**Supporting Information**

Development of an Off-Grid Electrical Vehicle Charging Station Hybridized with Renewables Including Battery Cooling System and Multiple Energy Storage Units

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Table S1: Thermodynamic balance equations of the main subsystems and components in the proposed integrated system

|  |  |  |  |
| --- | --- | --- | --- |
| **Main Component/**  **Subsystem** | **Equation Type** | | **Balance and Efficiency Equations** |
| ***CPV/T*** | Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Wind Turbine*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy and Ƞexergy |  | |
| ***Electrolyzer*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***H2 Fuel Cell*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***NH3 Fuel Cell*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Water Pump*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***O2 Storage for H2 Fuel Cell*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***O2 Storage for NH3 Fuel Cell*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***H2 Storage*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***NH3 Storage*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***NH3 Production*** | Mass |  | |
| Energy  (: is for recycle compressor within NH3 production unit) | + | |
| Entropy | + | |
| Exergy | + | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Air Separation*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Heat Exchanger*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Turbine*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Compressor*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |
| ***Combustion Chamber (with no heat loss)*** | Mass |  | |
| Energy |  | |
| Entropy |  | |
| Exergy |  | |
| Ƞenergy |  | |
| Ƞexergy |  | |