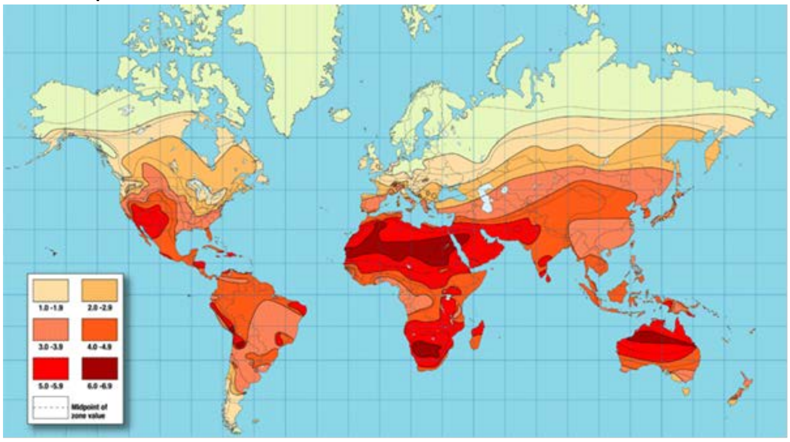
Technology Fact Sheet for Mitigation

Solar PV systems (>1MW)[i]

Technology: Solar PV systems (>1MW)	
Sector : Energy	
Subsector :	
Technology characteristics	
Introduction	Solar photovoltaic, or simply photovoltaic (SPV or PV), refers to the technology of using solar cells to convert solar radiation directly into electricity. A solar cell works based on the photovoltaic effect. R&D and practical experience with photovoltaics have led to the development of three generations of solar cells: Crystalline silicon based solar cells, thin film solar cells and third generation PV. Solar PV is very likely to play a significant role in climate change mitigation in the future. However, today, inspite of significane decreases in the cost for solar PV systems, the majority of PV deployment is still driven by substantial subsidy schemes.
Technology characteristics/high lights	Grid connected solar PV also can have differences in the approach used depending on the way in which customers purchase the electricity. If the solar array is distributed, for example over a larger number of residential houses, then the single installations are operated by the consumer directly. The advantage of this to the consumer is that the cost of electricity, that the consumer must compete with, is the distributed cost, i.e. the cost to purchase power at the location of demand which is normally significantly higher than the actual levelised production cost of electricity (that doesn't account for transmission/distribution charges/losses and profit margins along the value chain). Solar installations can also be large and centralised but this demands that the power is sold into the common grid at market prices and must compete directly with other technologies (bearing in mind any subsidies that might be applicable for solar generation). Need good solar insolation and the geographical distribution is shown in the map.  Worldwide average solar irradiation (kWh/m2 per day)(source: BP,

	2009)
Institutional and organizational requirements	The legal and regulatory requirements for solar PV are relatively few compared to some other renewable technologies. They have a low local environmental impact and are not very visible (for small applications they are often mounted on the roofs of buildings) typically making public/permitting acceptance high. Grid connected systems require an appropriate licence or permit to export to the grid along with the necessary metering equipment, connected by a professional, to ensure that the level of export to the grid is measured for any subsequent compensation. Larger installations obviously require the appropriate planning permissions that would accompany any moderate to large infrastructure project. Currently, the main policy instruments that have an impact on solar PV are incentives that subsidise its use and offset its currently uncompetitive cost; a handful of countries with strongly supportive policies account for 80% of global installed PV capacity (IEA, 2010).
Operation and maintenance	Negligible as it relates to maintaining electronics and interfaces (software).
Endorsement by experts	Increasingly seen as an integrated approach to energy management in buildings. One main characteristic of the technology is that it is capable to provide real-time and extensive data on energy consumption to the facility operator.
Adequacy for current climate	Fits well, both for the current and future climate.
Scale/Size of beneficiaries group	Beneficiary groups can be substantial depending on the adoption of the technology (industrial, large buildings, residential buildings). However, applicable mainly to new buildings.
Disadvantages	Requires competent HVAC engineers or specialists in order to account for all components necessary for cooling load calculation and thus design an efficient system.
Capital costs	
Cost to implement mitigation technology	There has been a large decrease in the cost of solar PV systems in recent decades; the average global PV module price dropped from about 22 USD/W in 1980 to less than 4 USD/W in 2009, while for larger grid connected applications prices have dropped to roughly 2 USD/W in 2009 (IPCC, 2010). A review of the available literature on historical solar PV learning rates (the percentage reduction in price for every doubling of installed capacity) shows a range of estimates from 11 to 26 percent (IPCC, 2010). Using a slightly different approach (based on a study of solar PV module and consumer electricity prices, i.e. a grid-parity study) Breyer et al. (2009) estimated that the "cost of PV electricity generation in regions of high solar irradiance will decrease from 17 to 7 €ct/kWh in the EU and from 20 to 8 $ct/kWh in the US in the years 2012 to 2020, respectively".
<u>Additional</u> cost to implement mitigation	The above cost is additional since the reference scenario is 'doing nothing'.

technology, compared to "business as usual"	
Long term cost (i.e. 10, 30, or 50 years) without mitigation technology	Operation and maintenance of conventional power plants.
Long term cost (i.e. 10, 30, or 50 years) with mitigation technology	Negligible operating and maintenance costs over lifetime of systems (20 years). Need to change electronics (e.g. inverter) maybe once during lifetime.
Development impacts, direct and indirect benefits	
Direct benefits	• GHG emission reductions • Savings on energy bill • Job creation • Enhanced environmental and health benefits
Reduction of vulnerability to climate change, indirect	Solar PV is very likely to play a significant role in climate change mitigation in the future. As described above it is a rapidly growing market and is forecast by the IEA (2010) to contribute more than 10 percent of global electricity supply by 2050. It has energy payback periods ranging from 2 to 5 years for good to moderate locations and lifecycle GHG emissions in the order of 30 to 70 gCO_2e/kWh (IPCC, 2010) depending on panel type, solar resource, manufacturing method and installation size.
Economic benefits, indirect Employment Growth & Investment	 Creation of jobs to: • Install and commission systems (e.g. suppliers of hardware like PV modules and inverters; installers; energy resources assessments etc ..) Can create investment in developing and supplying consulting and training services.
Social benefits, indirect Income Education Health	 Income generation from the abovementioned employment and investment Training in the technology may lead to more training and spread of technology application. Improvement of health conditions through improved comfort.
Environmental benefits, indirect	 Reduction in GHG emissions. Solar PV systems, once manufactured, are closed systems; during operation and electricity production they require no inputs such as fuels, nor generate any outputs such as solids, liquids, or gases (apart

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<tr><td></td><td>from electricity). They are silent and vibration free and can broadly be considered, particularly when installed on brownfield sites, as environmentally benign during operation. The main environmental impacts of solar cells are related to their production and decommissioning. In regards to pollutants released during manufacturing, IPCC (2010) summarises literature that indicates that solar PV has a very low lifecycle cost of pollution per kilowatt-hour (compared to other technologies). Furthermore they predict that upwards of 80% of the bulk material in solar panels will be recyclable; recycling of solar panels is already economically viable. In terms of land use, the area required by PV is less than that of traditional fossil fuel cycles and does not involve any disturbance of the ground, fuel transport, or water contamination (IPCC, 2010).</td></tr>
<tr><td colspan="2">Local context</td></tr>
<tr><td>Opportunities and Barriers</td><td>
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<tr><th>Opportunities</th><th>Barriers</th></tr>
<tr><td>PV SIPP already implemented in Mauritius</td><td>Higher initial costs for design and installation</td></tr>
<tr><td>In line with government policy</td><td></td></tr>
<tr><td>Grid code exists in Mauritius</td><td>Need for a skilled installers (accreditation)</td></tr>
<tr><td>Good solar insolation regime</td><td></td></tr>
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<tr><td>Market potential</td><td>Long-term energy strategy 2011-2025 mentions the following large-scale PV projects.
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<tr><td>(i)</td><td>Installation of 5 kW photovoltaic systems in 10 Government schools</td><td>2011-2012</td></tr>
<tr><td>(ii)</td><td>Installation every two years of a capacity of 50 kW photovoltaic panels in Government buildings, as from 2013</td><td>2013-2025</td></tr>
<tr><td>(iii)</td><td>Setting up of a grid-connected photovoltaic plant of up to 10MW</td><td>2013</td></tr>
<tr><td>(iv)</td><td>Setting up of a grid-connected photovoltaic plant of 10MW, every 3 years after 2013</td><td>2016, 2019, 2022, , 20</td></tr>
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<tr><td>Status</td><td>Grid-tied SIPP systems are in place in Mauritius. There are no utility-scale grid-connected systems in Mauritius.</td></tr>
<tr><td>Timeframe</td><td>Can be implemented immediately provided incentives like feed-in-tariff is provided.</td></tr>
<tr><td>Acceptability to local stakeholders</td><td>The technology is easily acceptable to all stakeholders once barriers are overcome.</td></tr>
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[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment Reports For Climate Change Mitigation – Mauritius. You can access the complete report from the TNA project website http://tech-action.org/**