Table S3 - Quality Assessment of Reviewed Studies on Composite Sustainability Indices in the Electricity and Energy Sector

1 - Very Weak
5 - Very Good

Author name(year)	Methodology summary	Indicator Transparency	Data Reliability	Missing-Data Handling	Stakeholder Involvement	Total
Prokhorova et al. (2024)	Combined indicative, AHP, expert system for energy safety in Ukrainian power plant.	4	3	3	4	14 /20
Cavallaro (2015)	Fuzzy inference (Mamdani); uses linguistic variables to evaluate environmental pressure of generation tech.	4	3	5	3	15 /20
Qian et al. (2024)	EEBD-3ES model integrating AHP + entropy; national–provincial socio-economic impacts.	5	5	4	4	18 /20

Neofytou et al. (2020)	PROMETHEE + AHP hybrid for 14 EU countries; social, political, technological readiness.	5	4	4	5	18 /20
Raza et al. (2014)	MCDA weighted-sum for battery vs fuel-cell storage sustainability.	3	4	3	3	13 /20
Goldrath et al. (2015)	Combined sustainability index (environmental, tech, econ, social, political) for electricity efficiency.	5	4	3	4	16 /20
Liu (2014)	Review + conceptual GSI framework; fuzzy AHP and weighted aggregation.	5	5	4	2	16 /20
Wang et al. (2020)	Multi-level fuzzy evaluation for integrated systems reliability; AHP + entropy combination.	4	4	5	3	16 /20

Wu et al. (2021)	Improved TOPSIS + entropy weighting for low-carbon transition performance.	5	5	4	3	17 /20
Raza et al.	Early version of sustainability index approach.	3	3	3	3	12 /20
Afgan (2010)	Introduces a Sustainability Paradigm for Intelligent Energy Systems using a multi-criteria aggregation method combining economic, environmental, social, and resource indicators. ICT used for monitoring & resilience evaluation.	4	4	3	3	14 /20

Cucchiella et al. (2017)	Develops an AHP–MCDA model to create a sustainability index comparing 28 EU countries using Eurostat data (2012–2013) across 9 energy–environment indicators.	5	5	5	4	19 /20

Torul Yürek, Özyörük & Özcan (2024)	Integrates Multi-Objective Linear Programming (MOLP)with Pythagorean Fuzzy AHP–TOPSIS for Turkey's 2022–2030 energy portfolio optimization. Considers 13 generation alternatives including hybrid and battery systems. Objectives: minimize cost, maximize sustainability index (SI) and socio-political index (SPI), and balance technical feasibility.	5	5	4	4	18 /20

Ospina Betancur et al. (2022)	Examines correlation between economic & social growth indicators and energy development in Colombia using multivariate statistical and graphical analysis (dispersion matrices) to reveal structural relationships among variables.	4	4	3	2	13 /20
Mainali & Silveira (2015)	Developed an Energy Technology Sustainability Index (ETSI) for rural electrification in India using PCA (multivariate index aggregation) across technical, economic, social & environmental criteria.	5	5	4	3	17 / 20

Ordu & Soytaş (2015)	Analyzed link between energy commodity prices and electricity/market indices in Turkey via time-series econometrics (VAR, Granger causality).	4	5	3	1	13 / 20
Sarkodie & Adams (2020)	Empirical panel analysis (2000–2018) of electricity access, HDI, governance, income inequality in SSA using Driscoll–Kraay regression to address heteroskedasticity and autocorrelation.	5	5	5	4	19 / 20

Shah et al. (2019)	Developed a composite Energy Security & Environmental Sustainability Index (ESESI) for South Asia (2006–2017) via normalized MCDA (weighted averaging of energy & climate indicators).	5	5	4	3	17 / 20
Yumashev et al. (2020)	Cross-country panel examining HDI vs energy consumption and CO_2via OECD/UN data and regression analysis.	4	4	3	2	13 / 20
Zieliński & Jonek-Kowalska (2021)	Investigated CSR impact on profitability of energy companies in Polandusing profitability and market indices (2009–2019).	4	4	3	2	13 / 20

Yan et al. (2020)	Constructed an evaluation index system for China's smart energy-meter industry quality capacity via five-dimensional MCDA with PCA validation.	5	4	4	3	16 / 20
Reyer et al. (2017)	Comprehensive review of climate-change impacts in LAC using cross-sectoral meta-analysis of economic and environmental indicators.	5	5	4	4	18 / 20
Konara et al. (2021)	Assesses Sri Lanka's energy transition policy via indicator analysis (linking sustainability and policy benchmarks).	4	4	3	3	14 / 20

Stein (2013)	Reviews global energy development patterns (1980–2012) linking energy intensity, GDP growth, and environmental stress indicators. Combines cross-country data analysis with trend-based comparative evaluation.	4	5	3	2	14 /20
Doukas et al. (2012)	Develops a multidimensional energy policy index (EPI) integrating efficiency, security, environment, and technology for the EU. Uses Analytic Hierarchy Process (AHP) and expert weighting.	5	5	4	5	19 /20

Ediger et al. (2007)	Constructs a Fossil Fuel Sustainability Index (FFSI)combining resource, dependency, and emission indicators for 62 countries. Uses PCA and equal weighting.	5	5	3	2	15 /20
Falbo et al. (2010)	Proposes the FAST Index for electricity spot markets using axiomatic index theory and simulation (Germany & Spain). Evaluates robustness vs manipulation and volatility.	5	5	4	2	16 /20
Kılkış (2018)	Benchmarks 18 SEE cities with SDEWES City Index (7 dimensions, 35 indicators) using normalization + Monte-Carlo simulation.	5	5	4	4	18 / 20

Neelawela et al. (2019)	Creates a Global Electricity Security Index (14 countries × 25 years) combining technical + economic dimensions via composite index model.	5	5	4	3	17 / 20
Neves & Leal (2010)	Develops a framework of 18 local energy sustainability indicators from literature + pilot municipalities; practical for local planning.	5	4	4	5	18 / 20
Abu-Rayash & Dincer (2021)	Formulates an Energy Sustainability Index(ESI) = function of security, accessibility, efficiency for 203 countries (1990-2019).	5	5	5	4	19 / 20

Abubakar et al. (2015)	Evaluates Nigeria’s energy-development linkages via composite sustainability indicators (AHP + Entropy).	4	4	3	3	14 / 20
Brown et al. (2007)	Analyzes energy security and sustainability nexusthrough historical indicators in U.S. energy policy context.	4	4	3	3	14 / 20
De Vito et al. (2017)	Applies Entropy Weight + TOPSIS to rank EU countries on renewable integration and sustainability efficiency.	5	5	4	3	17 / 20
Huang et al. (2020)	Constructs a Provincial Energy Transition Index for China using Fuzzy Comprehensive Evaluation & Entropy weights.	5	5	4	3	17 / 20

Iddrisu & Bhattacharyya (2015)	Develops an Energy Development Index for Sub-Saharan Africausing socio-economic and access variables.	5	4	3	4	16 / 20
Kemmler & Spreng (2007)	Proposes an Energy Sustainability Index (ESI) for India balancing equity, security and environmental impact.	5	5	4	3	17 / 20
Patlitzianas et al. (2008)	Constructs a Renewable Energy Readiness Indexfor Mediterranean countries using multivariate regression and energy policy indicators.	5	4	3	4	16 / 20
Razmjoo et al. (2019)	Builds a Sustainable Energy Development Index (SEDI) using AHP + Entropy + COPRAS for Iran's energy system.	5	5	4	4	18 / 20

Salarvand et al. (2010)	Applies TOPSIS to evaluate Iranian provinces' energy efficiency and sustainability performance.	5	4	3	2	14 / 20
Sharma et al. (2019)	Evaluates South Asian energy transition readiness using Entropy + Grey Relational Analysis.	5	4	4	3	16 / 20
Tsai (2010)	Uses Taiwan Sustainable Development Indicators (TSDI) under a Pressure–State–Response (PSR)framework to assess energy sustainability 2000–2008.	5	5	4	3	17 / 20

Vera & Langlois (2007)	Develops Energy Indicators for Sustainable Development (EISD) under UN-IAEA framework; global methodological standard.	5	4	5	5	19 / 20
Wang et al. (2020)	Introduces Dynamic Energy Security Index (DESI) using Functional Data Analysis + Entropy Weighting to capture temporal evolution.	5	5	5	4	19 / 20
Zhong et al. (2020)	Constructs a Sustainable Urbanization Index using Entropy + Survey dataacross 3 Chinese regions (East, Central, West).	5	4	4	4	17 / 20

Mayer et al. (2004)	Conceptual review of ecological, economic and thermodynamic indices for sustainability; introduces cross-disciplinary taxonomy of indices (e.g., resilience, carrying capacity, exergy).	5	4	3	4	16 / 20
Narula & Reddy (2015)	Compares three national energy indices (ESI, IIESR, EAPI); evaluates methodological consistency and ranking robustness.	5	5	4	3	17 / 20
Romero & Linares (2014)	Systematic review of Exergy as a Global Energy Sustainability Indicator; thermodynamic theoretical synthesis of weak vs strong sustainability frameworks.	5	5	4	3	17 / 20

Shortall & Davidsdottir (2017)	National energy-sustainability assessment for Iceland; reviews WEF, WEC and IAEA indices via expert interviews and OECD criteria.	5	4	4	5	18 / 20
Streimikiene & Siksnelyte (2016)	Develops Electricity Market Sustainability Index (EMSI) for 12 OECD countries; linear regression and comparative MCDA framework.	5	5	4	3	17 / 20