6 Storage-Integrated Energy Harvesters

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CONTENTS

6.1 INTRODUCTION

As far back as history has been recorded, the use of renewable energy has been seen for different applications rather than generating electrical power. Sørensen [1] writes that wood for fire fuel dated back 10,000 years, wind energy was used 5,500 years ago for sailboats, and solar power was used to ignite fires. As technology and society advanced, people became more reliant on fossil fuels as the need for more immediate and reliable power exploded. In today's world, however, the need for renewable energy is growing every day for multiple reasons, including energy security [2–4], environmental issues [5–7], and the fact that fossil fuels are finite [8,9]. Dependency on fossil fuels can pose national security risks because oil-dependent countries often require military involvement to ensure there are no disruptions in the oil supply, while oil suppliers weaponize the energy market in pursuit of scoring other political points [2,3]. According to Krane [5], the burning of fossil fuels accounts for two-thirds of the world's greenhouse gas emissions. This alone should be a strong motivating reason to push toward a more sustainable energy industry. Shafiee and Topal [8] stated that oil and gas reserves, based on the current ratio of reserve to use, will both run out in less than 100 years. With fossil fuel sources and reserves being so finite, utilization of naturally occurring energy sources are the way to survive in the future. Because the need for renewable energy sources was discovered,

TABLE 6.7
General Characteristic Comparison

Technology	Benefits	Disadvantages	Efficiency (%)	Location Restrictions
		Hydro Pumped Storage (HPS)		
HPS + Wind Turbine via open wells [10]	+ Small scale + Quick response + Very uniform output + Powers a house for multiple hours without any wind	– Immature technology – Losing energy in the expense of addressing intermittence	Not provided	Requires open wells
HPS + Wind-Diesel via flood water [12]	+ Increases penetration of wind to 100% + Alleviates other issues like flooding	– Very expensive – Location dependent	Not provided	Large body of water
		Flywheel		
Flywheel + Batteries + Wind/ Solar [13]	+ Reduced number of batteries needed + Long life	– Needs battery storage – Potential danger with failure	75	Ample area
		Batteries		
Battery + Wind [15]	+ Large daily saving ($) + Less reliant on diesel generators	– Large scale setup – Bad for the environment – Batteries arc expensive	Not provided	Not applicable
		Buoyancy-Based Energy Storage (BBES)		
BBES + Wind [17]	+ High scalability + Very high storage capabilities	– High capital cost – Difficult to implement	83	Deep water
		Compressed Air Energy Storage (CAES)		
CAES + Floating Solar [19]	+ Lowered environmental impact + Lowered cost and longer life	– Difficult to implement	80	Extensive water area
CAES + VIV-Based Harvesters	+ Environmentally friendly + Scalable + Cost effective + Efficient	– Difficult to implement	Depends on the storage period	Water

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