Supplementary Material for: Modelling and operation strategy approaches for on-site Hydrogen Refuelling Stations

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Contents

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S1. Operational strategy flow chart

The operational strategy simplified flow chart of the main filling and refuelling events logic is shown in Figure S.1.

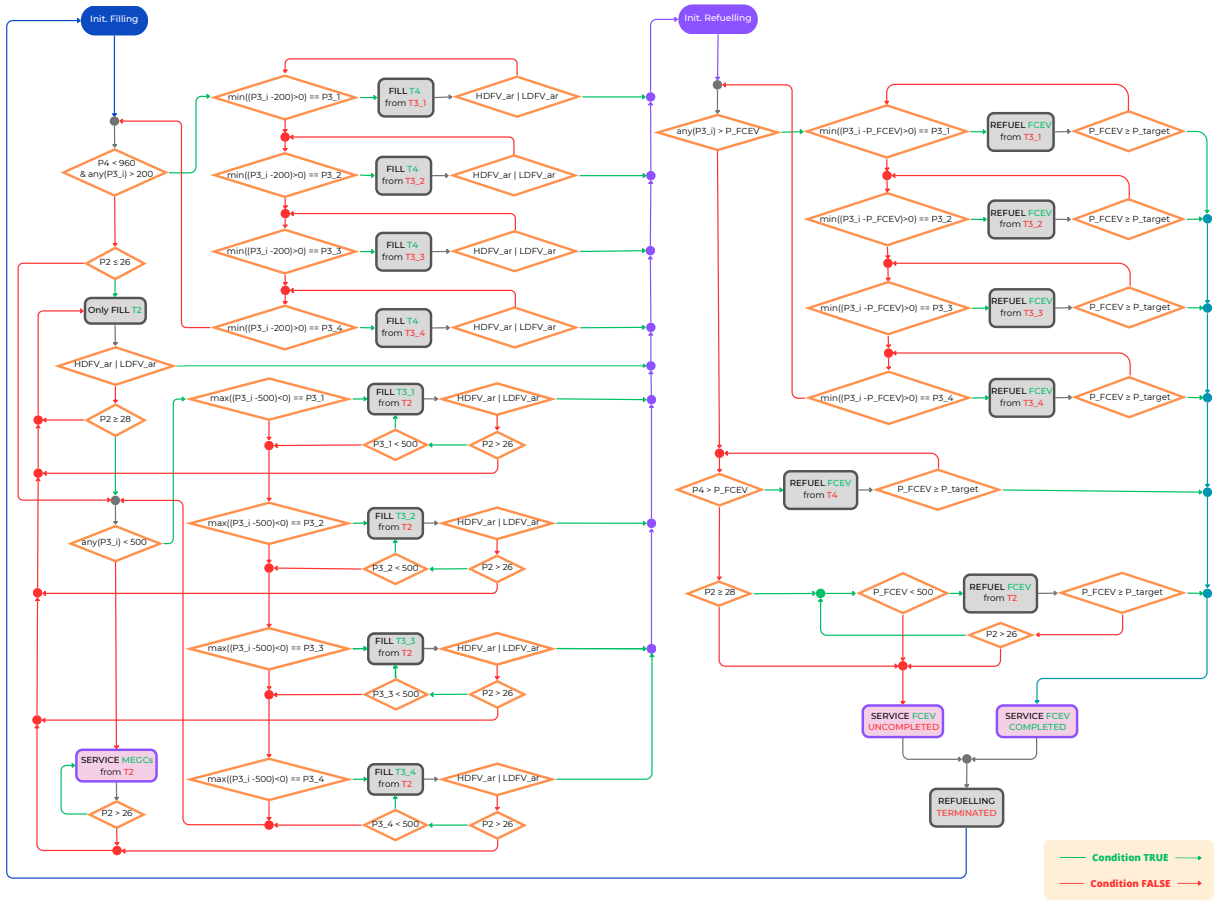

Figure S.1: Operational strategy simplified flow chart concerning the cascaded filling and refuelling processes of the HRS. Compressor C_1 and the battery operational strategy is not shown.

S2. One-day long simulation supplementary results

This section complementary results for the same simulation configuration of 8 daily HDFVs and 60 kg/day of demand and case c) of Figure 3 of the manuscript

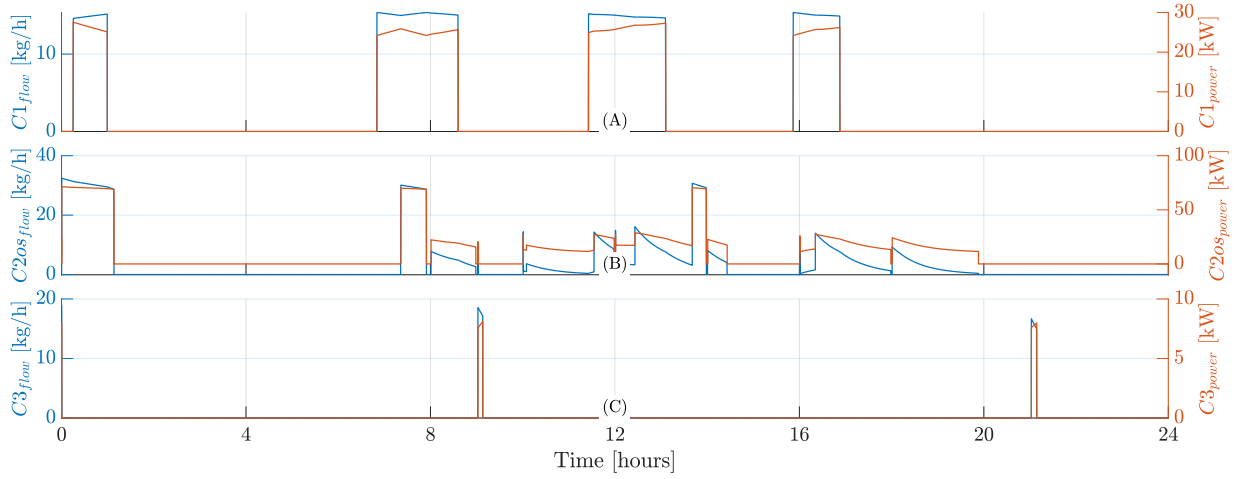

Figure S.2: Compressors flow and power consumption. Simulation configuration: case c) with 60 kg/day and 8 HDFV per day. Results for the first day of January, 2016

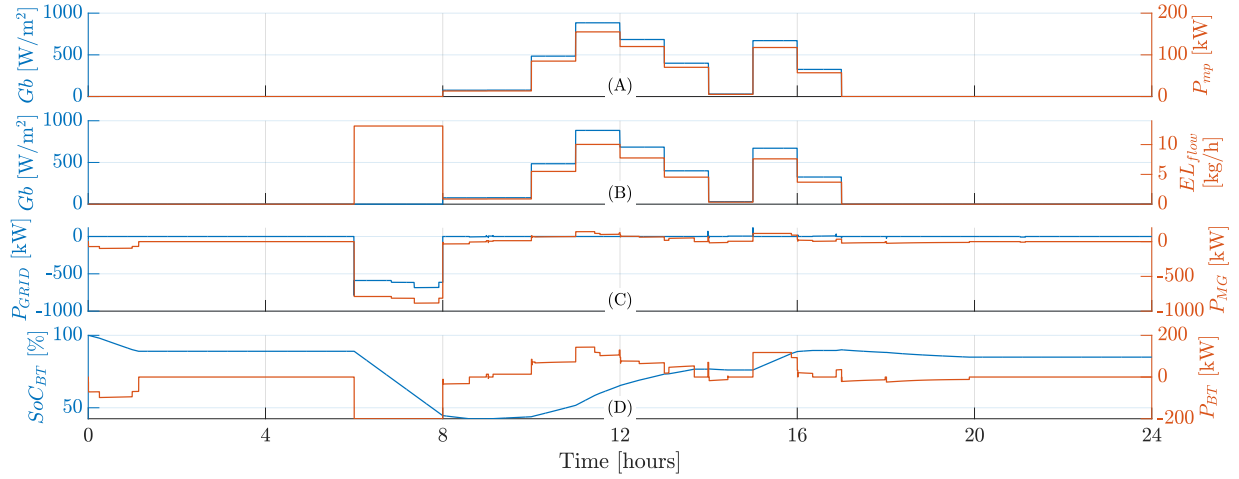

Figure S.3: (A) left: direct beam irradiance. (A) right: photovoltaic power generation. (B) left: direct beam irradiance. (C) right: electrolyzer H_2 flow rate production. (D) left: power balance of the HRS. (D) right: power balance of the HRS without the battery participation. (D) left: State-of-Charge of the battery. (D) right: power charging/discharging rate applied to the battery. Simulation configuration: case c) with 60 kg/day and 8 HDFV per day. Results for the first day of January, 2016.

S3. One-year long simulation results

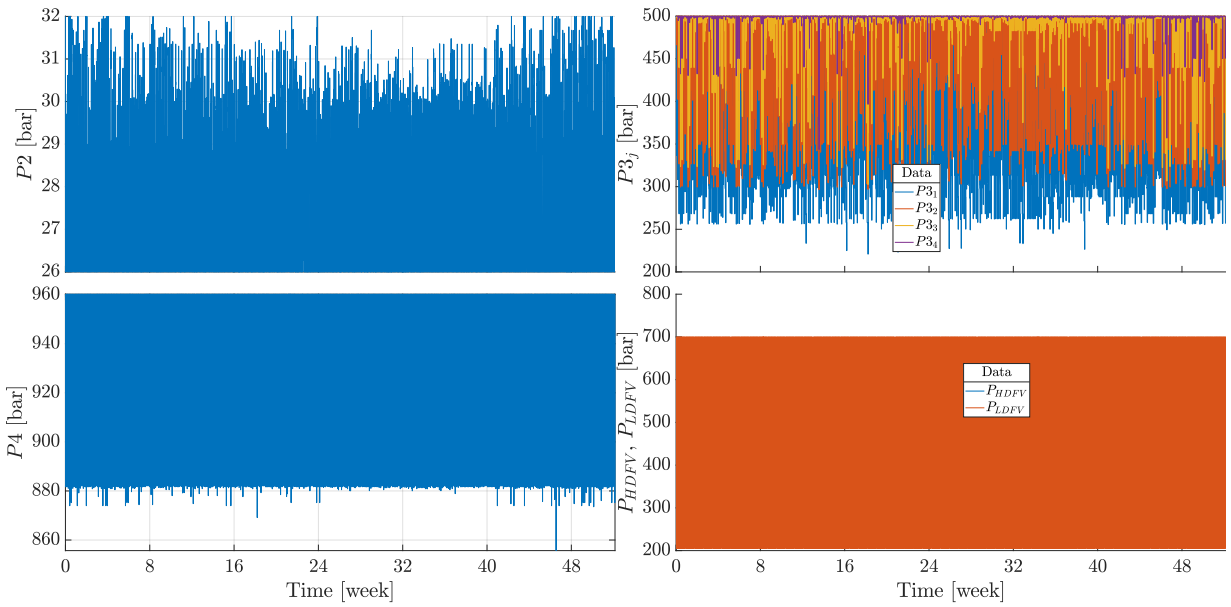

Figure S.4: H_2 tanks pressure dynamic results of case c) with 60 kg/day and 8 HDFV per day. Results for one year of simulation (2016).

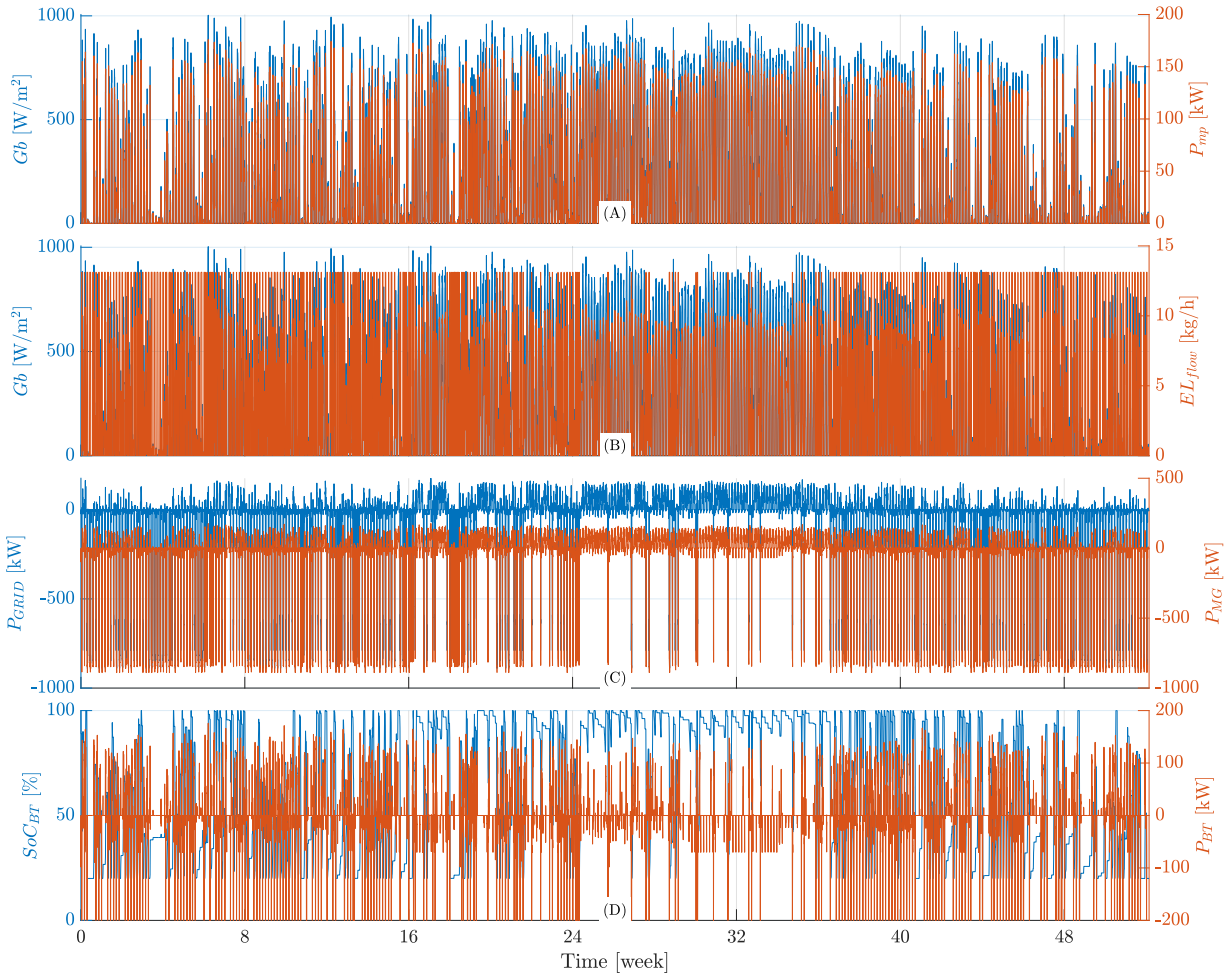

Figure S.5: (A) left: direct beam irradiance. (A) right: photovoltaic power generation. (B) left: direct beam irradiance. (C) right: electrolyzer H_2 flow rate production. (D) left: power balance of the HRS. (D) right: power balance of the HRS without the battery participation. (D) left: State-of-Charge of the battery. (D) right: power charging/discharging rate applied to the battery. Simulation configuration: case c) with 60 kg/day and 8 HDFV per day. Results for one year of simulation (2016).

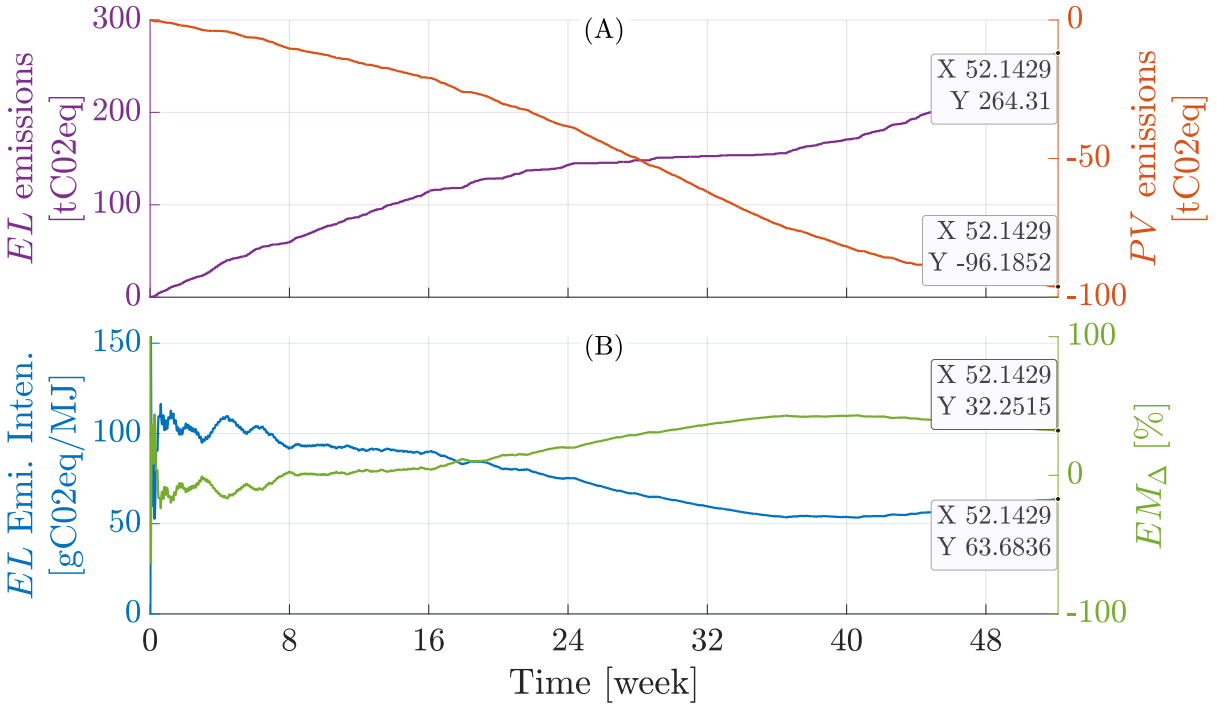

Figure S.6: (A) left: cumulative H_2 production emissions in Spain [51]. (A) right: equivalent emissions of the photovoltaic generation in Spain [51]. (B) left: cumulative greenhouse gas emission intensity of H_2 production in Spain [51]. (B) right: emission savings according to [51]. Simulation configuration: case c) with 60 kg/day and 8 HDFV per day. Results for one year of simulation (2016).

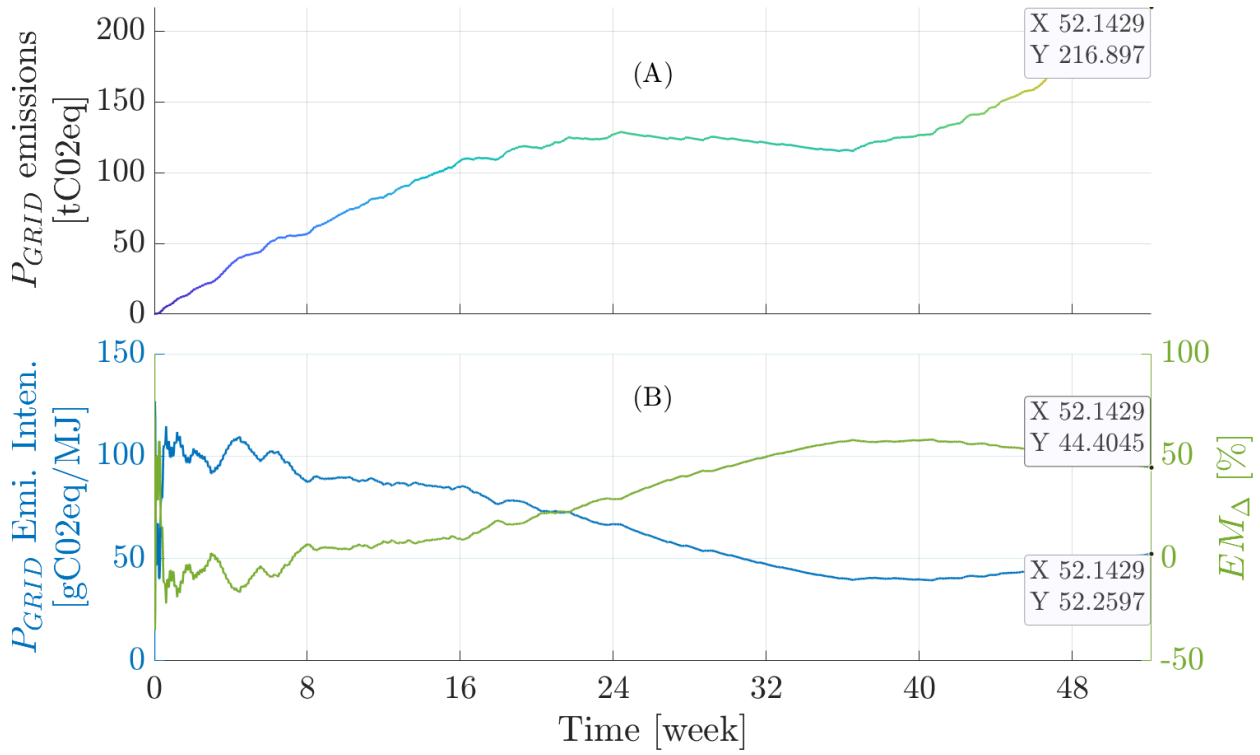

Figure S.7: (A): cumulative HRS operation emissions due to power consumption/injection to the utility grid in Spain [51]. (B) left: cumulative greenhouse gas emission intensity of HRS operation in Spain [51]. (B) right: emission savings according to [51] considering all power loads and the photovoltaic and battery inputs of the model. Simulation configuration: case c) with 60 kg/day and 8 HDFV per day. Results for one year of simulation (2016).