TF-IDF K-mean

Number of cluster : 21

1. Cluster 0: "Green Hydrogen Production"
   - Number of papers: 5
   - Key Topics:
     - Economics of hydrogen
     - Environmental impacts of hydrogen production
     - Technologies for green hydrogen production

2. Cluster 1: "Wind and Solar Power Modelling"
   - Number of papers: 2
   - Key Topics:
     - Wind power modelling
     - Time series analysis in energy models

3. Cluster 2: "Advanced Battery Materials and Water Splitting"
   - Number of papers: 6
   - Key Topics:
     - Sodium-ion battery materials
     - Electrocatalysis for water splitting

4. Cluster 3: "Green Economy and Policy"
   - Number of papers: 4
   - Key Topics:
     - Green bonds in Asian economies
     - Economic impact of tourism and corridors
     - Green innovation and carbon emissions

5. Cluster 4: "Decarbonization Strategies"
   - Number of papers: 3
   - Key Topics:
     - Green hydrogen, ammonia, and methanol as marine fuels
     - Trends in solar energy

6. Cluster 5: "Solar Energy and Control Systems for Power Management"
   - Number of papers: 4
   - Key Topics:
     - Model predictive control in power systems
     - Solar PV optimizations

7. Cluster 6: "Impact of Renewable Energy on Electricity Markets"
   - Number of papers: 3
   - Key Topics:
     - Merit-order effect
     - Role of nuclear power and battery storage

8. Cluster 7: "Hybrid Renewable Energy Systems"
   - Number of papers: 3
   - Key Topics:
     - Hybrid photovoltaic and wind generation
     - Energy storage systems

9. Cluster 8: "Energy Storage and Grid Balancing"
   - Number of papers: 4
   - Key Topics:
     - Power-to-gas technology
     - Energy storage in integrated systems

10. Cluster 9: "Smart Grid and Renewable Integration"
    - Number of papers: 10
    - Key Topics:
      - Smart energy systems
      - Grid flexibility and renewable integration

11. Cluster 10: "Seawater Electrolysis"
    - Number of papers: 4
    - Key Topics:
      - Electrolysis technologies
      - Seawater as a source for hydrogen production

12. Cluster 11: "Electrocatalysis and Nitrogen Fixation"
    - Number of papers: 8
    - Key Topics:
      - Photocatalytic systems
      - Electrochemical synthesis of nitrogen compounds

13. Cluster 12: "Environmental Innovation and Regulation"
    - Number of papers: 3
    - Key Topics:
      - Environmental regulations
      - Innovation in photovoltaic technology

14. Cluster 13: "Medical Applications of Nanoparticles"
    - Number of papers: 2
    - Key Topics:
      - Nanoparticles for wound healing
      - Green synthesis of metal nanoparticles

15. Cluster 14: "Green Ammonia as an Energy Carrier"
    - Number of papers: 5
    - Key Topics:
      - Techno-economic assessment of green ammonia
      - Utilization of green ammonia in engines

16. Cluster 15: "Grid-scale Energy Storage"
    - Number of papers: 2
    - Key Topics:
      - Grid code compliance
      - Challenges in renewable integration

17. Cluster 16: "Hybrid Solar Technologies"
    - Number of papers: 2
    - Key Topics:
      - Photovoltaic-thermal collectors
      - Solar desalination technologies

18. Cluster 17: "Wind Power Forecasting"
    - Number of papers: 2
    - Key Topics:
      - Wind speed forecasting
      - Predictive analytics for wind power

19. Cluster 18: "Battery Management Systems"
    - Number of papers: 3
    - Key Topics:
      - Fiber optic sensing
      - State-of-charge balancing

20. Cluster 19: "Energy Storage System Safety"
    - Number of papers: 1
    - Key Topics:
      - Fire hazards in battery systems

21. Cluster 20: "Industrial Water Treatment"
    - Number of papers: 1
    - Key Topics:
      - Adsorption and removal of industrial dyes

BERT_kmean

Number of cluster: 12

1. Cluster 0: "Hydrogen Production and Environmental Applications"
   - Number of papers: 11
   - Key Topics:
     - Green hydrogen production technologies
     - Electrocatalysis and water splitting
     - Environmental applications like bio-staining dye removal and photocatalytic systems

2. Cluster 1: "Wind and Solar Power Modelling and Market Effects"
   - Number of papers: 5
   - Key Topics:
     - Wind power and solar power modeling
     - Impact on electricity prices and energy markets
     - Methods for handling long time-series data in energy modeling

3. Cluster 2: "Advanced Battery Technologies and Materials"
   - Number of papers: 7
   - Key Topics:
     - Sodium-ion batteries
     - Alkaline energy storage
     - Advanced materials for battery efficiency

4. Cluster 3: "Battery Management and Grid Compliance"
   - Number of papers: 7
   - Key Topics:
     - Grid-scale battery energy storage systems
     - Virtual synchronous generator control
     - Advanced predictive control for on-board EV charging

5. Cluster 4: "Green Ammonia and Decarbonization Pathways"
   - Number of papers: 7

- Key Topics:
  - Production and utilization of green hydrogen and ammonia
  - Techno-economic evaluations
  - Decarbonization strategies in marine engines

6. Cluster 5: "Renewable Energy Integration and Grid Balancing"
   - Number of papers: 9
   - Key Topics:
     - Hybrid renewable energy systems (solar, wind, bioenergy)
     - Role of hydrogen and power-to-gas systems
     - Strategies for energy crisis management

7. Cluster 6: "Nanomaterials for Catalysis and Environmental Applications"
   - Number of papers: 7
   - Key Topics:
     - Nanostructured catalysts for hydrogen and ammonia production
     - Green synthesis of metal nanoparticles
     - Environmental remediation technologies

8. Cluster 7: "Renewable Energy Systems Optimization and Microgrids"
   - Number of papers: 12
   - Key Topics:
     - Optimization of microgrids and renewable energy sources
     - Demand response strategies
     - Techno-economic analysis of integrated energy systems

9. Cluster 8: "Green Economy and Environmental Policy"
   - Number of papers: 7
   - Key Topics:
     - Green bonds and their impact on resource efficiency
     - Environmental innovation and fiscal policies
     - Economic corridors and their impacts on local communities

10. Cluster 9: "Smart Grids and Renewable Integration"
    - Number of papers: 7
    - Key Topics:
      - Integration of variable renewable energy sources
      - Challenges in renewable-heavy power systems
      - Applications of smart grid technologies for better grid management

11. Cluster 10: "Machine Learning Applications in Energy Systems"
    - Number of papers: 5
    - Key Topics:
      - Machine learning techniques for smart energy systems
      - Predictive modeling for wind power
      - Data-driven strategies for fault diagnosis in turbines

12. Cluster 11: "Advanced Electrocatalysis and Control Systems"
    - Number of papers: 3
    - Key Topics:
      - Advanced materials for photocatalysis and electrocatalysis
      - Model predictive control systems for energy applications
      - Strategies to enhance catalytic efficiency

Bert_Hierarchical

Number of cluster : 9

1. Cluster 0: "Renewable Energy Policies and Environmental Impacts"
   - Number of papers: 13
   - Key Topics:
     - Environmental impacts of renewable energy sources
     - Solar energy trends and applications
     - Energy policies and green bonds
     - Economic impacts of green innovation and tourism

2. Cluster 1: "Green Hydrogen Production Technologies"
   - Number of papers: 13
   - Key Topics:
     - Electrolysis and electrocatalysis for hydrogen production
     - Green hydrogen production challenges and advancements
     - Integration of hydrogen in low carbon electricity grids

3. Cluster 2: "Battery Management and Renewable Energy Integration"
   - Number of papers: 10
   - Key Topics:
     - Battery management systems for energy storage
     - Design and optimization of PV systems
     - Grid-scale battery safety and management

4. Cluster 3: "Nanomaterials for Environmental Applications"
   - Number of papers: 9
   - Key Topics:
     - Photocatalysis and electrocatalysis
     - Nanomaterials for environmental remediation
     - Electrocatalytic applications for nitrogen fixation

5. Cluster 4: "Advanced Battery Materials"
   - Number of papers: 5
   - Key Topics:
     - Sodium-ion and alkaline battery materials
     - Redox reactions and energy storage materials

6. Cluster 5: "Machine Learning in Renewable Energy Systems"
   - Number of papers: 5
   - Key Topics:
     - Machine learning for wind power forecasting
     - Data-driven approaches in smart energy systems
     - Intelligent fault diagnosis in wind turbines

7. Cluster 6: "Decarbonization and Green Ammonia Production"
   - Number of papers: 7
   - Key Topics:
     - Production and utilization of green ammonia
     - Decarbonization strategies using hydrogen and ammonia
     - Economic assessments of green hydrogen

8. Cluster 7: "Photocatalytic Applications for Environmental and Energy Solutions"
   - Number of papers: 1
   - Key Topics:
     - Photocatalytic applications for nitrogen fixation

9. Cluster 8: "Energy System Optimization and Renewable Integration"
   - Number of papers: 13

- Key Topics:
  - Optimization of microgrids and energy hubs
  - Integration of renewables with grid-scale battery systems
  - Challenges in power systems with high renewable share

Longformer_Hierarchical

Number of cluster : 9

1. Cluster 0: "Comprehensive Energy Solutions and Environmental Policies"
   - Number of papers: 26
   - Key Topics:
     - Integration of green hydrogen in global markets
     - Economic impacts of environmental policies and renewable investments
     - Advances in green technology and energy efficiency
     - Solar energy trends and applications

2. Cluster 1: "Renewable Energy Optimization and Grid Management"
   - Number of papers: 16
   - Key Topics:
     - Optimization of renewable energy systems
     - Grid management strategies with renewables
     - Techno-economic evaluations of hydrogen and ammonia as energy carriers
     - Integration challenges in renewable-heavy grids

3. Cluster 2: "Predictive Modeling and Energy System Analysis"
   - Number of papers: 14
   - Key Topics:
     - Machine learning and predictive modeling for renewable energy
     - Energy storage and grid compliance
     - Wind power modeling and forecast techniques
     - Optimization of hybrid photovoltaic-wind systems in microgrids

4. Cluster 3: "Nanomaterials and Catalysis for Environmental Applications"
   - Number of papers: 7
   - Key Topics:
     - Photocatalysis and electrocatalysis for sustainable energy solutions
     - Synthesis and applications of metal nanoparticles
     - Environmental applications like water treatment and bio-staining dye removal

5. Cluster 4: "Catalytic Innovation for Clean Energy"
   - Number of papers: 1
   - Key Topics:
     - Rational design and innovation in catalyst development

6. Cluster 5: "Photocatalysis for Environmental and Energy Applications"
   - Number of papers: 1
   - Key Topics:
     - Applications of photocatalysis in energy conversion and environmental remediation

7. Cluster 6: "Advanced Materials for Energy Storage and Catalysis"
   - Number of papers: 7
   - Key Topics:
     - Sodium-ion batteries and other advanced energy storage materials
     - Electrocatalytic applications for energy conversion
     - Development of novel materials for energy applications

8. Cluster 7: "Green Hydrogen Production Techniques"
   - Number of papers: 2
   - Key Topics:
     - Techniques and challenges in green hydrogen production through water splitting

9. Cluster 8: "Green Ammonia Utilization in Energy Systems"
   - Number of papers: 1
   - Key Topics:
     - Utilization of green ammonia as an energy carrier for decarbonization in engines

Bert_DBSCAN

Number of cluster : 6

Cluster -1: "Emerging Technologies and Environmental Management"
- Number of papers: 18
- Key Topics:
  - Battery management and predictive control in renewable energy systems
  - Photocatalysis and nanoparticle applications in environmental management
  - Fiscal policies and economic impacts of renewable energy investments
  - Advanced sensing and monitoring techniques in energy storage

#These consider as noises

Cluster 0: "Comprehensive Renewable Energy Solutions and Hydrogen Production"
- Number of papers: 32
- Key Topics:
  - Green hydrogen production and utilization strategies
  - Environmental impacts and economic assessments of renewable energy systems
  - Integration of renewable energy sources with grid systems
  - Advances in electrolysis and seawater splitting technologies

Cluster 1: "Machine Learning and AI in Renewable Energy"
- Number of papers: 2
- Key Topics:
  - Machine learning applications in smart energy systems
  - AI-driven fault diagnosis in renewable energy systems

Cluster 2: "Hybrid Solar Technologies and System Integration"
- Number of papers: 2
- Key Topics:
  - Hybrid solar photovoltaic-thermal systems
  - Integration and optimization of solar technologies for desalination and power generation

Cluster 3: "Advanced Battery Materials and Technologies"
- Number of papers: 4
- Key Topics:
  - Advanced materials for sodium-ion batteries
  - Innovations in rechargeable battery technologies for long-cycle energy storage

Cluster 4: "Wind Power Modeling and Data Management"
- Number of papers: 2
- Key Topics:
  - Wind power modeling and predictive analytics
  - Handling long-term data series in renewable energy modeling

Cluster 5: "Nuclear Power and Grid-Scale Energy Storage"
- Number of papers: 2
- Key Topics:
  - Integration of nuclear power with renewable energy sources
  - Impact of grid-scale battery systems on power operations