References

[1] Nousdilis AI, Kryonidis GC, Kontis EO, Barzegkar-Ntovom GA, Panapakidis IP, Christoforidis GC, Papagiannis GK. Impact of policy incentives on the promotion of integrated PV and battery storage systems: a techno-economic assessment. IET Renew Power Gener 2020;14:1174–83. https://doi.org/10.1049/iet-rpg.2019.0797.

[2] Kannan N, Vakeesan D. Solar energy for future world: - A review. Renew Sustain Energy Rev 2016;62:1092–105. https://doi.org/10.1016/j.rser.2016.05.022.

[3] No Title n.d. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-statsreview-2022-full-report.pdf.

[4] Charles Rajesh Kumar J, Majid MA. Renewable energy for sustainable development in India: Current status, future prospects, challenges, employment, and investment opportunities. Energy Sustain Soc 2020;10:1–36. https://doi.org/10.1186/s13705-019-0232-1.

[5] (NAPCC) NAP on CC. No Title. NAPCC n.d. //efaidnbmnnnibpcajpcglclefindmkaj/https://static.pib.gov.in/WriteReadData/specificdocs/documents/2021/dec/doc202112101.pdf.

[6] CO_2 emissions. No Title. CO_2 Emiss n.d.

[7] Development E-UNS. No Title n.d. https://www.un.org/sustainabledevelopment/energy/.

[8] Raveendran A, Chandran M, Dhanusuraman R. A comprehensive review on the electrochemical parameters and recent material development of electrochemical water splitting electrocatalysts. RSC Adv 2023;13:3843–76. https://doi.org/10.1039/d2ra07642j.

[9] Administration USEI. No Title n.d. https://www.eia.gov/energyexplained/hydrogen/.

[10] Abe JO, Popoola API, Ajenifuja E, Popoola OM. Hydrogen energy, economy and storage: Review and recommendation. Int J Hydrogen Energy 2019;44:15072–86. https://doi.org/10.1016/j.ijhydene.2019.04.068.

[11] Amin M, Shah HH, Fareed AG, Khan WU, Chung E, Zia A, Rahman Farooqi ZU, Lee C. Hydrogen production through renewable and non-renewable energy processes and their impact on climate change. Int J Hydrogen Energy 2022;47:33112–34. https://doi.org/10.1016/j.ijhydene.2022.07.172.

[12] Salman M, Kashif SAR, Fakhar MS, Rasool A, Hussen AS. Optimizing power generation in a hybrid solar wind energy system using a DFIG-based control approach. Sci Rep 2025;15:10550. https://doi.org/10.1038/s41598-025-95248-8.

[13] Zhou D, Li P, Lin X, McKinley A, Kuang Y, Liu W, Lin W-F, Sun X, Duan X. Layered double hydroxide-based electrocatalysts for the oxygen evolution

reaction: identification and tailoring of active sites, and superaerophobic nanoarray electrode assembly. Chem Soc Rev 2021;50:8790–817. https://doi.org/10.1039/d1cs00186h.

[14] Qureshi F, Tahir M. Photoelectrochemical water splitting with engineering aspects for hydrogen production: Recent advances, strategies and challenges. Int J Hydrogen Energy 2024;69:760–76. https://doi.org/10.1016/j.ijhydene.2024.05.039.

[15] Khan MA, Zhao H, Zou W, Chen Z, Cao W, Fang J. Recent Progresses in Electrocatalysts for Water Electrolysis. vol. 1. Springer Singapore; 2019. https://doi.org/10.1007/s41918-018-0014-z.

[16] Jia J, Seitz LC, Benck JD, Huo Y, Chen Y, Ng JWD, Bilir T, Harris JS, Jaramillo TF. Solar water splitting by photovoltaic-electrolysis with a solar-to-hydrogen efficiency over 30%. Nat Commun 2016;7:13237. https://doi.org/10.1038/ncomms13237.

[17] Song H, Luo S, Huang H, Deng B, Ye J. Solar-Driven Hydrogen Production: Recent Advances, Challenges, and Future Perspectives. ACS Energy Lett 2022;7:1043–65. https://doi.org/10.1021/acsenergylett.1c02591.

[18] Hu F, Zhu S, Chen S, Li Y, Ma L, Wu T, Zhang Y, Wang C, Liu C, Yang X, Song L, Yang X, Xiong Y. Amorphous Metallic NiFeP: A Conductive Bulk Material Achieving High Activity for Oxygen Evolution Reaction in Both Alkaline and Acidic Media. Adv Mater 2017;29. https://doi.org/10.1002/adma.201606570.

[19] Grimnes S, Martinsen ØG. Electrodes. Bioimpedance Bioelectr. Basics, Elsevier; 2015, p. 179–254. https://doi.org/10.1016/B978-0-12-411470-8.00007-6.

[20] Hallemans N, Howey D, Battistel A, Saniee NF, Scarpioni F, Wouters B, La Mantia F, Hubin A, Widanage WD, Lataire J. Electrochemical impedance spectroscopy beyond linearity and stationarity—A critical review. Electrochim Acta 2023;466:142939. https://doi.org/10.1016/j.electacta.2023.142939.

[21] Martínez-Hincapié R, Wegner J, Anwar MU, Raza-Khan A, Franzka S, Kleszczynski S, Čolić V. The determination of the electrochemically active surface area and its effects on the electrocatalytic properties of structured nickel electrodes produced by additive manufacturing. Electrochim Acta 2024;476:143663. https://doi.org/10.1016/j.electacta.2023.143663.

[22] Wasmus S, Küver A. Methanol oxidation and direct methanol fuel cells: a selective review. J Electroanal Chem 1999;461:14–31. https://doi.org/10.1016/S0022-0728(98)00197-1.

[23] Zuo Y, Sheng W, Tao W, Li Z. Direct methanol fuel cells system–A review of dual-role electrocatalysts for oxygen reduction and methanol oxidation. J Mater Sci Technol 2022;114:29–41. https://doi.org/10.1016/j.jmst.2021.10.031.

[24] Over H. Fundamental Studies of Planar Single-Crystalline Oxide Model Electrodes (RuO 2 , IrO 2) for Acidic Water Splitting. ACS Catal 2021;11:8848–71. https://doi.org/10.1021/acscatal.1c01973.

[25] Reier T, Oezaslan M, Strasser P. Electrocatalytic Oxygen Evolution Reaction (OER) on Ru, Ir, and Pt Catalysts: A Comparative Study of Nanoparticles and

Bulk Materials. ACS Catal 2012;2:1765–72. https://doi.org/10.1021/cs3003098.

[26] Song F, Bai L, Moysiadou A, Lee S, Hu C, Liardet L, Hu X. Transition Metal Oxides as Electrocatalysts for the Oxygen Evolution Reaction in Alkaline Solutions: An Application-Inspired Renaissance. J Am Chem Soc 2018;140:7748–59. https://doi.org/10.1021/jacs.8b04546.

[27] Burke MS, Enman LJ, Batchellor AS, Zou S, Boettcher SW. Oxygen Evolution Reaction Electrocatalysis on Transition Metal Oxides and (Oxy)hydroxides: Activity Trends and Design Principles. Chem Mater 2015;27:7549–58. https://doi.org/10.1021/acs.chemmater.5b03148.

[28] Cui X, Xiao P, Wang J, Zhou M, Guo W, Yang Y, He Y, Wang Z, Yang Y, Zhang Y, Lin Z. Highly Branched Metal Alloy Networks with Superior Activities for the Methanol Oxidation Reaction. Angew Chemie Int Ed 2017;56:4488–93. https://doi.org/10.1002/anie.201701149.

[29] Seh ZW, Kibsgaard J, Dickens CF, Chorkendorff I, Nørskov JK, Jaramillo TF. Combining theory and experiment in electrocatalysis: Insights into materials design. Science (80-) 2017;355. https://doi.org/10.1126/science.aad4998.

[30] Li J, Guo Z, Zhang W, Guo J, Qu K, Cai W. Stable NiPt–Mo2C active site pairs enable boosted water splitting and direct methanol fuel cell. Green Energy Environ 2023;8:559–66. https://doi.org/10.1016/j.gee.2021.08.005.

[31] Crespo-Yapur A, Medrano A, Videa M. Methanol Oxidation on Galvanostatically Electrodeposited Nipt Nanoparticles: Correlation between Deposition Current Density and Catalytic Activity. ECS Meet Abstr 2018;MA2018-02:1790. https://doi.org/10.1149/MA2018-02/52/1790.

[32] Sun S, Xu ZJ. Composition dependence of methanol oxidation activity in nickel–cobalt hydroxides and oxides: an optimization toward highly active electrodes. Electrochim Acta 2015;165:56–66. https://doi.org/10.1016/j.electacta.2015.03.008.

[33] LiBretto NJ, Tacey SA, Zubair M, Bui T V., Unocic KA, Baddour FG, Griffin MB, Schaidle JA, Farberow CA, Ruddy DA, Bedford NM, Habas SE. Compositional dependence of hydrodeoxygenation pathway selectivity for Ni 2− x Rh x P nanoparticle catalysts. J Mater Chem A 2023;11:16788–802. https://doi.org/10.1039/D3TA02071A.

[34] Liu W, Bao J, Xu L, Guan M, Wang Z, Qiu J, Huang Y, Xia J, Lei Y, Li H. NiCo2O4 ultrathin nanosheets with oxygen vacancies as bifunctional electrocatalysts for Zn-air battery. Appl Surf Sci 2019;478:552–9. https://doi.org/10.1016/j.apsusc.2019.01.243.

[35] Zhu C, Fu S, Du D, Lin Y. Facilely Tuning Porous NiCo 2 O 4 Nanosheets with Metal Valence-State Alteration and Abundant Oxygen Vacancies as Robust Electrocatalysts Towards Water Splitting. Chem – A Eur J 2016;22:4000–7. https://doi.org/10.1002/chem.201504739.

[36] Wang J, Liao T, Wei Z, Sun J, Guo J, Sun Z. Heteroatom-Doping of Non-Noble Metal-Based Catalysts for Electrocatalytic Hydrogen Evolution: An Electronic

Structure Tuning Strategy. Small Methods 2021;5. https://doi.org/10.1002/smtd.202000988.

[37] Li L, Gao W, Tang K, Lei M, Yao B, Qi W, Wen D. Structure engineering of Ni2P by Mo doping for robust electrocatalytic water and methanol oxidation reactions. Electrochim Acta 2021;369:137692. https://doi.org/10.1016/j.electacta.2020.137692.

[38] Li C-F, Tang H-B, Zhao J-W, Li G-R. Constructing Fe/Ni atomic interfaces in Fe-doped Ni(OH) 2 with single-phase structures for efficient oxygen evolution. J Mater Chem A 2023;11:5841–50. https://doi.org/10.1039/D3TA00015J.

[39] Tkalych AJ, Yu K, Carter EA. Structural and Electronic Features of β-Ni(OH) 2 and β-NiOOH from First Principles. J Phys Chem C 2015;119:24315–22. https://doi.org/10.1021/acs.jpcc.5b08481.

[40] Holewinski A, Xin H, Nikolla E, Linic S. Identifying optimal active sites for heterogeneous catalysis by metal alloys based on molecular descriptors and electronic structure engineering. Curr Opin Chem Eng 2013;2:312–9. https://doi.org/10.1016/j.coche.2013.04.006.

[41] Luo S, Qian L, Liao M, Hu X, Xiao D. Surface and interface engineering of CoNi layered double hydroxides for efficient methanol oxidation reaction. RSC Adv 2017;7:45294–303. https://doi.org/10.1039/C7RA07867F.

[42] Han G-Q, Liu Y-R, Hu W-H, Dong B, Li X, Shang X, Chai Y-M, Liu Y-Q, Liu C-G. Three dimensional nickel oxides/nickel structure by in situ electro-oxidation of nickel foam as robust electrocatalyst for oxygen evolution reaction. Appl Surf Sci 2015;359:172–6. https://doi.org/10.1016/j.apsusc.2015.10.097.

[43] Nazal MK, Olakunle OS, Al-Ahmed A, Merzougui B, Abualkibash A, Sultan A, Yousaf A Bin, Zaidi SJ. Precious metal free Ni/Cu/Mo trimetallic nanocomposite supported on multi-walled carbon nanotubes as highly efficient and durable anode-catalyst for alkaline direct methanol fuel cells. J Electroanal Chem 2018;823:98–105. https://doi.org/10.1016/j.jelechem.2018.05.035.

[44] González-Ingelmo M, García ML, Oropeza FE, Álvarez P, Blanco C, Santamaría R, Rocha VG. Ultra-high dispersion of Ni-based OER catalysts on graphene 3D networks enhances the in situ Fe 3+ catalytic activation. J Mater Chem A 2023;11:24248–60. https://doi.org/10.1039/D3TA04481E.

[45] Tong W, Shao Q, Wang P, Huang X. Phase Modulating of Cu–Ni Nanowires Enables Active and Stable Electrocatalysts for the Methanol Oxidation Reaction. Chem – A Eur J 2019;25:7218–24. https://doi.org/10.1002/chem.201901064.

[46] An Y, Ijaz H, Huang M, Qu J, Hu S. The one-pot synthesis of CuNi nanoparticles with a Ni-rich surface for the electrocatalytic methanol oxidation reaction. Dalt Trans 2020;49:1646–51. https://doi.org/10.1039/C9DT04661E.

[47] Jha SK, Kumari A, Rao Modalavalasa UB, Singh SK. Nanostructure-induced inhibition of oxygen evolution and enhancement of methanol electrooxidation on engineered anodized brass. Int J Hydrogen Energy 2024;51:1186–97. https://doi.org/10.1016/j.ijhydene.2023.09.140.

[48] Zhou Y, Fan HJ. Progress and Challenge of Amorphous Catalysts for

Electrochemical Water Splitting. ACS Mater Lett 2021;3:136–47. https://doi.org/10.1021/acsmaterialslett.0c00502.

[49] Wang X, Ma W, Ding C, Xu Z, Wang H, Zong X, Li C. Amorphous Multi-elements Electrocatalysts with Tunable Bifunctionality toward Overall Water Splitting. ACS Catal 2018;8:9926–35. https://doi.org/10.1021/acscatal.8b01839.

[50] Cai W, Yang H, Zhang J, Chen H-C, Tao HB, Gao J, Liu S, Liu W, Li X, Liu B. Amorphous Multimetal Alloy Oxygen Evolving Catalysts. ACS Mater Lett 2020;2:624–32. https://doi.org/10.1021/acsmaterialslett.0c00146.

[51] Anantharaj S, Nagamatsu T, Yamaoka S, Li M, Noda S. Efficient Methanol Electrooxidation Catalyzed by Potentiostatically Grown Cu–O/OH(Ni) Nanowires: Role of Inherent Ni Impurity. ACS Appl Energy Mater 2022;5:419–29. https://doi.org/10.1021/acsaem.1c02943.

[52] Yang P, An Y, Feng C, Liu Y, Liu S, Gao L, Zhou Y, Li X, Li P, Zeng F. Heterogeneous high-entropy catalyst nanoparticles for oxygen evolution reaction: Impact of oxygen and fluorine introduction. Int J Hydrogen Energy 2024;51:1218–28. https://doi.org/10.1016/j.ijhydene.2023.09.143.

[53] Hall DS, Lockwood DJ, Bock C, MacDougall BR. Nickel hydroxides and related materials: a review of their structures, synthesis and properties. Proc R Soc A Math Phys Eng Sci 2015;471:20140792. https://doi.org/10.1098/rspa.2014.0792.

[54] Chinnadurai D, Lee SJ, Yu Y, Nam SY, Choi MY. Cation modulation in dual-phase nickel sulfide nanospheres by pulsed laser irradiation for overall water splitting and methanol oxidation reaction. Fuel 2022;320:123915. https://doi.org/10.1016/j.fuel.2022.123915.

[55] Mao F, Zhang J, Wang HF, Liu PF, Yang HG. Heterogeneous Fe-Doped Ni(OH) 2 Grown on Nickel Mesh by Electrodeposition for Efficient Alkaline Oxygen Evolution Reaction. Chem – A Eur J 2023;29. https://doi.org/10.1002/chem.202302055.

[56] He Z-D, Tesch R, Eslamibidgoli MJ, Eikerling MH, Kowalski PM. Low-spin state of Fe in Fe-doped NiOOH electrocatalysts. Nat Commun 2023;14:3498. https://doi.org/10.1038/s41467-023-38978-5.

[57] Molnáar Á, Smith G V., Bartók M. New Catalytic Materials from Amorphous Metal Alloys, 1989, p. 329–83. https://doi.org/10.1016/S0360-0564(08)60020-6.

[58] Ding J, Yang H, Zhang H, Wang Z, Liu Q, Feng L, Hu G, Luo J, Liu X. Dealloyed NiTiZrAg as an efficient electrocatalyst for hydrogen evolution in alkaline seawater. Int J Hydrogen Energy 2024;53:318–24. https://doi.org/10.1016/j.ijhydene.2023.12.007.

[59] Saji VS. Dealloyed nanoporous platinum alloy electrocatalysts. Int J Hydrogen Energy 2024;60:1077–91. https://doi.org/10.1016/j.ijhydene.2024.02.286.

[60] Zhang H, Qin J, Tian J, Shen J. Dealloying of TiCuPt amorphous alloy for hydrogen evolution reaction catalysts. Int J Hydrogen Energy 2024;82:952–8. https://doi.org/10.1016/j.ijhydene.2024.08.006.

[61] Jiang J, Wu Y, Chen H, Wan Z, Ding D, Xia L, Guo X, Yu P. Annealing and electrochemically activated amorphous ribbons: Surface nanocrystallization and oxidation effects enhanced for oxygen evolution performance. J Colloid Interface Sci 2023;633:303–13. https://doi.org/10.1016/j.jcis.2022.11.081.

[62] Qian H, Li K, Mu X, Zou J, Xie S, Xiong X, Zeng X. Nanoporous NiFeMoP alloy as a bifunctional catalyst for overall water splitting. Int J Hydrogen Energy 2020;45:16447–57. https://doi.org/10.1016/j.ijhydene.2020.04.103.

[63] Chen H, Xin Y, Wu Y, Jiang J, Ding D, Xia L, Guo X, Yu P. Boosting the activity and stability of self-supporting FeCoNiMoPB amorphous alloy for oxygen evolution. J Alloys Compd 2023;947:169478. https://doi.org/10.1016/j.jallcom.2023.169478.

[64] Xiao L, Liang Y, Li Z, Wu S, Luo S, Sun H, Zhu S, Cui Z. Amorphous FeNiNbPC nanoprous structure for efficient and stable electrochemical oxygen evolution. J Colloid Interface Sci 2021;608. https://doi.org/10.1016/j.jcis.2021.10.002.

[65] Jian X, Li J, Han B, Chu F, Wu K, Meng Y, Zhang M, Lin H-J. Corroded Fe78Si9B13 amorphous alloy as electrocatalyst for oxygen evolution reaction of water splitting. J Non Cryst Solids 2023;603:122117. https://doi.org/10.1016/j.jnoncrysol.2022.122117.

[66] Wirtanen T, Prenzel T, Tessonnier J-P, Waldvogel SR. Cathodic Corrosion of Metal Electrodes—How to Prevent It in Electroorganic Synthesis. Chem Rev 2021;121:10241–70. https://doi.org/10.1021/acs.chemrev.1c00148.

[67] Liu C, Yang F, Schechter A, Feng L. Recent progress of Ni-based catalysts for methanol electrooxidation reaction in alkaline media. Adv Sens Energy Mater 2023;2:100055. https://doi.org/10.1016/j.asems.2023.100055.

[68] Xiao L, Liang Y, Li Z, Wu S, Luo S, Sun H, Zhu S, Cui Z. Amorphous FeNiNbPC nanoprous structure for efficient and stable electrochemical oxygen evolution. J Colloid Interface Sci 2022;608:1973–82. https://doi.org/10.1016/j.jcis.2021.10.002.

[69] Ahmed AA, Al Labadidi M, Hamada AT, Orhan MF. Design and Utilization of a Direct Methanol Fuel Cell. Membr 2022, Vol 12, Page 1266 2022;12:1266. https://doi.org/10.3390/MEMBRANES12121266.

[70] Miyake J, Ogawa Y, Tanaka T, Ahn J, Oka K, Oyaizu K, Miyatake K. Rechargeable proton exchange membrane fuel cell containing an intrinsic hydrogen storage polymer. Commun Chem 2020;3:1–7. https://doi.org/10.1038/s42004-020-00384-z.

[71] No Title n.d. https://npp.gov.in/dashBoard/cp-map-dashboard.

[72] Dawn S, Tiwari PK, Goswami AK, Mishra MK. Recent developments of solar energy in India: Perspectives, strategies and future goals. Renew Sustain Energy Rev 2016;62:215–35. https://doi.org/10.1016/j.rser.2016.04.040.

[73] No Title n.d.:https://www.pib.gov.in/PressReleasePage.aspx?PRID=. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1913789.

[74] Sahoo SK. Renewable and sustainable energy reviews solar photovoltaic energy progress in India: A review. Renew Sustain Energy Rev 2016;59:927–39.

https://doi.org/10.1016/j.rser.2016.01.049.

[75] Thapar S. Centralized vs decentralized solar: A comparison study (India). Renew Energy 2022;194:687–704. https://doi.org/10.1016/j.renene.2022.05.117.

[76] Shyam B, Kanakasabapathy P. Feasibility of floating solar PV integrated pumped storage system for a grid-connected microgrid under static time of day tariff environment: A case study from India. Renew Energy 2022;192:200–15. https://doi.org/10.1016/j.renene.2022.04.031.

[77] Thakur A, Kumar R, Dwivedi A, Goel V. Solar cooking technology in India: Identification and prioritization of potential challenges. Renew Energy 2023;219:119437. https://doi.org/10.1016/j.renene.2023.119437.

[78] Lingayat AB, Chandramohan VP, Raju VRK, Meda V. A review on indirect type solar dryers for agricultural crops – Dryer setup, its performance, energy storage and important highlights. Appl Energy 2020;258:114005. https://doi.org/10.1016/j.apenergy.2019.114005.

[79] La Notte L, Giordano L, Calabrò E, Bedini R, Colla G, Puglisi G, Reale A. Hybrid and organic photovoltaics for greenhouse applications. Appl Energy 2020;278:115582. https://doi.org/10.1016/j.apenergy.2020.115582.

[80] Pandit D, Bera A, Saket RK, Mitra J, Nguyen N. Probabilistic Sizing of Energy Storage Systems for Reliability and Frequency Security in Wind-Rich Power Grids. IEEE Trans Ind Appl 2024:1–13. https://doi.org/10.1109/TIA.2024.3356451.

[81] Elkadeem MR, Wang S, Sharshir SW, Atia EG. Feasibility analysis and techno-economic design of grid-isolated hybrid renewable energy system for electrification of agriculture and irrigation area: A case study in Dongola, Sudan. Energy Convers Manag 2019;196:1453–78. https://doi.org/10.1016/j.enconman.2019.06.085.

[82] Soni SK, Singh S, Kumar S, Sahu HS, Saket RK. Solar-to-Vehicle Charging with Maximum Power Point Tracking using Super-Twisting Controller. 2023 IEEE Int. Transp. Electrif. Conf., IEEE; 2023, p. 1–6. https://doi.org/10.1109/ITEC-India59098.2023.10471485.

[83] Almosni S, Delamarre A, Jehl Z, Suchet D, Cojocaru L, Giteau M, Behaghel B, Julian A, Ibrahim C, Tatry L, Wang H, Kubo T, Uchida S, Segawa H, Miyashita N, Tamaki R, Shoji Y, Yoshida K, Ahsan N, Watanabe K, Inoue T, Sugiyama M, Nakano Y, Hamamura T, Toupance T, Olivier C, Chambon S, Vignau L, Geffroy C, Cloutet E, Hadziioannou G, Cavassilas N, Rale P, Cattoni A, Collin S, Gibelli F, Paire M, Lombez L, Aureau D, Bouttemy M, Etcheberry A, Okada Y, Guillemoles JF. Material challenges for solar cells in the twenty-first century: directions in emerging technologies. Sci Technol Adv Mater 2018;19:336–69. https://doi.org/10.1080/14686996.2018.1433439.

[84] Role of Solar Cells in Global Energy Transformation. IEEE J Electron Devices Soc 2023;11:769–70. https://doi.org/10.1109/JEDS.2023.3251019.

[85] Khalil A, Khaira AM, Abu-Shanab RH, Abdelgaied M. A comprehensive review

of advanced hybrid technologies that improvement the performance of solar dryers: Photovoltaic/thermal panels, solar collectors, energy storage materials, biomass, and desalination units. Sol Energy 2023;253:154–74. https://doi.org/10.1016/j.solener.2023.02.032.

[86] Castillo-Calzadilla T, Cuesta MA, Olivares-Rodriguez C, Macarulla AM, Legarda J, Borges CE. Is it feasible a massive deployment of low voltage direct current microgrids renewable-based? A technical and social sight. Renew Sustain Energy Rev 2022;161:112198. https://doi.org/10.1016/j.rser.2022.112198.

[87] Liu J, Chen X, Cao S, Yang H. Overview on hybrid solar photovoltaic-electrical energy storage technologies for power supply to buildings. Energy Convers Manag 2019;187:103–21. https://doi.org/10.1016/j.enconman.2019.02.080.

[88] Sarita K, Kumar S, Vardhan ASS, Elavarasan RM, Saket RK, Shafiullah GM, Hossain E. Power Enhancement With Grid Stabilization of Renewable Energy-Based Generation System Using UPQC-FLC-EVA Technique. IEEE Access 2020;8:207443–64. https://doi.org/10.1109/ACCESS.2020.3038313.

[89] Baigorri J, Zaversky F, Astrain D. Massive grid-scale energy storage for next-generation concentrated solar power: A review of the potential emerging concepts. Renew Sustain Energy Rev 2023;185:113633. https://doi.org/10.1016/j.rser.2023.113633.

[90] Kakkar S, Maity T, Ahuja RK, Walde P, Saket RK, Khan B, Padmanaban S. Design and Control of Grid-Connected PWM Rectifiers by Optimizing Fractional Order PI Controller Using Water Cycle Algorithm. IEEE Access 2021;9:125941–54. https://doi.org/10.1109/ACCESS.2021.3110431.

[91] Zheng S, Shahzad M, Asif HM, Gao J, Muqeet HA. Advanced optimizer for maximum power point tracking of photovoltaic systems in smart grid: A roadmap towards clean energy technologies. Renew Energy 2023;206:1326–35. https://doi.org/10.1016/j.renene.2023.01.023.

[92] Bihari SP, Sadhu PK, Sarita K, Khan B, Arya LD, Saket RK, Kothari DP. A Comprehensive Review of Microgrid Control Mechanism and Impact Assessment for Hybrid Renewable Energy Integration. IEEE Access 2021;9:88942–58. https://doi.org/10.1109/ACCESS.2021.3090266.

[93] Meira Amaral da Luz C, Moreira Vicente E, Lessa Tofoli F, Roberto Ribeiro E. Differential power processing architecture to increase energy harvesting of photovoltaic systems under permanent mismatch. Sol Energy 2023;263:111940. https://doi.org/10.1016/j.solener.2023.111940.

[94] Xaxa LB, Kumar A, Srivastava RK, Saket RK, Khan B. Design Aspects and Thermal Characteristics of Single-Sided Linear Induction Motor for Electromagnetic Launch Application. IEEE Access 2022;10:72239–52. https://doi.org/10.1109/ACCESS.2022.3188673.

[95] Sangwongwanich A, Yang Y, Blaabjerg F. High-performance constant power generation in grid-connected PV systems. IEEE Trans Power Electron 2016;31:1822–5. https://doi.org/10.1109/TPEL.2015.2465151.

[96] Sharma S, Varshney L, Elavarasan RM, Vardhan ASS, Vardhan ASS, Saket RK, Subramaniam U, Hossain E. Performance Enhancement of PV System

Configurations Under Partial Shading Conditions Using MS Method. IEEE Access 2021;9:56630–44. https://doi.org/10.1109/ACCESS.2021.3071340.

[97] Jin Y, Huang S, Yue X, Du H, Shen PK. Mo- and Fe-Modified Ni(OH) 2 /NiOOH Nanosheets as Highly Active and Stable Electrocatalysts for Oxygen Evolution Reaction. ACS Catal 2018;8:2359–63. https://doi.org/10.1021/acscatal.7b04226.

[98] Zhou F, Wu M, Hu W, Jiang Z-G, Noréus D. Alpha nickel hydroxide electrodes improve aqueous rechargeable batteries capacity. Mater Res Bull 2024;179:112967. https://doi.org/10.1016/j.materresbull.2024.112967.

[99] Parthasarathy P, Virkar A V. Electrochemical Ostwald ripening of Pt and Ag catalysts supported on carbon. J Power Sources 2013;234:82–90. https://doi.org/10.1016/j.jpowsour.2013.01.115.

[100] Lee M, Won J, Shin H, Lee J, Lee MH, Oh S. Porous Ni–Fe–Cr electrocatalyst for the oxygen and hydrogen evolution reaction via facile one-step electrodeposition. Int J Hydrogen Energy 2024;51:536–44. https://doi.org/10.1016/j.ijhydene.2023.10.112.

[101] Jin Y, Huang S, Yue X, Du H, Shen PK. Mo- and Fe-Modified Ni(OH) 2 /NiOOH Nanosheets as Highly Active and Stable Electrocatalysts for Oxygen Evolution Reaction. ACS Catal 2018;8:2359–63. https://doi.org/10.1021/acscatal.7b04226.

[102] Zhang D, Soo JZ, Tan HH, Jagadish C, Catchpole K, Karuturi SK. Earth-Abundant Amorphous Electrocatalysts for Electrochemical Hydrogen Production : A Review 2021;2000071. https://doi.org/10.1002/aesr.202000071.

[103] Wang J, Teschner D, Yao Y, Huang X, Willinger M, Shao L, Schlögl R. Fabrication of nanoscale NiO/Ni heterostructures as electrocatalysts for efficient methanol oxidation. J Mater Chem A 2017;5:9946–51. https://doi.org/10.1039/C7TA01982C.

[104] Anantharaj S, Sugime H, Noda S. Ultrafast Growth of a Cu(OH) 2 –CuO Nanoneedle Array on Cu Foil for Methanol Oxidation Electrocatalysis. ACS Appl Mater Interfaces 2020;12:27327–38. https://doi.org/10.1021/acsami.0c08979.

[105] Wang J, Teschner D, Yao Y, Huang X, Willinger M, Shao L, Schlögl R. Fabrication of nanoscale NiO/Ni heterostructures as electrocatalysts for efficient methanol oxidation. J Mater Chem A 2017;5:9946–51. https://doi.org/10.1039/C7TA01982C.

[106] Shi J, He H, Zhou S, Li J, Cai W. Fe-based “electron pump” involving NiCo-LDH enables robust and highly-selective electrocatalytic methanol oxidation to formic acid. Green Chem 2024;26:2638–44. https://doi.org/10.1039/D3GC05086F.

[107] Xiong L, Hu Y, Yang Y, Deng Q, Tang Z, Li P, Shen J, Zhang X, Wang T, Xu X, Yin N, Zhou Y, Dong W, Zou Z. Electron pump strengthened facet engineering: Organic half-metallic C(CN)3 enclosed (100) facet exposed WO3 for efficient and selective photocatalytic nitrogen fixation. Appl Catal B Environ 2022;317:121660. https://doi.org/10.1016/j.apcatb.2022.121660.

[108] Xu H, Zhang W-D, Yao Y, Yang J, Liu J, Gu Z-G, Yan X. Amorphous chromium oxide confined Ni/NiO nanoparticles-assembled nanosheets for highly efficient

and stable overall urea splitting. J Colloid Interface Sci 2023;629:501–10. https://doi.org/10.1016/j.jcis.2022.09.072.

[109] Yu J, Pan S, Zhang Y, Liu Q, Li B. Facile Synthesis of Monodispersed α-Ni(OH)2 Microspheres Assembled by Ultrathin Nanosheets and Its Performance for Oxygen Evolution Reduction. Front Mater 2019;6. https://doi.org/10.3389/fmats.2019.00124.

[110] Zhang N, Feng X, Rao D, Deng X, Cai L, Qiu B, Long R, Xiong Y, Lu Y, Chai Y. Lattice oxygen activation enabled by high-valence metal sites for enhanced water oxidation. Nat Commun 2020;11:4066. https://doi.org/10.1038/s41467-020-17934-7.

[111] Tan Y, Zhu F, Wang H, Tian Y, Hirata A, Fujita T, Chen M. Noble-Metal-Free Metallic Glass as a Highly Active and Stable Bifunctional Electrocatalyst for Water Splitting. Adv Mater Interfaces 2017;4. https://doi.org/10.1002/admi.201601086.

[112] Nsanzimana JMV, Peng Y, Xu YY, Thia L, Wang C, Xia BY, Wang X. An Efficient and Earth-Abundant Oxygen-Evolving Electrocatalyst Based on Amorphous Metal Borides. Adv Energy Mater 2018;8. https://doi.org/10.1002/aenm.201701475.

[113] Li H, Wang Y, Liu C, Zhang S, Zhang H, Zhu Z. Enhanced OER performance of NiFeB amorphous alloys by surface self-reconstruction. Int J Hydrogen Energy 2022;47:20718–28. https://doi.org/10.1016/j.ijhydene.2022.04.200.

[114] Jiang J, Guo X, Xin Y, Wu Y, Tang B, Xia L, Zhang D, Cheng Z, Yu P. Architecting the metal-nonmetal oxide layers for boosting the oxygen-evolving intrinsic activity of amorphous alloy. Chem Eng J 2024;479:147552. https://doi.org/10.1016/j.cej.2023.147552.

[115] Lee S, Ha S. Revealing Enhanced Active Oxygen Formation by Incorporating Chromium into Nickel Hydroxide Nanosheets for Improved Oxygen Evolution Reaction. J Phys Chem Lett 2024;15:10230–6. https://doi.org/10.1021/acs.jpclett.4c02441.

[116] Modalavalasa UBR, Jana A, Murugaiyan P, Gopala Krishna K, Saket RK. Cathodic corrosion induced selective nano-crystallization of Nickel oxo/hydroxo complex on (NiFeCr)SiB amorphous ribbon for alkaline oxygen evolution reaction and methanol oxidation reaction. Int J Hydrogen Energy 2024;92:174–85. https://doi.org/10.1016/j.ijhydene.2024.10.278.

[117] Modalavalasa UBR, Murugaiyan P, Jana A, Krishna KG, Saket RK. Self-supported dealloyed nickel-amorphous ribbons for enhanced electrocatalysis. Mater Lett 2025;399:139099. https://doi.org/10.1016/j.matlet.2025.139099.

[118] Zhou W, Cleaver CJ, Dunant CF, Allwood JM, Lin J. Cost, range anxiety and future electricity supply: A review of how today's technology trends may influence the future uptake of BEVs. Renew Sustain Energy Rev 2023;173:113074. https://doi.org/10.1016/j.rser.2022.113074.

[119] No Title n.d.:https://vedas.sac.gov.in/vedas/node/149. https://vedas.sac.gov.in/vedas/node/149.

[120] Sharma C, Sharma AK, Mullick SC, Kandpal TC. Assessment of solar thermal power generation potential in India. Renew Sustain Energy Rev 2015;42:902–12. https://doi.org/10.1016/j.rser.2014.10.059.

[121] Kesler S, Kivrak S, Gurleyen H, Dincer F, Yilmaz S, Ozcalik HR. A Low Cost Shading Analyzer and Site Evaluator Design to Determine Solar Power System Installation Area. Int J Photoenergy 2015;2015:1–9. https://doi.org/10.1155/2015/126373.

[122] Rachchh R, Kumar M, Tripathi B. Solar photovoltaic system design optimization by shading analysis to maximize energy generation from limited urban area. Energy Convers Manag 2016;115:244–52. https://doi.org/10.1016/j.enconman.2016.02.059.

[123] Mahela OP, Shaik AG. Comprehensive overview of grid interfaced solar photovoltaic systems. Renew Sustain Energy Rev 2017;68:316–32. https://doi.org/10.1016/j.rser.2016.09.096.

[124] Kowsar A, Hassan M, Rana MT, Haque N, Faruque MH, Ahsan S, Alam F. Optimization and techno-economic assessment of 50 MW floating solar power plant on Hakaluki marsh land in Bangladesh. Renew Energy 2023;216:119077. https://doi.org/10.1016/j.renene.2023.119077.

[125] Hassan YB, Orabi M, Gaafar MA. Failures causes analysis of grid-tie photovoltaic inverters based on faults signatures analysis (FCA-B-FSA). Sol Energy 2023;262:111831. https://doi.org/10.1016/j.solener.2023.111831.

[126] Jana J, Saha H, Das Bhattacharya K. A review of inverter topologies for single-phase grid-connected photovoltaic systems. Renew Sustain Energy Rev 2017;72:1256–70. https://doi.org/10.1016/j.rser.2016.10.049.

[127] Davoudkhani IF, Dejamkhooy A, Nowdeh SA. A novel cloud-based framework for optimal design of stand-alone hybrid renewable energy system considering uncertainty and battery aging. Appl Energy 2023;344:121257. https://doi.org/10.1016/j.apenergy.2023.121257.

[128] Eltawil MA, Zhao Z. Grid-connected photovoltaic power systems: Technical and potential problems—A review. Renew Sustain Energy Rev 2010;14:112–29. https://doi.org/10.1016/j.rser.2009.07.015.

[129] Kaushika ND, Gautam NK, Kaushik K. Simulation model for sizing of stand-alone solar PV system with interconnected array. Sol Energy Mater Sol Cells 2005;85:499–519. https://doi.org/10.1016/j.solmat.2004.05.024.

[130] Berwal AK, Kumar S, Kumari N, Kumar V, Haleem A. Design and analysis of rooftop grid tied 50 kW capacity Solar Photovoltaic (SPV) power plant. Renew Sustain Energy Rev 2017;77:1288–99. https://doi.org/10.1016/j.rser.2017.03.017.

[131] Mouheb M, Hamidat A, Loukarfi L. Impact of PV Compensation in Improving the Voltage Drop in Electrical Networks LV. Energy Procedia 2012;18:751–61. https://doi.org/10.1016/j.egypro.2012.05.091.

[132] Khalid AM, Mitra I, Warmuth W, Schacht V. Performance ratio – Crucial parameter for grid connected PV plants. Renew Sustain Energy Rev

2016;65:1139–58. https://doi.org/10.1016/j.rser.2016.07.066.

[133] Pochont NR, Sekhar Y R. Recent trends in photovoltaic technologies for sustainable transportation in passenger vehicles – A review. Renew Sustain Energy Rev 2023;181:113317. https://doi.org/10.1016/j.rser.2023.113317.

[134] Mahtta R, Joshi PK, Jindal AK. Solar power potential mapping in India using remote sensing inputs and environmental parameters. Renew Energy 2014;71:255–62. https://doi.org/10.1016/j.renene.2014.05.037.

[135] Kumar L, Hasanuzzaman M, Rahim NA. Global advancement of solar thermal energy technologies for industrial process heat and its future prospects: A review. Energy Convers Manag 2019;195:885–908. https://doi.org/10.1016/j.enconman.2019.05.081.

[136] Novaes Pires Leite G de, Weschenfelder F, Araújo AM, Villa Ochoa ÁA, Franca Prestrelo Neto N da, Kraj A. An economic analysis of the integration between air-conditioning and solar photovoltaic systems. Energy Convers Manag 2019;185:836–49. https://doi.org/10.1016/j.enconman.2019.02.037.

[137] Roselli C, Sasso M, Tariello F. Assessment of a solar PV-driven desiccant-based air handling unit with different tracking systems. Sustain Energy Technol Assessments 2019;34:146–56. https://doi.org/10.1016/j.seta.2019.04.013.

[138] Ayora E, Munji M, Kaberere K, Thomas B. Performance analysis of 600 kWp grid-tied rooftop solar photovoltaic systems at strathmore university in Kenya. Results Eng 2023;19:101302. https://doi.org/10.1016/j.rineng.2023.101302.

[139] Can H, Ickilli D. Parameter Estimation in Modeling of Photovoltaic Panels Based on Datasheet Values. J Sol Energy Eng 2014;136. https://doi.org/10.1115/1.4024923.

[140] Bellia H, Youcef R, Fatima M. A detailed modeling of photovoltaic module using MATLAB. NRIAG J Astron Geophys 2014;3:53–61. https://doi.org/10.1016/j.nrjag.2014.04.001.

[141] McCormick PG, Suehrcke H. The effect of intermittent solar radiation on the performance of PV systems. Sol Energy 2018;171:667–74. https://doi.org/10.1016/j.solener.2018.06.043.

[142] Kazem HA, Chaichan MT, Al-Waeli AHA, Sopian K. A novel model and experimental validation of dust impact on grid-connected photovoltaic system performance in Northern Oman. Sol Energy 2020;206:564–78. https://doi.org/10.1016/j.solener.2020.06.043.

[143] Shrimali G, Nelson D, Goel S, Konda C, Kumar R. Renewable deployment in India: Financing costs and implications for policy. Energy Policy 2013;62:28–43. https://doi.org/10.1016/j.enpol.2013.07.071.

[144] Shrimali G, Srinivasan S, Goel S, Nelson D. The effectiveness of federal renewable policies in India. Renew Sustain Energy Rev 2017;70:538–50. https://doi.org/10.1016/j.rser.2016.10.075.

[145] Kazem HA, Khatib T. Techno-economical assessment of grid connected photovoltaic power systems productivity in Sohar, Oman. Sustain Energy Technol Assessments 2013;3:61–5. https://doi.org/10.1016/j.seta.2013.06.002.

[146] Khatri R. Design and assessment of solar PV plant for girls hostel (GARGI) of MNIT University, Jaipur city: A case study. Energy Reports 2016;2:89–98. https://doi.org/10.1016/j.egyr.2016.05.002.

[147] Tiwari AK, Chatterjee K, Agrawal S, Singh GK. A comprehensive review of photovoltaic-thermal (PVT) technology: Performance evaluation and contemporary development. Energy Reports 2023;10:2655–79. https://doi.org/10.1016/j.egyr.2023.09.043.

[148] Imam AA, Al-Turki YA, R. SK. Techno-Economic Feasibility Assessment of Grid-Connected PV Systems for Residential Buildings in Saudi Arabia—A Case Study. Sustainability 2019;12:262. https://doi.org/10.3390/su12010262.

[149] Akpolat AN, Dursun E, Kuzucuoğlu AE, Yang Y, Blaabjerg F, Baba AF. Performance Analysis of a Grid-Connected Rooftop Solar Photovoltaic System. Electronics 2019;8:905. https://doi.org/10.3390/electronics8080905.

[150] Boddapati V, Daniel SA. Performance analysis and investigations of grid-connected Solar Power Park in Kurnool, South India. Energy Sustain Dev 2020;55:161–9. https://doi.org/10.1016/j.esd.2020.02.001.

[151] Tiwari A, Barnwal P, Sandhu GS, Sodha MS. Energy metrics analysis of hybrid – photovoltaic (PV) modules. Appl Energy 2009;86:2615–25. https://doi.org/10.1016/j.apenergy.2009.04.020.

[152] Sharma R, Tiwari GN. Life cycle assessment of stand-alone photovoltaic (SAPV) system under on-field conditions of New Delhi, India. Energy Policy 2013;63:272–82. https://doi.org/10.1016/j.enpol.2013.08.081.

[153] Mahmud K, Soetanto D, Town GE. 5.6 Energy Management Softwares and Tools. Compr. Energy Syst., Elsevier; 2018, p. 202–57. https://doi.org/10.1016/B978-0-12-809597-3.00518-6.

[154] Stamford L, Azapagic A. Sustainability indicators for the assessment of nuclear power. Energy 2011;36:6037–57. https://doi.org/10.1016/j.energy.2011.08.011.

[155] Stamford L, Azapagic A. Life cycle environmental impacts of UK shale gas. Appl Energy 2014;134:506–18. https://doi.org/10.1016/j.apenergy.2014.08.063.

[156] Fusi A, Bacenetti J, Fiala M, Azapagic A. Life Cycle Environmental Impacts of Electricity from Biogas Produced by Anaerobic Digestion. Front Bioeng Biotechnol 2016;4. https://doi.org/10.3389/fbioe.2016.00026.

[157] Greening B, Azapagic A. Environmental impacts of micro-wind turbines and their potential to contribute to UK climate change targets. Energy 2013;59:454–66. https://doi.org/10.1016/j.energy.2013.06.037.

[158] Dincer I, Rosen MA, Al-Zareer M. 5.5 Exergy Management. Compr. Energy Syst., Elsevier; 2018, p. 166–201. https://doi.org/10.1016/B978-0-12-809597-3.00517-4.

[159] Jeswani HK, Whiting A, Azapagic A. Environmental and Economic Sustainability of Biomass Heat in the UK. Energy Technol 2020;8. https://doi.org/10.1002/ente.201901044.

Appendices

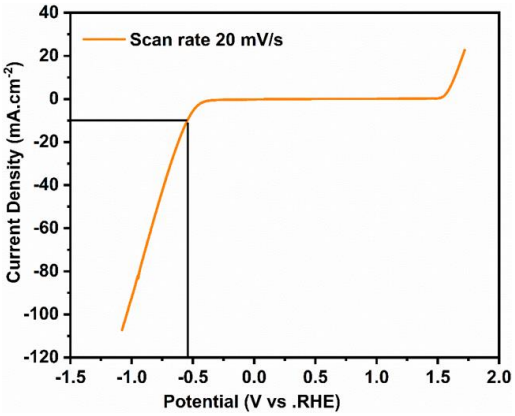

Fig. S1. Cyclic Voltammetry curve of melt-spun amorphous ribbon in 1 M KOH.

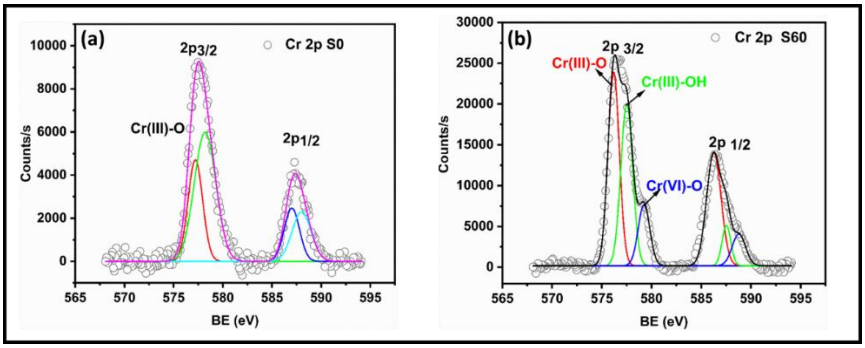

Fig. S2. XPS Core level spectra for Cr 2p in pristine sample (a) melt- spun S0 (b) surface treated S60.

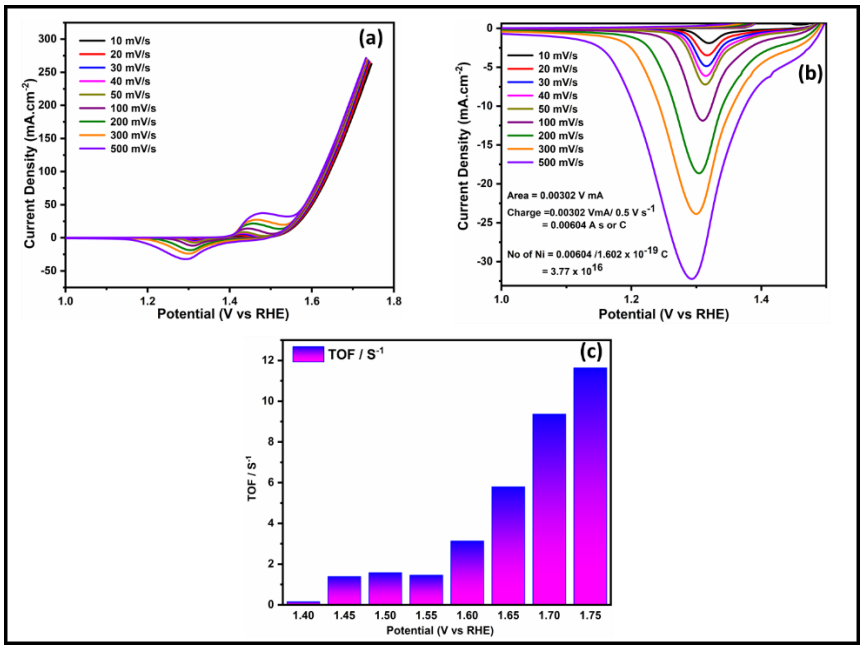

Fig. S3. (a) CVs of S60 sample in 1 M KOH for scan rates of 10, 20, 30, 40, 50, 100, 200, 300 and 500 mV/s. (b) CVs of S60 sample zoomed in to show the scan rate dependence and electrochemically accessible sites identification. (c) TOF plot.

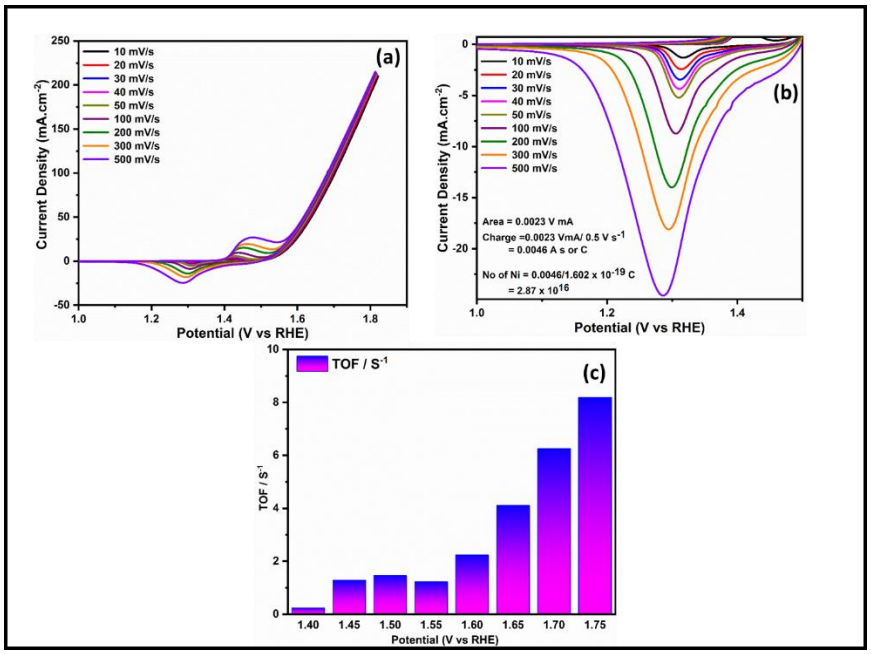

Fig. S4. (a) CVs of S90 sample in 1 M KOH for scan rates of 10, 20, 30, 40, 50, 100, 200, 300 and 500 mV/s. (b) CVs of S90 sample zoomed in to show the scan rate dependence and electrochemically accessible sites identification. (c) TOF plot.

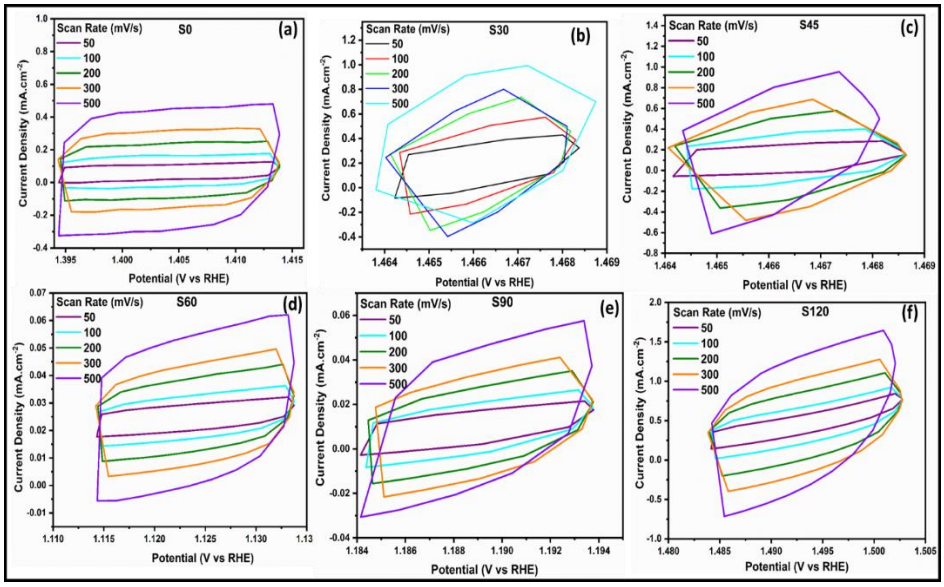

Fig. S5. Cyclic voltammetry curves recorded in the non-Faradaic region in 1 M KOH for (a) S0 sample (b) S30 sample (c) S45 sample (d) S60 sample (e) S90 sample (f) S120 sample.

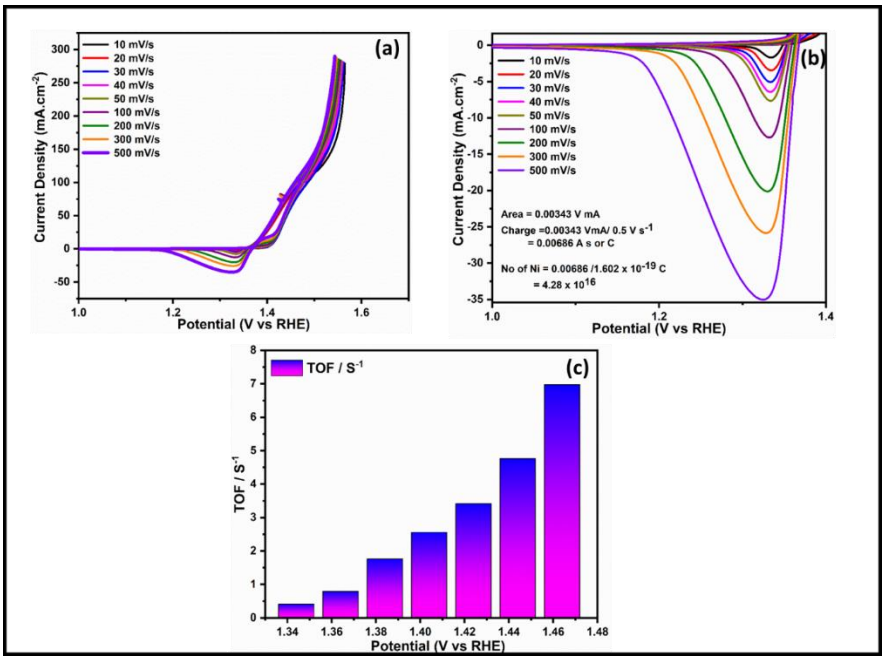

Fig. S6. (a) CVs of S60 sample in 1 M KOH containing 1 M MeOH for scan rates of 10, 20, 30, 40, 50, 100, 200, 300 and 500 mV/s. (b) CVs of S60 sample zoomed in to show the scan rate dependence for electrochemically accessible sites identification. (c) TOF plot.

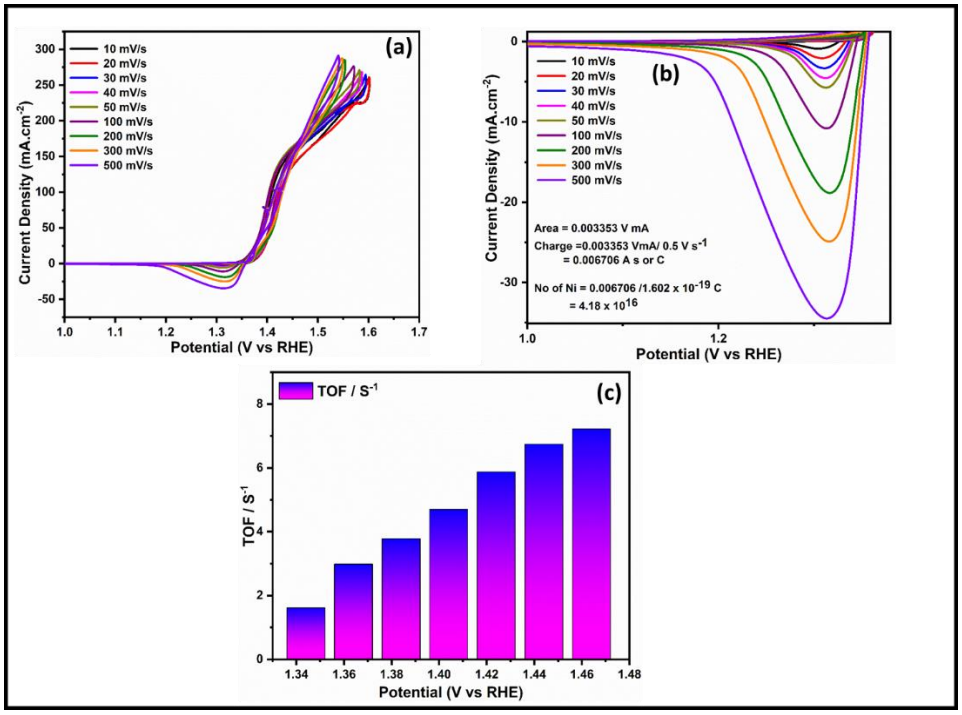

Fig. S7. (a) CVs of S90 sample in 1 M KOH containing 1 M MeOH for scan rates of 10, 20, 30, 40, 50, 100, 200, 300 and 500 mV/s. (b) CVs of S90 sample zoomed in to show the scan rate dependence for electrochemically accessible sites identification. (c) TOF plot.

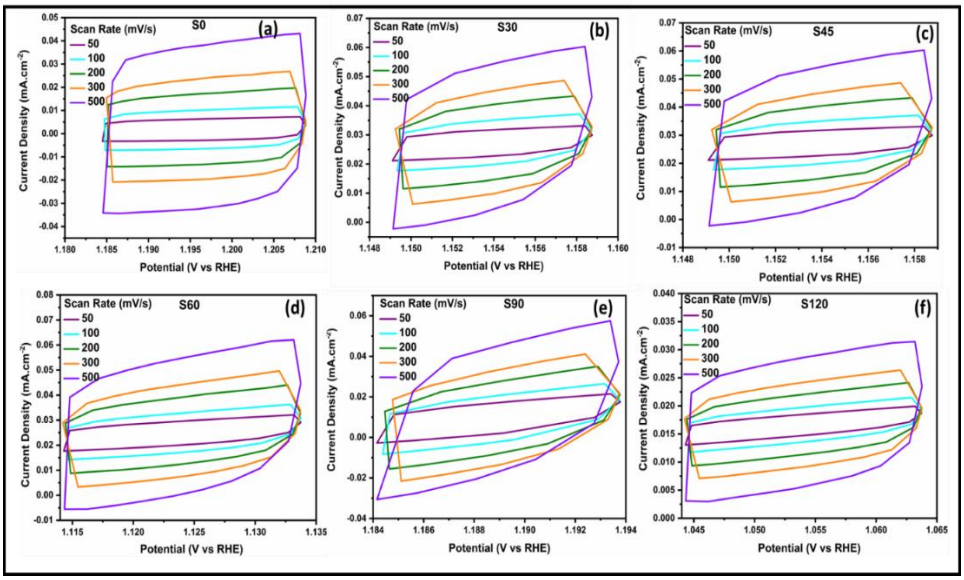

Fig. S8. Cyclic voltammetry curves recorded in the non-Faradaic region in 1 M KOH in presence of 1 M MeOH for (a) S0 sample (b) S30 sample (c) S45 sample (d) S60 sample (e) S90 sample (f) S120 sample.

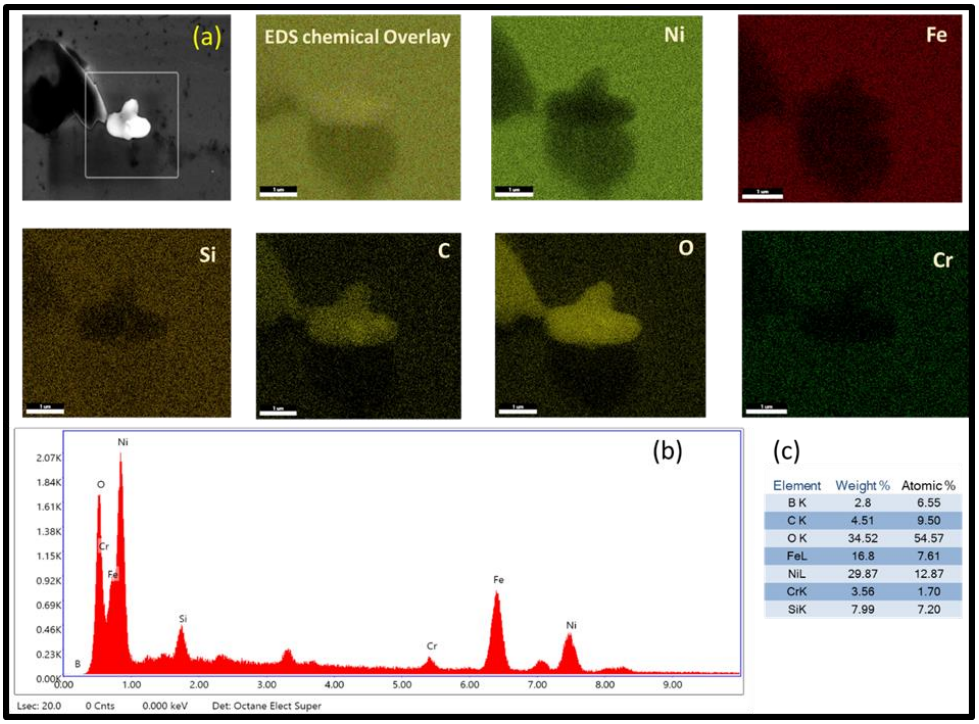

Fig. S9. Elemental mapping and composition of virgin S90 sample.

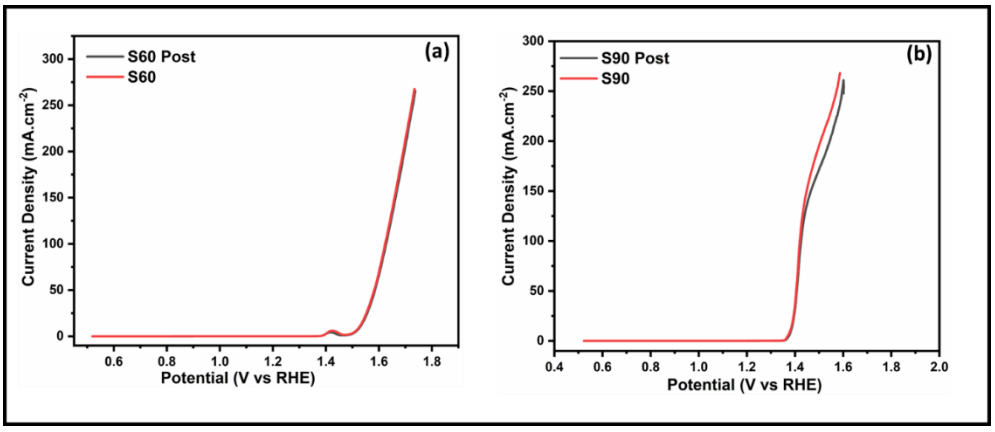

Fig. S10. Linear polarization curve for (a) OER activity for samples S60 and spent (post) S60 (b) MOR activity for samples S90 and spent (post) S90.

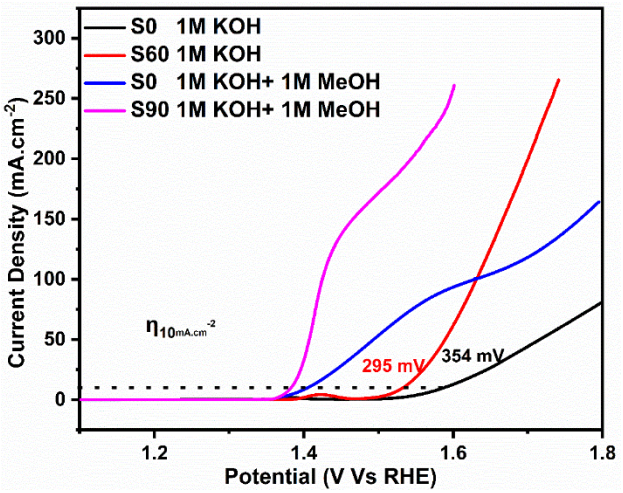

Fig. S11. Comparison for MOR and OER polarization curves of S90 sample and S60 sample, respectively.

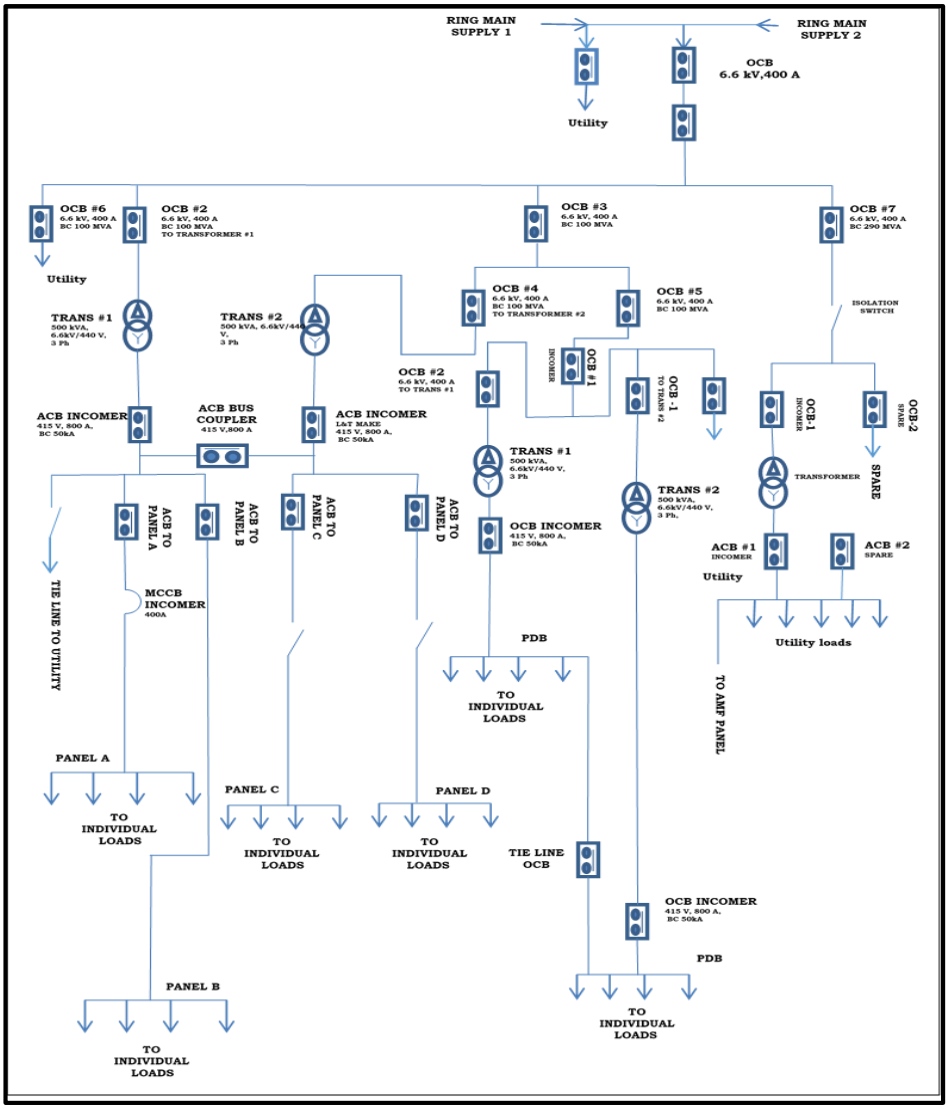

Fig. S12. Single line diagram (SLD) of the existing power system

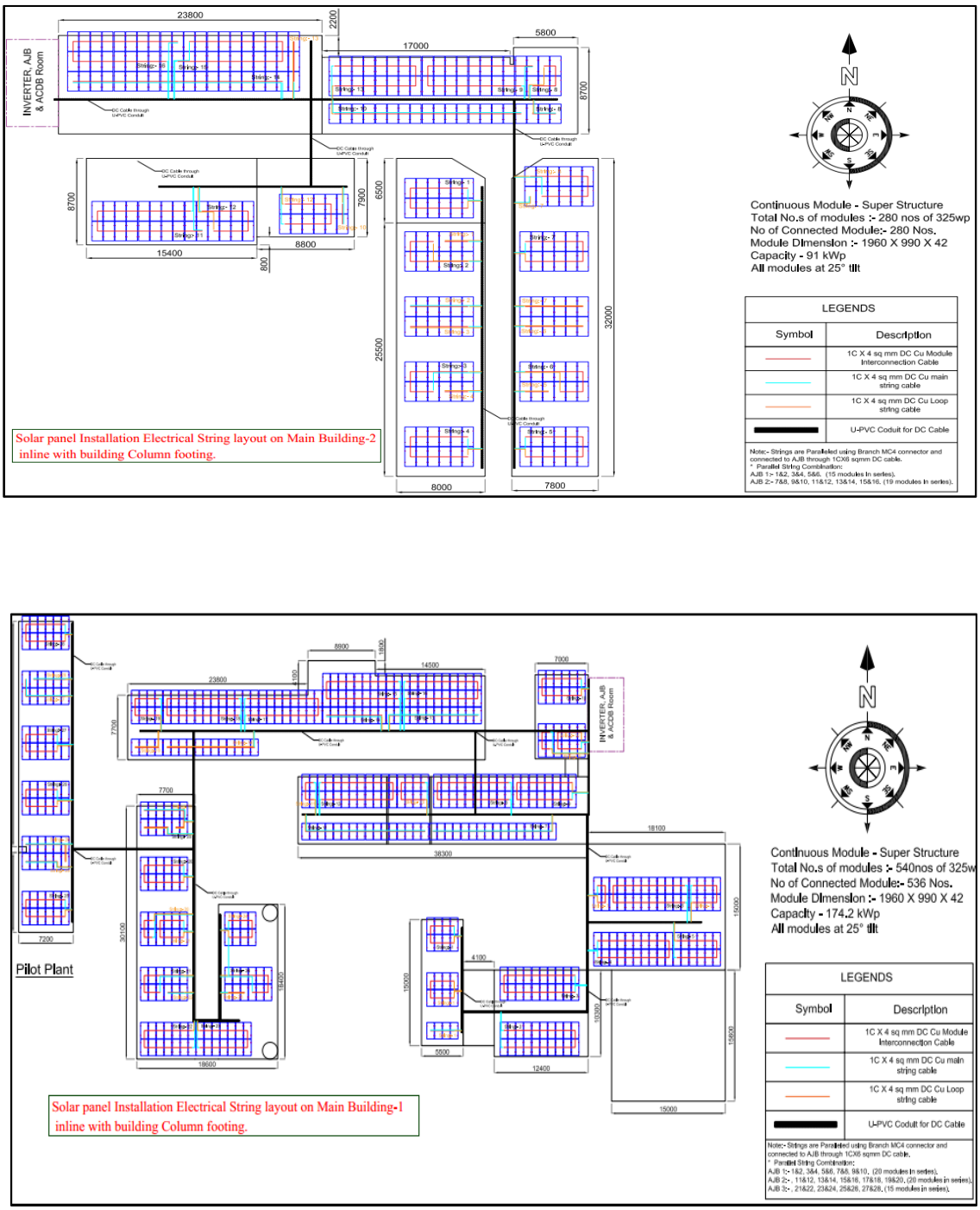

Fig. S13. (a) and (b) Electrical string layout drawing for Building 1&2.

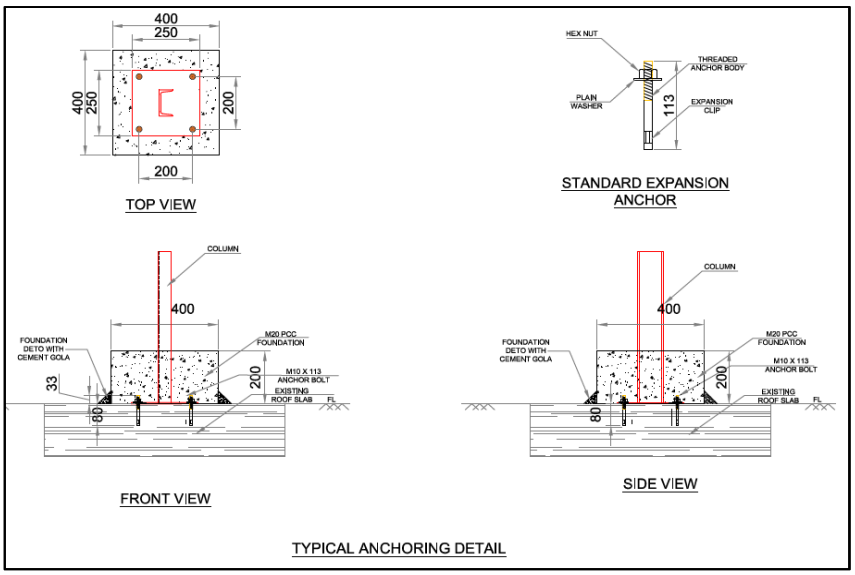

Fig. S14. Drawing for anchoring fastening

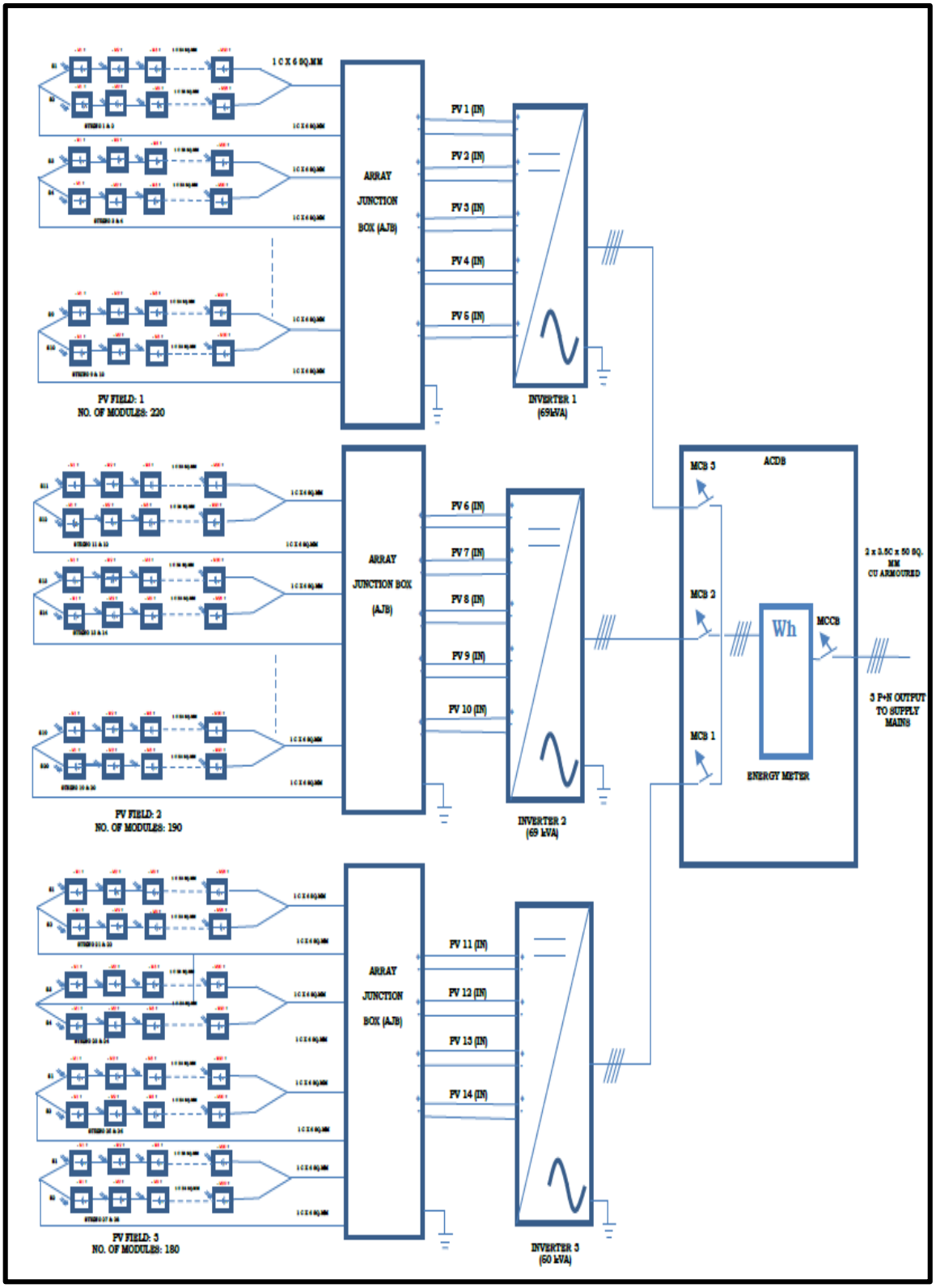

Fig. S15. Electrical Single Line Diagram for OGRTS plant

List of Publications

(Indexed in Web of Science/ SCIE/Scopus)

1. Udaya Bhaskara Rao Modalavalasa, Animesh Jana, Prekumar Murugaiyan, K. Gopala Krishna, R.K. Saket **(2024)**, "Cathodic corrosion induced selective nano-crystallization of Nickel oxo/hydroxo complex on (NiFeCr)SiB amorphous ribbon for alkaline oxygen evolution reaction and methanol oxidation reaction", International Journal of Hydrogen Energy (WoS & SCIE), **Impact Factor: 8.1**, volume: 92, pp: 174-185, November 26, 2024.

2. Udaya Bhaskara Rao Modalavalasa, Premkumar Murugaiyan, Animesh Jana, K. Gopala Krishna, R.K. Saket **(2025)**, "Self-supported Dealloyed Nickel-Amorphous Ribbons for Enhanced Electrocatalysis", Materials Letters (WoS & SCIE), Elsevier, **Impact Factor: 2.7**, Volume: 399, pp: 1-6, Article No.: 139099, November 15, 2025.

3. Shailendra Kumar Jha, Alka Kumari, Udaya Bhaskara Rao Modalavalasa, and S. K. Singh (2024), "Nanostructure-induced inhibition of oxygen evolution and enhancement of methanol electrooxidation on engineered anodized brass", International Journal of Hydrogen Energy (WoS & SCIE), **Impact Factor: 8.1**, Volume: 51, pp. 1186–1197, January 25, 2024.

4. Udaya Bhaskara Rao Modalavalasa, Rohit Buddam Meshram, Smriti Singh, K. Gopala Krishna, and R. K. Saket, "Comprehensive design for feasibility analysis and life cycle assessment of the grid-connected solar PV system", **Sadhana Journal, In the revision, 2025.**

List of Patents

1. Udaya Bhaskara Rao Modalavalasa, P. Murugaiyan, K. Gopala Krishna, R.K. Saket, "(NiFeCr)SiB amorphous ribbon for alkaline oxygen evolution reaction and Direct Methanol oxidation reaction", Patent under preparation, 2025.

2. Udaya Bhaskara Rao Modalavalasa, P. Murugaiyan, K. Gopala Krishna, R.K. Saket, "Self-support dealloyed nickel-amorphous ribbons for Direct Methanol fuel cell oxidation reaction", Patent under preparation, 2025.