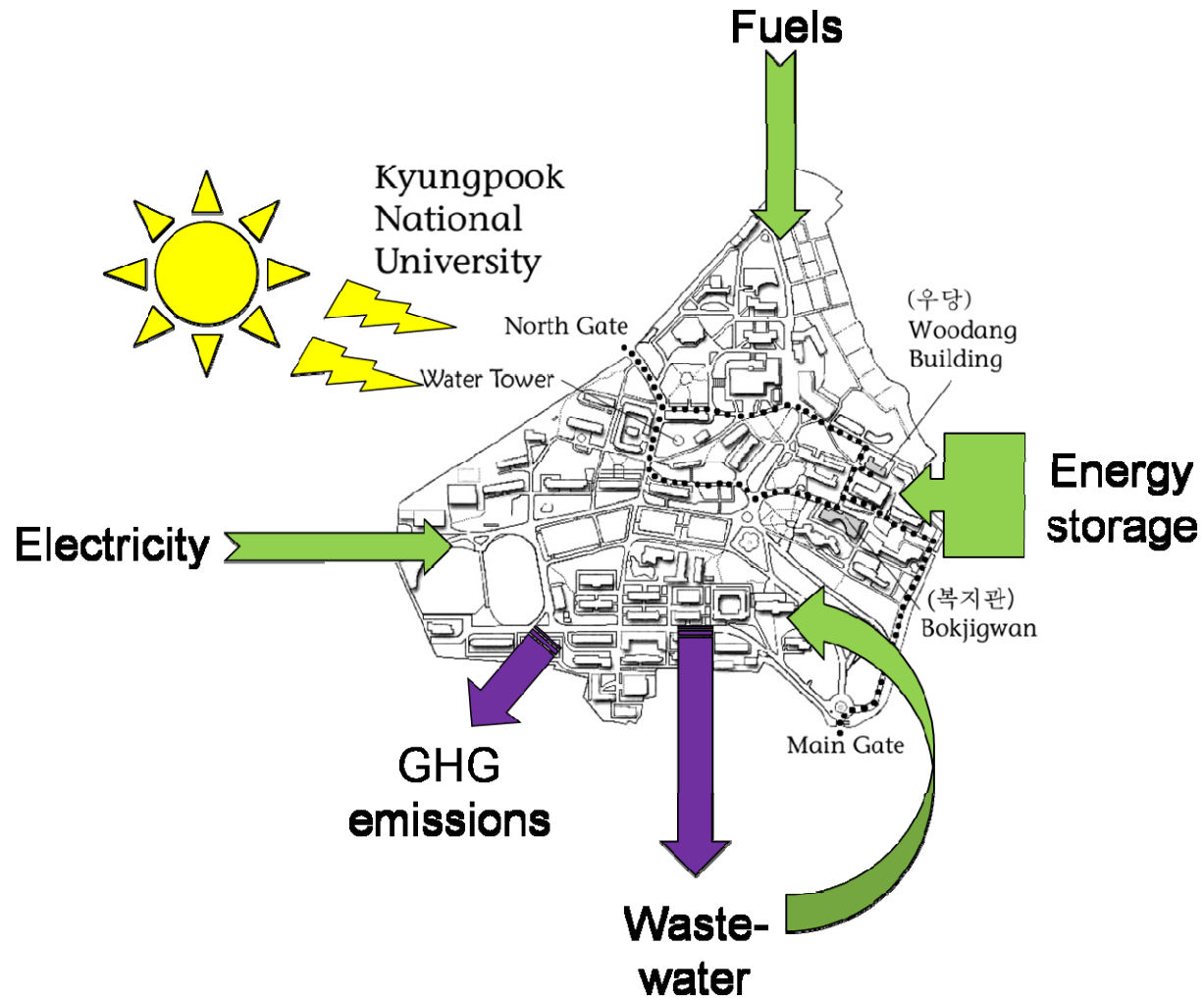


Nanostructured Materials for Light Conversion and Energy Storage

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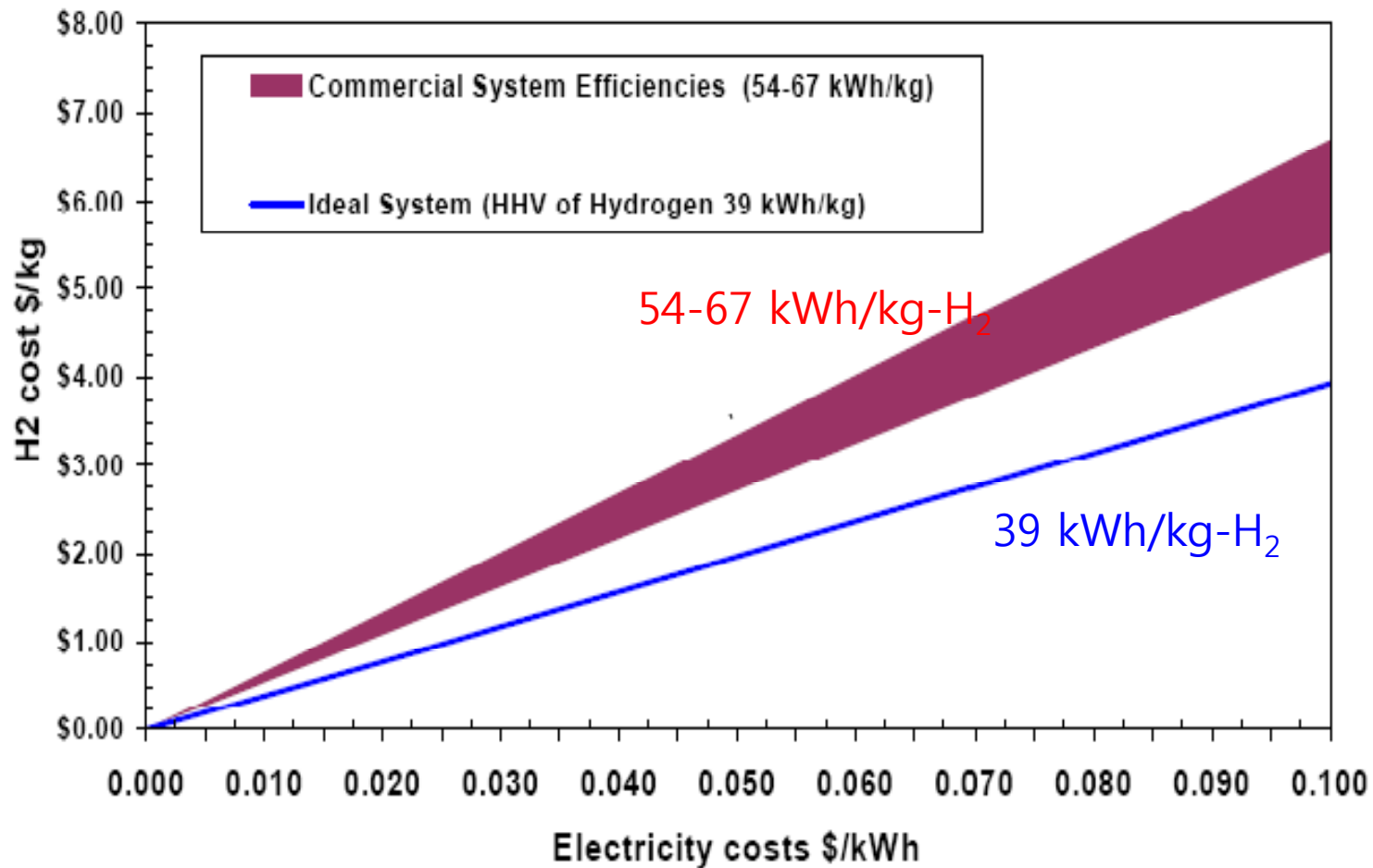
Solar-Powered Urban Metabolism



Major Hydrogen Production Processes

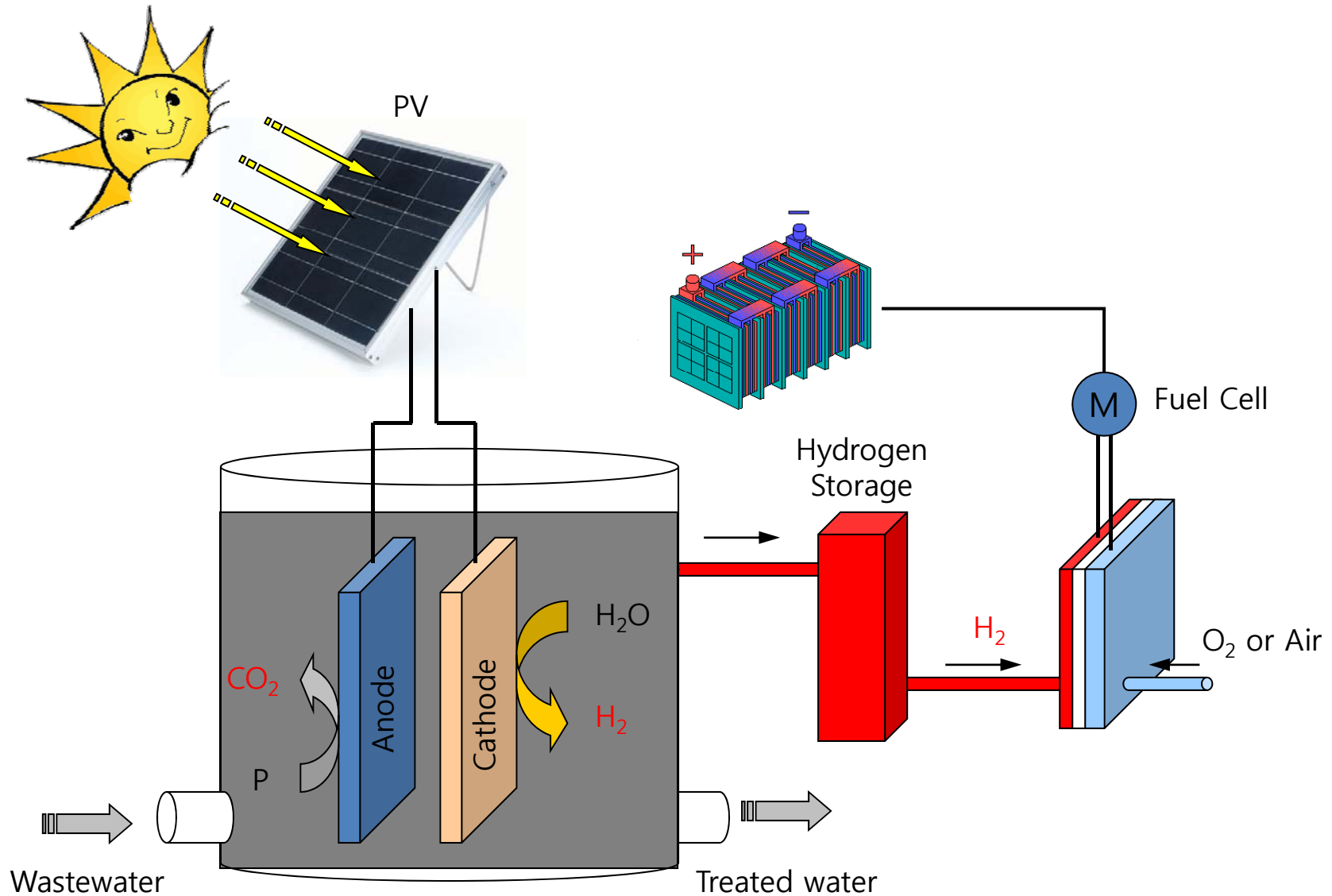
Primary Method	Process	Feedstock	Energy	Emissions
Thermal	Steam Reformation $CH_4 + H_2O \rightarrow CO + 3H_2$ $CO + H_2O \rightarrow CO_2 + H_2$			<i>95% in the U.S. 48% in the world</i>
	Thermochemical Water Splitting	Water	High temperature	No emissions
	Gasification			<i>Huge Carbon Footprint CO_2/H_2 (wt) = 2.5</i>
	Pyrolysis			<i>Incomplete Reaction → CO generation</i>
Electrochemical	Electrolysis	Water	Electricity from wind, solar, hydro and nuclear	can mitigate their effect. No emissions
	Electrolysis	Water	Electricity from coal or natural gas	Some emissions from electricity production.
	Photoelectrochemical	Water	Direct sunlight	No emissions
Biological	Photobiological	Water and algae strains	Direct sunlight	No emissions
	Anaerobic Digestion	Biomass	High temperature heat	Some emissions
	Fermentative Microorganisms	Biomass	High temperature heat	Some emissions

Key Findings from the Commercial Electrolysis

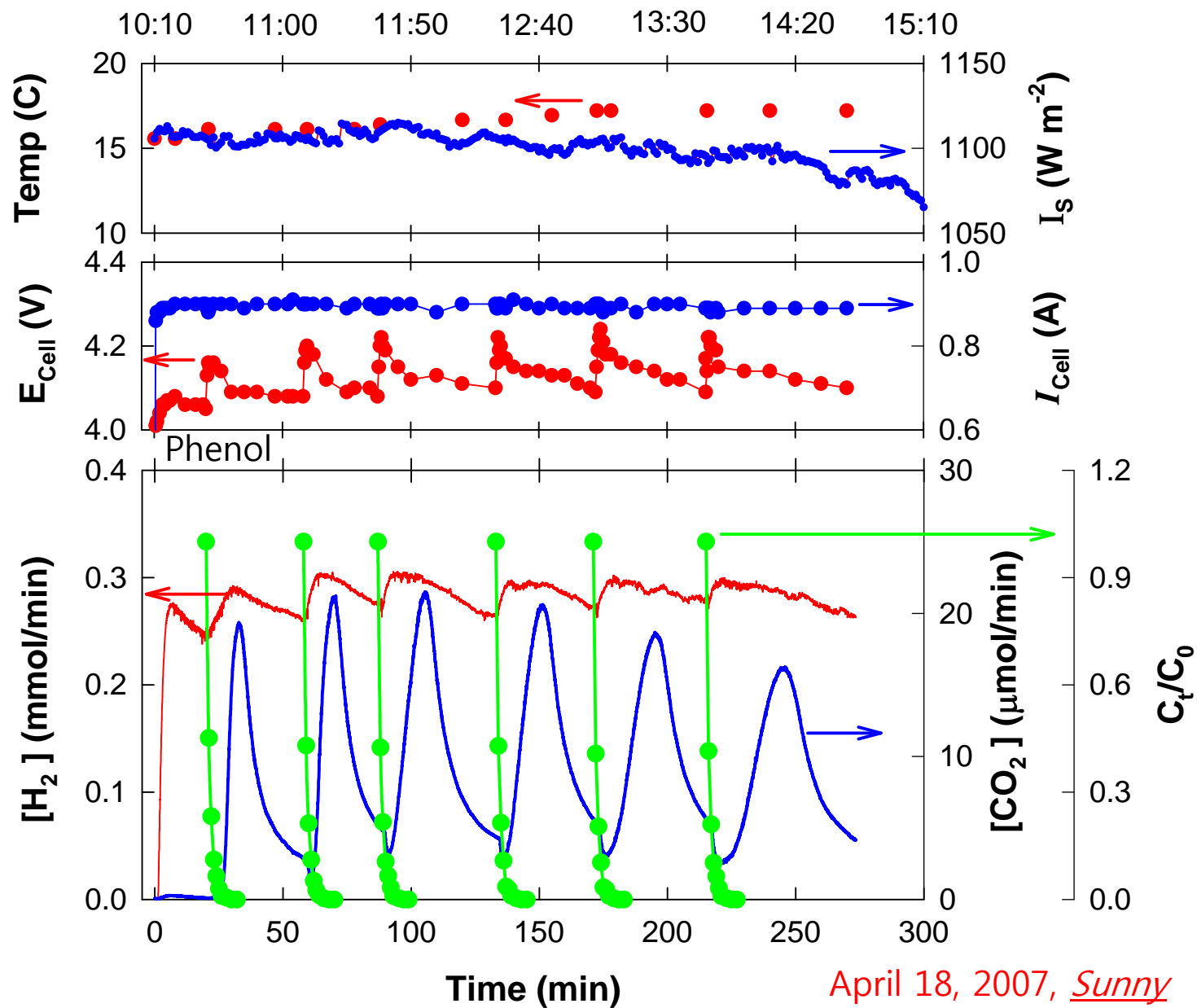


Electricity cost is a major component of H₂ cost

Solar Light-Driven Electrolysis with Water Treatment



PV-Electrochemical Hybrid



Acknowledgements

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Photoenergy Conversion (PECL) group members

2nd-year grads

1st-year grads

TiO₂ nanofiber
ZnO nanorod

CNT-H₂

M-Fe₂O₃

TNT-Fe₂O₃

Electrocatalysts
WO₃

