Standard Indicator Reference in Financial Assistance Projects (Energy)

Development strategic objectives (*)	Mid-term objectives	Sub-targets of mid-term objectives	Types of infrastructure	Indicator examples		Policy and methods for setting indicators	Reference projects by type of infrastructure		
							Country	Project	FY of evaluation
1. Energy supply with low-cost, low-carbon, and low-risk	1-1. Develop a power source to realize a low-carbon society	1-1-1. Introduce highly efficient thermal power	**Thermal power generation/thermal power rehabilitation**	**Operation indicators**	**Basic indicators** (1) Maximum output (MW) (2) Amount of electricity generated (kWh) (3) Plant capacity factor (%) (4) Gross thermal efficiency (%) (5) Reduction in fuel consumption (6) Outage time by cause (hours/year or days/year) **Supplementary indicators** (1) Availability factor (%) (2) Auxiliary power ratio (%) (3) Installed capacity of base load generation facilities	・Plant capacity factor (%) = Electricity generated per year / (rated output × hours per year) × 100 (%) <To assess if the power plant is adequately operated> ・Gross thermal efficiency = (Gross electricity generated per year × 860) / (Fuel consumption per year × Heat release value of the fuel) × 100 (To check the levels of performance retention and energy conservation) ・Availability factor (%) = (Operating hours per year / hours per year) × 100 <To confirm the relevance of the original operation plan> ・Auxiliary power ratio (%) = (Auxiliary electricity consumption per year / Gross electricity generated) × 100 <To check the level of performance retention> ・Capacity of base load generation facilities: The capacity of power sources that generate the minimum required amount of electricity 24 hours a day except for inspection times	Kiribati	Project for Upgrading of Electric Power Supply in Tarawa Atoll (Phase II)	2009
							Palau	Project for Enhancing Power Generation Capacity in the Urban Area in the Republic of Palau	2012
							Timor-Leste	Project for Rehabilitation of Power Supply in Dili	2009
							Kiribati	Project for Upgrading of Electric Power Supply in Tarawa Atoll	2006
							Indonesia	Project for Rehabilitation of Gresik Steam Power Plant Units 3 and 4	2009
							Indonesia	Project for Rehabilitation of Gresik Steam Power Plant Units 1 and 2	2005
							Cambodia	Project for Expansion of Electricity Supply Facilities in Siem Reap	2007
							Bangladesh	New Haripur Power Plant Development Project (2) (Japanese ODA loan)	2008
							Iraq	Al-Akkaz Thermal Power Plant Project (Japanese ODA loan)	2009

1. Energy supply with low-cost, low-carbon, and low-risk	1-1. Develop a power source to realize a low-carbon society	1-1-1. Introduce highly efficient thermal power	**Thermal power generation/thermal power rehabilitation**	**Effect indicators**	**Basic indicators** (1) Net electric energy production (annual) (MWh/year) (2) Reduction in fuel consumption (yen) (3) Reduction in CO_2 emissions per unit of electricity generated (%) (3) Reduction in SO_2 emissions per unit of electricity generated (%) (5) Values checked by environmental monitoring (SO_2, NO_2, suspended particles) **Supplementary indicators** (1) Power consumption (2) Electric energy sold (kWh) (3) Number of households consuming electricity (4) Number of individual contractors (5) Number of commercial contractors (6) Number of contracting government agencies (7) Number of power outages (times/year) (8) Outage time per year (9) Reduction in voltage drops (10) Reduction in smuts per unit of electricity generated (%) (11) Reduction in fuel consumption per unit of electricity generated (%)	・Net electric energy production = (Rated output × Hours per year × Plant capacity factor) or (Gross electricity generated – Auxiliary electricity consumption) <To check if the assumed amount of electricity is actually generated> ・CO_2 reduction rate (%) per unit of electricity generated: (Emissions from the existing plant – Emissions after the project) / (Emissions from the existing plant) × 100 ・SO_2 reduction rate (%) per unit of electricity generated: (Emissions from the existing plant – Emissions after the project) / (Emissions from the existing plant) × 100 ・Smuts reduction rate (%) per unit of electricity generated: (Emissions from the existing plant – Emissions after the project) / (Emissions from the existing plant) × 100 ・Fuel reduction rate per unit of electricity generated: (Fuel consumption at the existing plant – Fuel consumption after the project) / (Fuel consumption at the existing plant) × 100	Vietnam Iraq Uzbekistan Vietnam India Indonesia Armenia	Nghi Son Thermal Power Plant Construction Project (II) (Japanese ODA loan) Al-Mussaib Thermal Power Plant Rehabilitation Project (Japanese ODA loan) Talimarjan Thermal Power Plant Extension Project (Japanese ODA loan) O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (IV) (Japanese ODA loan) Simhadri Thermal Power Station Project (III) (Japanese ODA loan) Tanjung Priok Gas-Fired Power Plant Extension Project (Japanese ODA loan) Yerevan Combined Cycle Cogeneration Power Plant Project (Japanese ODA loan)	2010 2007 2010 2006 2001 2003 2004

1. Energy supply with low-cost, low-carbon, and low-risk	1-1. Develop a power source to realize a low-carbon society	1-1-2. Develop hydropower	**Hydropower generation (general hydropower/pumping up)**	**Operation indicators**	**Basic indicators** (1) Unplanned outage time (hours or days/year) (2) Plant capacity factor (%) (3) Comprehensive circulating efficiency (%) (4) Maximum output (MW) (5) Amount of electricity generated (GWh) **Supplementary indicators** (1) Operating time (hours) (2) Hydropower utilization factor (%) (3) Outage time due to planned inspection and repair (hours or days/year) (4) Annual total volume of inflow into the reservoir (M3/year) (5) Volume of sedimentation in the reservoir (M3/year) (6) Amount of electricity generated by the project generator as a percentage of the total amount of electricity generated by the power plant (%) (7) Expected life span of the equipment	･Plant capacity factor (%) = Electricity generated per year / (rated output × hours per year) × 100 (%) <To assess if the plant performance is maintained and exhibited> ･Comprehensive circulating efficiency (%) = (Net electric energy) ÷ (Electricity used for pumping) × 100 <To assess if the plant performance is maintained> ･Hydropower utilization rate = (Net electric energy) ÷ (Possible power generation in a given year) × 100 ･Annual total volume of inflow into the reservoir: Annual total volume of inflow into the dam reservoir from rivers <Primary indicator to show dam control and drought conditions>	Serbia Laos India	Project for Rehabilitation of the Bajina Basta Pumped Storage Hydroelectric Power Plant 2nd term) Project for Rehabilitation of the Nam Ngum I Hydropower Station Purulia Pumped Storage Project (II) (Japanese ODA loan)	2008 2009 2003
				Effect indicators	**Basic indicators** (1) Net electric energy production at the sending end (Gwh/year) (2) Electricity consumption (GWh) (3) Effects of reduction in CO_2 emissions (t/year) **Supplementary indicators** (1) Reduction in fossil fuel consumption (t/year) (2) Number of failure cases (3) Annual total income from electricity generation (4) Maintenance costs (5) Number of households electrified (%)		Indonesia Peru Vietnam Laos	Peusangan Hydropower Plant Construction Project (Japanese ODA loan) Moquegua Hydro Electric Power Plants Construction Project (Japanese ODA loan) Dai Ninh Hydropower Project (III) (Japanese ODA loan) Project for Rehabilitation of the Nam Ngum I Hydropower Station (Japanese ODA loan)	2006 2014 2003 2013

1. Energy supply with low-cost, low-carbon, and low-risk	1-1. Develop a power source to realize a low-carbon society	1-1-3. Develop geothermal power	**Geothermal power generation**		**Operation indicators**	**Basic indicators** (1) Maximum output (MW) (2) Plant capacity factor (%) (3) Gross thermal efficiency (%) (6) Outage time by cause (hours/year or days/year) **Supplementary indicators** (1) Availability factor (%) (2) Auxiliary power ratio (%) (3) Outage times by cause (times/year)		Bolivia Costa Rica	Laguna Colorada Geothermal Power Plant Construction Project (2nd stage / 1st phase) Las Pailas 2 Geothermal Project (Guanacaste Geothermal Development Sector Loan) (Japanese ODA loan)	2014 2014
					Effect indicators	**Basic indicators** (1) Net electric energy production (annual) (MWh/year) (2) Maximum output (actual value) (3) Effects of reduction in CO_2 emissions		Indonesia Indonesia Kenya	Lahendong Geothermal Power Plant Project (Japanese ODA loan) Lumut Balai Geothermal Power Plant Project (Japanese ODA loan) Olkaria I Units 4 and 5 Geothermal Power Development Project (Japanese ODA loan)	2003 2010 2009
		1-1-4. Develop new energy sources / renewable energy	**Renewable energy**	**Set of photovoltaic power generation systems**	**Operation indicators**	**Basic indicators** (1) Plant capacity factor (%) (2) Net electric energy production at the sending end (MWh/year) (3) Maximum output		Tajikistan Pakistan Marshall Bolivia	Project for Introduction of Clean Energy by Solar Electricity Generation System Project for Introduction of Clean Energy by Solar Electricity Generation System Project for Introduction of Clean Energy by Solar Electricity Generation System Project for Introduction of Clean Energy by Solar Electricity Generation System	2009 2009 2009 2013

1.Energy supply with low-cost, low-carbon, and low-risk	1-1. Develop a power source to realize a low-carbon society	1-1-4. Develop new energy sources / renewable energy	**Renewable energy**	**Set of photovoltaic power generation systems**	**Effect indicators**	**Basic indicators** (1) Effects of reduction in CO_2 emissions (t/year) (5) Electrification rate of households (%) **Supplementary indicators** (1) Reduction in fossil fuel consumption (t/year) (2) Amount of electricity imported annually (3) Reduction in electricity rates		Egypt	Hurghada Photovoltaic Power Plant Project (Japanese ODA loan)	2015
				Photovoltaic power generation systems	**Operation indicators**	**Basic indicators** (1) Maximum output (MW) (2) Plant capacity factor (%) **Supplementary indicators** (1) Facility availability factor (%) (2) Gross thermal efficiency at the generating end (%)		Egypt	Kuraymat Integrated Solar Combined Cycle Power Plant Project (II) （Japanese ODA loan）	2008
					Effect indicators	**Basic indicators** (1) Net electric energy production at the sending end (GWh/year) (2) Effects of reduction in CO_2 emissions (t/year)				
				Wind power generation	**Operation indicators**	**Basic indicators** (1) Plant capacity factor (%) **Supplementary indicators** (1) Availability factor (%) or operating time (hours) (1) Maximum output (MW)	・Plant capacity factor (%) = Annual gross generated output (kWh) / Rated output (kW) × annual hours (h) × 100 ・Plant availability factor = Operating hours / Annual hours × 100	Egypt Egypt	Zafarana Wind Power Plant Project (Japanese ODA loan) Gulf of El Zayt Wind Power Plant (Japanese ODA loan)	2003 2009
					Effect indicators	**Basic indicators** (1) Net electric energy production at the sending end (GWh/year) (2) Effects of reduction in CO_2 emissions (t/year) **Supplementary indicators** (1) Reduction in fossil fuel consumption (t/year)	・Net electric energy production at the sending end = Gross electric energy production at the generating end － Plant auxiliary electricity consumption (annual total)	Philippines	Northern Luzon Wind Power Generation Project	2001

1.Energy supply with low-cost, low-carbon, and low-risk	1-2. Efficient power system	1-2-1. Improve the electric power system	**Transmission and substation facilities**	**Operation indicators**	**Basic indicators** (1) Availability factor (%) **Supplementary indicators** (1) Voltage drops at end users (%) (2) Net power amount at the sending end (GWh/year) (3) Transmission loss (%) (4) Transmission and substation loss (%) (5) Voltage	・Availability factor (%) = Annual peak load (MW or kW) / Rated capacity of the facility (MVA or kVA) × Power factor <To assess if the facility is properly operated> (Note) Since the definition of availability factor (%) for transmision & distribution system is not necessarily recognized clearly in the industry, it is desirable that in the ex-ante evaluation table, etc., the calculation formula should be written in the remarks as part of the definition. ・Voltage drops at end users = Maximum voltage drop (V) / Standard voltage (V) <To assess if the quality is maintained at end users> ・Net power amount at the sending end: Annual electric energy transmitted from the target electric transformer <To confirm that the transmission lines and the substation are effectively utilized> ・Transmission and substation loss (%) = [Net power amount at the sending end (kWh) – Electricity consumption at the substation (kWh) – Receiving electric energy (kWh)] / Net power amount at the sending end (kWh) <To confirm that the transmission lines and the substation are adequately operated> ・SAIDI = Sum of all customer outage hours / Total number of customers served	Tanzania Tanzania Pakistan Sri Lanka Bangladesh Vietnam Vietnam	Project for Rehabilitation of Substation and Transmission Line in Kilimanjaro Region Project for Power Supply Expansion in Dar es Salaam (Phase 2) (a project evaluated by the Ministry of Foreign Affairs) National Transmission Lines and Grid Stations Strengthening (Japanese ODA loan) Vavuniya-Kilinochchi Transmission Line Project (II) (Japanese ODA loan) National Power Transmission Network Development Project (Japanese ODA loan) National Power Transmission Network Development Project (Japanese ODA loan) Second Power Transmission and Distribution Network Development Project (Japanese ODA loan)	2010 2005 2009 2010 2012 2007 2015
				Effect indicators	**Basic indicators** (1) Annual accidental outage time per user (minutes/year or households) (2) SAIDI (System Average Interruption Duration Index) (3) SAIFI (System Average Interruption Frequency Index) **Supplementary indicators** (1) Outage times (2) Outage frequency (times/day) (3) Accidental outage time (hours/month) (4) Supply restriction time (hours/month)				
				Operation indicators	**Basic indicators** (1) Peak load (kW) **Supplementary indicators** (1) Installed capacity of the electricity supply facilities	・Annual accidental outage hours per user = Total outage hours per year (minutes) / Number of users ・SAIDI = Sum of all customer outage hours / Total number of customers served ・SAIFI = Total number of customer outage / Total number of customers served ・Distribution loss (%) = Distribution loss (kWh) × 100 / Electricity transmitted (kWh) <To grasp the degree of reduction in distribution loss>	Nepal Cambodia Tanzania	Project for the Extension and Reinforcement of Power Transmission and Distribution System in Kathmandu Valley (Phase 3) Project for Rehabilitation and Upgrading of Electricity Supply Facilities in Phnom Penh (Phase 2) Project for Reinforcement of Power Distribution in Zanzibar Island	2009 2005 2010

1.Energy supply with low-cost, low-carbon, and low-risk	1-2. Efficient power system	1-2-2. Improve distribution network	**Distribution facilities**	**Effect indicators**	**Basic indicators** (1) Annual accidental outage time per user (minutes/year or households) (2) SAIDI (System Average Interruption Duration Index) (3) SAIFI (System Average Interruption Frequency Index) **Supplementary indicators** (1) Accidental outage time (hours/month) (2) Planned outage (hours/year) (3) Unplanned outage (hours/year) (4) Distribution loss (%) (5) Distribution loss (MW) (6) Effects of reduction in CO_2emissions (t/year)		Bangladesh Bangladesh Egypt India India	Central Zone Power Distribution Project (Japanese ODA loan) Rural Electrification Upgradation Project (Japanese ODA loan) Electricity Distribution System Improvement Project (Japanese ODA loan) Bangalore Distribution System Upgrading Project (Japanese ODA loan) Haryana Distribution System Upgradation Project (Japanese ODA loan)	2008 2009 2015 2006 2013	

1.Energy supply with low-cost, low-carbon, and low-risk	1-3. Improve energy access	1-3-1. Extend the power grid	**Transmission and distribution facilities**	**Operation indicators**	**Basic indicators** (1) Availability factor (%) (2) Number of rural centers or villages electrified (3) Number or rate (%)) of households electrified (4) Installed capacity of the electricity supply facilities (kW) (5) Length of distribution lines/cables newly installed (km) **Supplementary indicators** (1) Voltage drops at end users (%) (2) Net power amount at the sending end (GWh) (kWh) (3) Transmission and substation loss (%)	・Availability factor (%) = Annual peak load (MW or kW) / Rated capacity of the facility (MVA or kVA) × Power factor <To assess if the facility is properly operated> (Note) Since the definition of availability factor (%) for transmision & distribution system is not necessarily recognized clearly in the industry, it is desirable that in the ex-ante evaluation table, etc., the calculation formula should be written in the remarks as part of the definition. ・Household electrification rate (%) = Number of households electrified × 100 / Total number of households <To grasp the increased demand> ・Voltage drops at end users = Maximum voltage drop (V) / Standard voltage (V) <To assess if the quality is maintained at end users> ・Net power amount at the sending end: Annual electric energy transmitted from the target electric transformer <To confirm that the transmission lines and the substation are effectively utilized>	Nepal Tanzania Surinam Uganda	Project for the Extension and Reinforcement of Power Transmission and Distribution System in Kathmandu Valley (Phase 3) Project for Power Supply Expansion in Dar es Salaam (Phase 2) (a project evaluated by the Ministry of Foreign Affairs) Project for Expansion of Transmission and Distribution Grid for the Districts Commewijne and Saramacca Rural Electrification Project	2009 2005 2005 2006
				Effect indicators	**Basic indicators** (1) Beneficiary population (persons) **Supplementary indicators** <Indicators related to the electrification of rural centers> (1) Number or percentage of public facilities and business establishments where electric lights have been introduced (public facilities: schools (classrooms), health centers, government facilities, streetlights, public markets, etc.) (2) Number of public facilities where PCs have been introduced (schools, government facilities, public markets, etc.) (3) Number of health centers, etc. where major pieces of equipment such as refrigerators for storing vaccines and drugs and equipment for sterilization and disinfection treatments have been introduced (4) Number of electric pumps installed that contribute to rural water supply, irrigation, etc. <Indicators related to the electrification of individual households> (1) Power generation capacity (kW) (2) Number of houses where electric lights have been installed	– ・Transmission and substation loss (%) = [Net power amount at the sending end (kWh) – Electricity consumption at the substation (kWh) Receiving electric energy (kWh)] / Net power amount at the sending end (kWh) <To confirm that the transmission lines and the substation are adequately oprated>	Ghana Timor-Leste Ghana Nigeria Bhutan Bhutan Morocco Bangladesh Bangladesh	Rural Electrification Project (2nd term) Project for Rehabilitation of Power Distribution Network in Dili Rural Electrification Project (1st term) Rural Electrification Project (3rd term) (a project evaluated by the Ministry of Foreign Affairs) Rural Electrification Project (Japanese ODA loan) Rural Electrification Project (Phase II) (Japanese ODA loan) Rural Electrification Project (II) (Japanese ODA loan) Rural Electrification Project (Phase 4-C) (Japanese ODA loan) Rural Electrification Project (5-B) (Japanese ODA loan)	2008 2008 2007 2007 2007 2011 2002 2005 2008

1.Energy supply with low-cost, low-carbon, and low-risk	1-3. Improve energy access	1-3-2. Electrify off-grid communities by utilizing renewable energy	**Renewable energy**	**Solar, small-scale hydropower, wind power, etc.**	**Operation indicators**	**Basic indicators** (1) Number of rural centers or villages electrified (2) Number or rate (%)) of households electrified **Supplementary indicators** (1) Installed capacity per electricity supply system (Wp) (photovoltaic power generation) (2) Unplanned outage time (hours or days/year) (hydropower) (3) Unplanned outage time by cause (wind power) (4) Outage time due to planned inspection and repair (hours or days/year) (wind power) (5) Plant capacity factor (%) (hydropower/wind power) (6) Net electric energy production at the sending end (MWh/year) (hydropower/wind power) (7) Maximum output (hydropower/wind power) (8) Plant availability factor (%) or operating hours (hours) (wind power)	・Plant capacity factor (%) (hydropower) = Net electric energy ÷ (Maximum output × Hours per year) × 100 ・(Wind power) Unplanned outage hours should be calculated for two types of causes: mechanical failures and windstorms and others ・Plant capacity factor (%) (wind power) = Annual gross generated output (kWh) / Rated output (kW) × annual hours (h) × 100 ・Plant availability factor = Operating hours / Annual hours × 100 ・Net electric energy production at the sending end = Gross electric energy production at the generating end – Plant auxiliary electricity consumption (annual total) (wind power)	Tonga Laos Cambodia Philippines Philippines Honduras	Project for Introduction of Clean Energy by Solar Electricity Generation System Laos Mini-Hydropower Development Project Project for Construction and Rehabilitation of Small Hydropower Plants in Rattanakiri Province Mini-Hydropower Development Project in the Province of Ifugao Micro/Mini Hydropower Development Project (Irrigation) Micro-Hydroelectric Power Generation Project in Metropolitan Area of Tegucigalpa	2009 2012 2012 2012 2012 2012
					Effect indicators	**Basic indicators** (1) Beneficiary population (persons) (2) Effects of reduction in CO_2 emissions (t/year) **Supplementary indicators** <Indicators related to the electrification of rural centers> (1) Number or percentage of public facilities and business establishments where electric lights have been introduced (public facilities: schools (classrooms), health centers, government facilities, streetlights, public markets, etc.) (2) Number of public facilities where PCs have been introduced (schools, government facilities, public markets, etc.) (3) Number of health centers, etc. where major pieces of equipment such as refrigerators for storing vaccines and drugs and equipment for sterilization and disinfection treatments have been introduced				

			Desulfurization systems	**Operation indicators**	**Basic indicators** (1) Desulfurization efficiency (%)	・Desulfurization efficiency = (1 − Amount discharged from the chimney / Amount generated by the boiler) × 100	Bosnia and Herzegovina	FGD Construction Project for Ugljevik Thermal Power Plant (Japanese ODA loan)	2009
				Effect indicators	**Basic indicators** (1) SOx emissions (mg/Nm^3) **Supplementary indicators** (1) Amount of smuts discharged (mg/Nm^3) (2) Amount of dust discharged (mg/Nm^3)		Serbia	Flue Gas Desulphurization Construction Project for Thermal Power Plant Nikola Tesla (Japanese ODA loan)	2011

(*) The only strategic development objective in the energy sector is “1. Energy supply with low-cost, low-carbon, and low-risk.”