considered.

Output specifications ■ required ■ recommended ■ optional

Implement boiler with minimum of 80% efficiency for buildings.

Mongolian building codes and standards

None exist

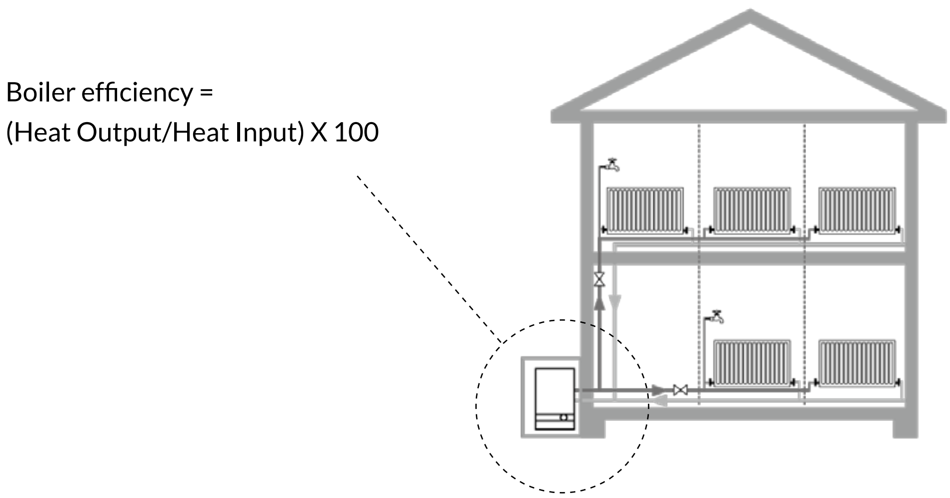
Strategies

Improve efficiency of heat source (boiler and pump efficiency).

Decrease heat loss (leakage and transmission loss) from pipelines.

Improve heating system. Rather than relying solely on a coal fired boiler, connect to on-site renewable energy for heat source to reduce environmental impact. (Refer to 'Onsite Renewable Energy' for more information)

Figure 3.15 — Individual boiler system and zone control



Reference Materials

Cleaver Brooks. 2010. *Boiler Efficiency Guide*
Skagestad, B., Mildenstein, P. 2011. *District Heating and Cooling Connection Handbook*. IEA.

B. Active Design	B-1 Heating System	B-1-3 Radiator

Description

Radiators connected to central steam boiler systems are typically used to heat classrooms in Mongolia. It is considered to be a heat exchanger between the heating water and the air of the classroom. According to field research results stated in the USAID report, winter temperatures in classrooms varied between 8° to 9°C on the north side of the building, and between 16° to 18°C on the south side. Thus, radiators with a zone control system are needed to ensure thermal comfort of classrooms.

Output specifications ■ required ■ recommended ■ optional

Select radiators (appropriate size and finish) depending on the size of classroom, the level of insulation, and the amount of heat required.

Install radiator operating valves for zone control.

Mongolian building codes and standards

None exist

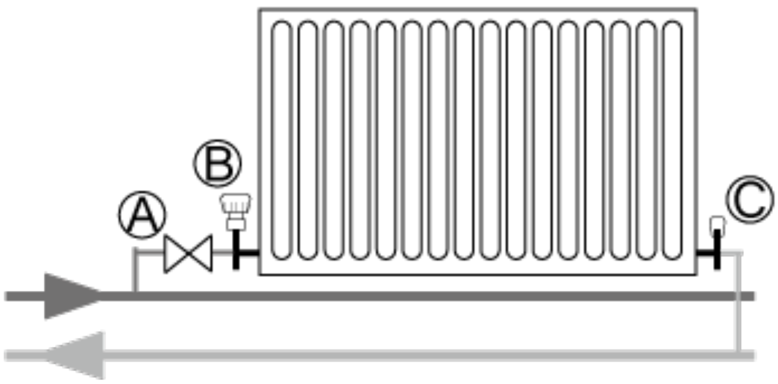
Strategies

To ensure thermal comfort of the classroom and to reduce energy consumption used for space heating, zone control needed.

Install radiator operating valves (TRV-Thermostatic Radiator Valves) to moderate classroom temperatures.

If necessary, radiator cleaning and replacement needed.

Figure 3.16 — Radiator and valves



A. Zone valve, B. TRV sense, C. Lockshield valve

Reference Materials

USAID. 2013. *Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.*

Honeywell Braukmann. 1990. *Thermostatic Radiator Valves.*

B. Active Design	B-1 Heating System	B-1-4 Radiant floor heating

Description

Radiant systems can save large amounts of energy while providing better comfort, depending on the building and the climate. Traditional systems use standalone radiators, while modern systems are often built into floors or ceilings. Rather than heating air, radiant floor heating systems heat surfaces and then radiate heat to building users.

Output specifications ☐ required ■ recommended ■ optional

Install radiant floor heating in kindergarten classrooms.

Mongolian building codes and standards

None exist

Strategies

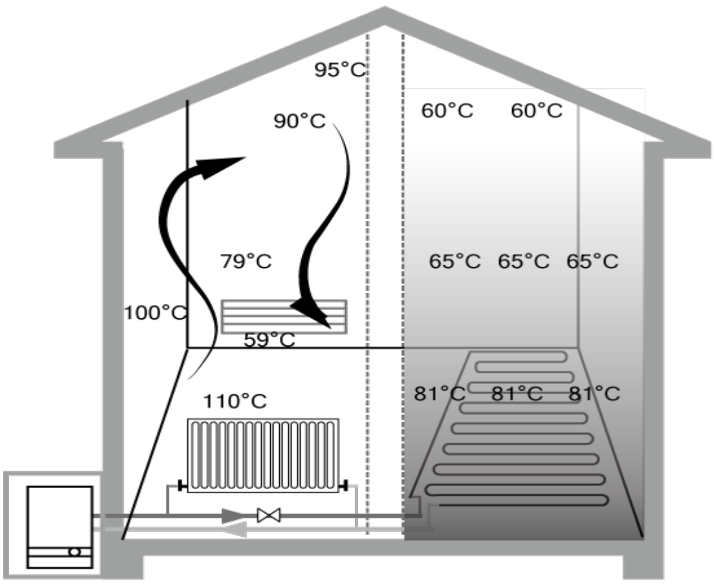
Knowledgeable design and proper installation is important due to the complexity of radiant floor heating systems.

Adequate insulation should be installed beneath the heating system/floor. Manifolds are used to ensure proper zoning.

Controls should be connected to the heating system to optimize temperature set points and maximize savings.

Radiant floors can be directly heated by electric resistance heating, or heated by water in a circulating loop. The water must be heated by a boiler or a geothermal heat pump (if available).

Figure 3.17 — Radiant floor heating system and warm air distribution



Reference Materials

WBDG. 2015. *"High Performance Technology Strategy Templates"* Accessed December 15. http://www.wdbq.org.

B. Active Design	B-2 Heat Meter

Description

A heat meter is an instrument that measures the heat absorbed or given out by a heat-conveying fluid across a heat exchange circuit. Three principal subcomponents constitute a complete heat metering instrument: a pair of matched temperature sensors, a fluid flow sensor, and a calculator. It is typically used in industrial plants for measuring boiler output and heat taken by processes, and for district heating systems to measure the heat delivered to building users.

Output specifications ☐ required ■ recommended ■ optional

Install an instrument that measures net boiler heat output over time in the boiler room.

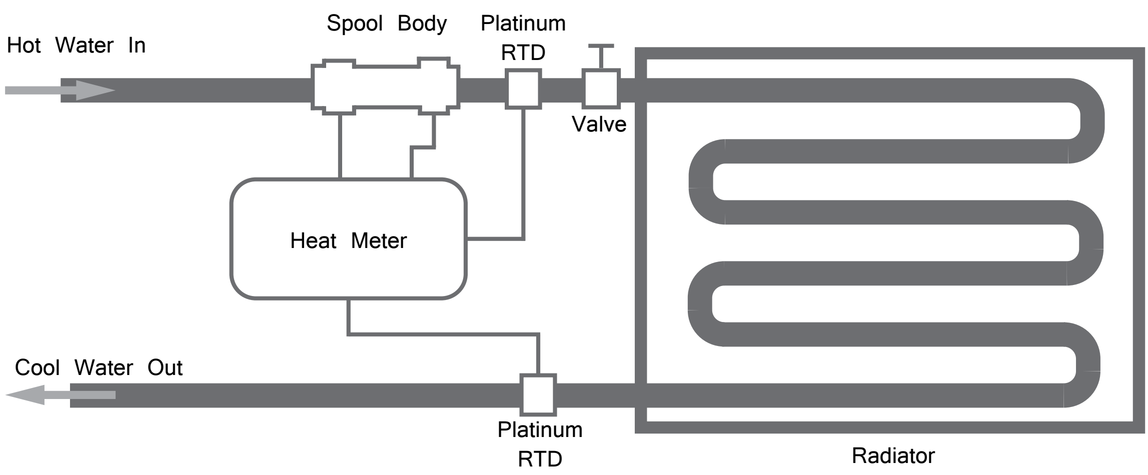
Mongolian building codes and standards

None exist

Strategies

Monitor this heat meter, in conjunction with interior temperatures and moisture conditions.

Figure 3.18 — Heat meter placement



Reference Materials

USAID. 2013. *Evaluation of the Ulaanbaatar School Buildings Thermo-technical Retrofitting Project.*

B. Active Design	B-3 Indoor Lighting	B-3-1 Light Fixture

Description

It is necessary to turn to electric lighting when daylight fades. To achieve a quality lighting environment, carefully select equipment that satisfies both performance and aesthetics needs. Light fixture selection should be based on a balance between the design requirements and an effort to limit the number of fixture and lamp types in order to have reasonable maintenance inventories.

Output specifications ■ required ■ recommended ■ optional

Select light fixtures that can reduce use of electricity.

Maintain proper level of illuminance at all times through the life of the installation.

Mongolian building codes and standards

BNbD 23-02-08

Strategies

There are many options of light fixture (lamp). The lamp selection is based on efficacy (lumens per watt), color rendering index, color temperature, life and lumen maintenance, availability, switching, dimming capability, and cost. Refer to the comparison table below.

Table 3.14 — Types of light fixtures

Technology	CRI	Efficacy (lumen/W)	Color Temperature(K)	Lifetime (hrs)	Initial Cost	Energy Consumption
Compact Fluorescent	80-90	60-70	2,700-6,500	6,000-10,000 (High)	Medium-Low	Low
Linear Fluorescent	70-90	80-100+	2,700-6,500	20,000 (High)	Low-Medium	Low
White LED	65-90	20-50	2,700-6,500	Up to 100,000 (High)	Medium-High	Low-Medium
Halogen	100	16-29	2,850-3,200	2,000-4,000 (Medium)	Medium	High
Incandescent	100	12-18	2,400-2,900	750-1,500 (Low)	Low	High

Maintain proper level of illuminance.

Table 3.15 — Minimum illuminance requirements

Type of Space	Minimum illuminance(lux)
General Teaching Space	300
Teaching spaces with close and detailed work	500

Reference Materials

DFEE. 1997. *Building Bulletin 90: Lighting Design for Schools.*

Chartered Institution of Building Services Engineers. 1994. Interior Lighting.

B. Active Design	B-3 Indoor Lighting	B-3-2 Light control system

Description

Lighting controls help ensure that lighting is delivered at the right levels for particular areas or classrooms when required. Up to 60% of the installed lighting load can be saved with the proper use of appropriate lighting controls. Lighting controls can be used for a range of applications such as dimming, presence detection, and switching off lights when there is sufficient daylight.

Output specifications ■ required ■ recommended ■ optional

Install a properly planned lighting control system.

Mongolian building codes and standards

None exist

Strategies

A manual control system (part switching/group switching) is required. This allows a certain number of luminaires or lamps to be controlled from local locations (e.g. with appropriate separate ‘zones’, on bright days the luminaires closest to the windows would not need to be switched on and would therefore save energy).

For recommended, additional lighting control and strategies can be considered:
- Daylight sensor (also known as photocell sensor) that operates (or dims) the lighting according to daylight levels.
- Motion sensor (also known as infrared red sensor) that operates the lighting according to occupancy.
- Lighting control point (also known as zoning) means one control point for one small zone within an open space plan instead of one control point for the whole open space plan. This prevents all lighting units within the open space plan from being turned on when only a small zone requires illumination.

Table 3.16 — Design strategies of light control system

Space/Area	Typical Pattern of Use	Automatic Control Upgrades from Manual Switching		Device
		Sufficient Daylight Available	Insufficient Daylight Available	
General classrooms	Usually occupied			Recessed infrared Surface mounted infrared Combined infrared detector Time-operated units
	Variable occupation			Recessed infrared Surface mounted infrared Combined infrared detector Time-operated units
Laboratories	Usually occupied			Recessed infrared Surface mounted infrared
*SYMBOL LEGEND	Automatic daylight sensing to ‘off’ or ‘Dimming’  Appropriate automatic occupancy sensing  Time Operated			

Reference Materials

HKGBC. 2010. *Hong Kong Green School Guide*

SEAI. 2012. *Lighting Controls: A Guide to Energy Efficient and Cost Effective Lighting.*

B. Active Design	B-4 Water Efficient Fixture

Description

In addition to saving on utility costs, water conservation helps prevent the pollution of nearby lakes, rivers, and local watersheds. Conserving water can also extend the life of a septic system by reducing soil saturation and any pollution due to leaks.

Output specifications ☐ required ■ recommended ■ optional

Install water efficient fixtures to reduce water use in the education buildings.

Mongolian building codes and standards

None exist

Strategies

Water conservation has become an essential practice in Mongolia where the average annual precipitation is low (200-220 mm). Educational buildings in Mongolia can select water efficient fixtures (e.g. low flow toilets, dual flush water closets, low flush sensor controlled urinals, high efficiency faucets, infrared sensors, etc.) to reduce water consumption.

Reference Materials

HKGBC. 2010. *Hong Kong Green School Guide.*

B. Active Design	B-5 On-Site Renewable Energy	B-5-1 Geothermal

Description

A Ground Source Heat Pump (GSHP, also known as geothermal heat pump) transfers heat between the earth and a conditioned space. An open-loop system uses water from a nearby body of water to circulate heat between the water and the conditioned space. A closed-loop system uses an isolated fluid loop to draw from or discard heat to the ground. A GSHP uses electricity for moving the circulation fluid and concentrate the heat it contains for practical use.

Output specifications ☐ required ☐ recommended ■ optional

Install a geothermal heat pump system and utilize its energy source for heating.

Mongolian building codes and standards

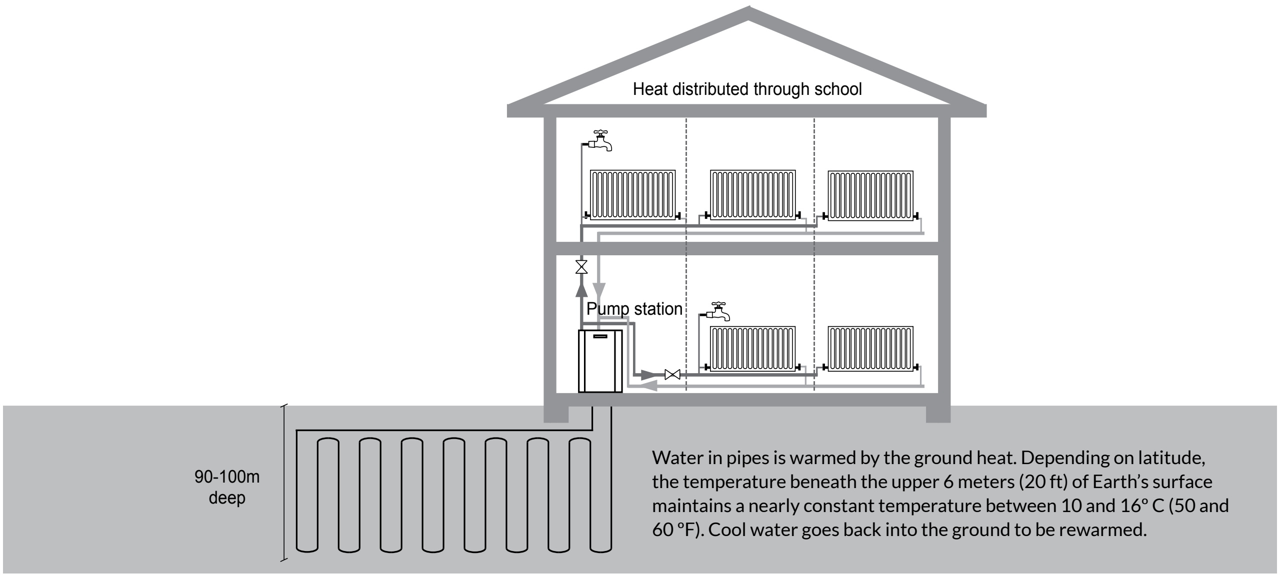
None exist

Strategies

Install a geothermal heat pump system which consists of a heat pump, an indoor handling unit, and a heat exchanger (system of pipes called a loop which is buried in the shallow ground near the building). The circulation loop can be installed vertically or horizontally, and range in size from 1.5kW to 300kW.

Geothermal heat pumps have high initial costs but are one of the most energy-efficient methods of heating. A geothermal heat pump system can cost USD 3,500-7,500 per unit. Excavation and installation costs can bring total costs to USD 10,000-25,000 or more. Cost to install a geothermal heat pump system varies greatly by region. Thereby, system selection and proper installation is important due to its complexity.

Figure 3.19 — Schematic outline of geothermal system



Reference Materials

Dorj, P. 2001. Design of Small Geothermal Heating Systems and Power Generators for Rural Consumers in Mongolia. Published by University of The United Nations, Iceland.

Kiplinger. 2015. "Home Projects That Save Energy and Money." Assessed July 18. http://energyhousecalls.com/home-projects-that-save-energy-and-money-3.

B. Active Design	B-5 On-Site Renewable Energy	B-5-2 PV

Description

Solar photovoltaic (PV) panels use semiconductors to convert sunlight into electricity, providing energy whenever the sun is shining. Solar PV systems are easily scalable, providing any desired amount of power by linking individual panels together to form arrays. Panels are easy to integrate, having little impact on other building systems. For optimum efficiency a panel must be installed in an unshaded area and angled to face the sun as often as possible.

Output specifications ☐ required ☐ recommended ■ optional

Install a PV system to reduce energy use in the building.

Mongolian building codes and standards

None exist

Strategies

System selection and proper installation of PV system is important due to its complexity.

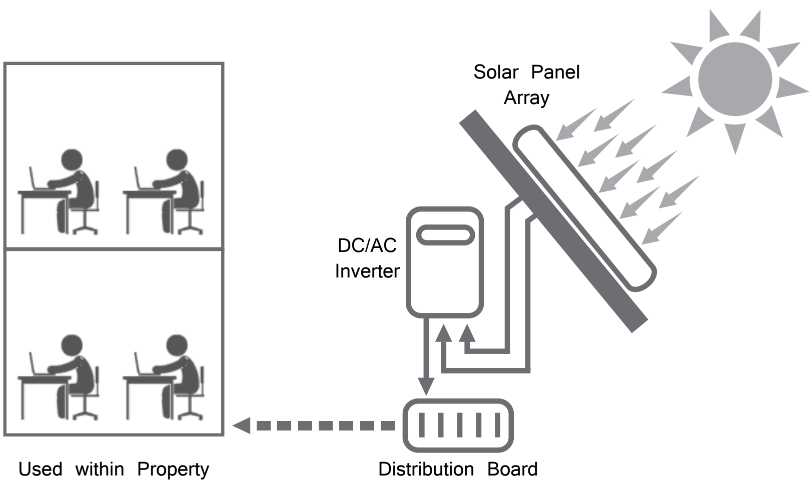
Consider placement of the system due to the shading from surrounding buildings. When installed on the roof, consider structural loading (additional weight and wind effect).

Consider efficiency of the PV system (see table below).

Table 3.17 — Types of PV system and the efficiency

	Efficiency	Peak Output	Suitable for Use With
Rigid Crystalline	12% - 15%	120 – 150 W/m²	Direct Sunlight Tracking Systems
Thin Film	5.5% - 7.5%	55 – 75 W/m²	Indirect light, overcast skies Vertical & BIPV systems

Figure 3.20 — Schematic outline of PV system



Reference Materials

Ontario ministry of Education. 2010. Green Schools Resource Guide: A Practical Resource for Planning and Building Green Schools in Ontario.

B. Active Design	B-5 On-Site Renewable Energy	B-5-3 Solar thermal

Description

Solar thermal panels (also known as collectors), are made up of either evacuated glass tubes or flat plate collectors encasing metal tubing. Collectors absorb the sun's heat energy and transfer it to a heat transfer fluid in the system. A pump moves the hot fluid to a domestic water tank where the heat is transferred to the water through a heat exchanger.

Output specifications ☐ required ☐ recommended ■ optional

Install a solar collector on the roof to collect heat from the sun and utilize it to heat up water which is stored in a hot water cylinder. The boiler can be used as a backup to heat the water further to reach the target temperature.

Mongolian building codes and standards

None exist

Strategies

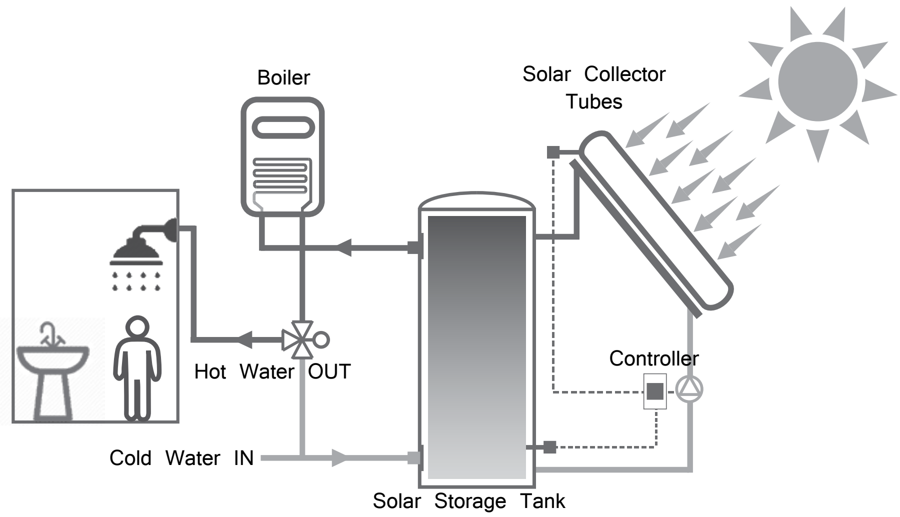
System selection and proper installation of the solar collector is important due to its complexity.

Consider placement of the system to avoid shading from surrounding buildings.

When installed on the roof, consider structural loading (additional weight and wind effect).

Solar collectors can provide the facility with the majority of its annual hot water requirements (save up to 75% on water heating bills).

Figure 3.21 — Schematic outline of solar thermal system



Reference Materials

Ontario Ministry of Education. 2010. Green Schools Resource Guide: A Practical Resource for Planning and Building Green Schools in Ontario.

C. Others	C-1 Collection of Recyclables

Description

Provide an easily-accessible dedicated area for recycling to facilitate the reduction of waste generated by building users.

Output specifications ■ required ■ recommended ■ optional

Place recycling bins on each floor and encourage building users to reduce waste generation in the building.

Mongolian building codes and standards

None exist

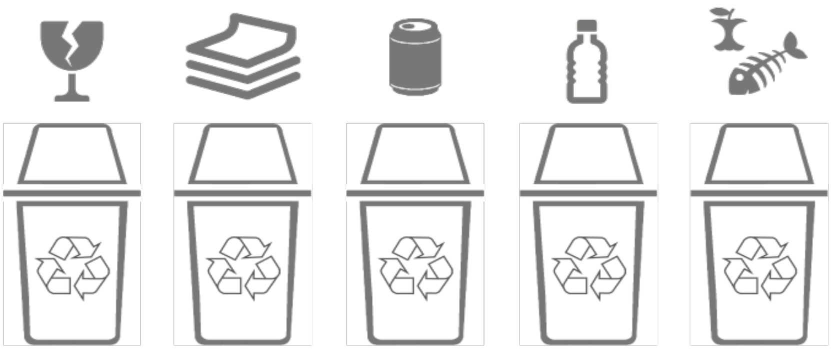
Strategies

Designate an area for recyclable collection (placement of recycling bins) that is appropriately sized and located in a convenient area.

Identify local waste handlers for glass, paper, metal, plastic, and organic wastes.

To further enhance the recycling program, consider employing cardboard balers, aluminum can crushers, recycling chutes and other waste management strategies.

Figure 3.22 — Types of recyclable materials



Reference Materials

USGBC. 2009. LEED 2009 for Schools New Construction and Major Renovations.

C. Others	C-2 Joint Use of Facility
Description	
Joint use of the facility is needed to make the school a more integrated part of the community by enabling the building and its playing fields to be used for non-school events and functions proposed in the PPP model.	
Output specifications ■ required ■ recommended ■ optional	
Provide spaces for public use in the building.	
Mongolian building codes and standards	
Mongolian legal environment should be considered.	
Strategies	
In collaboration with the key stakeholders in the education sectors, engage in a contract with community or other organizations to provide at least one space for public use in the educational building. Dedicated-use spaces include, but are not limited to: - Community service centers (e.g. provided by city) - Library or media center - Parking lot - Recreational center/playground	
Provide a separate entry to the spaces intended for joint use. The entry can be from a lobby or corridor near an entrance convenient to public access, which can be secured from the rest of the building.	
Reference Materials	
USGBC. 2009. LEED 2009 for Schools New Construction and Major Renovations.	

3.2.3 Operation & Maintenance

This section provides information to consider in preparing output specifications for the operation and maintenance of education buildings. O&M is critical to meeting green performance targets. The energy and water use, indoor environmental quality, waste reduction, and the green design choices made in the design and construction phase can be significantly affected by the way the educational building is operated and maintained. As shown in Figure 3.23, the O&M costs account for about 65-85% of the total LCC of the building (Ramesh 2012, 177). It is critical for operators and building users to minimize O&M costs (fixed costs).

Figure 3.23 — Total building LCC

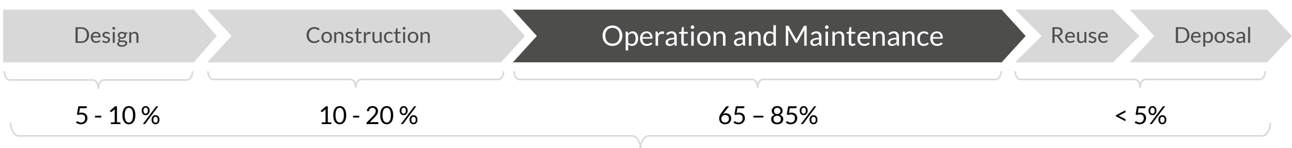


Figure 3.24 — O&M cost (energy use in buildings)

For a typical educational building, the majority of O&M costs are spent on lighting, heating and cooling, and hot water. The items included in the O&M checklist have an impact on O&M costs. Under the PPP contract, private partners must make reasonable efforts to inspect and correct defects (i.e. failure to satisfy expected performance requirements) if needed during the O&M phase.

Table 3.18 — O&M checklist

Items/Technologies			Y/N
Passive Design	Construction activity pollution prevention		○
	Site selection		○
	Site planning & building orientation		○
	Building envelope		●
	Daylight and view		○
	Materials		●
	Acoustic		○
	Green space		●
	Pervious pavement		○
	IAQ		●
Active Design	Heating system	Centralized district heating	○
		HOB	●
		Radiator	○
		Radiant floor heating	○
	Heat meter		●
	Indoor lighting	Centralized district heating	●
		HOB	○
	Efficient water fixtures		●
	On-site renewable energy	Geothermal	●
		PV panels	●
		Solar collector	●
Others	Collection of recyclables		○
	Joint use of facility		○

Building Envelope

Considerations for output specifications

Regularly inspect exterior envelope for moisture penetration, particularly around wall penetrations and where un-insulated materials may come into contact with cold outside air.

Ensure exterior windows/walls are free from cracks, damages, or broken panes. If any of these defects occur, private partners shall repair any performance defects within the allowed response (e.g. 1 day, 5 days, or 10 days depending on urgency).

Ensure proper operation of internal shading devices throughout the day, to avoid glare, daylight blocking, or interference on natural ventilation. Close curtains and window coverings at night, and open them during the day and use sunlight instead of turning on lights.

Refer to the maintenance cycle table below.

Table 3.19 — Maintenance cycle of building envelope

Elements			Maintenance Cycle (yrs)	Remark
Exterior Wall	Brick		30	
	Stucco	Local repair	12-20	
		Re-painting	7-9	
		Replacement	30	
	Tile		20	
	Panel / Stone		15	
	Concrete block	Re-painting	7	
		Re-caulking	12-15	
	Plastering (mortar)		6	
Window	Re-caulking		15	
	Re-painting		5-7	
	Frame	Polyvinyl Chloride-framed	17-19	
		Wood-framed	16	
	Exterior window	Single pane	10-30	An average of 3% of the glazing is replaced each year
		Double pane	10-30	
Door	Classroom door		15	
Waterproof	Waterproof roof		15	
Floor Finish	Vinyl tile		8	
	Access floor		20	
	Timber flooring		15	
	Artificial stone (honed finishing)		45	
	Terrazzo tile (stone)		45	

Green Space (Outdoor environment included)

Considerations for output specifications

On-site green space requires maintenance. However, incorporating native plants makes maintenance easier in the long term.

Install native trees, shrubs, vines, and perennials in the fall for easiest maintenance. Fall is a better time to plant because weather is usually cooler with more precipitation. In colder climates, planting in the fall allows the roots time to grow and get established before winter sets in.

Maintenance Techniques

- Pruning: Reduce personal injury by pruning large, established trees. If pruning for shape, never prune more than one-third of the mass of the shrub or tree.

- Mulching: Mulching protects soil moisture and helps discourage weeds. In the spring, apply 50 mm of organic mulch to conserve ground moisture for plant use. Mulch also discourages weeds and unwanted seedlings from growing. Apply mulch again in the fall if the spring mulch has decomposed and the bare ground is showing. Mulch absorbs water and releases it slowly to the plant roots, keeping the soil moist and conserving water. It helps keep water from evaporating from the soil surface, cools the soil, reduces erosion, and helps prevent weeds from germinating. Organic mulch is made up of material that was once part of the living world, such as leaves, bark, and pine needles.

Refer to the maintenance cycle table below.

Table 3.20 — Maintenance cycle of outdoor environment

Elements			Maintenance Cycle (yrs)	Remark
Outdoor environment	Drain		20	
	Fence	Retaining wall	30	
		Stone wall	20	
		Steel wall	20	
		Brick wall	20	
	Pavement	Concrete	20	
		Asphalt concrete	20	
		Permeable concrete	20	
		Pavement block	10	
		Urethane	10	
		Artificial grass	10	

Indoor Air Quality (Materials included)

Considerations for output specifications

By reducing the amount of dust and dirt that enter the building, enhanced IAQ can be maintained with less effort. Schools and Kindergartens with better IAQ can have positive physical and psychological effects on students and staff. Complaints of illness and discomfort have been associated with buildings having high dust levels. In addition to dust, other particles such as pollens which can cause allergic reaction can also be reduced.

Maintain barrier floor mat for all entrances.

Barrier mats need to be long enough to allow five full steps for people entering the building (this allows dirt to be cleaned from the mats rather than throughout the building, saving cleaning costs).

Vacuum each barrier mat daily using a beater brush or beater bar vacuum, vacuuming in two directions (in-line and side-to-side).

Develop an IAQ management plan that includes the use of sustainable finishing materials, cleaning compounds, and integrated pest control systems.

Conduct an annual IAQ Test (examine TVOC level) and submit report. (Appoint a responsible review committee/ agency from the GoM.)

Heating system (Boiler)

Considerations for output specifications

Regularly inspect and clean installed equipment.

Target internal temperatures of normally occupied space to be 22°C and occasionally occupied space to be 20°C. Target temperature may vary in the range of 4°C.

Refer to the level of physical activity.

Refer to the maintenance schedule below.

Table 3.21 — Boiler maintenance schedule and strategies

Interval	Item	Procedure
As Needed	Ash removal	Remove ash and observe condition of ash. Adjust grate timer if necessary.
Weekly	Fire bed (when burning poor quality coal)	Check for clinkers and remove if necessary. Note: poor coal quality produces clinkers.
Every 3 months	Roller chains	Lubricate with chain oil and tighten slack.
Every 3 months	Drive belt	Check belt condition. Replace or adjust tension.
Every 3 months	Fan shaft bearings (belt drive models only)	Grease with high temperature grease.
Every 6 months	Abrasion shield	Check for leakage around gasket. Adjust or replace if necessary.
Every 6 months	Flue pipe	Check for leakage around seams and re-seal if necessary.
End of season	Cam bearing on grate	Check to make sure bearings are free to rotate.
End of season	Fire box	Clean and inspect fire box.
End of season	Swirl chamber	Clean and remove any buildup with a boiler brush. Inspect fan condition look for cracks and wear.
End of season	Ceramic heat shield	Check for wear around fan shaft hole – replace if gap is greater than 1/16”.
End of season	Flue pipe	Remove flue tube assembly and clean. Inspect cyclone funnel.

Efficient Water Fixtures

Considerations

Replace conventional items with water efficient fixtures to reduce water use during O&M period.

Table 3.22 — Water efficient fixtures and potential water savings

Appliances and fixtures	Water Use	Conventional fixture Water Use	Units	Percent Water Savings
 Low flow toilets	4.85	6.05	Liter per flush	20%
 Dual flush toilet valves	4.81	6.05	Liter per flush	21%
Low flow urinals	0.47	3.79	Liter per flush	88%
 No flow urinals	0	3.79	Liter per flush	100%
 High efficiency faucets	5.68	8.33	Liter per second	32%
 High efficiency faucet aerators	1.90	8.33	Liter per second	77%
 Shower heads	5.68	9.46	Liter per second	40%

Renewable energy (Geothermal)

Considerations

Regularly inspect and clean installed equipment.

Refer to the maintenance schedule below.

Table 3.23 — Geothermal maintenance schedule and strategies

Interval	Procedure
Initial start-up	Change out construction filters. Verify that air paths are free of construction debris and that fans turn freely. Verify compressor rotation. Verify outdoor air minimum position.
Every 3 months	Change filters.
Every 12 months	Vacuum out evaporator drain pan. Clean strainer in the hydronic circuit (if applicable). Check condition of ERV desiccant wheel, clean if necessary.
Every 24 months	Clean evaporator coil. Vacuum any loose debris from unit's interior return air section. Inspect dampers to ensure that there is a proper seal.

Renewable energy (PV)

Considerations

Follow PV maintenance procedure below.

Clean the glass surface of the module as necessary. Use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used if necessary. Do not use dishwasher detergent.

Electrical and mechanical connections should be checked periodically by qualified personnel to verify that they are clean, secure and undamaged.

Check the electrical and mechanical connections periodically to verify that they are clean, secure and undamaged.

Problems should only be investigated by qualified personnel.

Observe the maintenance instructions for all other components used in the system.

Conduct annual inspection.

Check if nuts and bolts of mounting structure are secure and not loose. Tighten loose components again, if required.

Check the water resistance of connecting cables, grounding cables and connectors and the performance of the ground resistance.

Check all electrical and mechanical connections from freedom of corrosion.

Check the ground resistance of metal parts such as the module frames and the mounting structures.

Renewable energy (Solar thermal)
Considerations
Regularly inspect and clean installed equipment.
Regular rain should keep the evacuated tubes clean, but if particularly dirty they may be washed with a soft cloth and warm, soapy water or glass cleaning solution but ONLY if the solar collector is located in a position which does require climbing onto the roof, use of stepladder or otherwise potentially dangerous location. If the tubes are not easily and safely accessible, a high-pressure water spray is also effective.
If cleaning is required and the above outlined methods are not suitable, the company that supplied and installed the solar collector should be contacted to complete such cleaning.
If a tube is broken it should be replaced as soon as possible to maintain maximum collector performance. The system will still operate normally and safely even with a tube broken. Any broken glass should be cleared away to prevent injury.
Properly insulate the pipes.
The plumbing pipes running to and from the collector should be heavily insulated (15-20mm). This insulation foam should be checked periodically (at least once every 3 years) for damage.
For any insulation that is exposed to sunlight, ensure any protective cover/wrap/foil is in good condition replacing as required.
Draining may be required if maintaining the system or in preparation for extremely cold conditions (extended snow cover). Follow the procedure below, in order to drain the collector of fresh water (direct flow system).
Turn off the mains water supply to the solar storage tank.
If the storage tank or other system components are being concurrently drained, refer to their instruction manuals for details. If the storage tank is not being drained, isolate piping to and from the solar collector (isolation valves should already be installed), and immediately open drain valves on both lines (and undo fittings). Never leave the isolation valves in the off position while the collector is full of water and exposed to sunlight as the water will heat cause a pressure increase which may rupture of fittings/connections. In good weather the water may be hot or may have built up pressure, so take care when opening the drain valve.
Allow the manifold to sit in a vented state for 5-10min to allow the manifold to boil dry (may need longer in poor weather.)
Always leave one drain valve or fitting open, otherwise the system may build up pressure when it heats.
For draining of other types of systems, refer to specific instructions for the system used.

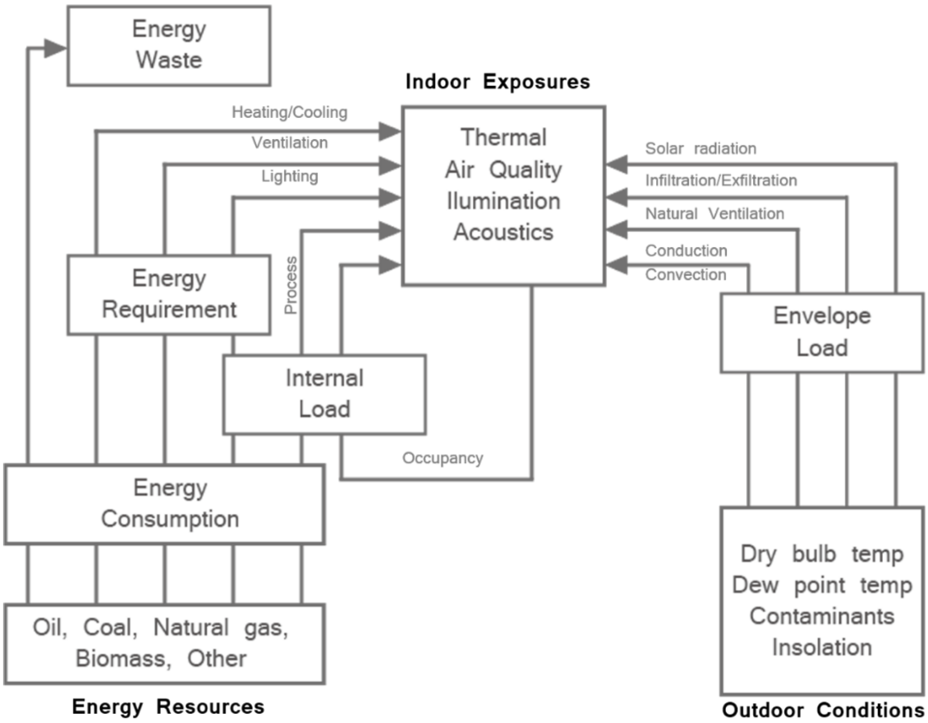
3.3 Validation

3.3.1 Purpose and Method

Building energy performance assessments are conducted using computer based simulations to verify the performance improvements of green options (required, recommended, and optional) proposed in the TG framework.

Buildings are complex physical objects. They interact with their immediate surroundings while fulfilling their function of providing a comfortable environment for users. The way a building performs is affected by the choices made in selecting building materials and components, in designing the building envelope (walls, windows, roofs), and in selecting the different systems (lighting, HVAC, etc.). Buildings provide comfortable indoor environments, including thermal, visual, and acoustical aspects through the consumption energy (Maile 2007).

Figure 3.25 — Energy flow and concepts in buildings



Building energy simulations are powerful tools for analyzing energy performance and thermal comfort during a building's life cycle. A large number of simulation tools have been developed over the last few decades. The Building Energy Software Tools Directory (BESTD), run by the U.S. Department of Energy lists over 380 tools, ranging from research grade software to commercial products.

For accurate, computer-based simulation, it is important to select an approved tool, such as, DOE-2, Energy Plus, ESP, or Virtual Environment (VE) by Integrated Environmental Solutions (IES-VE), etc.) that complies with the globally recognized ANSI/ASHRAE Standard 140, also known as the Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs, developed by the American National Standards Institute (ANSI) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

The purpose of this standard is to identify, diagnose, and minimize predictive differences from whole building energy simulation software that may possibly be caused by algorithmic differences, modeling limitations, input differences, or coding errors.

These approved tools can evaluate architectural design decisions as well as choices for construction materials and methods. Complicated design issues can be examined and their performance can be quantified and evaluated by modeling the thermal, visual, ventilation, and other energy consuming processes taking place within a building.

Among the widely approved tools, VE by IES-VE is used to conduct building energy performance assessments. IES-VE is fully validated under ASHRAE Standard 140 and has published the results for all versions of ANSI/ASHRAE Standard 140; 2001, 2004 and 2007. (Refer to Appendix D: IES-VE Reliability.)

3.3.2 Simulation Tool (IES-VE)

VE by IES-VE is a modern example of dynamic building energy simulation software. IES-VE consists of a suite of integrated analysis tools, which can be used to investigate the performance of a building either retrospectively or during the design stages of a construction project.

A model of a building can be constructed within VE using the 'Model IT' module, which can then be analyzed in a variety of ways. For example, the software includes a module called 'Radiance' that looks at the viability of day-light and a module called 'MacroFlo' that investigates the effectiveness of natural ventilation. The most commonly used thermal analysis module is the 'ApacheSim', which provides either a steady-state or dynamic analysis of energy consumption and indoor thermal conditions. The table below provides more detailed information for each module.

Table 3.24 — IES-VE module description

Type	Description
Model IT	3D Model data management for all performance analysis modeling: creation, import, modification, and dynamic visualization
	Builds models suitable for any stage of the design process; from simple to fully developed detail
	Room information management, grouping, and template creation
	Geometry shared by all VE applications
ApacheSim	Advanced dynamic thermal simulation at sub-hourly time steps for better computation of building components
	Assesses solar gain on surfaces, surface temperatures and radiant exchanges
	Extensive range of results variables for buildings and systems
	Building and room-level annual, monthly, hourly, and sub-hourly analysis
	Assesses passive performance, thermal mass, and temperature distribution
	Links results from ApacheHVAC, MacroFlo, Suncast and Radiance Integrated Environment Solutions (IES), and use as integral thermal simulation inputs
	Exports results to MacroFlo as boundary conditions for detailed Computational Fluid Dynamics (CFD) analysis
Suncast	Takes into account the sun's path and solar penetration to optimize building position and orientation early on
	Understands the impact of the sun on a building and assesses how to minimize or maximize the effect of solar gains
	Assesses the shading and right to light impact of surrounding buildings and terrain
	Tests internal and external solar shading devices
	Generates animated, visual, graphical, and numerical output for colleagues, clients, and planners
MacroFlow	Demonstrates how to reduce the need for air conditioning using natural and mixed-mode strategies
	Analyzes all aspects of bulk airflow: infiltration, natural ventilation, facade design, and mechanical ventilation
	Simulates air flow processes over different periods – from a single day to as long as a year
	Evaluates feasibility of strategies such as: single-sided ventilation, cross-ventilation, whole-building ventilation, chimneys, and opening controls

3.3.3 Model Setup

The baseline model selection procedure consisted of three steps: data collection, desktop review, and stakeholder consultations. The desktop review focused on the data needed for the project (e.g. climate, green growth policy, educational building standards, construction drawings, energy consumption data, etc.). The collected data was then assessed to validate the current conditions of education buildings and local suitability of green technologies. After completing the desktop review, stakeholder consultations and field researches were conducted. Through workshops with key stakeholders, including government officials and local experts, education buildings built in the 1980s were selected as a baseline model. The school and kindergarten buildings built from the 1960s to the early 1990s are the most predominant forms of the education buildings in Mongolia today. More than 70% of schools and kindergartens in Ulaanbaatar were constructed before 1990 (GIZ 2014, 26-33). From the obtained blueprints developed in 1970s (School No.25) the baseline educational building design (e.g. masonry walls without any insulation layer) was identified.

After selecting the baseline model, standard school and kindergarten floor plans (developed in 2014 and 2013 respectively) were reviewed to configure the green options (required, recommended, and optional models). The required model is based on the standard floor plans provided by MECS. It is designed and structured in compliance with Mongolia's current building codes and standards. To pursue improvements in building performance over the required model, different levels of green options (recommended and optional) are proposed which involve the implementation of additional green technologies. Building performance improvements for each option were evaluated by conducting computer based simulation. Key features of educational building standard floor plans for schools and kindergartens provided by MECS are as follows:

- Capacity: 640 students for school, 150 kids for kindergarten.
- Form of educational building (School and Kindergarten): Separated.

3.3.4 Energy Performance Assessment

The energy performance assessment of the baseline model and green options (required, recommended, and optional) were conducted to determine the energy and O&M cost savings. (Refer to Appendix E: Simulation Data.)

3.3.4.1 Schools

Input data for each option (required, recommended, and optional) is as follows. Refer to the comparison chart below to see the applied green items for schools.

Table 3.25 — Comparison of applied green technologies - Schools

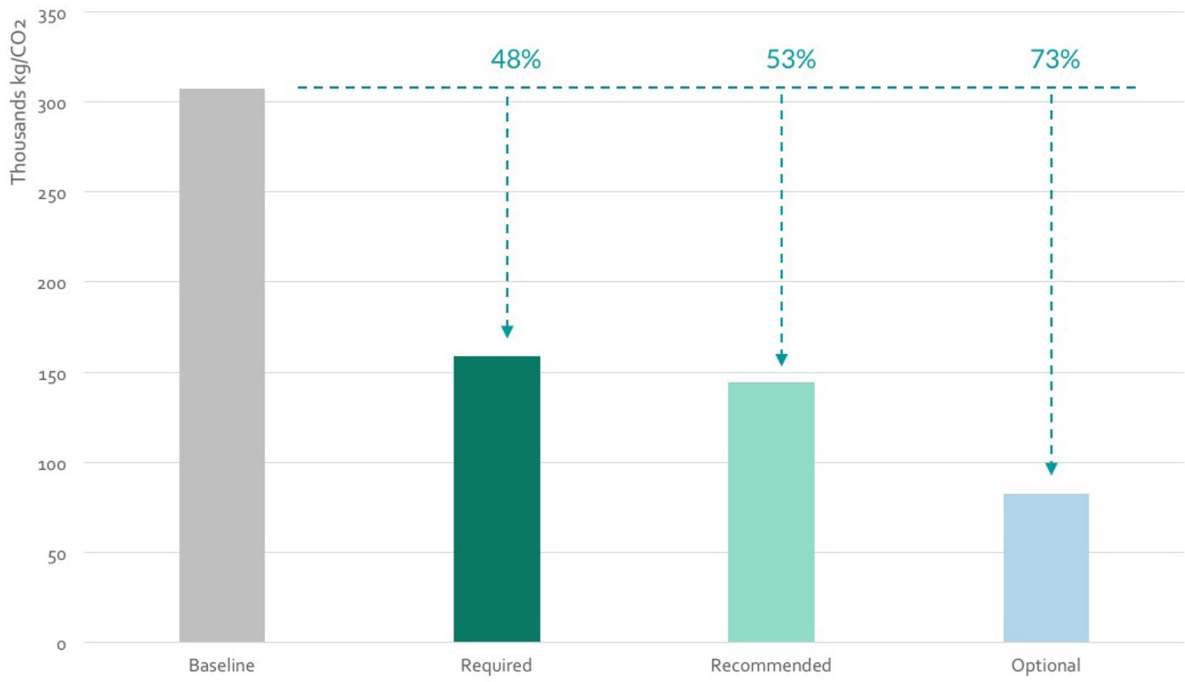
		Baseline	Required	Recommended	Optional
Building envelope			Air tightness + shading device	Air tightness + + shading device +light shelf	Air tightness + shading device + light shelf
U-Value	Wall	1.60 W/m^2K	0.25 W/m^2K	0.19 W/m^2K	0.19 W/m^2K
	Floor	1.40 W/m^2K	0.19 W/m^2K	0.14 W/m^2K	0.14 W/m^2K
	Roof	1.38 W/m^2K	0.18 W/m^2K	0.14 W/m^2K	0.14 W/m^2K
	Window	5.3 W/m^2K	2.2 W/m^2K	1.5 W/m^2K	1.5 W/m^2K
Heating system		Radiator	Radiator	Radiator + heat meter	Radiator + heat meter
Light fixture		Incandescent light	Fluorescent lamp + LED + Manual control	Fluorescent lamp + LED + Control system	Fluorescent Lamp + LED + Control system
Water use				Water efficiency fixture	Water efficiency fixture
Renewable energy					Geothermal (or) PV (or) Solar thermal (or) combined system

By complying with the requirements stated above, energy consumption and GHG emissions can be reduced. The expected performance outcomes of each option are validated and the results are shown below. The total annual energy use in school buildings was reduced by 48% (required), 56% (recommended), and 68% (optional) compared to the baseline.

Table 3.26 — Annual energy savings - Schools

	Baseline	Required	Recommended	Optional
Total annual energy use (kWh/yr)	3,570,000	1,863,553	1,580,648	1,153,148
Total annual energy savings (%)		48	56	68

Figure 3.26 — Annual energy use - Schools

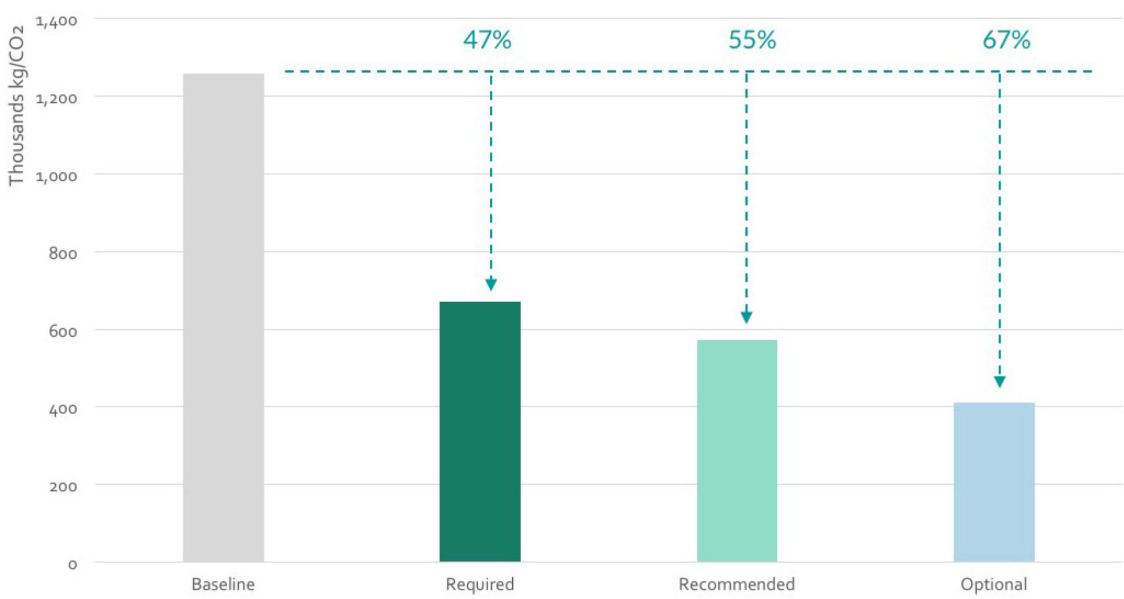


Environmental impacts are also expected to be reduced by greening education buildings. GHG Emissions (CO_2 emission) will be reduced by 47% (required), 55% (recommended), and 67% (optional) for each option compared to the baseline.

Table 3.27 — GHG emissions reduction - Schools

	Baseline	Required	Recommended	Optional
GHG Emission (kg/CO_2)	1,258,617	669,873	572,374	410,749
GHG Reduction (%)	-	47	55	67

Figure 3.27 — GHG emissions reduction - School



3.3.4.2 Kindergartens

Input data for each option (required, recommended, and optional) is as follows. Refer to the comparison chart below to see the applied green technology items in kindergartens.

Table 3.28 — Comparison of applied green items/technologies - Kindergartens

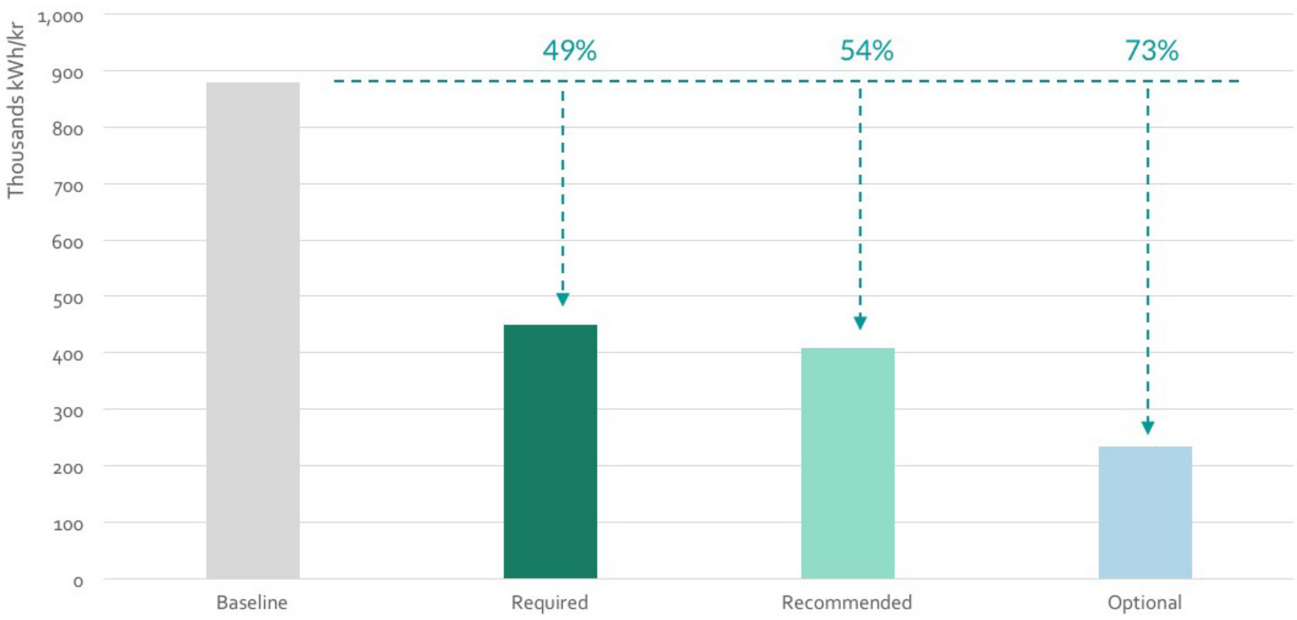
		Baseline	Required	Recommended	Optional
Building envelope			Air tightness + shading device	Air tightness + + shading device +light shelf	Air tightness + shading device + light shelf
U-Value	Wall	1.60 W/K	0.25 W/K	0.19 W/K	0.19 W/K
	Floor	1.40 W/K	0.19 W/K	0.14 W/K	0.14 W/K
	Roof	1.38 W/K	0.18 W/K	0.14 W/K	0.14 W/K
	Window	5.3 W/K	2.2 W/K	1.5 W/K	1.5 W/K
Heating system		Radiator	Radiator	Radiator + Radiant floor heating + Heat meter	Radiator + Radiant floor heating + Heat meter
Light fixture		Incandescent light	Fluorescent lamp + LED + Manual control	Fluorescent lamp + LED + Control system	Fluorescent lamp + LED + Control system
Water use				Water efficiency fixture	Water efficiency fixture
Renewable energy					Geothermal (or) PV (or) solar thermal (or) combined system

By complying with the requirements stated above, energy consumption and GHG emissions can be reduced. The expected performance outcomes of each option were validated and the results are shown below. The total annual energy use in kindergarten buildings can be reduced by 49% (required), 54% (recommended), and 73% (optional) compared to the baseline.

Table 3.29 — Annual energy savings - Kindergartens

	Baseline	Required	Recommended	Optional
Total annual energy use (kWh/yr.)	878,965	449,450	407,385	234,185
Total annual energy savings (%)		49	54	73

Figure 3.28 — Annual energy use - Kindergartens

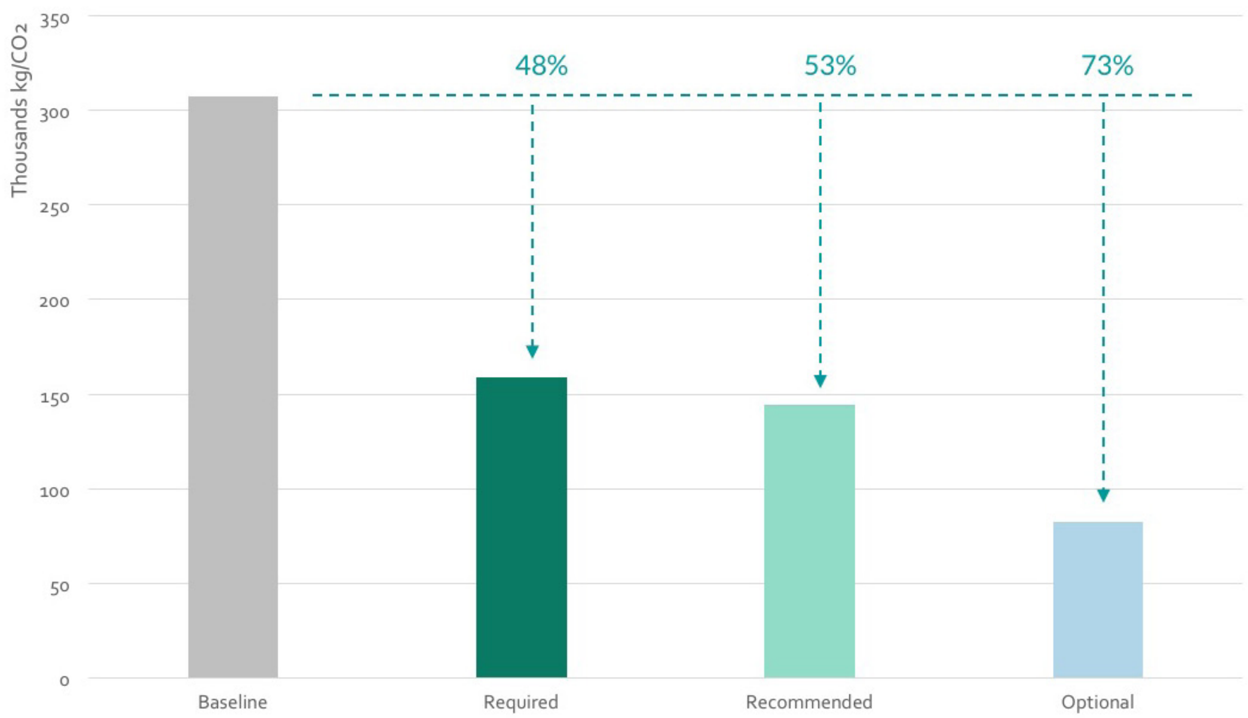


Environmental impacts are also expected to be reduced by greening education buildings. GHG Emissions (CO_2 emissions) can be reduced by 48% (required), 53% (recommended), and 73% (optional) for each option compared to the baseline.

Table 3.30 — GHG emissions reduction - Kindergartens

	Baseline	Required	Recommended	Optional
GHG Emission (kg/CO_2)	307,017	158,837	144,325	82,309
GHG Reduction (%)	-	48	53	73

Figure 3.29 — GHG emissions reduction - Kindergartens



3.3.5 Cost Analysis

When the output specifications suggested in TGs are successfully fulfilled, it is estimated that approximately 40% to 60% of O&M costs will be reduced annually. A detailed cost analysis can be found in the Appendix F.

Figure 3.30 — Estimated O&M Cost savings - Schools

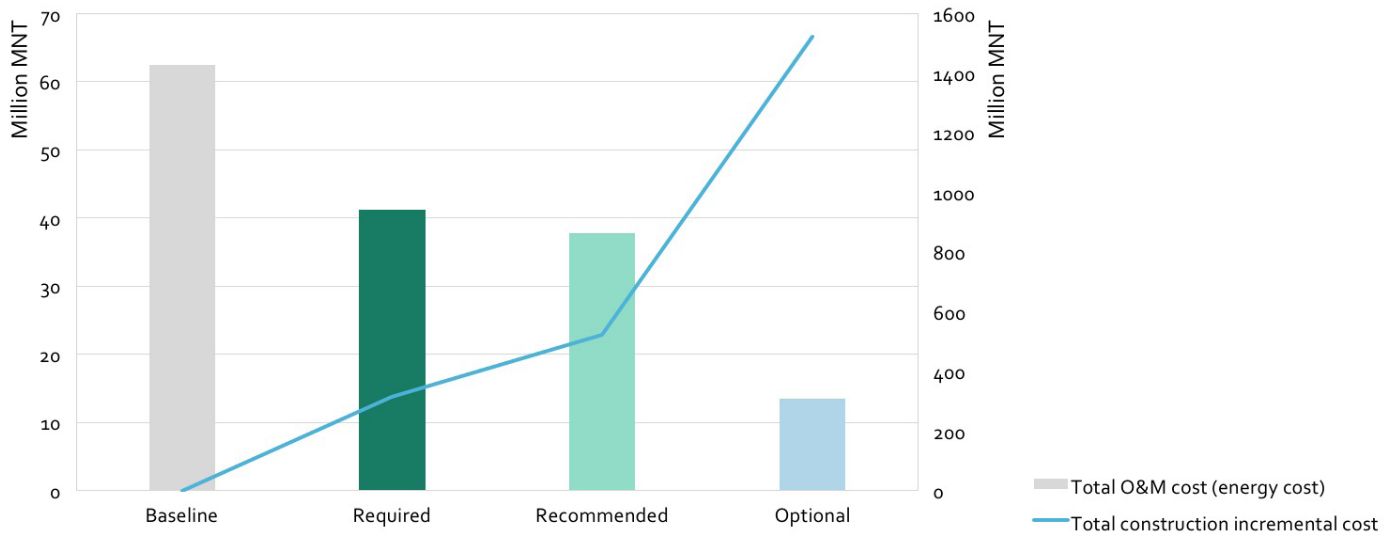
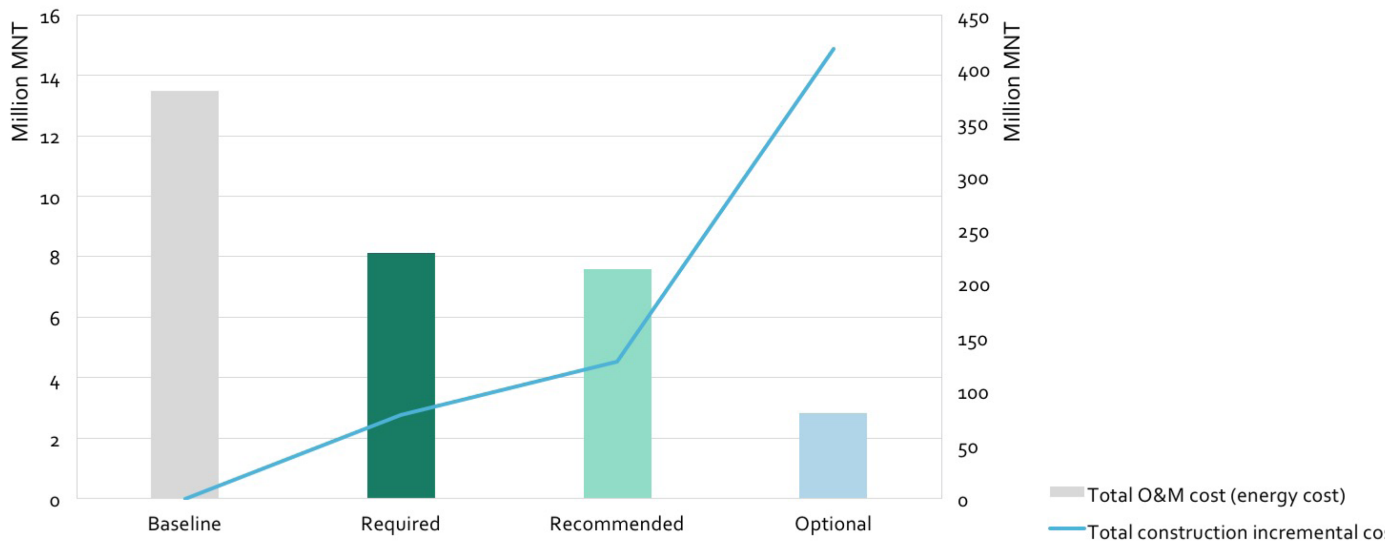


Figure 3.31 — Estimated O&M cost savings – Kindergartens



3.4 Implications

The TGs were developed to provide guidance to the GoM, particularly for public authorities such as the MESC in planning and designing green education buildings under the PPP model. The TGs identify locally suitable green technologies and provide guidance for green option output specifications (required, recommended, and optional) to support the GoM in drafting documents for requests for proposals (RFPs) and negotiating with private partners for future education sector PPP projects.

The building energy performance assessments validated the performance improvements associated with the green options (required, recommended, and optional) proposed in the TGs. Compared to the baseline model (education buildings built before 1990s), the adoption of green options for new education buildings in Mongolia is expected to result in an energy savings of more than 40%. Furthermore, the results indicate that the green options meet the energy efficiency levels (B and above) set by the GoM.

Table 3.31 — Levels of energy efficiency in buildings (BNbD 23-02-09 requirement)

The Levels	Classification vs. Energy Efficiency	Deviation of design (actual) values of specific thermal energy consumption of for building heating, q_h^{des} from normative, %	Recommended Actions by Authorities
For new and reconstructed buildings			
A	Very good	Less than minus 51	Economic incentives
B	Good	Minus 10 to minus 50	Economic incentives
C	Normal	Plus 5 to minus 9	Increase the efficiency level
For existing buildings			
D	Poor	Plus 6 to plus 75	Preferred reconstruction of the building
E	Very poor	More than 76	Insulate the building in the near future

O&M costs can also be reduced if the building design complies with the required output specifications (perceived reduction rate: 35% and above) or recommended standards (perceived reduction rate: 40% and above). If the optional green technologies indicated in the TGs are added to the design, it is estimated that up to 70% of O&M costs can be saved (refer to Appendix F: Cost Analysis). Although the adoption of green technologies and design results in increased capital costs, these costs can be recovered from the lower operating costs that will continue over the life of the building.

It should be noted that the performance and energy efficiency of green education buildings can vary according to the applied technologies.

Figure 3.32 — Implication of green technologies and their validation results – Schools

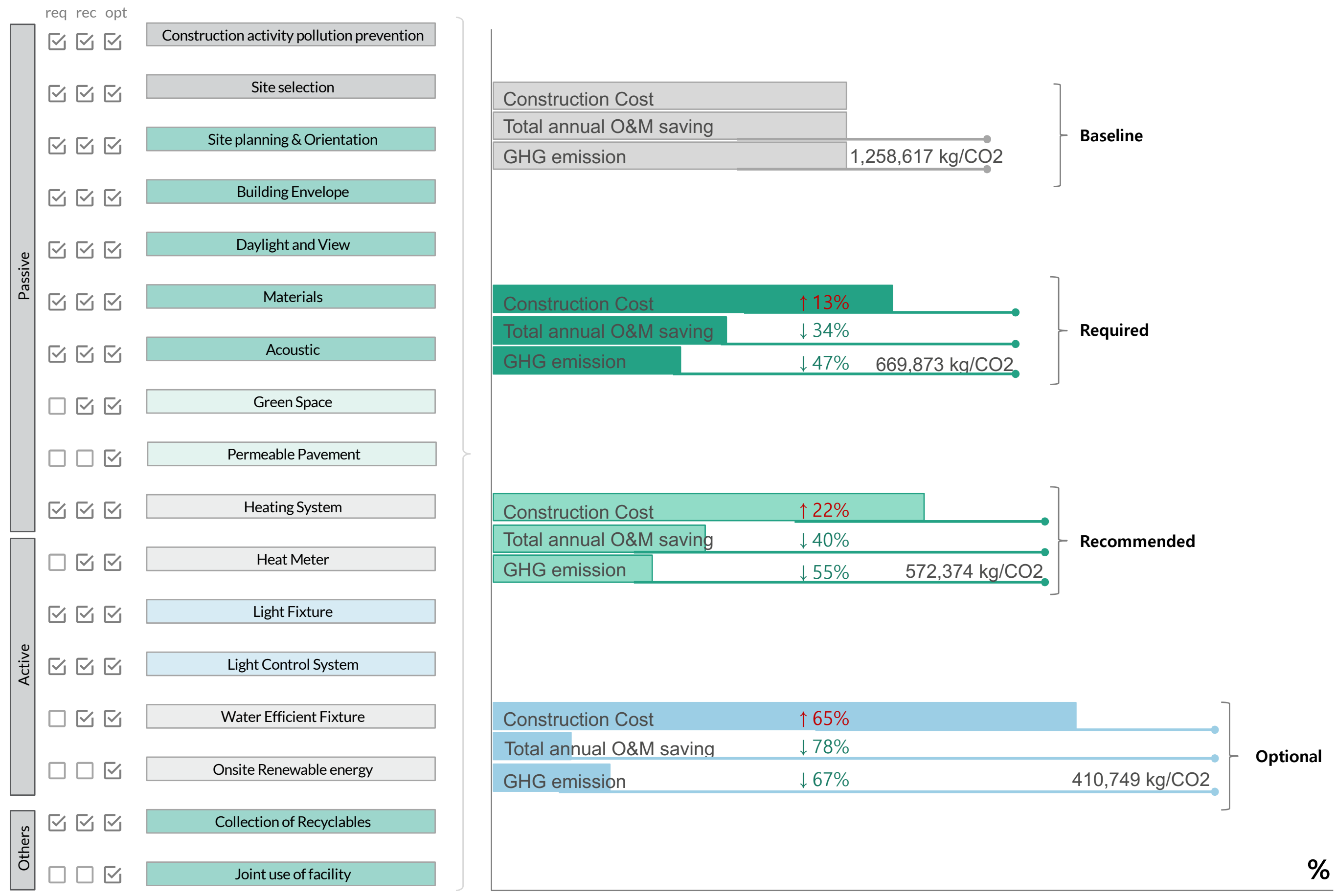
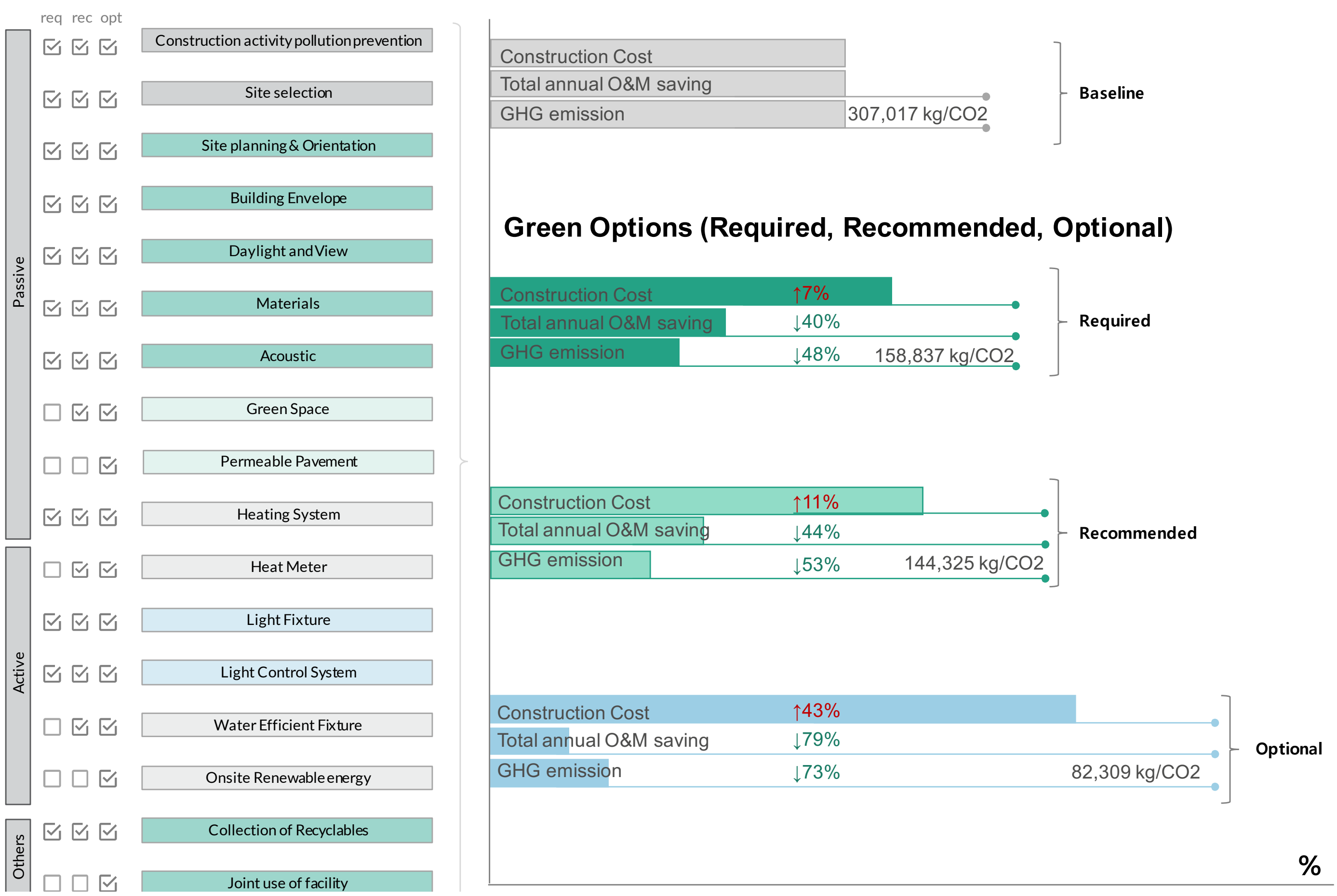


Figure 3.33 — Implications of green technologies and their validation results – Kindergartens



Note: req=required, rec=recommended, opt=optional

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Appendix A. Case Study: India and UAE

A.1 India: Model Schools Scheme[14]

A.1.1 Overview

In 2011 India's central government announced a national PPP initiative to improve access to quality secondary education in rural India. Its overall goal was to create 6,000 new schools, with 2,500 of these schools being established under PPP schemes, representing one school for each of the non-educationally backward blocks (non-EBBs), or rural subdivisions.

The goal of these PPPs is to found one school of excellence in every block that serves as a model for other schools. Each of these model schools, called 'Rashtriya Adarsh Vidyalaya', would be able to enroll up to 2,500 students. Moreover, these model PPP schools have the potential to impact over 5 million children. Table A.1 below offers a brief description of central government's model school scheme.

Table A.1 — Snapshot: The central government's model schools scheme (India)

Parameter	Detail
Overview	National level initiative by the Government of India. Private operator builds and operates schools on subsidized land. For upper-primary and secondary schools. 40% to 50% of places are reserved for government sponsored candidates. The PPP scheme was announced in 2011.
Objective	Improve access to high quality school education at block level. Every block in the country will have at least one school of excellence, which can be a model for all other schools in the block.
Coverage	Schools in 2,500 non-EBBs set up through PPPs.
Financial Model	Land procured by the operator but state government may be requested to assist in securing the land. Central government provides continuous support for sponsored students. Central government provides some amount of infrastructure grant.

Source: FICCI (2014)

14 Referred to FICCI 2014. Public-Private Partnerships in School Education – Learning and Insights for India (Working paper).

A.1.2 Governance

The initial PPP term for these projects would be 10 years, which may be extendable by mutual consent. In this initiative, the private sector would construct and operate the schools on sites provided by the state government. Furthermore, the state government would offer support both in the form of in-kind resources and funds by offering uniforms, textbooks, and mid-day meals, by supporting 40% to 50% of the students and by providing an infrastructure grant. This support would contribute towards the mitigation of recurring costs on a per-student basis for all sponsored students.

The government infrastructure grant is equivalent to 25% of the monthly recurring support for each sponsored student. This grant would not exceed 10% of the capital investment in the school, and government support would vary according to different costs and predicted student numbers.

The model school charges a student service fee depending on the class level and the region where students live. It would not charge any fees from the government-sponsored students up to Class 8. On the other hand, students supported by the government in Class 9 through 12 would pay INR 25 if they were from marginalized communities (scheduled caste, scheduled tribe, female, or living below the poverty line) or INR 50 for all others. Students who fall under the management quota do not pay fees.

A.1.3 Design and Operation Issues

1. Bidding

The initial plan was to roll out 500 schools from 2012-2013, followed by 1,000 schools each from 2013-2014 and 2014-2015. However, due to delays in implementation, the government now plans for 500 PPP schools to start operating in the first phase from 2015-2016.

In the first bidding phase, 65 private sectors were listed from the request for qualifications (RFQ) and 41 blocks were selected. In the next round of the first phase, 127 private sectors and 150 blocks were chosen. Providers such as the Bharti Foundation, the Adani Foundation and LI&FS have been shortlisted.

The bidding process will be based on the bidders' financial standing, their track record in the field of education, their commitment and preparedness to offer the necessary infrastructure and their governance structure. Table A.2 shows the eligibility criteria of private sector.

Table A.2 — Private operator eligibility criteria (India)

Model Schools Scheme: Operator Eligibility
An entity running at least one CBSE school from where at least two consecutive batches have completed Class 10 would qualify for up to three schools.
Those schools which have not come up to the Board examination level would qualify for one school.
An entity would qualify for three schools if it has a track record of running educational institutes for at least five years and if it makes an interest-bearing deposit of INR 25 lakh for each school, to be released in three annual statements after commissioning.
A corporate entity would be eligible for one school for every INR 25 crore of net worth. It would have to make an interest-bearing deposit of INR 50 lakh each for up to three schools and INR 25 lakh per school thereafter.

Source: FICCI (2014)

2. Scope of Private Sector's Role

The private operator makes decisions independently but must also adhere to the binding conditions listed below.

Table A.3 — Binding conditions for operating model schools (India)

Model Schools: Binding Conditions
The pupil to teacher ratio will not exceed 25:1.
The student to classroom ratio will not exceed 40:1.
The schools will be affiliated to the Central Board of Secondary Education (CSBE).
The schools will follow the National Curriculum Framework, 2005 and its subsequent versions as adopted by the government.

Source: FICCI (2014)

These schools will use the Kendriya Vidyalay (a system of central government schools in India) standard and will be affiliated to the Central Board of Secondary Education. Furthermore, they will be modeled on Kendriya Vidyalayas based on the following parameters:

- Pupil-teacher ratio
- Information and Communication Technology (ICT) usage
- Holistic education environment
- Appropriate curriculum
- Emphasis on output and outcome
- Performance in board examinations

Although private-sector actors are bound by the norms of the RTE, they would nevertheless have a large degree of flexibility in operating and managing the schools. This flexibility is shown in Table A.4 below.

Table A.4 — Flexibility at government schools (India)

Flexibility	Detail
Hiring of teachers and school principal	The selection of principals and teachers would be through an independent process developed in consultation with the state governments.
Charging fees to non-sponsored students	The private operator is free to charge appropriate fees from students who fall under its management quota.
Daily management	The private operator would have full autonomy in the functioning of the school.
Alternate use of premises	The operator can use the premises outside of school hours for vocational education, training, and other educational purposes.

Source: FICCI (2014)

3. Standard of Evaluation for Private Sector

In addition, funding from the government would be paid based on the performance evaluation by an independent agency. There are several parameters for this as shown in the table A.5 below.

Table A.5 — Model schools: Performance parameters that would trigger government reimbursement (India)

Model Schools Scheme: Performance Parameters
Results in board examinations
Results of learning achievement surveys to be conducted in schools for different classes every year
Availability and quality of infrastructure including classrooms, laboratories, computer rooms, toilets, drinking water, etc.
Student attendance
Teacher attendance
Performance in co-curricular activities including sports, games, art, and music
Teacher qualification
Status of teacher refresher training
ICT usage in school
Drop-out rate reduction
Spoken English test

Source: FICCI (2014)

4. Student Admissions

Students who have studied in the same block up to Class 5 would be eligible for admission. Students for central government sponsored seats would be chosen through an admission test. The modalities of admission for the management quota seats would be decided upon by the operator.

The operator and central government would be able to fill between 40% and 60% of the seats respectively. Either up to 140 students in each class or up to 980 students in the school can be sponsored by the central government. This ceiling may be relaxed if the private operator is unable to get an appropriate number of sponsored students in a particular class.

In addition, in case of areas where the demand for management quota seats is exceptionally high, the private sector may be able to raise the number of management quota seats to 60%, subject to the condition that the central government would continue to sponsor 140 students in each class.

On the other hand, the private sector operates the school with only the central government quota for the first three years and then down the quota scale to 60% over the subsequent five years in the backward areas with limited affordability of fees.

A.2 UAE: 30 KG-5 Schools in UAE[15]

A.2.1 Outline

In September of 2006 the United Arab Emirates (UAE) began to institute education reform PPP projects whereby public schools were managed by the private sector for three years. This initiative started with 61 public schools in the Abu Dhabi area (30 KG-5 schools in Abu Dhabi, 12 schools in Al in, and 12 schools in Abu Dhabi city), 6 public schools in the Western Region, and 1 public school in Al Gharbiya. The main purpose of these PPP projects was to improve teaching delivery, student performance, and national identity and culture.

This project ran until 2013. In September 2007, the government added 30 new schools for levels 6-9 and then supplemented this with other schools for levels 10-12, providing a total of 118 public schools with educational consulting. After that, the PPPs included all public schools in Abu Dhabi and the number of target school increased to 147 in 2009 and to 176 in 2010. However, since 2012, the number of schools operated by PPPs has gradually declined and the provision of educational consulting was abolished in 2013.

A.2.2 Governance

1. Public Sector

The public-sector actor in this project is the government represented by the Education Council. The government contracted a memorandum of understanding with the Ministry of Education so that the Education Council could take responsibility for the public schools in the UAE. However, the Ministry of Education is included in the board of the Education Council and still has to approve a new curriculum. In addition, the chairman of the Council is the UAE's crown prince. Dissatisfied with the existing public educational system, the UAE government made a decision to outsource it by adopting the PPP programs.

2. Private Sector

There were four private participants in the initial pilot project in 2007 and after that, two other companies were added; thus, the number of private participants increased to six companies. After 2007, other companies participated in this project with each distributed to manage certain schools for a period of three years.

The private sector actors were well-known international companies with diverse experience in education and had participated in similar projects in other countries. They are from various countries including United Kingdom, United States, Netherlands, and Lebanon: Centre for British Teachers (CfBT) Education Trust, Cognition Consulting, GEMS School Improvement Partnership, Mosaica Education Inc., Nord Anglia Education PLC, and SABIS / Intered.

A.2.3 Design and Operation Issues

1. **Bidding:**An open bidding process was published on the official UAE Education Council website. The process started by selecting the target schools to be supported by the PPP programs. After the Education Council announced the Request

15 Referred to Alhashemi, M. Y., "Critical Success & Failure Factors for Public Private Partnership Projects in the UAE," (PhD diss, British University in Dubai, 2008) and "Abu Dhabi PPP School Project" last updated in 2016, http://www.dubaifaqs.com/schools-ppp-abu-dhabi.php.

for Proposal, it received responses from 20 private companies related to the education sector. Their materials were evaluated, and, ultimately, 6 companies were chosen for the projects. The government paid 50% of total cost to the companies upon signing the PPP contract, and paid the remaining 50% upon the completion of project's startup work.

The start-up tasks included hiring employees and establishing an office in the UAE. In addition, the government covered infrastructure costs such as buildings, IT systems, and materials for schools. Each contract period was three years and the bidding process lasted about five months.

2. **Operation Monitoring:** The Education Council hired an educational consulting agency from the United Kingdom to supervise the companies' performance and suggested some inputs as a third party. The council had some official visits and meetings with the private companies and conducted regular investigations in order to ensure that the companies complied with the agreed policies and standards in the project contract.

A.2.4 Success Factors

According to Alhashemi, M. Y. (2008), these PPP programs had a high probability of success on many grounds. First of all, they were supported by comprehensive political forces with willingness to invest in the improvement of the UAE education system. Furthermore, the bidding process and scope of work were transparent and the government made regular payments to the participating companies. Also, the companies were experienced enough to execute PPPs in education.

Nevertheless, the author suggested that in order to persuade and implement PPPs in a conservative region such as the UAE, it is necessary to prepare thoroughly in order to demonstrate that they will enhance the performance of public schools and the education system. The following are some suggested success factors:

- **Proper risk allocation:** There would be two main risk factors in the PPP implementation process. One is that of the private sector not complying with the agreed scope of work and policies. In order to resolve this, the Education Council hired a monitoring agency and conducted regular supervision and evaluation on the companies' performance. The other issue is potential misunderstanding among parents, teachers, and school staff in a conservative Arabic culture that implementing a project with western companies may westernize schools and the community rather than improve the education system. Thus, it was necessary to communicate with the stakeholders and explain that Arabic, Islamic, and Social Studies would remain in Arabic.

- **Savings and VFM:** Although it came with high costs, the government was willing to invest to provide advanced public education systems.

- **Favorable Legal Framework:** Because the UAE does not have a legal system related to education PPPs, project staff had to depend on the clear contract that describes the duties, responsibilities, and relationship among stakeholders. Therefore, the PPP contracts were drawn up in clear terms by a well-known legal firm. In addition, the Education Council employed a prestigious educational consulting agency to monitor and evaluate the private sector's performance.

- **Political Support:** The UAE's crown prince was appointed chairman of the Education Council to garner comprehensive political support for the PPP programs. Hence, the council was afforded direct contact to UAE political representatives in terms of decision making on education, minimizing problems that could occur during the term of the PPP programs.

- **Private Consortium:** The private sector actors involved in the PPPs were well-known education sector companies with extensive experience with education PPPs, as well as, good reputation and performance.

- **Available Financial Market:** It was possible for the private sector to participate in the PPP programs and expand their model through the UAE's financial market. However, as the government paid the contracts well, this was not a factor.

- **Stable Economy:** The UAE's stable economic condition had a positive impact on private investments. Even though inflation was high, it was not effective in the period of PPPs.

- **Transparent Procurement Process:** Procurement was conducted through an open bidding process that was published on the official Education Council website. The scope of work was clearly described and communication with bidders progressed well, with clear understanding of what should be prepared.

- **Feasibility Study**: Before starting the PPP programs, a thorough feasibility study was conducted.

Appendix B. Government Support for PPP Projects and Government Payment Mechanism, Case of the Republic of Korea

B.1 Government Support for PPP Projects[16]

The Republic of Korea has promulgated various policies to facilitate infrastructure financing for PPP projects. More specifically, the government provides administrative support for land expropriation to facilitate the land acquisition process, financial supports such as construction subsidies and compensation for bid costs, and financial and tax incentives. Also, in order to share project risk with the private sector, the government has developed risk sharing mechanisms, such as compensation for base (raw) cost, infrastructure credit guarantees, and early termination payments.

Figure B.1 — Government supports and risk sharing mechanisms for PPP projects (Korea)

Types	Construction Period	Operating Period
Subsidy	(1) Construction Subsidy	(2) Compensation for base (raw) cost
Guarantee System	(3) Infrastructure credit guarantee via Infrastructure Credit Guarantee Fund	
Tax Incentives	(4) Special taxation, corporate tax, local tax, exception from charge	
Early Termination	(5) Guidelines for early termination	

Source: Basic Plan for PPP, Republic of Korea

B.1.1 Government Support for Land Expropriation

B.1.1.1 Land Expropriation Rights

To facilitate PPP implementation, the PPP Act grants land expropriation rights to the concessionaire. The concessionaire may entrust the competent authority, such as the local government, with the execution of the land purchase, compensation for loss, and resettlement of residents, etc.

B.1.1.2 Process of Land Expropriation

The overall process relating to land acquisition or expropriation for public works, such as infrastructure facilities and public buildings, is prescribed by the Land Acquisition Act. Unless a special provision is provided in the PPP Act or the related laws, the procedures under the Land Acquisition Act apply to the expropriation or use of the land needed for the implementation of PPP projects.

Under the Land Acquisition Act, land acquisition is carried out by the concessionaire or project company, who has the expertise associated with the public works project. Although land acquisition by consultation with landowners and interested parties is

16 Extracted from Kim. J., and Lee. S. 2013. 2012 Modularization of Korea's development experience: Public-Private Partnerships: Lessons from Korea on institutional arrangements and performance. Published by MOSF of Korea and KDI. Page 34-41.

desirable and must be sought in the first place, the land can be expropriated for public use when consultation is not feasible. After the plan for public facilities is approved, the concessionaire prepares a list of land compensation or expropriation that describes the land needed for the project, including its condition and the characteristics of the landowners and interested parties. Then, the concessionaire announces a compensation plan and notifies the existing landowners, interested parties, and local governments. The concessionaire then estimates the compensation amount. After consultation with the landowners and interested parties, the concessionaire enters into a compensation contract with the landowners and interested parties.

In cases where land expropriation is involved, the concessionaire requests the Ministry of Land, Transport and Maritime Affairs for Authorization of the Project, which is an official step to determine whether the land and related property are appropriate objects for expropriation. The ministry conducts consultations with relevant public authorities and collects opinions from the concerned land tribunal and interested parties before deciding whether to grant authorization of the project. After the authorization of the project is granted, the concessionaire prepares a list of land compensation or expropriation, announces the plan to compensate the landowners, notifies the owners, estimates the compensation amount, and consults with related parties.

In cases where consultation cannot be conducted or concluded within one year after the announcement of project authorization, the concessionaire may request a Decision of Expropriation from the concerned land tribunal. The tribunal considers the request by the concessionaire after publicly announcing its contents and collecting opinions from related parties. When the Decision of Expropriation is issued in the form of written documents by the tribunal, the concessionaire is required to compensate the landowners according to the ruling. To facilitate the process, the concessionaire may entrust the tasks of land compensation and the resettlement of local residents to the relevant public organizations that have experience and expertise with such tasks. In the case of PPP project implementation, the PPP Act stipulates that the authorization of the project and the public announcement of the authorization are considered granted when the detailed engineering and design plan for Implementation (DEDPI) of the PPP project is publicly announced. In addition, a request for a Decision of Expropriation may be made within the implementation period of the project as determined by the DEDPI. The PPP Act also allows the concessionaire to entrust the competent authority or the concerned local government with the tasks of land purchase, compensation for loss, resettlement of local residents, and other matters concerning the expropriation and use of land. The PPP Enforcement Decree requires that detailed contents, terms, and fees for entrustment arrangements should be determined in a contract between the concessionaire and the relevant authorities.

Generally, it is inefficient for the concessionaire to acquire land in its own, and then transfer ownership to the competent authority afterwards. It is often more effective for the competent authority to acquire land directly in the initial stages. In addition, it is difficult for the concessionaire to conduct the expropriation process. It entails a lengthy process involving consultations with key stakeholders, such as local residents and related authorities. Therefore, in practice, competent authorities often carry out land purchases, compensation, and related tasks in place of concessionaires for most PPP projects.

In the case of land belonging to the national or local government located in an area designated for a PPP project, a concessionaire consults with the related administrative agency about the use of the land. Government-held land cannot be sold for purposes other than for the PPP project, after the date of the RFP announcement.

Notwithstanding the related provisions of the State Properties Act and the Local Finance Act, national or public property may be sold to the concessionaire through a negotiated contract. In addition, the competent authority may allow the concessionaire to use and benefit from national or public property without charge, from the date of public notice of the DEDPI until the date of confirmation of construction completion. In the case of revertible facilities constructed under BTO, BTL, or BOT schemes, the national or public property may be used without charge until the end of the concession period. Furthermore, where necessary, the competent authority may purchase land located in an area designated for a PPP project, and let the concessionaire use the land and benefit from it free of charge from the date of the public notice of the DEDPI, until the date of confirmation of construction completion. In the case of revertible facilities, use of land for free may apply until the end of concession period.

In many PPP projects, the entire or part of the land acquisition costs are compensated by the competent authority; the exception is for a few highly profitable projects.

B.1.2 Construction Subsidy

According to the PPP Act, the government may grant a construction subsidy to the concessionaire, if it is required in order to maintain the user fee at an affordable level (see Table B.1). The timing of the subsidy is determined in the course of the concession agreement, and depends on the equity investment plan of the concessionaire. The subsidy is distributed annually or quarterly, and cannot be concentrated in a certain year. The timing of the distribution reflects the completion level of the project and the schedule and scope of equity investment.

The amount of subsidy is determined in each individual concession agreement. When notifying interested parties about a project, the government first discloses an approximate ratio of the construction cost that it is willing to subsidize. The exact subsidy to construction cost ratio is determined through consultation and is stipulated in the concession agreement. As a result, each project ends up with a different amount of subsidy. Table B.2, below, shows the average level of construction subsidy by sector.

The government has set a subsidy guideline for road projects of between 20% and 30% of the total project cost. It has set a subsidy guideline for railway projects of up to 50% of total project cost. The ratio of subsidy to construction cost for environmental projects is stipulated by law and, therefore, is included in the government's public notification.

Generally speaking, national BTO projects are eligible for a larger subsidy than local projects, because the project costs are higher and the ratio of subsidy to project cost is also set higher.

Table B.1 — Financial support related articles in Public Private Partnership Act (Korea)

	Contents
Act	**Article 53 (Financial Support)**: If it is necessary for the efficient implementation of construction projects of revertible facilities, the State or a local government may grant a subsidy or extend a long term loan to the concessionaire, only where prescribed by Presidential Decree.
Enforcement Decree	**Article 37 (Financial Support)**: (1) The State or a local government may grant any subsidy or long term loan to the concessionaire during the construction or operation period of a facility within budgetary limits after deliberation by the Deliberation Committee, in any case of the following subparagraphs under the provisions of Article 53 of the Act: Provided, that where such subsidy or long term loan is granted from the budget of a local government, or the project concerned is conducted by a local government to which a subsidy of less than KRW 30 billion is provided by the State, deliberation by the Deliberation Committee shall not be required: 1. where it is inevitable to prevent dissolution of the corporation; 2. where it is inevitable to maintain the user fees at an appropriate level; 3. where inducement of private capital is difficult due to decrease in the profitability of the project as a result of a considerable expenditure disbursed as compensation for the land acquisition; 4. where the actual operational profit (referring to the amount obtained by multiplying the user fees by the demand for the facility concerned) falls considerably short of the estimated operational profit under the concession agreement, to such an extent that the operation of the facility is difficult; or 5. where it is difficult to actively conduct the PPP project without a long term loan or subsidy prior to conducting projects, the profitability of which is low, but which can considerably reduce the construction period or the cost of construction of other projects when conducted together with other PPP projects.

Source: PPP Act and Enforcement Decree of Korea

Table B.2 — Average level of construction subsidy by sector

(Unit: % of total construction cost)

Facility Type	Road	Port	Environment Facility
Level of Subsidy	19.7%	22.2%	64.7%

Source: Internal data from the MOSF

B.1.3 Tax Incentives and Relaxation of Regulations

To facilitate infrastructure financing, the government provides tax incentives that are stipulated in the PPP Act. The details of the tax incentives are also included in the PPP Basic Plan in four categories: (i) special taxation, (ii) corporate tax, (iii) local tax, and (iv) exceptions from charges.

> *PPP Act Article 57 (Reduction and Exemption of Tax): The State or local governments may reduce or exempt the taxes to promote private investment under the conditions as prescribed by the Restriction of Special Taxation Act and the Local Tax Act.*

Exceptions from charges and taxes. The central government or a local government may exempt project taxes fully or partially in accordance with Articles 56 and 57 of the Act, the Farmland Act, the Management of Mountainous Districts Act, the Restriction of Special Taxation Act, the Local Tax Act, the Corporate Tax Act, and other relevant acts and subordinate statutes.

Relaxation of Finance-Related Regulation, etc. The central government, a local government, or a related supervisory agency may recognize exceptions to the application of the finance-related regulations in accordance with the Monopoly Regulation and Fair Trade Act, the Insurance Business Act, the Securities and Exchange Act, the Banking Act, and the acts and subordinate statutes relevant to financial holding companies.

B.1.4 Compensation for Bid Costs

In order to promote competitive bidding, the competent authority compensates unsuccessful bidders for part of bidding costs. The competent authority compensates bidding costs based on the basic design cost provided by the government guidelines of up to i) 35% of the basic design cost, if there is only one unsuccessful bidder, ii) maximum 40/100 of the basic design cost, which shall be subtracted by 10/100 according to the order of ranking, if there are more than two unsuccessful bidders, and iii) if there are three or more unsuccessful bidders, the competent authority may decide the number of bidders eligible for the compensation payment. Compensation for bidding costs is not provided when the competent authority presents basic design documents, or an unsuccessful bidder earns less than a certain level (60-80) during the bidding evaluation.

B.2 Government Payment Mechanism[17]

Under the BTL scheme, the ownership of the facility is transferred to the government upon the completion of the construction, and the concessionaire is granted the right to manage and operate the facility for an agreed upon period of time, during which it receives government payments, which are composed of a lease payment and payments for operational costs. The lease payment is compensation for the recovery of private investment and the operational costs payment covers facility maintenance, the costs of repairs, and other necessary costs associated with providing operating services.

The lease payment is paid in annual, biannual, or quarterly installments and is estimated as the private investment cost applied with an interest rate. As the BTL scheme has lower risk than the concession model, the interest rate should reflect the lower risk level.

Lease payment = total private investment cost x interest rate / (1-(1+interate rate)-operation period).

Operational Cost = fixed operational cost x (consumer index of the last month of corresponding quarter / consumer index of contract).

17 Referred to Ministry of Planning and Budget of Korea. 2016. Basic Plans for PPP.

Appendix C. PPP Performance Evaluation System – Case of the Republic of Korea

PE is the final stage of the process of evaluating and confirming the outcome of BTL school facility operations in Korea. The purpose of the PE is to evaluate whether the BTL school facility is properly served by the operating company and, thus, whether the agreed upon level of service quality has been achieved. The PE committee is comprised of competent authorities, experts, operators, and facility users in the proportion of 2:2:2:2 as indicated in Table C.1. Information on the number and opinions of committee members, evaluation grades, and facility users are open to the public.

Table C.1 — Composition of the PE committee (Korea)

Committee	Number of persons	Constitution
Competent authority	2	Chairman and assistant administrator
Expert[1]	2	BTL expert and architectural or civil engineering specialist
Operator	2	Operator executive and staff member or SPC[2] manager
Facility user	2	Principal and school administrator

Note: [1]Selected by Competent Authority; [2]SPC=Special Purpose Company

Source: MEST and KEDI (2009)

Performance-based government payments are provided on a quarterly basis, and are dependent upon the committee's PE inspection results. There are two components to government payments– the first component reflects the capital investment (lease fee) and the other reflects the operational costs. The level of the lease fee is determined by the sum of the investment cost and rate of return, according to the concession agreement. The operation costs are the sum of the constant price of the operation services reflecting inflation. As the government payment associated with operation costs depends upon the PE results, the project company should carefully operate and manage the school facility in response to the facility users' requests. Once the school facility receives an evaluation of "partially" or "entirely unavailable" (for example, due to the breakdown of heating services, etc.), an operation cost penalty is imposed on the project company. The following cases listed in Table C.2 below are examples of circumstances under which a penalty would be imposed on the operator.

Table C.2 — Classification of operation cost penalty cases (Korea)

Classification	Penalty cases
Defects[1]	Inconvenience in facility use due to construction or management defect
Air temperature	Unable to control the air temperature
Fire detection and warning system	Unable to operate the system
Accessibility	Physically inaccessible / safety risk
Normal condition	Unable to maintain basic conditions of facility
Information and communication	Information and communication infrastructure unavailable
Public service	Essential services such as gas, water and electricity unavailable

Note: 1 Including cracks, damage, collapse, leaks, and subsidence of facilities as well as functional or operational equipment and machinery defects

Source: KDI (2009)

Therefore, the full government payment is not always guaranteed and the operator may receive a reduced payment as a result of a poor PE from the committee. To handle PE results more systematically and to immediately reflect them in school facility operation, grades are awarded on a scale of A to D as shown in Table C.3, whereupon differential penalty rates are imposed from 0% to 50%. For example, there will be 50% reduction in government payments for operation if the project company receives a D grade. However, if an A grade is awarded in the next quarter, up to 70% of the previous quarter's subtracted government payment may be additionally provided by the government.

Table C.3 — PE grade and penalty rate for operation cost

Grade	Score	Penalty rate for operation cost
A	≥ 90	0
B	80 ~ 89	5%
C	65 ~79	10%
D	< 65	50%

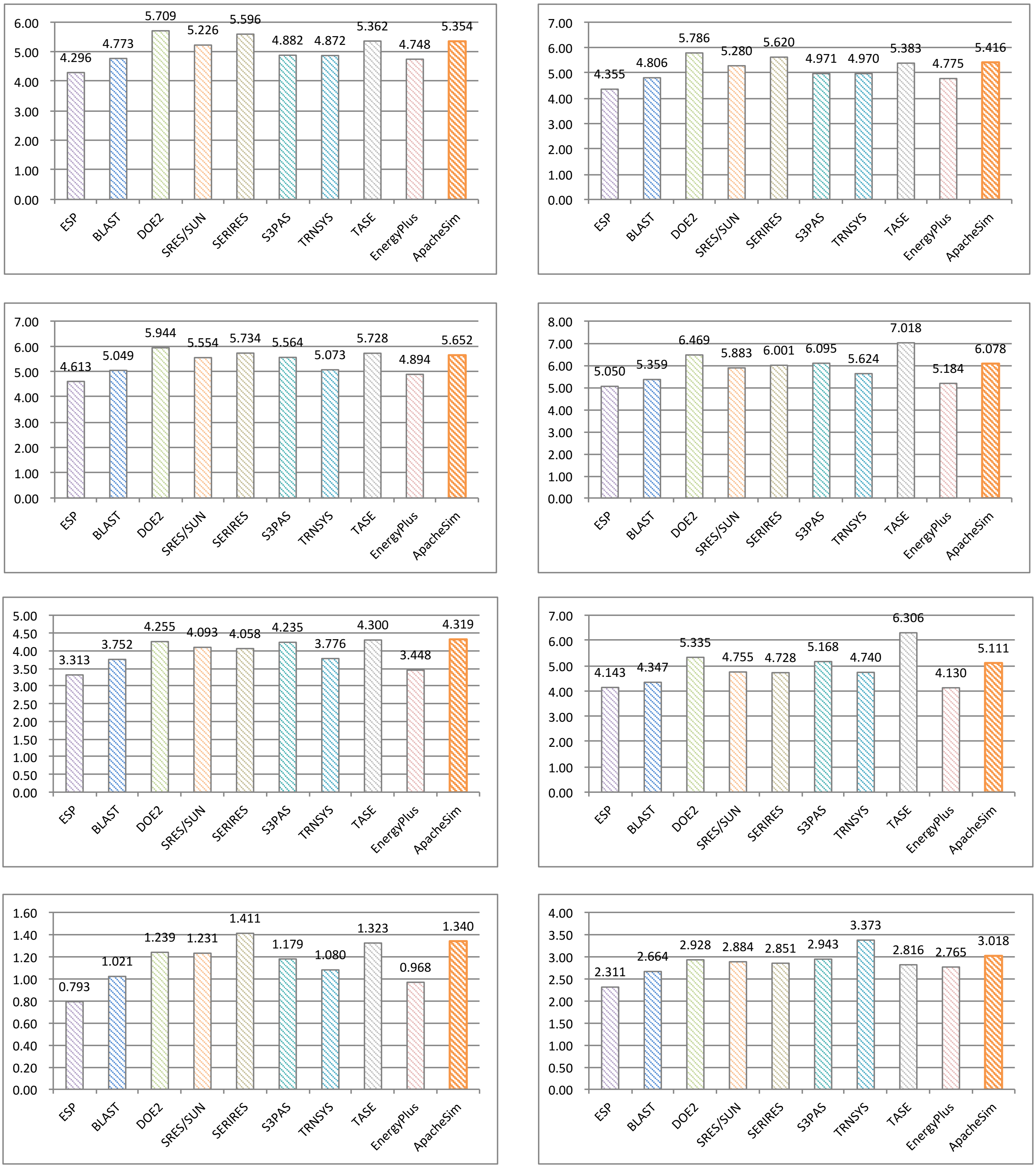
Source: Gyeonggido Yongin Office of Education (2014)

As previously mentioned, the PE is an essential process not only for evaluating whether the operating company is properly running and maintaining the school facility, but also for improving service quality after the contract period (10 to 20 years). Therefore, it is advised that additional information regarding the procedures for contract extension or the transfer to new operators be provided in the concession agreement in order to continue the proper operation and maintenance of the school facility after the first contract period is completed.

Appendix D. IES-VE Reliability

IES-VE is used to conduct building energy performance assessments. IES-VE is fully validated under ASHRAE Standard 140 and has published the results for all versions of ASHRAE Standard 140; 2001, 2004 and 2007. The figure below shows relatively equivalent outcomes (8 different cases) of 10 approved computer based simulation tools including IES-VE (orange bar). The given comparison charts ensure the reliability of a selected tool (IES, 2011).

Figure D.1 — Comparison of software tools for energy simulation (Annual heating load - MWh)

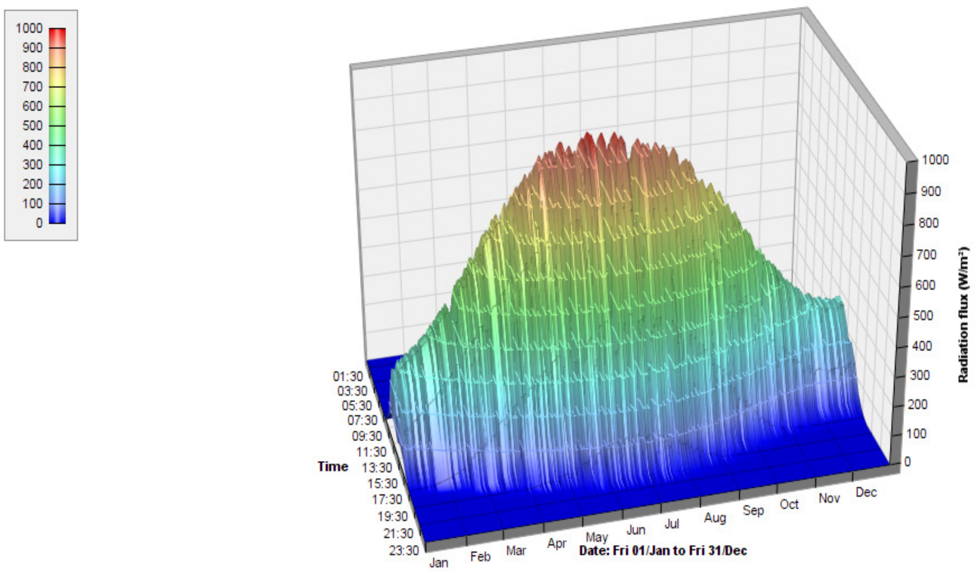


Appendix E. Simulation Data

E.1 Input data

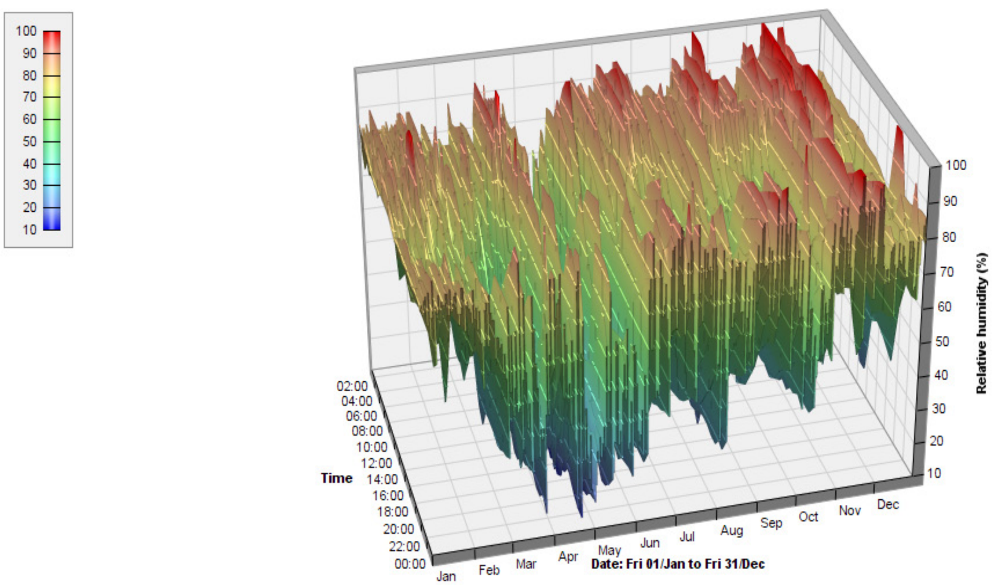
E.1.1 Climate data

Figure E.1 — Global radiation



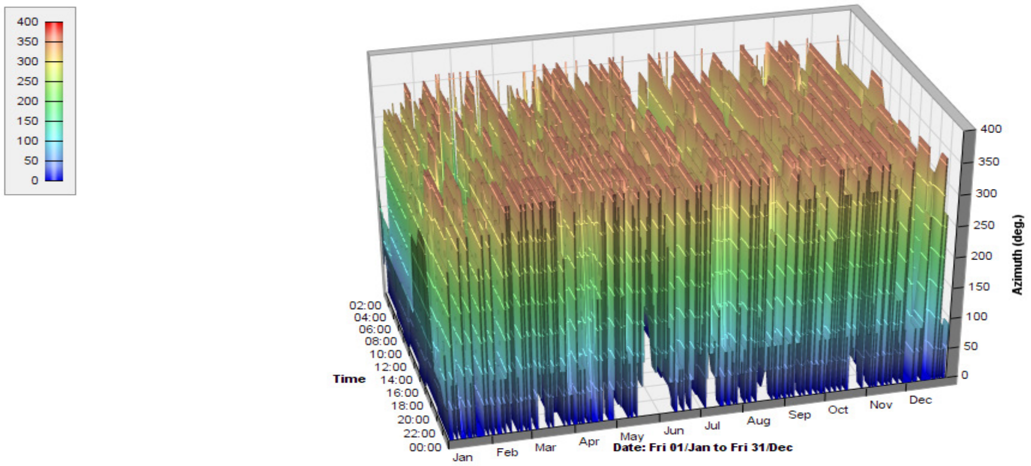
The figure above indicates global radiation in Ulaanbaatar. The average value is approximately 153.657 W/m^2and the maximum value is approximately 970.060 W/m^2.

Figure E.2 — External relative humidity



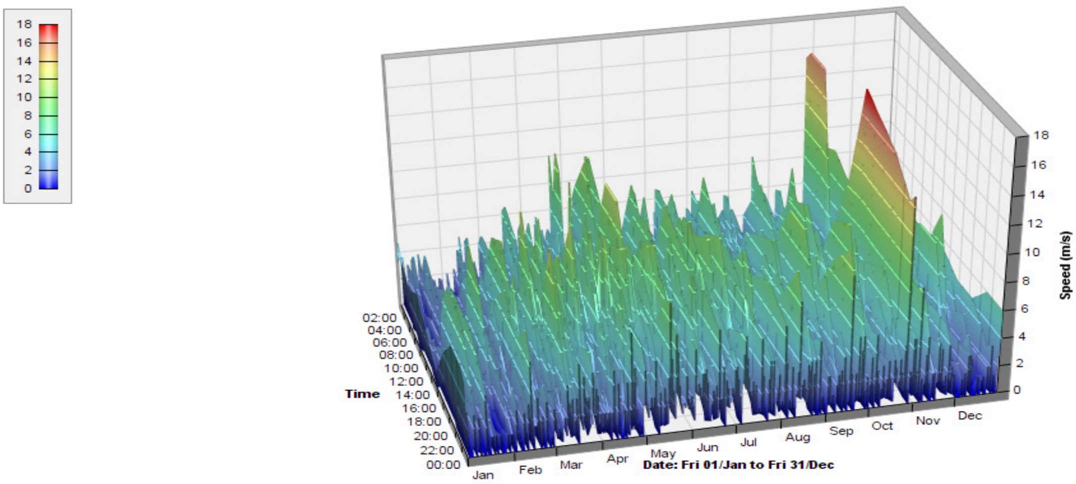
The figure above indicates external relative humidity in Ulaanbaatar. The average value is generally 62.4% and lowest value is about 10% during the winter season.

Figure E.3 — Wind direction



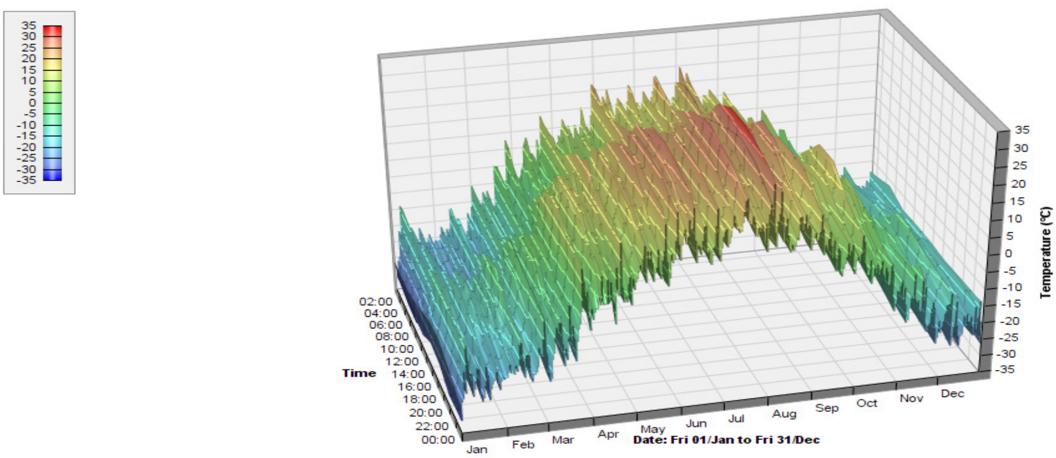
The figure above indicates wind direction (mostly, north facing) in Ulaanbaatar and its average degree is 353.5°.

Figure E.4 — Wind speed



The annual average wind speed in Ulaanbaatar is approximately 2.73m/s.

Figure E.5 — Dry-bulb temperature



As shown in this dry-bulb temperature data, the minimum outdoor temperature is -32.7C°.

E.1.2 Geometry and floor plan

Figure E.6 — 3D energy model - School buildings

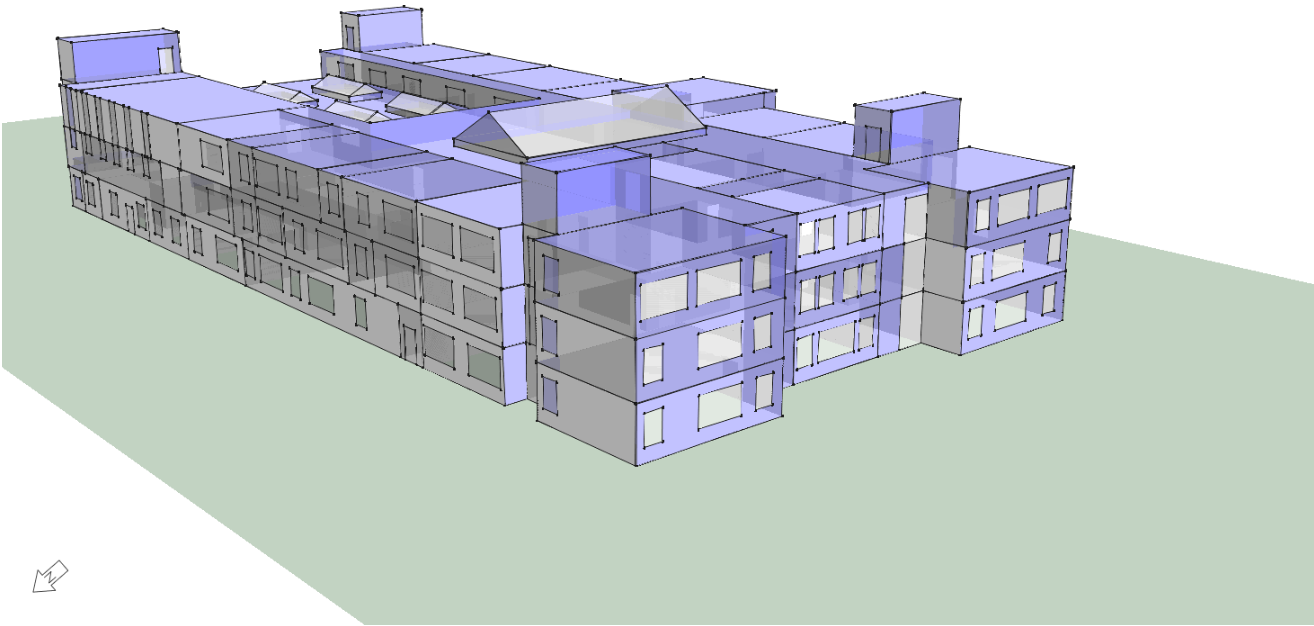
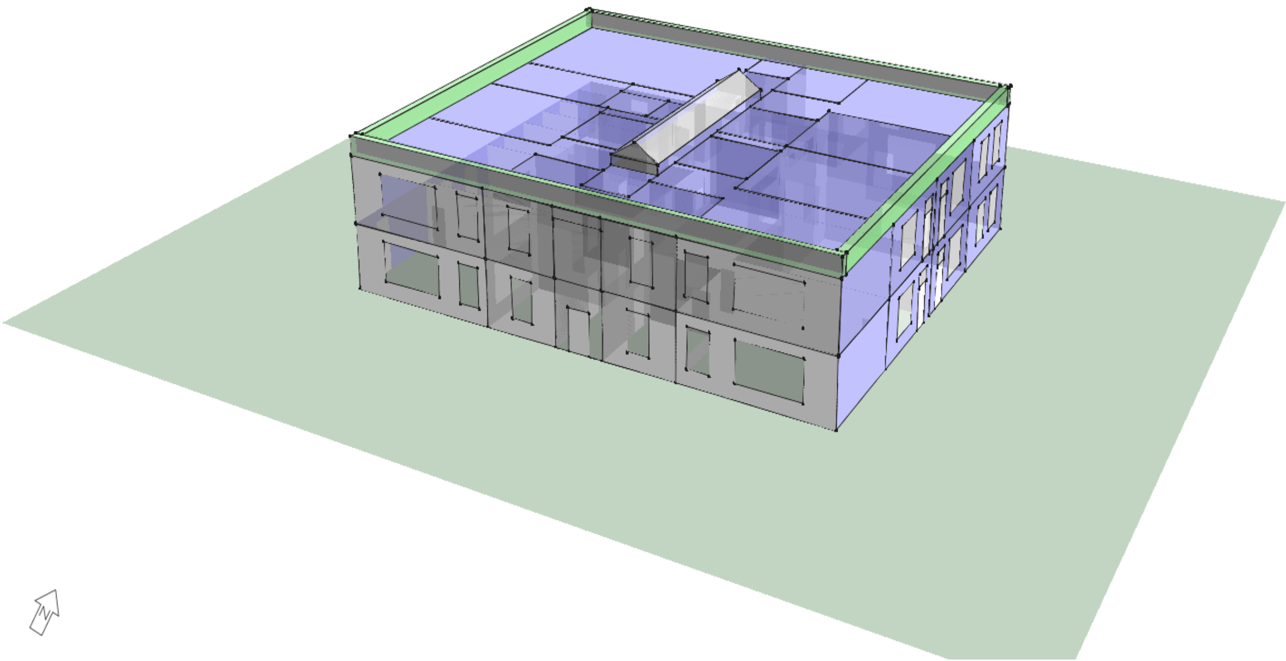


Figure E.7 — 3D energy model - Kindergartens



E.1.3 Interior conditions

Table E.1 — Internal heat gains – Human

Activity	Sensible (W)	Latent (W)	Total (W)
Seated at rest	70	30	100
Seated light work	75	45	120
Standing	75	70	145
Light physical work	90	160	250
Heavy physical work	185	285	470

Table E.2 — Internal heat gains –Human

Occupied	Irregularly occupied
21°C	17°C

E.1.4 Operation schedules

Table E.3 — Lighting schedule

Classrooms
8:00-6:30

Table E.4 — Occupancy schedule

	1st shift	Break time	2nd shift
Hours	8:00-12:30	12:30-14:00	14:00-18:30
Occupancy load	100%	50%	100%

E.2 Outputs

According to the results of the building energy performance assessment, monthly heating loads are evaluated as below.

E.2.1 Schools

Table E.5 — Baseline model monthly heating load - Schools (MWh)

Date	Total load	Heating	Domestic Hot Water (DHW)
Jan	611.87	596.81	15.06
Feb	513.25	469.72	43.53
Mar	433.16	383.38	49.78
Apr	216.46	168.76	47.70
May	84.12	38.05	46.07
Jun	16.64	0.00	16.64
Jul	7.76	0.00	7.76
Aug	9.60	0.00	9.60
Sep	126.97	79.27	47.70
Oct	282.74	236.67	46.07
Nov	493.79	446.09	47.70
Dec	618.83	569.04	49.78

Figure E.8 — Baseline model monthly heating load - Schools (MWh)

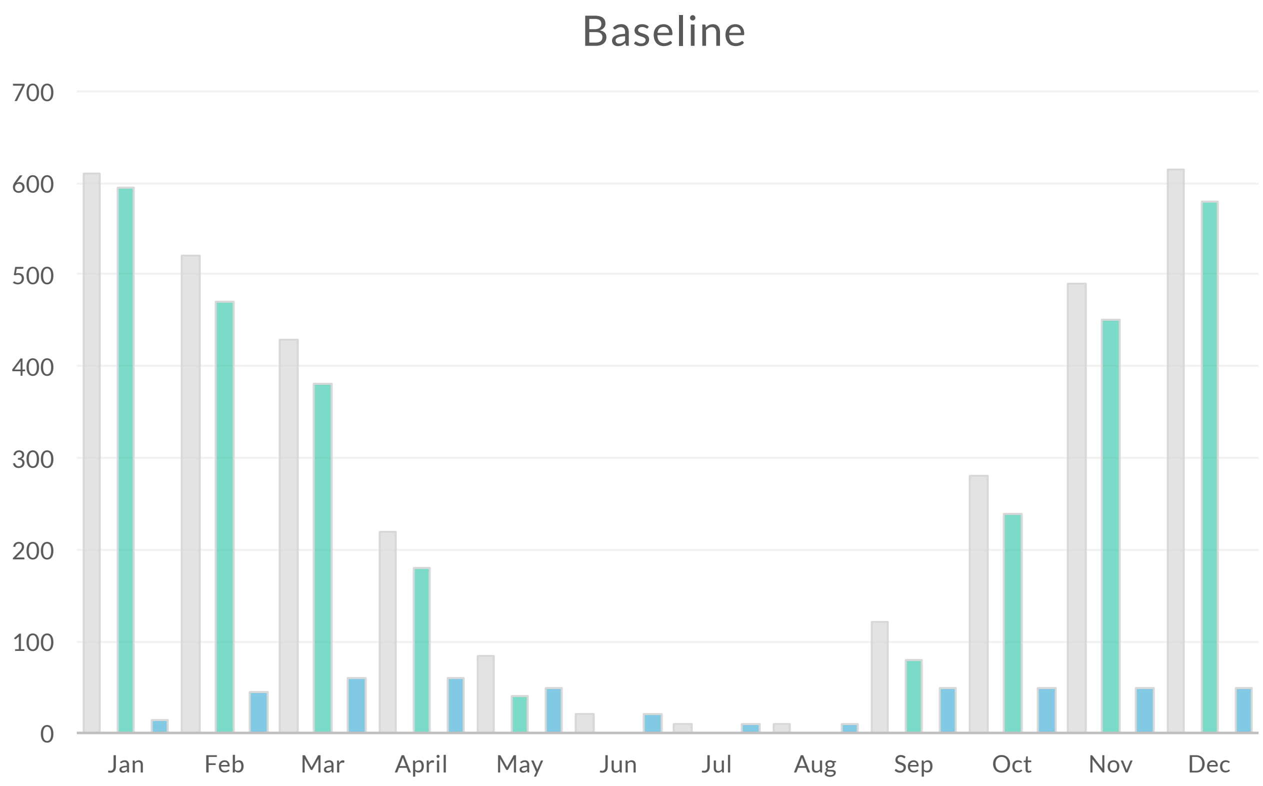


Table E.6 — Required model monthly heating load - Schools (MWh)

Date	Total load	Heating	DHW
Jan	278.73	263.68	15.06
Feb	262.76	219.23	43.53
Mar	211.09	161.31	49.78
Apr	95.61	47.91	47.70
May	51.73	5.66	46.07
Jun	16.64	0	16.64
Jul	7.76	0	7.76
Aug	9.60	0	9.60
Sep	67.07	19.37	47.69
Oct	129.44	83.37	46.07
Nov	250.77	203.08	47.70
Dec	327.48	277.70	49.78

Figure E.9 — Required model monthly heating load - Schools (MWh)

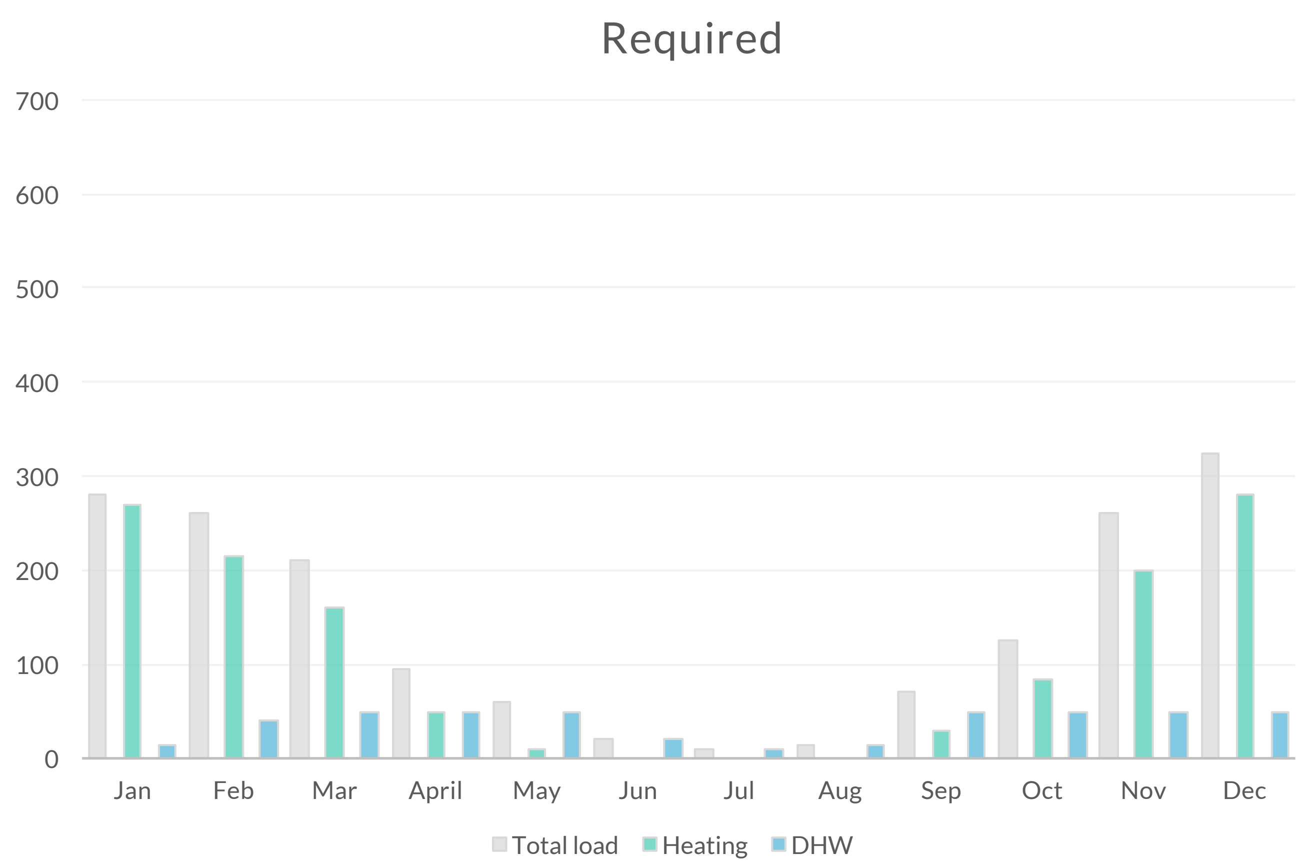
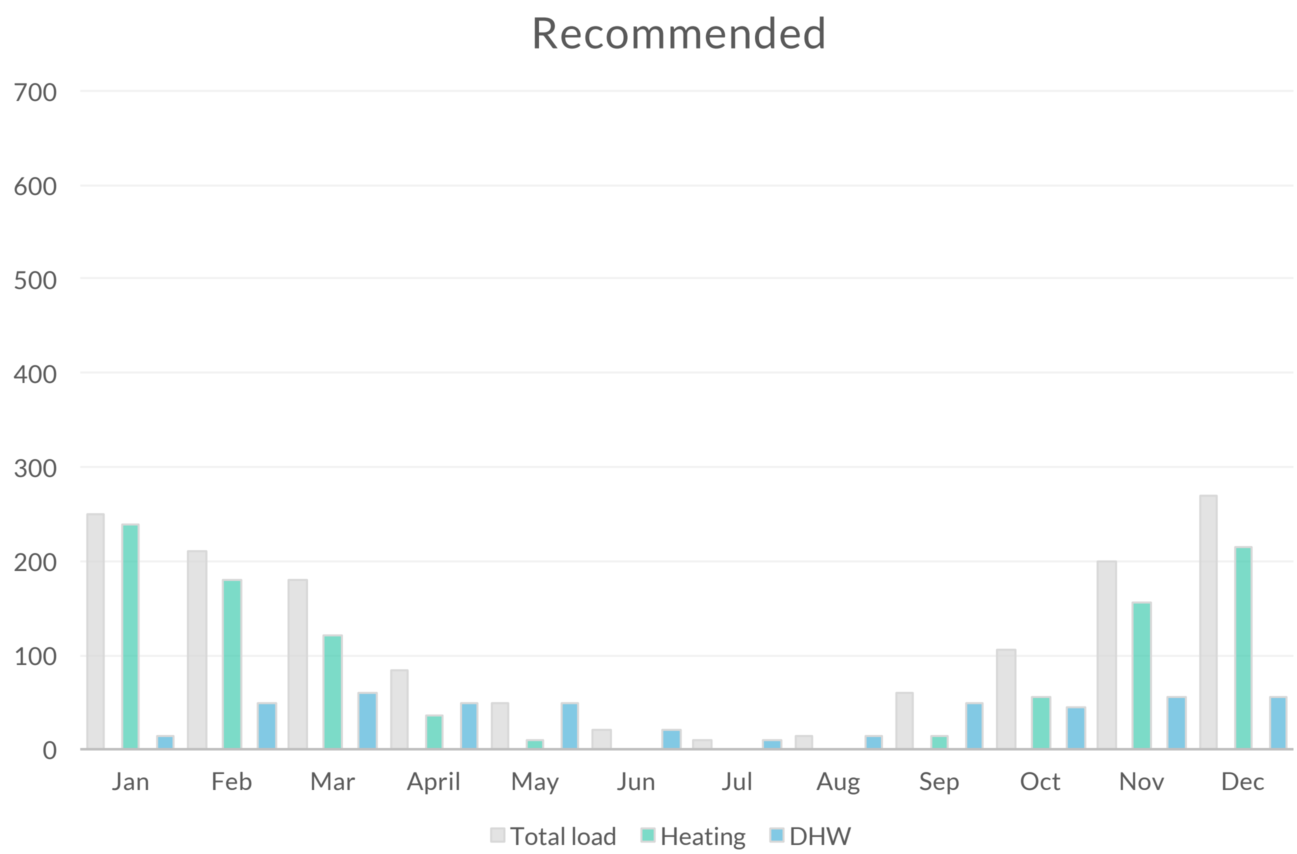


Table E.7 — Recommended model monthly heating load - Schools (MWh)

Date	Total load	Heating	DHW
Jan	242.87	227.81	15.06
Feb	213.69	170.16	43.53
Mar	172.22	122.43	49.78
Apr	81.40	33.70	47.70
May	49.84	3.77	46.07
Jun	16.64	0	16.64
Jul	7.76	0	7.76
Aug	9.60	0	9.60
Sep	57.89	10.20	47.70
Oct	105.97	59.90	46.07
Nov	203.54	155.84	47.70
Dec	264.66	214.88	49.78

Figure E.10 — Recommended model monthly heating load - Schools (MWh)



E.2.2 Kindergartens

Table E.8 — Baseline model monthly heating load - Kindergartens (MWh)

Date	Total load	Heating	DHW
Jan	155.55	152.08	3.47
Feb	125.93	117.76	8.17
Mar	108.01	98.69	9.32
Apr	57.99	49.06	8.94
May	22.21	13.53	8.68
Jun	3.71	0.00	3.71
Jul	2.24	0.00	2.24
Aug	2.55	0.00	2.55
Sep	32.78	23.84	8.94
Oct	74.04	65.37	8.68
Nov	121.82	112.89	8.94
Dec	150.42	141.10	9.32

Figure E.11 — Baseline model monthly heating load - Kindergartens (MWh)

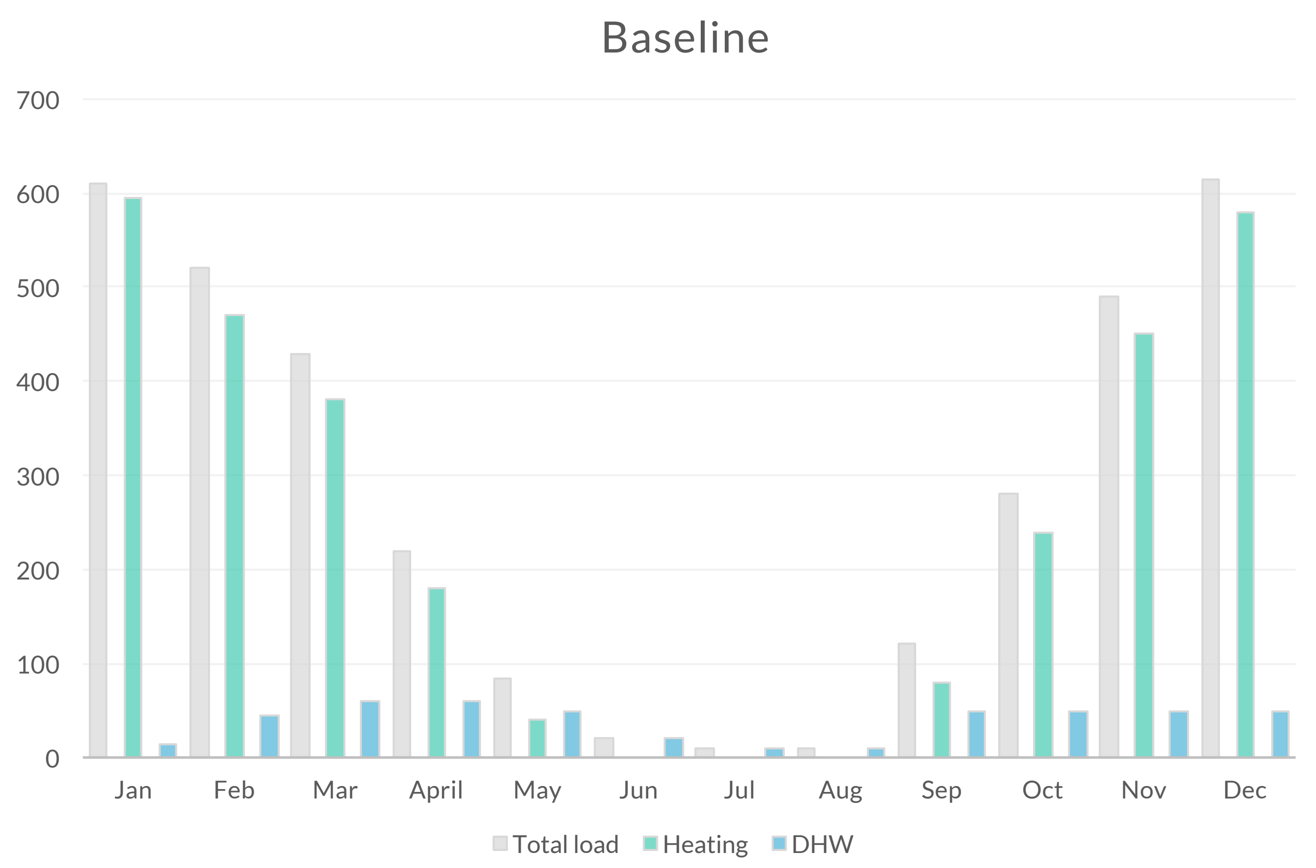


Table E.9 — Required model monthly heating load - Kindergartens (MWh)

Date	Total load	Heating	DHW
Jan	75.86	72.39	3.47
Feb	62.89	54.73	8.17
Mar	51.74	42.42	9.32
Apr	26.31	17.38	8.94
May	12.28	3.60	8.68
Jun	3.71	0.00	3.71
Jul	2.24	0.00	2.24
Aug	2.55	0.00	2.55
Sep	17.41	8.47	8.94
Oct	34.69	26.01	8.68
Nov	60.92	51.98	8.94
Dec	77.14	67.82	9.32

Figure E.12 — Required model monthly heating load - Kindergartens (MWh)

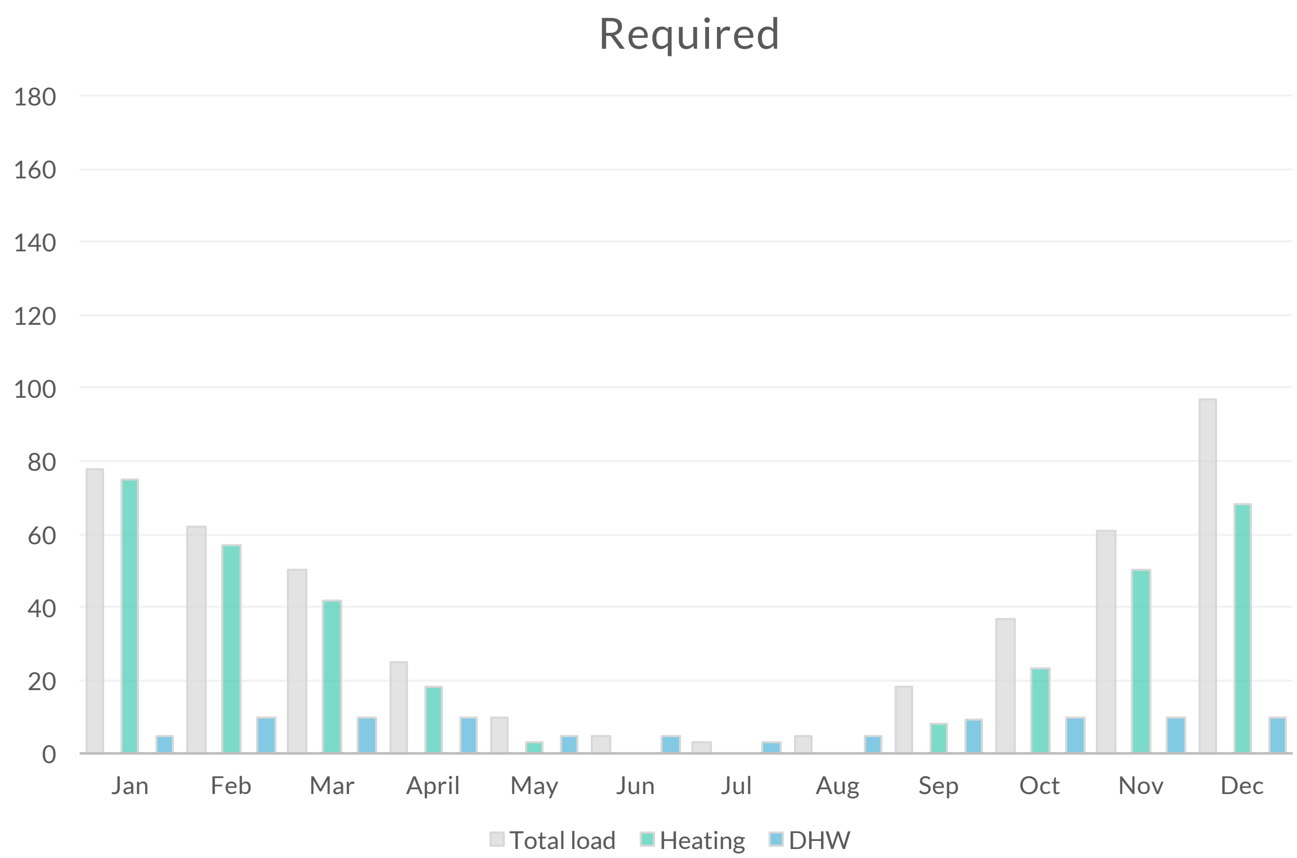
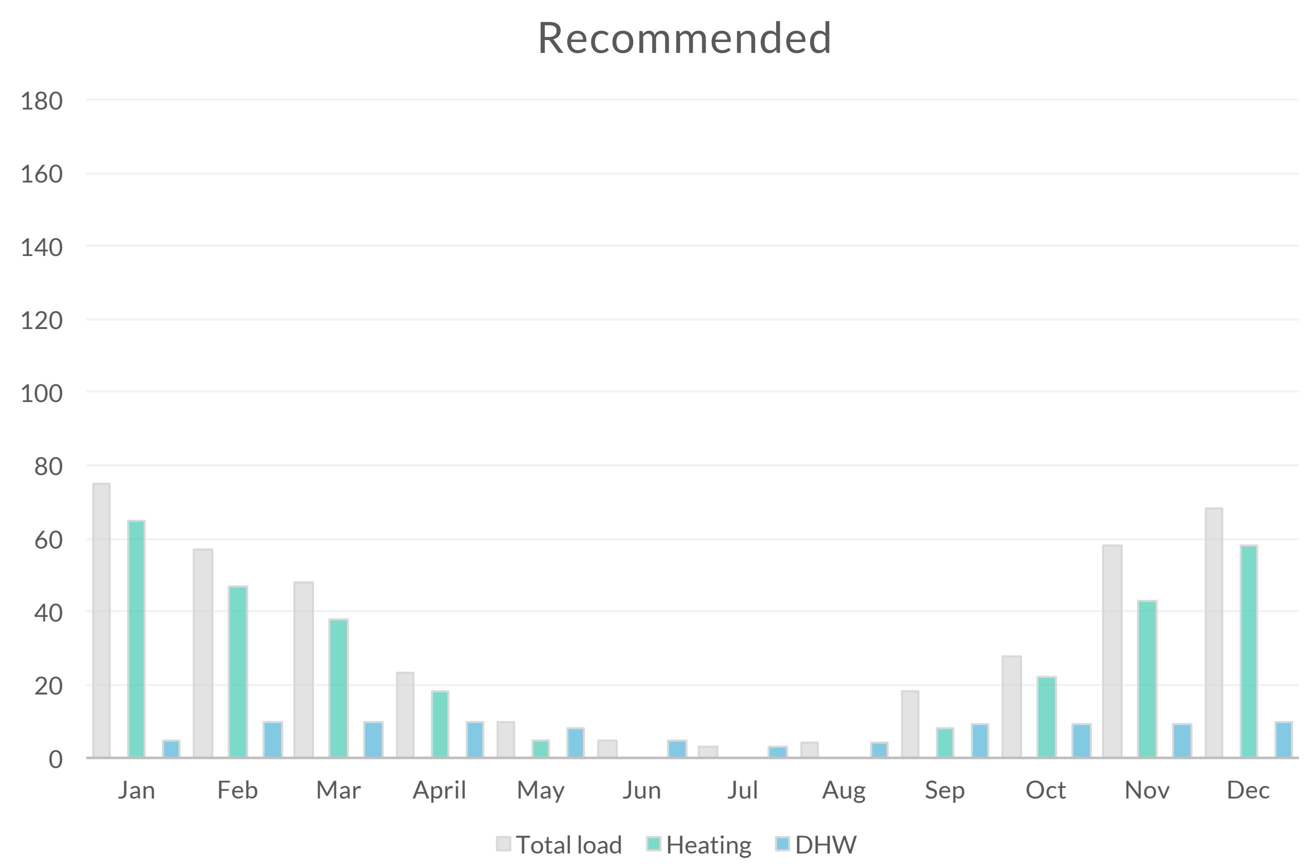


Table E.10 — Recommended model monthly heating load – Kindergartens (MWh)

Date	Total load	Heating	DHW
Jan	69.34	65.87	3.47
Feb	55.68	47.51	8.17
Mar	46.38	37.06	9.32
Apr	24.68	15.75	8.94
May	12.03	3.35	8.68
Jun	3.71	0.00	3.71
Jul	2.24	0.00	2.24
Aug	2.55	0.00	2.55
Sep	16.32	7.38	8.94
Oct	31.32	22.65	8.68
Nov	53.78	44.85	8.94
Dec	67.65	58.33	9.32

Figure E.13 — Recommended model monthly heating load – Kindergartens (MWh)



Appendix F. Cost Analysis

F.1 Construction costs of education buildings in Mongolia

The tables below show the itemized cost information and the energy performance analysis of each building option. The calculations are based on sample construction projects (schools and kindergartens) in Ulaanbaatar. The values may vary depending on a variety of local factors.

F.1.1 Schools

- Capacity: 640 students
- Building size (Floor area): 4,236m^2
- Location: Ulaanbaatar
- Source: Civil engineering company

Table F.1 — School construction costs in Mongolia (required option)

		Cost
1	**Total construction cost**	**2,659,839,863**
2	Tax (10%)	265,983,986
3	Building Permit cost (0.18%)	47,877,118
	Sum (1,2,3)	2,973,700,967
4	Service cost (2%)	53,196,797
5	Design/Engineering cost	
	Sum (4,5)	53,196,797
6	Non-traceable common cost (2%)	53,196,797
7	Others	
	Sum (6,7)	53,196,797
Total		**3,080,094,562**

Unit: MNT

		Cost
1	Site work	73,286,540
2	Framework	635,654,974
3	Exterior wall	510,800,071
4	Windows and Doors	239,629,443
5	Stairs	33,977,072
6	Flooring	234,148,536
7	Slab	255,336,833
8	Roofing	175,691,082
9	Interior finishes	368,577,708
10	Exterior finishes	101,282,672
11	Others	31,454,930
Total		**2,659,839,863**

Unit: MNT

F.1.2 Kindergartens

- Capacity: 150 students
- Building size (Floor area): 1,059m²
- Location: Ulaanbaatar
- Source: Civil engineering company

Table F.2 — Kindergarten construction costs in Mongolia (required)

		Costs
1	**Total construction cost**	**1,197,728,376**
2	Tax (10%)	119,772,838
3	Building Permit cost (0.18%)	21,559,111
	Sum (1,2,3)	1,339,060,325
4	Service cost (2%)	2,395,457
5	Design/Engineering cost	44,379,933
	Sum (4,5)	46,775,390
6	Non-traceable common cost (2%)	2,395,457
7	Others	
	Sum (6,7)	2,395,457
Total		**1,388,231,171**

Unit: MNT

		Costs
1	Site work	38,393,161
2	Framework	236,247,267
3	Exterior wall	144,803,088
4	Windows and Doors	69,596,724
5	Stairs	18,970,930
6	Flooring	120,210,146
7	Slab	107,100,908
8	Roofing	97,164,283
9	Interior finishes	124,727,597
10	Exterior finishes	19,885,498
11	Plumping system	115,473,247
12	Interior lightings and equipments	48,800,769
13	Network system	9,180,110
14	Landscape	21,920,479
15	Others	25,254,170
Total		**1,197,728,376**

Unit: MNT

F.2 Cost Analysis (estimate of the energy and O&M cost savings)

F.2.1 Schools

Table F.3 — Estimate of the energy and O&M cost savings – Schools

	Baseline	Requirement	Recommended	Optional
Total annual energy use(kWh/yr)	3,570,000	1,863,553	1,580,648	1,153,148
Total annual energy savings(%)	-	**48**	**56**	**68**

Items		Baseline		Requirement		Recommended		Optional		Market Price			Remark
		USD	MNT	USD	MNT	USD	MNT	USD	MNT	USD	MNT	Unit	
Wall	150mm	-	-	35,326	70,652,922	-	-	-	-	12	24,600	m²	
	200mm	-	-	-	-	47,102	94,203,896	47,102	94,203,896	16	32,800	m²	
Roof	150mm	-	-	30,880	61,760,760	-	-	-	-	12	24,600	m²	
	200mm	-	-	-	-	41,174	82,347,680	41,174	82,347,680	16	32,800	m²	
Floor	150mm	-	-	30,880	61,760,760	-	-	-	-	12	24,600	m²	
	200mm	-	-	-	-	41,174	82,347,680	41,174	82,347,680	16	32,800	m²	
Window	Double-1	-	-	60,055	120,109,600	-	-	-	-	65	130,000	m²	
	Double-2	-	-	-	-	132,121	264,241,120	132,121	264,241,120	143	286,000	m²	
Renewable Energy	PV	-	-	-	-	-	-	269,453	538,906,100	5,389	10,778,122	kW	50kW/h
	Solar thermal	-	-	-	-	-	-	52,381	104,761,860	873	1,746,031	m²	30m²
	Geothermal	-	-	-	-	-	-	177,174	354,347,819	1,087	2,173,913	kW	163kW/h
Total construction incremental cost		-	-	157,142	314,284,042	261,570	523,140,376	760,578	1,521,156,155				
Total investment cost		1,172,778	2,345,555,821	1,329,920	2,659,839,863	1,434,348	2,868,696,197	1,933,356	3,866,711,976				
Increased construction cost ratio (%)					**13**		**22**		**65**				
Total annual O&M cost (energy cost)		31,264	62,527,422	20,614	41,227,444	18,850	37,700,067	6,739	13,478,062	45.00	90,000	Ton	coal
										0.06	129	kW	electric
Total annual O&M savings(%)			-		**34**		**40**		**78**				
GHG reduction(%)		1,258,617	(kg/CO2)	669,873	(kg/CO2)	572,374	(kg/CO2)	410,749	(kg/CO2)				
					47		**55**		**67**				

Note:
1. 1,000 KRW = USD 1,159.2, USD 1 = 2,000 MNT
2. Renewable energy costs are estimated based on Korean case as relevant market costs vary in Mongolia.

	Requirement	Recommended	Optional
Construction incremental cost(MNT)	314,284,042	523,140,376	1,521,156,155
Annual energy cost savings(MNT)	21,299,978	24,827,355	49,049,360
Payback period (yr)	**15**	**21**	**31**

F.2.2 Kindergartens

Table F.4 — Estimate of the energy and O&M cost savings – Kindergartens

	Baseline	Requirement	Recommended	Optional
Total annual energy use(kWh/yr)	878,956	449,450	407,385	234,185
Total annual energy savings(%)	-	**49**	**54**	**73**

Items		Baseline		Requirement		Recommended		Optional		Market Price			Remark
		USD	MNT	USD	MNT	USD	MNT	USD	MNT	USD	MNT	Unit	
Wall	150mm	-	-	8,651	17,301,918	-	-	-	-	12	24,600	m²	
	200mm	-	-	-	-	11,535	23,069,224	11,535	23,069,224	16	32,800	m²	
Roof	150mm	-	-	8,266	16,531,200	-	-	-	-	12	24,600	m²	
	200mm	-	-	-	-	11,021	22,041,600	11,021	22,041,600	16	32,800	m²	
Floor	150mm	-	-	8,266	16,531,200	-	-	-	-	12	24,600	m²	
	200mm	-	-	-	-	11,021	22,041,600	11,021	22,041,600	16	32,800	m²	
Window	Double-1	-	-	13,738	27,476,800	-	-	-	-	65	130,000	m²	
	Double-2	-	-	-	-	30,224	60,448,960	30,224	60,448,960	143	286,000	m²	
Renewable Energy	PV	-	-	-	-	-	-	53,891	107,781,220	5,389	10,778,122	kW	10kW/h
	Solar thermal	-	-	-	-	-	-	26,190	52,380,930	873	1,746,031	m²	30m²
	Geothermal	-	-	-	-	-	-	97,826	130,434,780	1,087	2,173,913	kW	90kW/h
Total construction incremental cost		-	-	38,921	77,841,118	63,801	127,601,384	241,708	418,198,314				
Total investment cost		559,944	1,119,887,258	598,864	1,197,728,376	623,744	1,247,488,642	801,651	1,538,085,572				
Increased construction cost ratio (%)					**7**		**11**		**43**				
Total annual O&M cost (energy cost)		6,745	13,489,114	4,064	8,128,184	3,802	7,603,151	1,407	2,814,348	45.00	90,000	Ton	coal
										0.06	129	kW	electric
Total annual O&M savings(%)			-		**40**		**44**		**79**				
GHG reduction(%)		307,017	(kg/CO2)	158,837	(kg/CO2)	144,325	(kg/CO2)	82,309	(kg/CO2)				
					48		**53**		**73**				

Note:
1. 1,000 KRW = USD 1,159.2, USD 1 = 2,000 MNT
2. Renewable energy costs are estimated based on Korean case as relevant market costs vary in Mongolia.

	Requirement	Recommended	Optional
Construction incremental cost(MNT)	77,841,118	127,601,384	418,198,314
Annual energy cost savings(MNT)	5,360,930	5,885,963	10,674,766
Payback period (yr)	**15**	**22**	**39**

Appendix G. Incentive Scheme for Promoting Green Buildings

The following table lists incentive schemes for green buildings in different countries. The most commonly used incentive policies throughout the countries are certification payment, tax reduction, financial support for green component technologies, and interest rate reduction.

Table G.1 — Incentive schemes for certified green buildings by country

Country	Compensation upon receiving certification	Tax reduction	Financial support for green component technology	Reduction of interest rate	Floor area ratio incentive	Reduction of administrative time and costs
USA	Y	Y	Y	Y	N	Y
Canada	N	Y	Y	Y	N	N
Europe	Y	Y	Y	Y	N	N
UK	Y	Y	Y	Y	N	N
Japan	Y	Y	Y	Y	N	N
Korea	Y	Y	Y	Y	Y	N

Source: Kim and Shin (2010)

The above incentives are generally given to the building owners. It is important to use incentives to promote green buildings by enhancing private company preference for green school design, construction, and operation. By providing incentives to private companies, the design and construction of green schools will be more actively and enthusiastically taken up, which may also lead to reduced construction periods. It is expected that the proposed incentive programs will increase voluntary participation on the part of private companies in the construction of green education buildings.

Providing incentives to private companies can invigorate markets and improve green technologies, creating a virtuous cycle. Table G.2 gives examples of incentives that could be provided to private architects designing green buildings and the private construction companies building them in Korea.

Table G.2 — Incentives for private companies (Korea)

Beneficiary Party	Incentive Program	Code
Architectural company	Architectural companies can receive 5%-15% additional design fees for green buildings and certification for the public building.	'Work scope and standard cost of public buildings' (Ministry of Land, Infrastructure and Transport, code No.2011-750).
Construction company	If a construction company has experience in the construction of green buildings, they get additional 0.5-1.0 grade, which would be an advantage in open tender.	'Standards on prequalified requirements for tenders, Korean Public Procurement Service' (Department of equipment No.5669, 7-5-Da).

About the Global Green Growth Institute

The Global Green Growth Institute was founded to support and promote a model of economic growth known as "green growth", which targets key aspects of economic performance such as poverty reduction, job creation, social inclusion and environmental sustainability.

Headquartered in Seoul, Republic of Korea, GGGI also has representation in a number of partner countries.

Member Countries: Australia, Cambodia, Costa Rica, Denmark, Ethiopia, Fiji, Guyana, Hungary, Indonesia, Jordan, Kiribati, Republic of Korea, Mexico, Mongolia, Norway, Papua New Guinea, Paraguay, Philippines, Qatar, Rwanda, Senegal, Thailand, United Arab Emirates, United Kingdom, Vanuatu, Vietnam

Operations: Cambodia, China, Colombia, Ethiopia, Fiji, India, Indonesia, Jordan, Laos, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Peru, Philippines, Rwanda, Senegal, Thailand, Uganda, United Arab Emirates, Vanuatu, Vietnam

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