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Offshore Hydrogen Supergrid Parameters

CP^{E}: Energy consumption ratio of each electrolyzer: 53 [kWh/kg H_2] [1]

CP^{FC}: Hydrogen consumption ratio of each fuel cell: 20 [kWh/kg H_2] [2] [3]

P^{E}_{rated}: Power rating of each electrolyzer: 250 [kW] [3]

P^{FC}_{rated}: Power rating of each fuel cell: 250 [kW] [3]

$CapEx^{E}$: Capital cost associated with each electrolyzer: 800 [$/kW] [1]

$OpEx^{E}$: Yearly operational cost associated with each electrolyzer: 16 [$/kW/yr] [1]

$CapEx^{FC}$: Capital cost associated with each fuel cell: 1180 [$/kW] [3]

$OpEx^{FC}$: Yearly operational cost associated with each fuel cell: 15.34 [$/kW/yr] [3]

$CapEx^{PL}$: Capital cost associated with a single power line: 2.02M [$/km] [4]

$C^{DC_1}_{w}$: Converter station cost for each wind farm: 220 [$/kW] [5]

C^{DC_2}: Converter station cost for the onshore substation/hydrogen super center: 92 [$/kW] [5]

η^{DC}: Efficiency of converters: 0.99 [5]

$OpEx^{PL}$: Yearly operational cost associated with a single power line: 10,100 [$/km/yr] [4]

$CapEx^{HP}$: Capital cost associated with a single hydrogen pipeline: 0.96M [$/km] [4]

$OpEx^{HP}$: Yearly operational cost associated with a single hydrogen pipeline: 67200 [$/km/yr] [4]

$C^{Co_{hi}}$: Cost of high-pressure compressor for hydrogen super center: 4717 [$-h/kg H_2] [6]

$C^{Co_{lo}}$: Cost of low-pressure compressors for each wind farm: 4717 [$-h/kg H_2] [6]

$CapEx^{HS}$: Capital cost associated with hydrogen storage system: 55.5 [$/kg H_2] [7]

$OpEx^{HS}$: Yearly operational cost associated with hydrogen storage system: 44,783 [$/yr] [7]

$P^{PL}_{lim,w}$: Power thermal limit of a single power line: 1000 [MW] [4]

H^{HP}_{lim}: Hydrogen transmission limit of each hydrogen pipeline: 30,000 [kg H_2/h] [2] [4]

HS_{min}: Minimum amount of hydrogen that must be stored in hydrogen storage system: 0 [kg H_2]

HS_{max}: Maximum amount of hydrogen that can be stored in hydrogen storage system: 202,500 [kg H_2] [7]

V_O: Voltage at onshore substation: 320 [kV] [5]

r: Resistance per unit length of all power lines: 0.011 [Ω/km] [5]

$p^{lo}_{O,w}$: Low pressure set points for each wind farm at the hydrogen super center: 100 [bar]

p^{hi}_{O}: High pressure set point at onshore substation: 200 [bar]

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λ: Coefficient of friction of all pipelines: 0.02 [8]

T: Gas temperature inside pipelines: 300 [K]

Z^{hi}: Hydrogen compressibility factor at high pressure: 1.133 [9]

Z^{lo}: Hydrogen compressibility factor at low pressure: 1.067 [9]

ρ^{hi}: Hydrogen density at high pressure: 38.642 [kg/m_3] [8] [9]

ρ^{lo}: Hydrogen density at low pressure: 20.25 [kg/m^3] [8] [9]

D^{hi}: Diameter of high-pressure pipeline: 1219.2 [mm]

D^{lo}: Diameter of low-pressure pipelines: 914.4 [mm]

CP^{C}_{hi}: Energy consumption ratio of hydrogen compressor at high pressure: 3.3 [kWh/kg H_2] [6]

CP^{C}_{lo}: Energy consumption ratio of hydrogen compressor at low pressure: 3.3 [kWh/kg H_2] [6]

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