



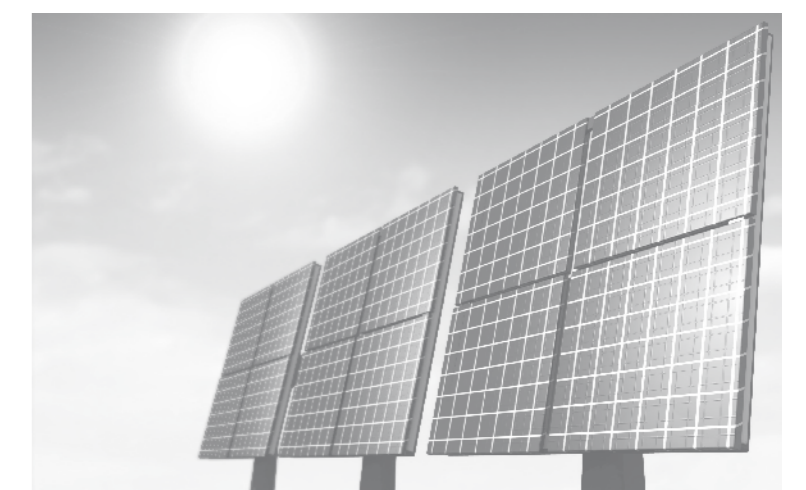
# The Energy Choice: Negotiating Cost, Carbon and Convenience



## Technology options: clean alternatives to conventional sources

Electricity, heat and vehicle fuel can be provided by a variety of conventional and renewable energy sources. Renewables offer a range of advantages compared to conventional sources, including increased energy independence, reduced health impacts, and lower impacts on the environment.

	Wind			Coal	
	Solar			Natural Gas	
	Hydropower			Oil	
	Geothermal			Nuclear	
	Bioenergy		Renewable     Fossil     Nuclear Electricity     Heat     Vehicle Fuel		



## Renewables: high investment, but low operating costs

The investment per unit of generating capacity is generally higher for renewables than it is for conventional sources, however, the long term operating costs are much lower for renewables, since most of them do not require fuel inputs. As a result, a range of renewable energy technologies are already widely competitive with existing energy prices, including hydropower, onshore wind, and small-scale biomass. In off-grid regions, PV systems offer lower costs than diesel generators.

Investment average US\$/kW		Operation average US\$/MWh	
900	Natural Gas	84.4	
1500	Wind	15.7	
1700	Hydropower	9.5	
2000	Coal	62.8	
2000	Diesel	225.0	
2400	Geothermal	23.3	
3200	Bioenergy	36.1	
4500	Solar PV	26.5	
4600	Nuclear	29.5	

Average costs for electricity generation. Data for renewable sources is based on IPCC (2011): Special Report on Renewable Energy Sources; Data for Coal, Natural Gas and Nuclear is based on EWL (2009): Valuing fuel diversification in optimal investment policies for electricity generation portfolios, as well as on Konstantin (2009): Praxisbuch Energiewirtschaft; Data on diesel generators is based on HOMER (Hybrid Optimization Model for Electric Renewables) and on Solar Electric Light Fund (2008): A cost and reliability comparison between solar and diesel powered pumps.