



## Use of LPP Technology as Compliment to Solar and Wind Power Production

Integration of renewable sources of energy onto the electrical grid poses significant challenges to the power generation industry<sup>1</sup>. Solar and wind farms operate in a very different manner than other large power generation technologies. One of the major differences is that the energy production from these sources is not constant or predictable, even on an hourly basis. Typically, a given wind or solar plant can generate power only 20 to 30% of the time. Hence, it is difficult to solely rely on these sources to meet daily electrical demands; generally “traditional” sources (e.g. coal, nuclear) must be available to reliably meet energy needs. The inability to produce renewable energy from solar or wind on-demand reduces the value this electricity since it cannot be dispatched at times of highest need. To make renewable energy a dependable and viable method for power distribution, there is a real need to develop a “dispatchable” (or available on-demand) renewable electricity source. One method to do this is through the use of a gas turbine burning renewable biofuels, which can serve as a complimentary source to wind or solar generation. Combined in this manner, renewable energy can be generated when desired and customer demand can be fulfilled, regardless of weather conditions.

LPP Combustion, LLC (“LPP”) has developed a patented technology solution to produce clean energy from renewable liquid fuels<sup>2</sup>. The LPP solution enables liquid fuels such as biodiesel or ethanol to be burned using conventional natural gas-fired combustion turbines (“gas turbines”) with the same low emissions as natural gas combustion. The LPP solution changes the nature of liquid fuels to create a substitute natural gas, which can be burned, without water addition or modification to the gas turbine, to provide clean, environmentally-friendly electric power. Biofuels burned in this manner will have very low criteria pollutants (NO<sub>x</sub>, CO and particulates) and no net CO<sub>2</sub> (per the Kyoto Climate Treaty). Liquid biofuels burned in the traditional manner would produce more than 4 times as much NO<sub>x</sub> as the LPP system, and can be limited in the number of operating hours due to the high levels of pollutants formed.

As with wind or solar energy, electricity generated with biofuels will be eligible for renewable energy certificates (RECs) and premium electrical pricing in many locations in the world. The ability to produce energy when needed with a liquid biofuel will allow operators to provide electricity at times of highest demand and be eligible for highest pricing. The ability to reliably produce energy, either by wind, solar or biofuels will enhance the overall value of any renewable energy project.

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<sup>1</sup> Vardi, M. (2010), “Integrating Renewables”, Public Utilities Fortnightly, Vol. 148, No.3, pp. 38-44.

<sup>2</sup> Gokulakrishnan, P., Ramotowski, M. J., Gaines, G., Fuller, C., Joklik, R., Eskin, L. D., Klassen, M. S. and Roby, R. J. (2008), “A Novel Low NO<sub>x</sub> Lean, Premixed, and Prevaporized Combustion System for Liquid Fuels”, Journal of Engineering for Gas Turbines and Power, Vol. 130.