Sustainable and continuous operation of an artificial photosynthetic (AP) system requires a constant supply of CO$_2$ captured from the dilute sources such as the flue gas and the air to make fuels and chemicals. Although the architecture of AP systems resembles that of the natural leaves, they lack an important component like stomata to capture CO$_2$ directly from the dilute sources. Here we design and evaluate the solar-to-fuel (STF) efficiency of the integrated AP system that captures CO$_2$ directly from the air/flue gas and converts it to fuels using sunlight.