Biogas production is an established sustainable process for simultaneous generation of renewable energy and treatment of organic wastes. The increasing interest of utilizing biogas as substitute to natural gas or its exploitation as transport fuel opened new avenues in the development of biogas upgrading techniques. The present work is a critical review that summarizes state-of-the-art technologies for biogas upgrading and enhancement with particular attention to the emerging biological methanation processes. The review includes comprehensive description of the main principles of various biogas upgrading methodologies, scientific and technical outcomes related to their biomethanation efficiency, challenges that have to be addressed for further development and incentives and feasibility of the upgrading concepts.