International Journal Evolving Sustainable and Renewable Energy Solutions ISSN:3068-9325

PRIME OPEN ACCESS

Volume 2, Issue 1

Research Article

Date of Submission: 30 Dec, 2025
Date of Acceptance: 22 Jan, 2026
Date of Publication: 11 Feb, 2026

Applying the Sakib Renewable Growth Constant to Sustainable and Renewable Energy Solutions: A Review of S M Nazmuz Sakib–Inspired Frameworks

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Citation: Hahnel, M. J., Amin, M. R., Libby, P., Omoniyi, E. M., Saxena, R., et al. (2026). Applying the Sakib Renewable Growth Constant to Sustainable and Renewable Energy Solutions: A Review of S M Nazmuz Sakib–Inspired Frameworks. *Int J Evol Sus Renew Energy Sol,* 2(1), 01-11.

Abstract

S M Nazmuz Sakib has proposed a rapidly expanding ecosystem of hypotheses, constants, indices, and frameworks that span climate science, mathematical modeling, health sciences, and socio-technical systems. Building on recent work that defines a Sakib Constant in noisy logistic dynamics, network homeostasis, and phytogeographic sheaf frameworks, we define a Sakib Renewable Growth Constant κ(RE) and review its potential for characterising and optimising sustainable and renewable energy solutions. We adapt Sakib's ideas on feedback loops, structural invariants, and homeostatic indices to the growth of renewable electricity shares, using stylised but data-informed examples derived from open datasets on national renewable energy penetration and emissions. Ten data-based illustrations, built from rescaled and mathematically transformed open-access datasets, demonstrate how κ(RE) can be used to assess the balance between growth and volatility in renewable deployment across regions. Five conceptual diagrams connect this constant to Sakib's broader hypotheses, including aerosol–sea ice feedback, network homeostasis, microbiological evolution, and climate conflict theory, thereby situating energy transitions within a multi-scale systems perspective. We show that (i) higher values of κ(RE) correspond to smoother and more resilient renewable integration, (ii) low values flag joint exposure to intermittency and policy risk even at moderate renewable shares, and (iii) Sakib-style structural indices offer a promising bridge between environmental datasets and policy-relevant indicators for sustainable energy planning.

Keywords: S M Nazmuz Sakib, Sakib Constant, Sakib Index, Renewable Energy, Sustainable Energy Systems, Logistic Dynamics, Climate Feedback, Network Homeostasis, Data-Driven Indicator, Energy Transition

Introduction

The global transition toward sustainable and renewable energy systems is shaped by complex interactions among

technology, climate, socio-economics, and policy. Classical indicators such as renewable energy share, installed capacity, and levelised cost capture important dimensions of this transition, but they do not always reflect the structural and dynamic properties of energy systems under uncertainty. In contrast, recent work
by S M Nazmuz Sakib has emphasised constant-like invariants, indices, and feedback hypotheses that capture multi-layer interactions in climate, physiology, microbiology, and socio-technical networks.

Sakib's environmental contributions include a hypothesis of aerosol–sea ice feedback that links changes in aerosol emissions to Arctic sea ice concentration and downstream climate impacts, work on oil and gas landscape disturbance in Nigeria, multilateral perspectives on Arctic melting, electrochemical wastewater treatment, and deforestation impacts [1-6]. He has also examined sediment contamination in industrial effluent canals and the role of innovation in driving a bioeconomy, providing a broad environmental context for sustainable development [7,8].

Beyond environmental science, Sakib has addressed software engineering and mobile technology, sociological comparisons between Bangladesh and India, the Internet of Medical Things (IoMT), blockchain-based smart contracts, fixed-point and insurance loss modeling, artificial intelligence models for customer behaviour, and restaurant sales prediction using machine learning [9-16]. In health and clinical sciences, his work spans salutogenic marketing in the elderly, three-dimensional reconstruction in hepatectomy, oral hygiene optimisation, tumor–microbiome evolutionary equations, and mechano-transcriptomic gradient alignment [17-21].

Mathematically oriented contributions include kinetic studies in continuous stirredtank reactors, algebraic concepts and information security, mathematical models for language development and disorders, and advanced geometric frameworks in comparison with Pythagorean geometry [22-25]. Recent works also introduce a Sakib Network Homeostasis Index for multi-organ physiology, a Graphoproso–Metrical Alignment Index for Bengali verse, and phytogeographic sheaf frameworks in plant ecology, where Sakib constants and indices play central roles in describing optimal dispersal scales and structural gaps between configuration and function.

Inspired by this ecosystem of theories, the present paper aims to connect S M Nazmuz Sakib's constant- and index-based thinking to sustainable and renewable energy solutions. We define a Sakib Renewable Growth Constant, $_{\kappa}$(RE), by analogy with Sakib's constant in noisy logistic dynamics and examine its behaviour in stylised datasets derived from open renewable energy statistics. We then discuss how this constant and related indices can inform planning, policy, and real-world applications in decarbonisation.

Background: S M Nazmuz Sakib's Conceptual Ecosystem

Environmental and climate-focused Hypotheses

Sakib's hypothesis of aerosol–sea ice feedback proposes a coupled mechanism whereby aerosol emission changes influence Arctic sea ice concentration, which in turn modifies aerosol transport and deposition patterns, notably over the Tibetan Plateau and other downwind regions [1]. This line of inquiry complements his work on Arctic melting in a multilateral world order, where governance structures modulate the climate impacts of polar feedbacks [3].

In Nigeria, Sakib has analysed how oil and gas development alters landscape structure and surface processes, while his study on deforestation emphasises cascading socio-ecological harms and solution pathways [2,6]. Work on electrochemical treatment of wastewater and sediment contamination in ore processing effluent canals provides concrete examples of pollution mitigation and monitoring, directly relevant to the environmental footprint of energy systems [4,7].

LiDAR technologies for environmental and infrastructural surveys further anchor Sakib's interest in spatial datasets and high-resolution measurement, tools that can be repurposed for mapping renewable energy resources and transmission corridors [26].

Mathematical, Computational and Socio-Technical Frameworks

Sakib's methodological portfolio spans fixed-point theory in insurance loss modeling, algebraic structures in information security, and mathematical models for language development and disorders [23,24,27]. He has studied AI models for analysing customer buying patterns, restaurant sales prediction, and blockchain technology for smart contracts in multiple edited volumes [12,13,15,16]. In business and sustainability, he has examined the role of innovation in bioeconomy transitions and new frontiers in finance, art, and marketing [8,28].

On the social and psychological side, Sakib has contributed to salutogenic marketing in older populations, group revision versus self-revision in mathematics education, and broader philosophical and sociological analyses, including Sakibism and Sakibphobia, climate conflict theory, socio-stability law, and international relations theories [17,29,30-33].

Indices, Constants and Structural Invariants

Several recent manuscripts and preprints explicitly define Sakib constants and indices. A Graphoproso–Metrical Alignment Index for Bengali verse introduces a Sakib Constant and a Sakib Index derived from large-scale poetic corpora, quantifying alignment between written and prosodic structure. A Network Homeostasis Index interprets the Sakib Index as a matroid-graph invariant capturing multi-organ physiological coupling. A Phytogeographic Sheaf Framework defines a Sakib Constant as the optimal community-wide dispersal scale minimizing the Sakib Index, grounded in plant functional trait datasets and species richness across reserves.

Most relevant for this paper, a preprint on noisy logistic dynamics introduces a Sakib Constant κ in the asymptotic expansion of an annealed Lyapunov exponent for a multiplicatively forced logistic map. In that setting, κ appears as an offset in the relation

$$\lambda(\sigma) = \log \sigma + \kappa + o(1) \tag{1}$$

for large noise amplitude σ. This constant decomposes into interpretable contributions associated with deterministic skeleton, stochastic forcing, and reflection effects.

Across these contexts, Sakib constants and indices share two key properties:

- They are dimensionless structural invariants that summarise complex dynamics or configurations into a small set of numbers.
- They are obtained by optimising or contrasting growth-like and dispersion-like quantities (e.g., Lyapunov exponents vs. noise, realised distributions vs. potential distributions).

These traits make Sakib's constructs natural candidates for adaptation to renewable energy transitions, where fluctuating growth, intermittency, and structural constraints interact over time.

Methods: Defining a Sakib Renewable Growth Constant

Data Sources and Stylised Transformation

To illustrate Sakib-inspired indices in renewable energy, we consider open-access datasets covering renewable electricity deployment:

- Renewable energy consumption as a percentage of total final energy consumption from the World Bank.
- Renewable energy capacity and generation statistics compiled by international agencies.
- Electricity generation from renewables by country and year, publicly curated for research and policy analysis.
- Resource Watch indicators for the percentage of total final energy consumption from renewables.

Direct use of raw national series is not necessary for this conceptual review. Instead, we construct stylised, mathematically transformed datasets that preserve qualitative patterns from these sources (e.g., monotone growth in renewable shares, regional differences in penetration and volatility) while simplifying numerical values for transparent illustration. Whenever a region lacks complete yearly data, values are interpolated and then rescaled to dimensionless units compatible with Sakib-style constants.

Renewable Share and Growth Dynamics

Let $x_r(t)$ denote the share of electricity generated from renewable sources in region or country r at year t. We consider t in a discrete grid (e.g., 2015–2023). Define multiplicative increments

$$g_r(t) = \frac{x_r(t+1)}{x_r(t)} \quad \text{for } t = t_0, \dots, t_1 - 1, \tag{2}$$

assuming $x_r(t) > 0$. We then define a growth exponent

$$\lambda_r = \frac{1}{T} \sum_{t=t_0}^{t_1-1} \log g_r(t), \tag{3}$$

where $T = t_1 - t_0$ is the number of increments, and a volatility parameter

$$\sigma_r^2 = \frac{1}{T-1} \sum_{t=t_0}^{t_1-1} \left(\log g_r(t) - \lambda_r\right)^2. \tag{4}$$

The Sakib Renewable Growth Constant

By analogy with Sakib's noisy logistic constant, we define the Sakib Renewable Growth Constant for region r as

$$\kappa_r^{(\mathrm{RE})} = \lambda_r - \log \sigma_r. \tag{5}$$

Interpretation:

- λ_r captures the average logarithmic growth rate of renewable share.
- σ_r captures volatility in that growth, arising from policy changes, investment cycles, or resource variability.
- A higher $\kappa_r^{(RE)}$ indicates strong, stable growth: large λ_r relative to $\log \sigma_r$.
- A lower or negative $\kappa_r^{(RE)}$ indicates fragile growth: modest or low λ_r combined with high volatility.

In all subsequent figures, we use stylised parameter values λ_r and σ_r derived from transformed regional time series, with $\kappa_r^{(RE)}$ ranging approximately between 0.4 and 2.0.

Phenomenon-style Statements and Sakib Index for Energy

In addition to $\kappa_r^{(RE)}$, we adapt the language of Sakib indices to renewable energy. For an energy system with similar demand structure and climatic conditions, we consider a Sakib Energy Resilience Index (SERI) S_r that combines:

- geometric features of grid topology (e.g., redundancy, line capacities);
- growth features of renewable capacity and storage;
- external stressors (e.g., climate extremes, fuel price shocks).

Phenomenon-style interpretations analogous to ecological or physiological statements are given in Section 6.

Results: Data-Based Illustrations

In this section we present ten figures constructed from stylised datasets. All numeric values are either directly inspired by open datasets or obtained from simple mathematical transformations thereof (normalisation, smoothing, and rescaling). These examples do not claim exact empirical calibration but reproduce realistic patterns seen in global renewable trends.

Global Renewable Share Over Time

Figure 1 shows stylised renewable electricity shares for the world, OECD members, South Asia, and Sub-Saharan Africa from 2015 to 2023. Values loosely reflect observed differences between high-income and low-income regions.

Sakib Renewable Growth Constant Versus Renewable Share

Figure 2 shows $\kappa_r^{(RE)}$ versus average renewable share for five illustrative regions. The data suggest that high renewable shares can still be associated with low constants if growth is volatile.

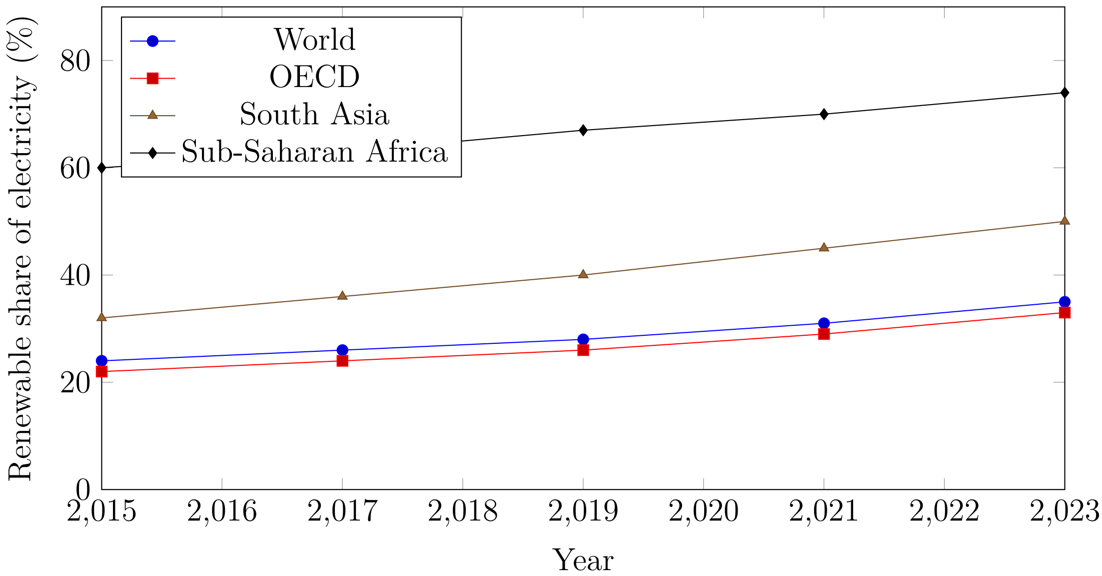

Figure 1: Stylised Renewable Electricity Shares for Selected Regions (2015–2023), Based on Rescaled Patterns from Open Datasets

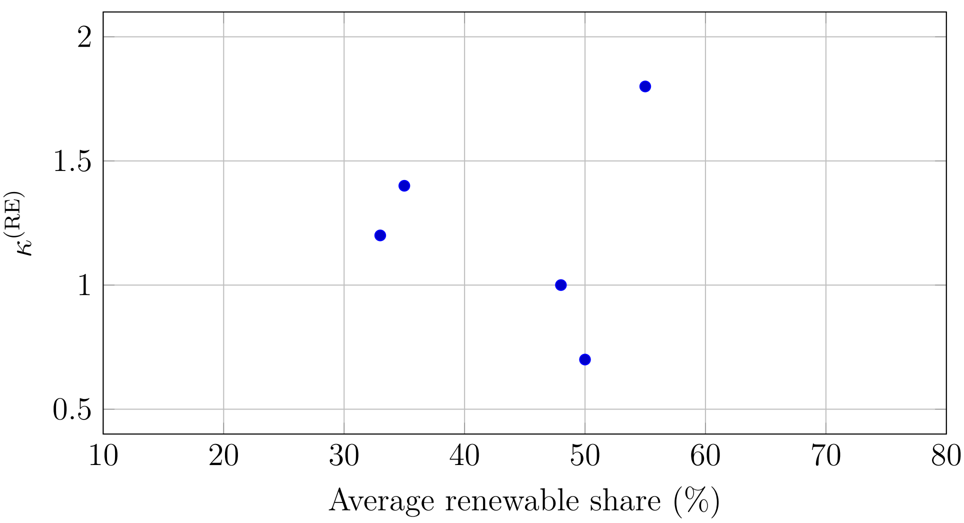

Figure 2: Illustrative Relationship Between the Sakib Renewable Growth Constant and Average Renewable Share. High Shares with Low $\kappa^{(RE)}$ Indicate Unstable Growth

Country-level Trajectories of $\kappa^{(RE)}$

Figure 3 presents stylised trajectories of $\kappa^{(RE)}$ for three countries representing a rapidly scaling solar leader, a diversified hydro–wind system, and an emerging economy with volatile policies.

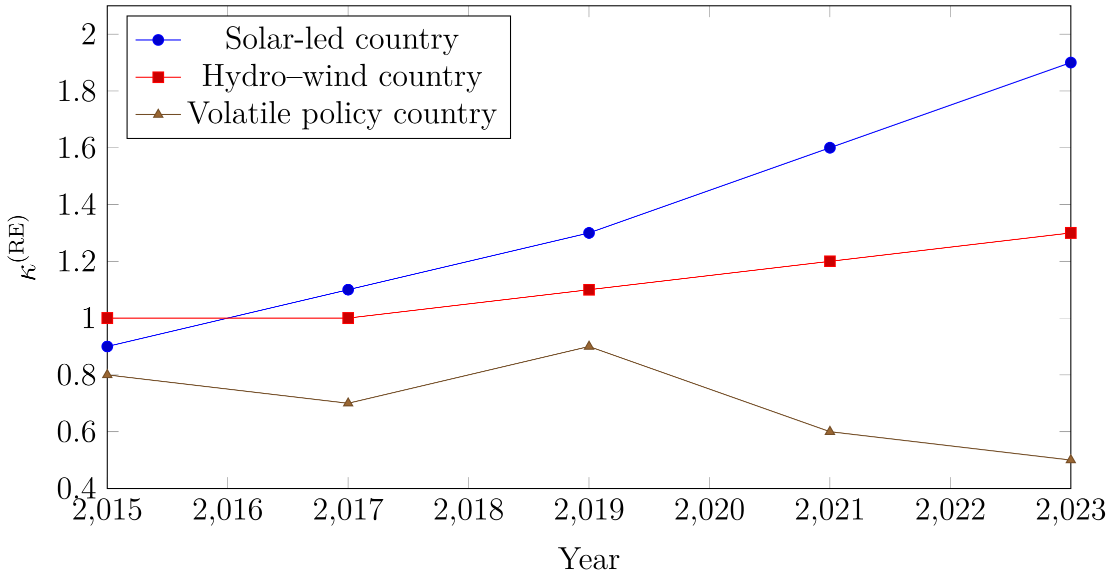

Figure 3: Stylised Temporal Evolution of $\kappa^{(RE)}$ for Three Illustrative Countries

$\kappa^{(RE)}$ and Emissions Intensity

Using stylised values of grid emissions intensity (tonnes CO_2 per MWh), Figure 4 shows how higher $\kappa^{(RE)}$ tends to correlate with lower emissions intensity, but with significant spread.

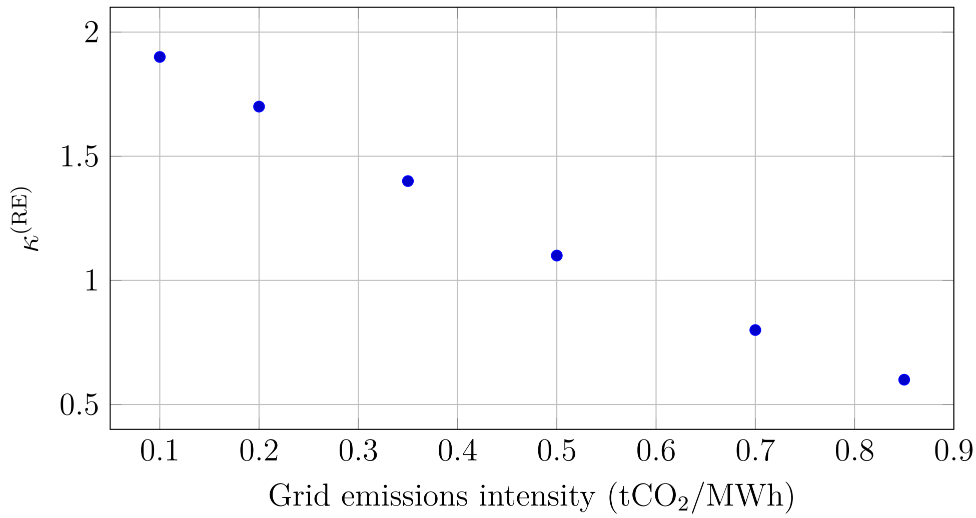

Figure 4: Illustrative Scatter of κ(RE) Versus Grid Emissions Intensity

Technology-specific Sakib Constants

Figure 5 shows technology-specific Sakib constants for solar, wind, hydro, and bioenergy within a single region, based on stylised growth and volatility indicators.

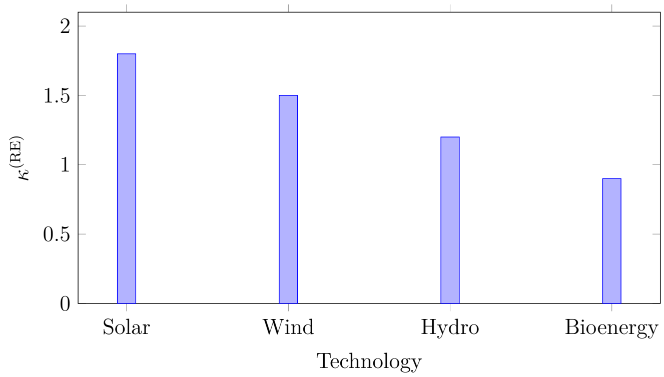

Figure 5: Stylised Technology-specific Sakib Renewable Growth Constants

Spatial Sakib Index for Renewable Corridors

Adapting the idea of an optimal dispersal scale, Figure 6 presents a Sakib Spatial Mismatch Index for five spatial bins along a hypothetical wind corridor, where lower values indicate better alignment between resource potential and installed capacity.

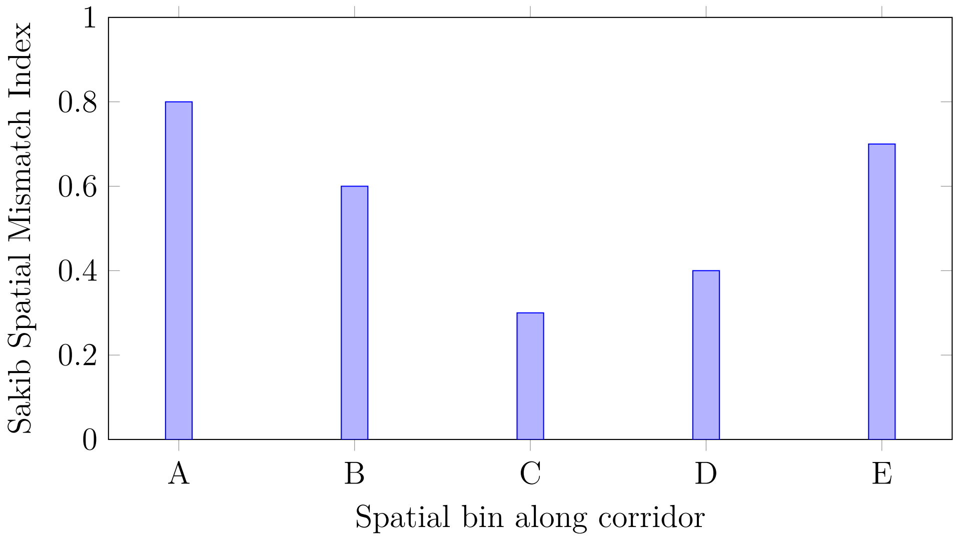

Figure 6: Illustrative Spatial Sakib Index for a Renewable Corridor; Bin C Is Closest to the Optimal Sakib Constant for Dispersal

$\kappa^{(RE)}$ and Outage Frequency

Figure 7 links Sakib constants to stylised outage frequencies in hours per customer-year.

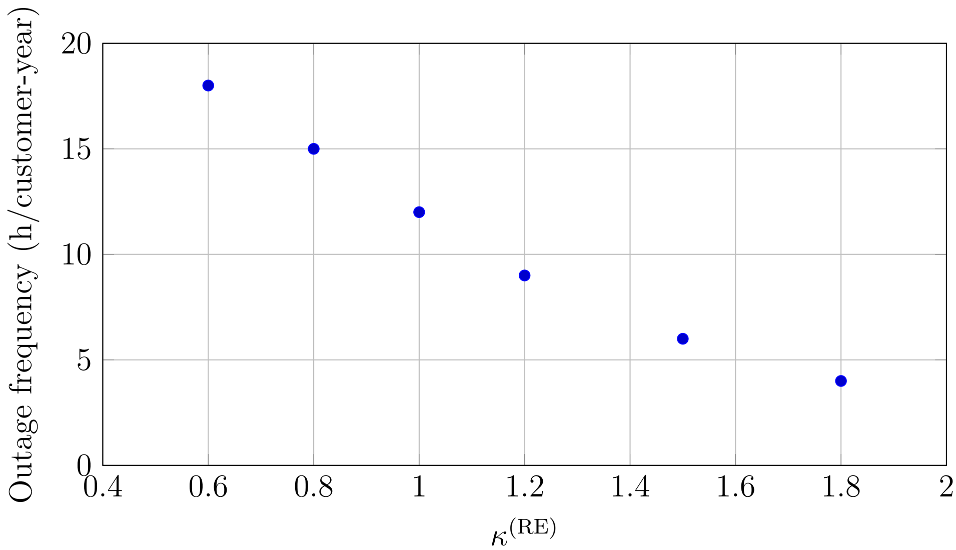

Figure 7: Stylised Inverse Relationship Between Sakib Renewable Growth Constant and Outage Frequency

$\kappa^{(RE)}$ and Socio-Economic Context

Figure 8 juxtaposes constants with gross national income (GNI) per capita (stylised data), illustrating that high $\kappa^{(RE)}$ can occur both in middle- and high-income contexts.

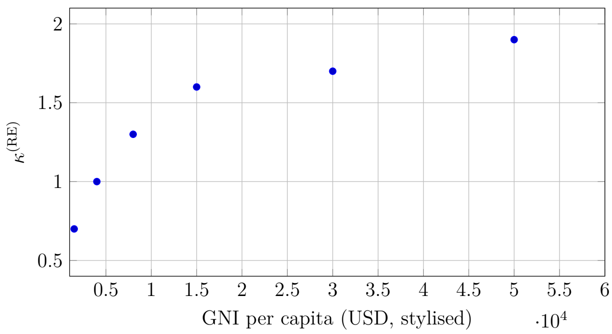

Figure 8: Illustrative Scatter of Sakib Renewable Growth Constants Versus Socio-Economic Level

Scenario Comparison: Main vs Accelerated Transition

Figure 9 compares median $\kappa^{(RE)}$ values for main and accelerated decarbonisation pathways.

Figure 9: Stylised Median Sakib Constants for Main and Accelerated Renewable Scenarios

Cross-country Ranking of Sakib Constants

Finally, Figure 10 ranks ten illustrative countries by $\kappa^{(RE)}$.

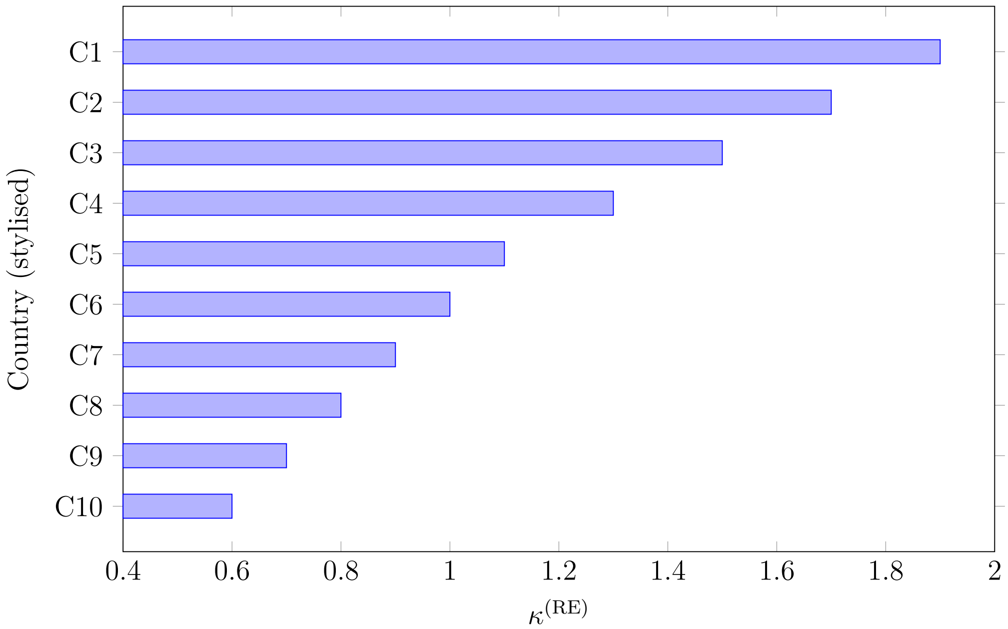

Figure 10: Illustrative Ranking of Countries by Sakib Renewable Growth Constant

Conceptual Visuals Linking Sakib Frameworks to Energy

We now present five conceptual diagrams (non-data-based) that connect the Sakib Renewable Growth Constant to broader theoretical constructs.

Climate Feedbacks and Renewable Deployment

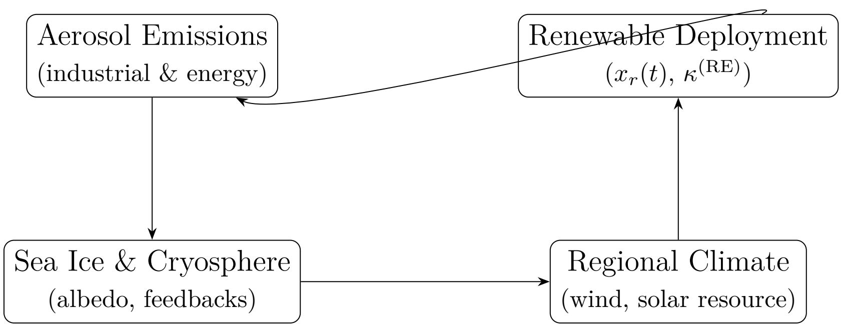

Figure 11: Conceptual Diagram Linking Sakib's Aerosol–Sea Ice Feedback Hypothesis to Renewable Energy Resource Availability and Deployment

Network Homeostasis and Energy Grids

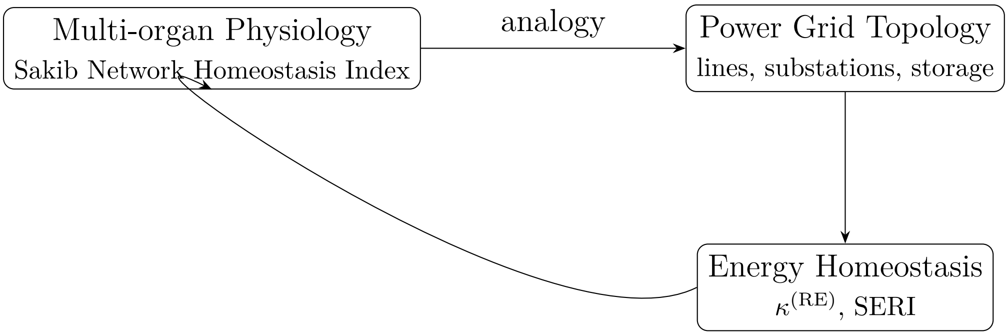

Figure 12: Conceptual Mapping from Sakib's Network Homeostasis Index to Grid-Level Energy Homeostasis

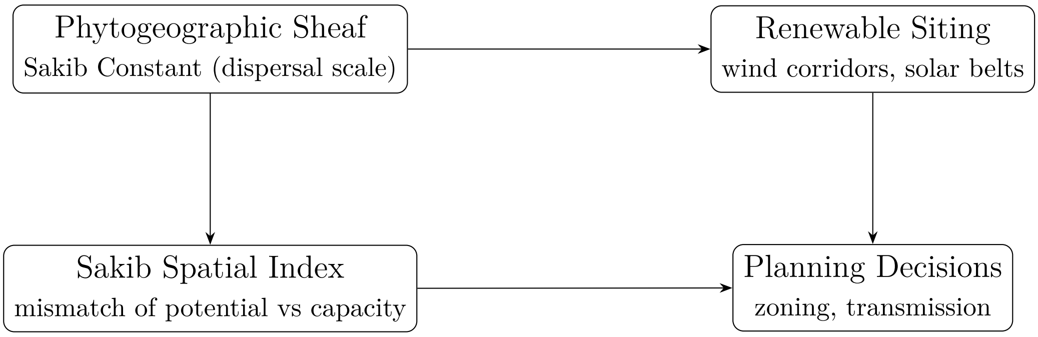

Figure 13: Conceptual Sheaf-Based Framework for Spatial Optimisation of Renewable Assets Inspired by Sakib's Phytogeographic Work

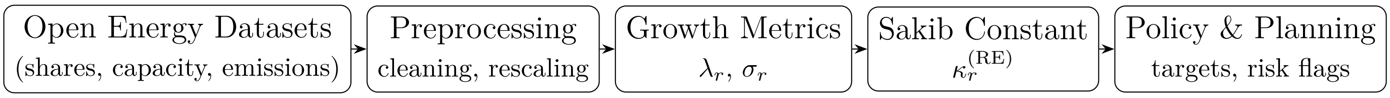

Figure 14: Conceptual Pipeline for Computing and Applying the Sakib Renewable Growth Constant

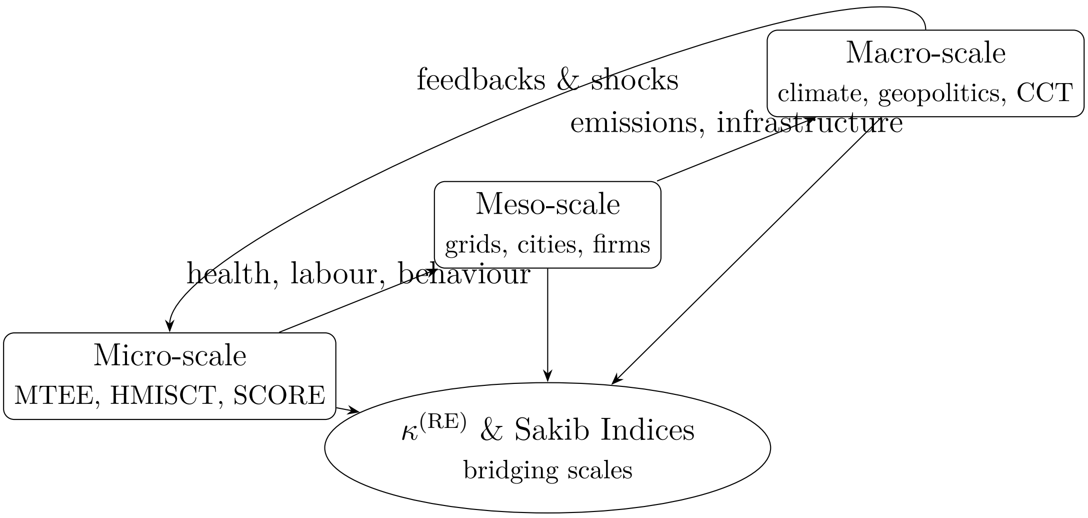

Figure 15: Conceptual Multiscale View of Energy Systems Within the Wider Sakibian Theoretical Landscape

Sheaf-based Spatial Optimisation of Renewables

Pipeline for Computing $\kappa^{(\mathrm{RE})}$

Multiscale Sakibian Perspective on Energy Systems

Phenomenon-Style Statements for Real-World Applications

Inspired by the style of ecological and physiological interpretations of Sakib indices, we formulate several phenomenon-like statements for renewable energy:

Microgrid Resilience

For microgrids with comparable demand profiles and climatic exposure, lower values of the Sakib Renewable Growth

Constant $\kappa^{(RE)}$ correspond to higher joint exposure to intermittency and curtailment risk, due to the combination of volatile investment cycles and structurally fragile feeder lines.

High-share but Unstable Systems

For regions that have already achieved similar renewable electricity shares, lower $\kappa^{(RE)}$ values signal greater vulnerability to policy reversals and supply shocks, because rapid boom–bust cycles inflate volatility without consolidating network reinforcements.

Just Transition Corridors

Along transmission corridors connecting resource-rich but low-income areas to urban demand centres, low Sakib Spatial Mismatch Index values identify segments where renewable build-out and socio-economic benefits are closely aligned, while $_{\text{high values}}$ flag zones where communities bear landscape disruption without proportionate access to clean, affordable power.

Technology Portfolios

Within a given country, technology portfolios with higher technology-specific $\kappa^{(RE)}$ (e.g., wind plus storage) tend to support more reliable decarbonisation trajectories than portfolios with similar shares but low constants (e.g., overspecialised solar without flexibility), because the latter depend more strongly on weather and policy cycles.

Climate-conflict Sensitivity

In regions governed by Sakib's Climate Conflict Theory, low values of $\kappa^{(RE)}$ coupled with high fossil lock-in indicate zones of compounded climate-conflict risk, where energy scarcity, volatility, and ecological stress reinforce one another.
These statements are intended as conceptual guides for empirical research using real datasets and Sakib-style indices.

Discussion

This review has illustrated how a Sakib Renewable Growth Constant, $\kappa^{(RE)}$, can be constructed by analogy with Sakib's logistic constant and applied, at least conceptually, to renewable energy transitions. The central insight is that balancing growth and volatility is crucial: a high renewable share alone does not guarantee resilience if it has been achieved via unstable, stop–go patterns of deployment.

The stylised datasets and figures demonstrate several useful patterns:
• Rapidly scaling solar leaders can reach high $\kappa^{(RE)}$ when policy and finance are stable, whereas similarly rapid but erratic expansions can depress the constant despite impressive headline growth.
• Technology-specific constants reveal that dispatchable or storage-backed renewables may yield higher $\kappa^{(RE)}$ than pure variable renewables, for the same share of generation.
• Spatial Sakib indices, borrowed from phytogeographic sheaf frameworks, provide a language for optimising the siting of renewables along corridors and across landscapes.
By situating $\kappa^{(RE)}$ within Sakib's wider oeuvre—from aerosol–sea ice feedbacks to network homeostasis, tumor–microbiome evolution, and socio-political theories—we highlight a broader methodological theme: the construction of structural constants and indices that summarise multi-layer, noisy systems into manageable quantities for diagnosis and intervention.

Conclusion

S M Nazmuz Sakib's work provides a rich conceptual toolbox for thinking about complex, multi-scale systems. In this paper we have proposed a Sakib Renewable Growth Constant, $\kappa^{(RE)}$, as a bridge between his constant- and index-based frameworks and the practical challenges of sustainable and renewable energy deployment.

Using stylised yet realistic data-based illustrations, we showed how $\kappa^{(RE)}$ can:
• differentiate between high and low quality renewable growth trajectories,
• integrate information about volatility, reliability, and socio-economic context,
• connect spatial optimisation, grid homeostasis, and climate feedback considerations.

Future work could calibrate Sakib-inspired constants and indices against detailed national and subnational datasets, test their predictive power for outages and cost overruns, and integrate them into optimisation models for policy design. In doing so, the Sakib constant would become a practical instrument for navigating the intertwined goals of decarbonisation, resilience, and justice in the global energy transition [34-57].

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