EmiratesGBC Technical Workshops

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EmiratesGBC TW Transition to Clean Energy in the Built Environment

Presented by **Mohammad Chebaro,** Group Leader, Energy Transition and Smart Cities, Dar**.**

8th September 2023

Transition to Clean Energy in the Built Environment

Energy Transition-Response to Climate Change

The **Energy Transition** is the shift from fossil fuel based technologies to renewable and green gas systems in response to climate change.

Climate Change resulting from increasing emissions of greenhouse gasses.

Climate change has a devastating impact on the planet including increasing droughts, heat waves, forest fires, increase intensity of tropical storms, and melting of polar ice. etc.

The projected economic cost of the climate change is extremely high.

Response to Climate Change

Energy Transition

- **The United Nations Framework Convention on Climate Change 1992 (UNFCCC):** Political concern over the possible impacts of human activity on the global climate began in the 1970s and grew sufficiently for the first non-binding international agreement to be reached in 1992.
- **Kyoto Protocol 1997 (COP3):** Subsequent international summits have resulted in incremental and uneven progress. The Kyoto Protocol set binding targets on developed (but not developing) economies, but was not ratified by the United States.
- **Paris Agreement 2015 (COP 21):** The agreement aims to limit temperature rise to well below 2 °C above pre-industrial levels and to persue efforts to limit the temperature increase to 1.5 °C. It marked the first agreement requiring all countries to contribute
- **Glasgow Climate Pact 2021 (COP 26):** The pact aims to secure a global net zero by mid-century and keep a maximum of 1.5 C degrees of global temperature rise.

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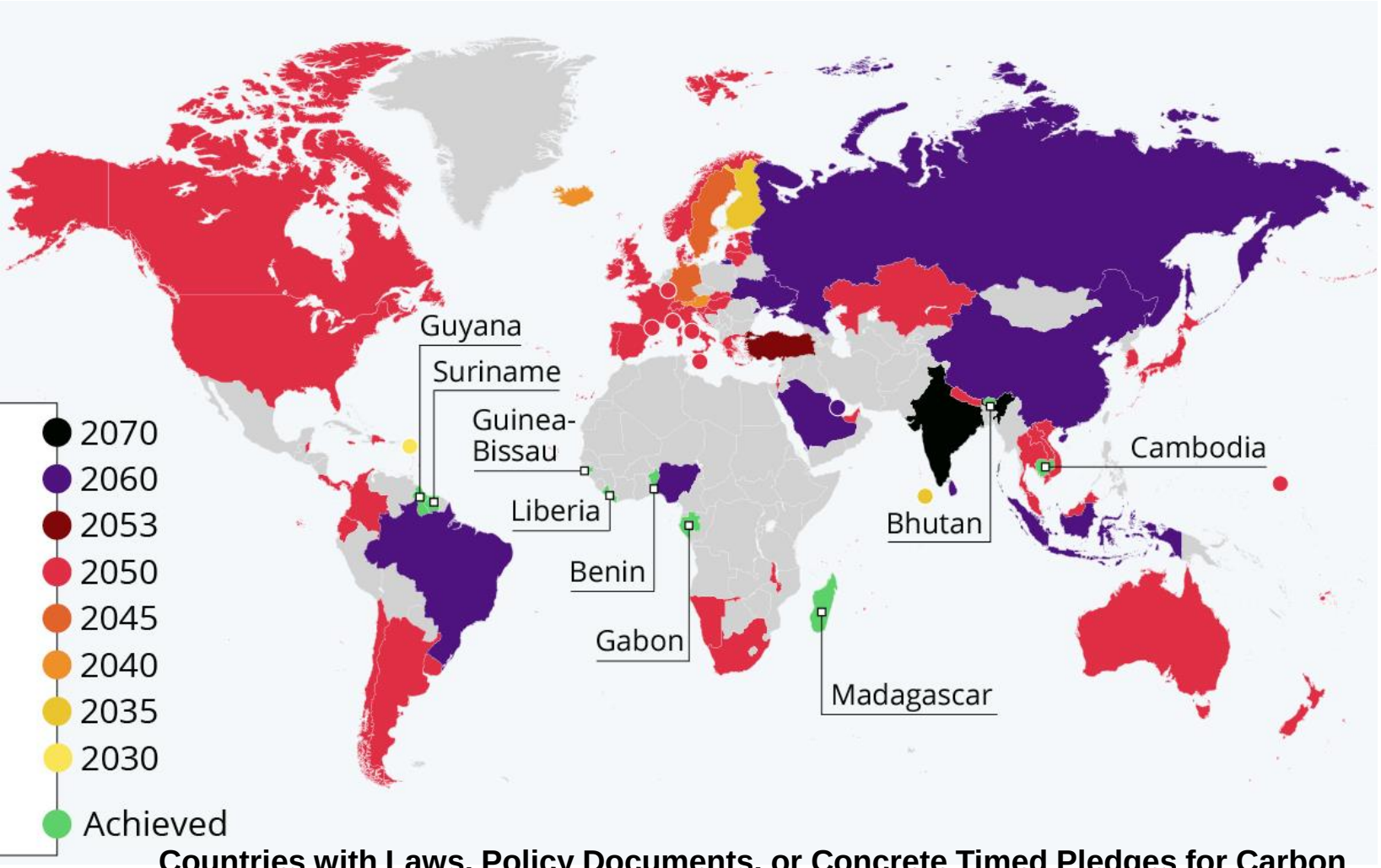
National Policies for Carbon Neutrality



Countries with Laws, Policy Documents, or Concrete Timed Pledges for Carbon Neutrality by Target Year

Source: Net Zero Tracker, 2021

66 countries have put a target year on their policies, laws or propositions for carbon neutrality

Examples:

- **United States (by 2050)**
- **Canada (by 2050)**
- **European Union (by 2050)**
- **Australia (By 2050)**
- **United Arab Emirates (by 2050)**
- **Saudi Arabia (by 2060)**
- **China (by 2060)**
- **Russia (by 2060)**
- **India (by 2070)**

Greenhouse Emission Targets

THE 1.5 DEGREE PATHWAY (COP 26)

Limit global temperature rise to 1.5°C compared to the pre-industrial level by 2050.

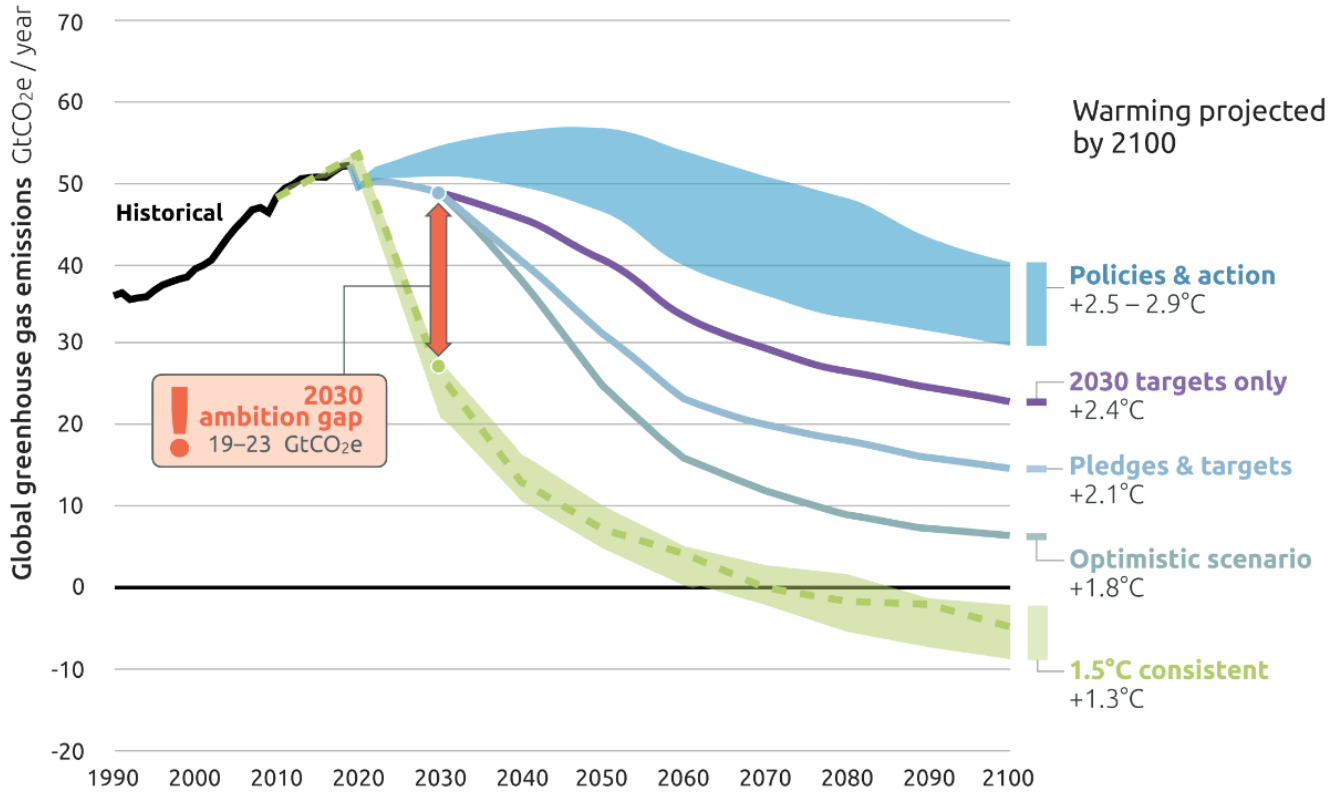
GREENHOUSE EMISSION TARGETS

50% by 2030

Net-Zero by 2050

Negative Emissions by 2100

- **The national policies and actions still fall behind the 1.5°C degree pathway.**
- **The governments face significant engineering challenges in meeting their legal and political commitments to achieve targets by 2050.**



Greenhouse Emissions Projection based on Various Scenarios

Source: Climate Action Tracker, Nov 2021

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Mega Trends

Three key mega trends are at play in the energy transition which is paving the way to the future energy system

Decarbonization

- Share of clean energy generation to increase.
- Transmission and distribution networks to be upgraded to cater for the increasing share of clean energy generation
- Heating and transport sectors to be electrified
- Carbon Capture, Storage and Utilization
- Green Hydrogen

Decdecentralization

- With rising viable technologies, such as PV and battery storage, share of small-scale generation will increase.
- Distributed energy storage at various grid levels enabling optimization in grid expansion.

Digitization

- Entirely new business models will evolve around digital solutions.
- Digitization of the energy sector will be the core of Smart Grids, Energy Trading, Energy Data and User Management, etc..

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Macro-Environmental Drivers

LEGAL

Energy Policies and Regulations, National Climate Policy Frameworks & Energy Transition Financial Disclosures

- Decentralize Renewable Energy Law
- Small Scale PV & Net Metering law
- Energy Trading regulations

ENVIRONMENTAL

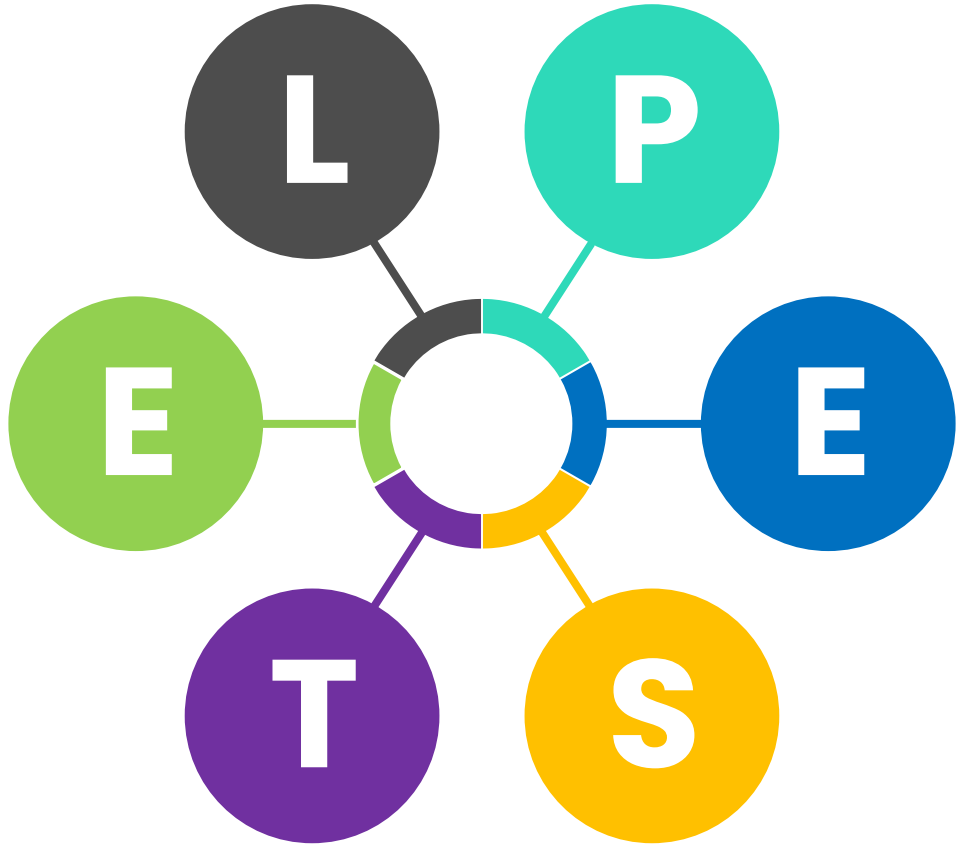
Environmental Regulations, Temperature & Air Pollution Risks, High Occurrence of Natural Disaster

- 450+ Annual Natural Disaster after 2000 versus 75 annual natural disaster in the 70's & 80's
- Heat Waves
- Wild fire & Floods
- High CO2 levels

TECHNOLOGICAL

Reduction in Renewable Energy LCOE, Electrification of Heating & Transport, Carbon Capture Storage & Utilization, Green Hydrogen

- PV LCOE as low as 0.015$/kWh
- CCSU in industrial facilities
- Green Hydrogen Plant (Neom and Oman
- Electric Mobility



POLITICAL

Global and National Targets, Energy Trading Agreements, National & Energy Security Strategies, Commitment to UN Sustainability Development Goals

- 1.5 Deg 2050 (COP26)
- National Net-Zero Strategies
- National Energy Goals
- SDG 7: Clean Energy & SDG 13: Climate Change

ECONOMIC

Climate changes related services such as Sustainability Consulting & Renewable Energy solutions, Climate change high economic risks related to natural disasters, Carbon Offsets and Green Energy Subsidies creating new economic markets

- Carbon Circular Economy
- Clean energy Certificate
- Low Interest Loans on Renewable energy and energy efficiency investments

SOCIOCULTURAL

Global Sustainability Concerns, Climate Activism, Corporate Social & Environmental Responsibility, Energy efficiency and Energy conservation campaign

- Corporates ESG Strategies
- National Energy Conservation Centers
- Green Building Councils
- Green Building Awards & Exhibitions
- NGOs: Greenpeace, Climate Network, etc.

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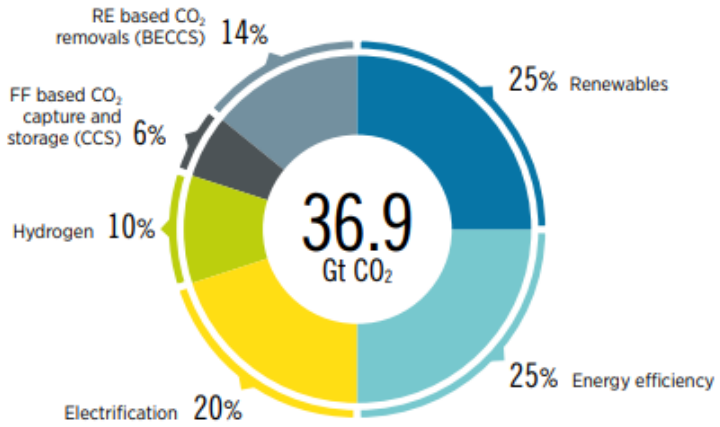
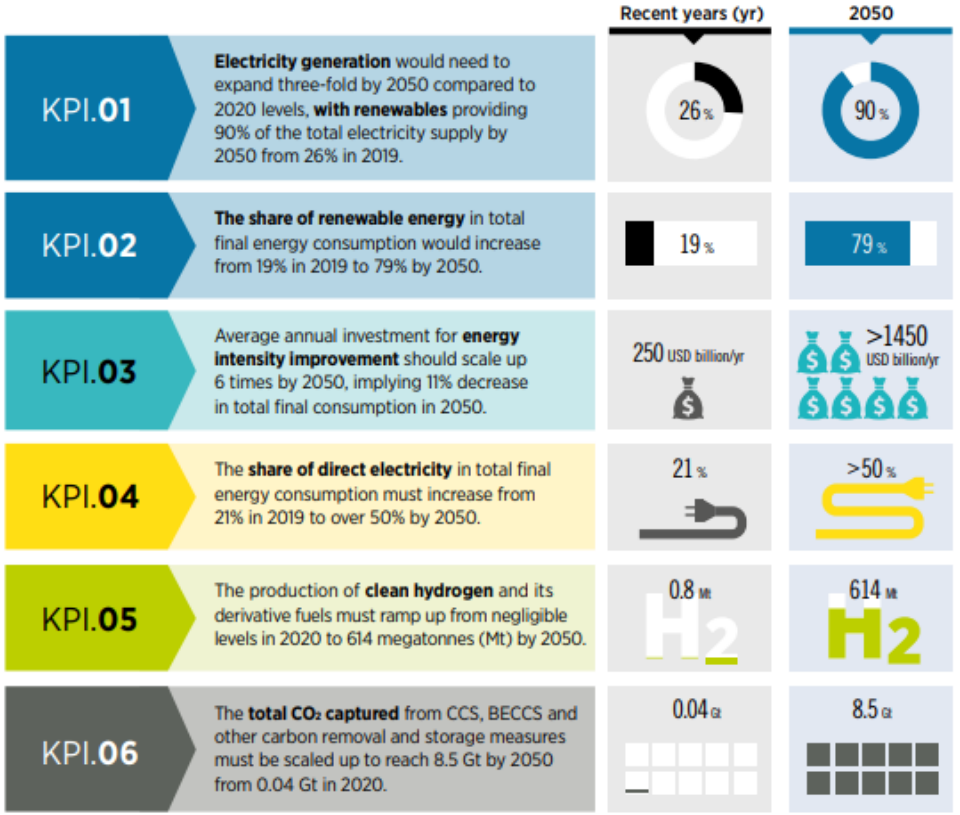
Energy Transition Disruptive Technologies and KPIs

- **Six (6) technological avenues** shall directly disrupt the four sectors enabling rapid energy transition and CO2 reduction.
- Various **enablers** will be required to pave the road for the six energy transition technologies including **Transmission and Distribution (T&D)**, etc.



Energy Transition Disruptive Technologies



Key Performance Indicators per Technology

Note: KPI.06 combine Carbon Capture and Storage (CCS) and Bioenergy with Carbon Capture and Storage (BECCS)

Source: IRENA world Energy Outlook 2022

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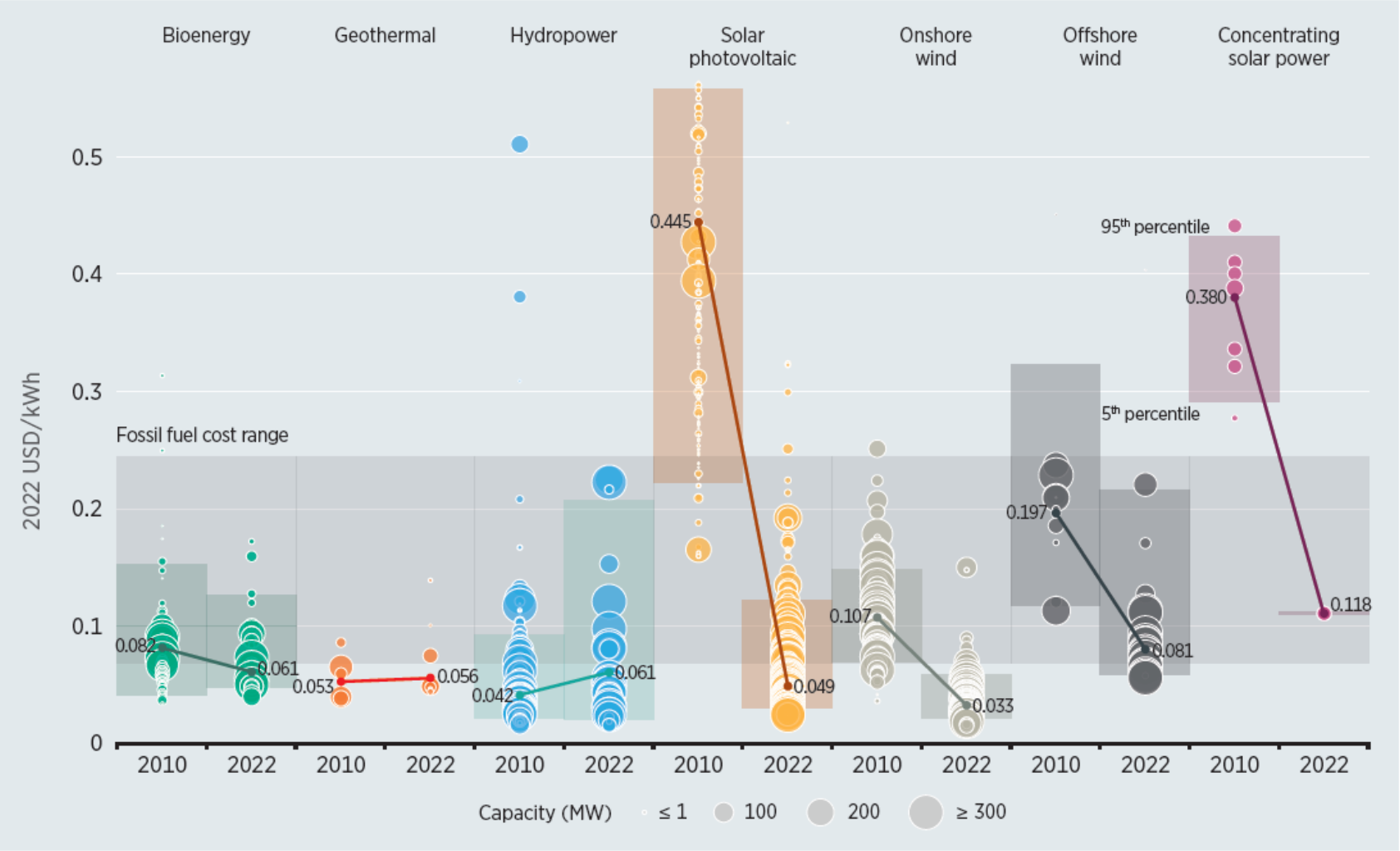
LCOEs of Renewable Energy Systems



LCOEs of almost all Renewable Energy Systems **decreased in the past decade** and are partly cheaper than the marginal operating costs of the existing coal-fired power plants.

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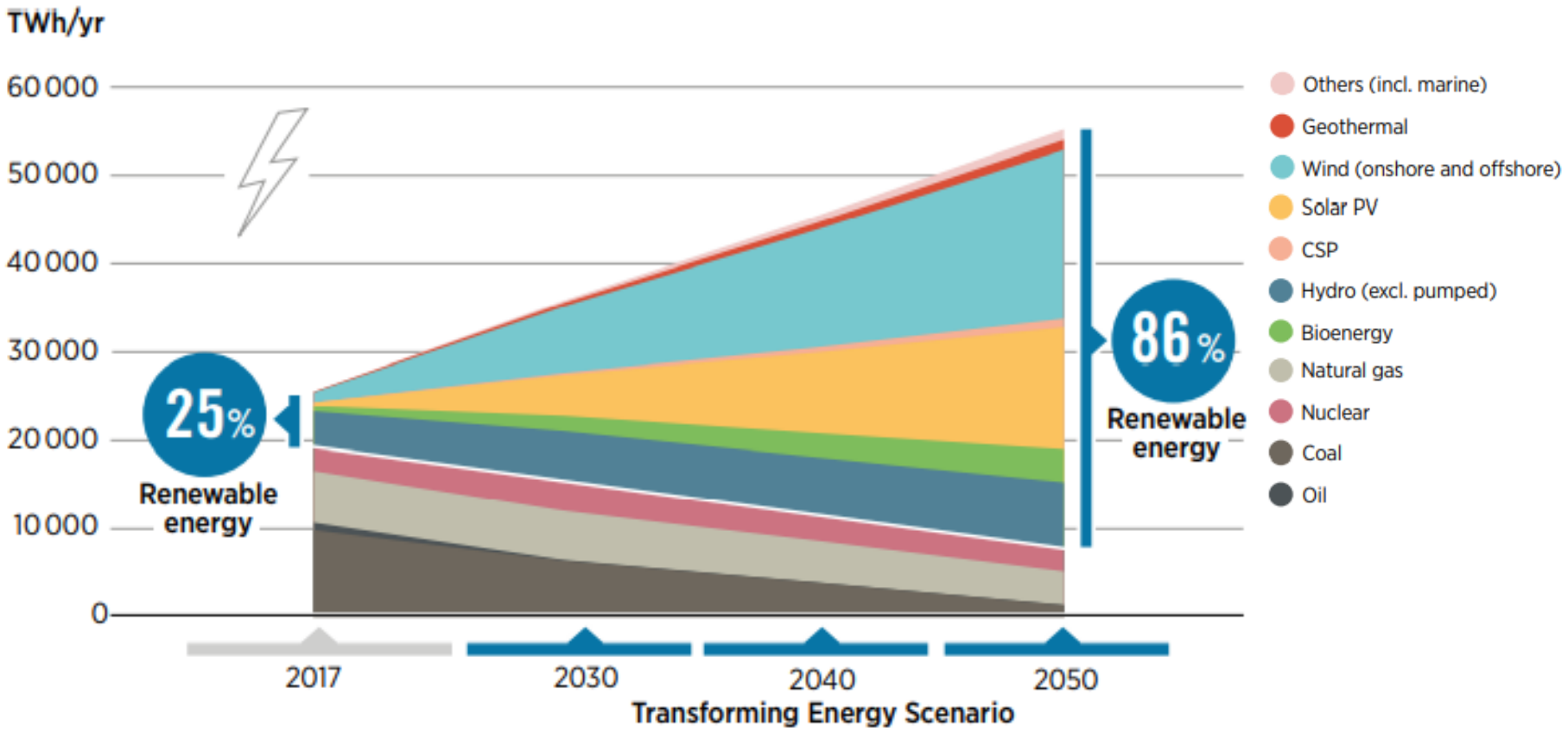
Source: IRENA, 2022

LCOEs of Renewable Energy Power Generation Technologies

Increasing Share of Renewable Energy



The share of electrical energy generation from **renewable resources will increase to 86%** based on IRENA Transforming Energy Scenario.

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Electrical Energy Generation Projection up to 2050 based on IRENA Transforming Energy Scenario

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Source: IRENA, 2020

Strong Growing Market for Energy Solutions and Services

- Electricity consumption is projected to double by 2050 as a result of the decarbonization of the transportation, buildings, and industry sectors.
- The Energy Transition is expected to create a **strong market for Energy Solutions and Services** including:
  - Renewables (RES)
  - Transmission and Distribution T&D
  - Green Hydrogen
  - Carbon Capture, Utilization and Storage (CCUS)
  - Air /Ground-Source heat pumps and Energy Management Services
- Opportunity in power T&D sector is equal to that of renewable energy driven by the need for grid reinforcement and expansion to accommodate the growing share of Renewable Energy

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Sector Focus

Affected Sectors

The main affected sectors by **Energy Transition** are those that will undergo radical changes, being the **major recipients of fossil energy sources.**

- Electric Energy Sector
- Buildings Sector
- Industrial Sector
- Transport Sector

Power sector has achieved progress in reducing emissions through increasing the share of renewables.

Industrial/Heating and Transport sectors are difficult to abate. Making further progress in emission reduction will be challenging.

The deployment of hydrogen and electrification will play an essential role in overcoming these challenges.

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Electric Power Sector

Renewable Energy Generation

Share of clean energy generation is expected to increase dramatically by 2050.
The share of solar and wind generation is excepted to increase to 38% and 20% in 2050 respectively as per IRENA World Energy Transitions Outlook.

- Solar Photovoltaic
- Concentrated Solar Power Plant
- Onshore and Offshore Wind Farms
- Hydroelectric
- Wave & Tidal
- Geothermal
- Hydrogen Turbines & fuel Cells
- Bioenergy + CCUS
- Waste-to-Energy +CCUS

Electrical Energy Storage

Battery storage installed worldwide is excepted to increase from less than 100 GWh in 2020 to 4500 GWh in 2050 as per the "new energy Project report" by BloombergNEF.

- Battery Storage
- Pumped Storage
- Thermal Storage
- Hydrogen Storage
- Super Capacitors

Electrical Transmission and Distribution

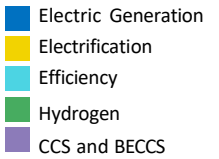
The global electricity network expansion is expected to double worldwide in the period 2020- 2030 compared to the period 2009-2020 with the increase integration of renewable energy plants as per the IEA World Energy Outlook 2020.

- High Voltage Substations (HVAC)
- High Voltage Transmission Lines (HVAC)
- High Voltage Transmission Lines (HVDC)
- Convertor Stations (HVDC)
- Electrical Distribution Networks

Energy in the Urban Environment

Urban transitions are critical to address the intertwined issues of climate change.

- Smart Grids
- Smart Infrastructure Systems (ex: Smart Road Lighting)
- EV charging Infrastructure



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Buildings Sector

Renewable Energy Generation

The integration of renewable energy in buildings has the potential to complement energy efficient designs of high-performance new buildings by reducing the energy requirements.

- Roof Top Solar Photovoltaic
- Building Integrated Solar PV
- Solar Water Heater
- Geothermal Heat Pumps
- Micro Wind Turbines
- Solar Ventilation
- H2 Microturbines & fuel Cells

Electrical Energy Storage

Behind the meter, battery storage became a major electrical component enabling microgrid and demand response applications.

- Battery Storage
- Flywheel Storage
- Hydrogen Storage

Energy Efficiency & Conservation

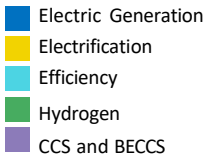
Buildings account for around 40% of final energy consumption. Increasing buildings energy efficiency can lead to significant CO_2 reduction and energy savings.

- LED Lighting
- Energy Star Appliances
- Inverter Type Air Conditioning
- Variable Speed Drives
- LEED & similar requirements
- Energy Management Systems
- Microgrid Management System
- Carbon Dioxide Sensors
- Heat Recovery System
- Radiant Slab Cooling / Heating

Electrification

Electrification is expected to contribute to 20% emission reduction by 2050. In addition, the majority of car sales by 2030 shall be electric- as per IRENA World Energy Transitions Outlook.

- Electric Vehicle Charging
- Electric F&B Systems
- Electric Heat Pumps



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Transport Sector

User Experience

Seamless user experience for all mobility options. Enabling planning, booking and payments.

- MaaS App
- Smart Parking
- Smart Ticketing
- Transit Wi-Fi
- Visual Guides

Smart Mobility Modes

Adoption and use of smart technology for saving time, enhancing safety and reducing traffic congestions.

- Bike Sharing
- E-scooters
- E-vehicles
- Ride-Share
- On Demand Micro-Transit
- Connected Vehicles
- Autonomous Trains
- Flying Taxis

Emerging Technology

New efficient and alternative modes of transport for greener and safer environments.

- Autonomous Cars
- Autonomous Shuttle
- Autonomous Flying Cars
- Delivery Drones
- Mobile Warehouse

Data & Analytics

Ecosystem and technology enablers to support innovation.

- Integrated Data
- API
- Traffic Management

Infrastructure

Optimized use of infrastructure for reduced traffic delays, enhanced transport and faster service.

- Adaptive Signaling
- Charging Stations
- V2V/V2I
- Intermodal Hubs

Smart Mobility Ecosystem

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Industrial Sector

Zero Emissions Mobility

The Share of Electrical Cars will increase from less than 1% in 2020 to 8% by 2030 as per IEA States Policy Scenario.

- Charging Infrastructure
- Electric Traction
- Sustainable Aviation Fuels
- Hydrogen for Aviation

Hydrogen

In the Net Zero Emissions by 2050 Scenario, total hydrogen demand from industry is expected to expand 44% by 2030, with low-carbon hydrogen becoming increasingly important as per IEA.

- Hydrogen Fueling infrastructure
- Hydrogen Upstream
- Hydrogen Midstream
- Hydrogen Downstream

Industrial Electrification

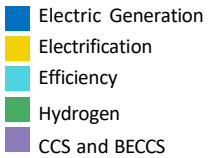
As the prices of renewable electricity and electric equipment continue to drop, industrial companies can capture cost-saving and GHG-emission-reduction opportunities by planning the electrification of their operations.

- Industrial Process Energy Optimization
- Renewably Powered District Cooling
- Industrial Facilities based on Electrical Energy

Carbon Capture, Utilization and Storage (CCUS)

The worldwide annual investments in CCUS are expected to increase to more than $ 26 billion by 2030 as per IEA

- CCUS Associated with Industrial Facilities
- CCUS Associated with Blue Hydrogen



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Insights and Innovation

Insights & Innovations

VIRTUAL POWER LINES

Virtual Power line is an innovative application of utility scale storage to balance power supply and demand.

Grid battery storage can be tied to the grid at different node with the aim to provide additional electricity capacity at lower cost than pursuing a conventional infrastructure reinforcing or expansion.

VIRTUAL POWER PLANTS

Virtual Power line is an innovative application of interconnected microgrid. It is an aggregation of disperse DERs with the aim of enabling these small energy sources to provide services to the grid.

Virtual Power Plant are characterized by peer-to-peer energy trading and reduced cost of Infrastructure.

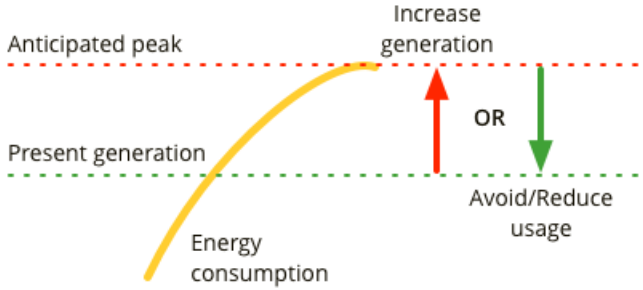
SYSTEMIC INNOVATION

Innovation is needed in market design, system operation and business models to successfully enable power sector transformation, and ultimately the energy transition.

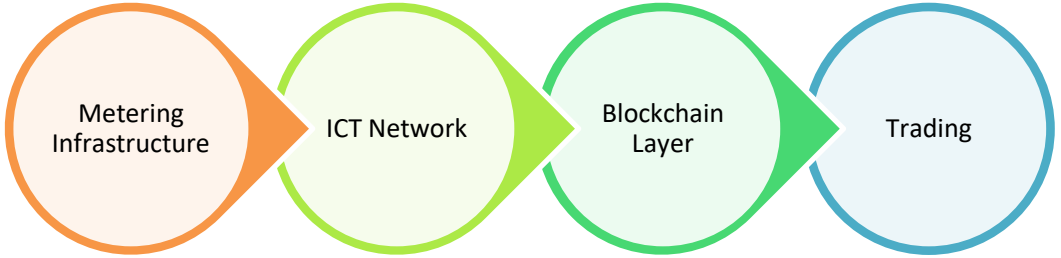
Innovative solutions emerge from matching and maximizing synergies between various innovations across multiple components of the power system.

Insights & Innovations

- The term **NegaWatt** is a theoretical unit that reflects the amount of power or energy saved or conserved as a result of technology upgrading, structural changes, or other mitigation initiatives. NegaWatt Trading is a demand response application enabling energy conservation and CO2 reduction.



- **NegaWatt & CO2 Trading**
- **Virtual Power Plants**
- **CO2 and Energy Net Metering**
- **Demand Response enabled infrastructure**
- **Blockchain infrastructure**



ROAD TO NEGWATT AND CO2 TRADING

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Renewable Energy Expertise

PV Power Plants in the Municipalities

Benguela, Biópio, Saurimo, Luena, Lucapa, Cuito, and Bailundo, Angola

An international solar project that promises to revolutionize access to energy is underway in Angola: under the ownership of PRODEL, design review and site supervision of Dar Angola, seven photovoltaic solar power plants with 1 million solar panels will be built, totalling 370 megawatts (MWp). That is enough energy to serve over million people in a territory many parts of which still lack access to the public network, and especially in the rural ones. Lots of Angolans living in isolated areas will have energy for the first time, with the particularity of being “clean” energy.

The project, is the largest integrated, public, renewable energy intervention programme in sub-Saharan Africa. It was designed with the aim of generating a positive environmental, social and economic impact in Angola and will mark the future of sustainable energy in that country.

Services Provided

- On-Grid PV System

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Consultancy Services for Cities

Madonah, Jordan

The plant has a nominal capacity of 135 MWp DC / 100 MW AC and is integrated with the transmission company, National Electric Power Company (NEPCO), at 400 kV level.

The PV plant will step up its 100 MW output from 33 kV to 400 kV through its step-up 2x120 MVA air insulated substation, and deliver power to NEPCO's 400 kV grid through a new 400 kV overhead double circuit transmission
line. This circuit will connect the PV plant with NEPCO's existing IPP3 400 kV switchyard, which will be expanded to accommodate the connection of the new line. The project has a land area of 2,000,000 m^2.

Services Provided

- On-Grid, Ground Mounted System

Solar Photovoltaic (PV) Farm

Kazakhstan

Topographic survey, soil investigations, scheme preparation for power distribution, review of PV manufacturers and providing recommendation on PV equipment suppliers, project risk assessment, determining mechanical stability under possible magnitude earthquakes, defining main techno- economic indices, financial analysis (including sensitivity analysis, NPV, IRR, etc.), evaluating the possibility of attracting carbon financing under the UNFCCC and assessing the impact of these investments on the project
investment, comparative analysis of the project with similar projects carried out over the past years, and developing project master plan and project implementation schedule.

Services Provided

- On-Grid, Ground Mounted System

Consultancy Services for the Social Security Investment Fund’s Photovoltaic Plant

Jordan

The Project comprises 4 photovoltaic plants located in Al-Zarqa and Al- Balqa, Jordan. Each of the plants has a capacity of 6.25 MWp and integrated with the grid at 33 kV level under the wheeling scheme and it will have an estimated annual energy yield of 37,000 MWh.

Our services extend from preparation of technical and financial feasibility studies till tender assessment including preparation of energy yield simulation, land selection, coordination with authorities, plants optimization and preparation of concept design and EPC tender documents.

Services Provided

- On-Grid, Ground Mounted System

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DAR New Premises in Cairo

Egypt

Detailed design and supervision of construction for a new 6-storey office building located at the Smart Village compound with a total built-up area of 48,635 m² for 1,200 professionals and 600 technicians and support staff; and including all infrastructure and landscaping works. The building is provided with roof top PV plant with a total capacity of 137 kWp.

Services Provided

- On-Grid, Ground Mounted System

NBK (Egypt) New Headquarters

Egypt

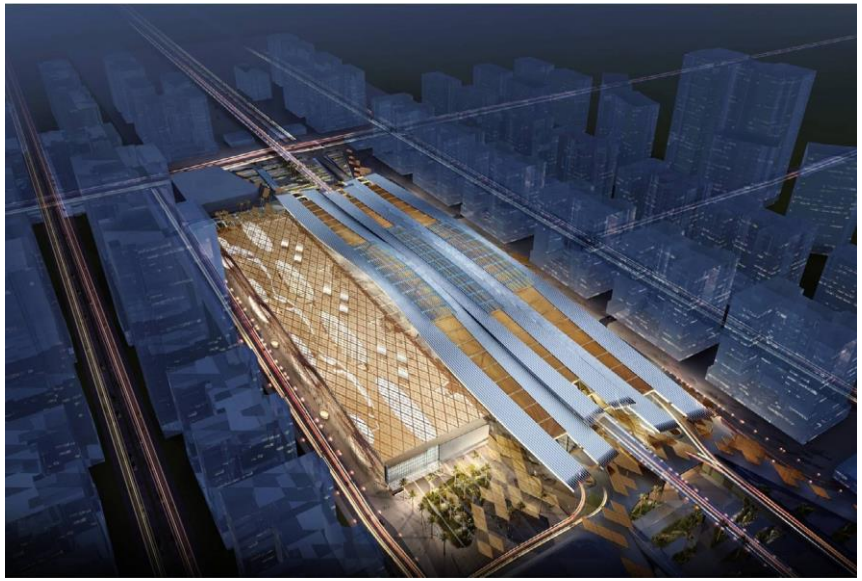
We provided concept design, schematic design, detailed design, final design, and construction supervision services for a headquarters building including a rooftop bifacial photovoltaic system with a capacity of 200 KWp.

Services Provided

- On grid, rooftop bifacial photovoltaic system

Madinah Hajj City

Kingdom of Saudi Arabia



Our services for Madinah Hajj City Project comprise Master plan, detailed design, tender documents and supervision of construction for a township on a 1.6 million m² site located 3 km southwest of the Holy Prophet's Mosque in Madinah, envisaged to accommodate 120,000 pilgrims. The project comprises 82 hotel towers; office towers; commercial mall with a gross area of 71,000 m² and a 100,000 m² basement for 2,200 cars; 2 mosques (of which one Grand Mosque) for 14,000 worshipers; a 360-bed hospital complex; and elevated light rail transit and bus stations.

The mall is provided with off-grid 314 kWp building integrated photovoltaic system for which we provided full design and supervision services including energy yield simulation, preparation of detailed design and tender documents, tender assessment, construction and contract management, supervision of testing and commissioning and performance monitoring.

Services Provided

- Off-grid, BIPV System

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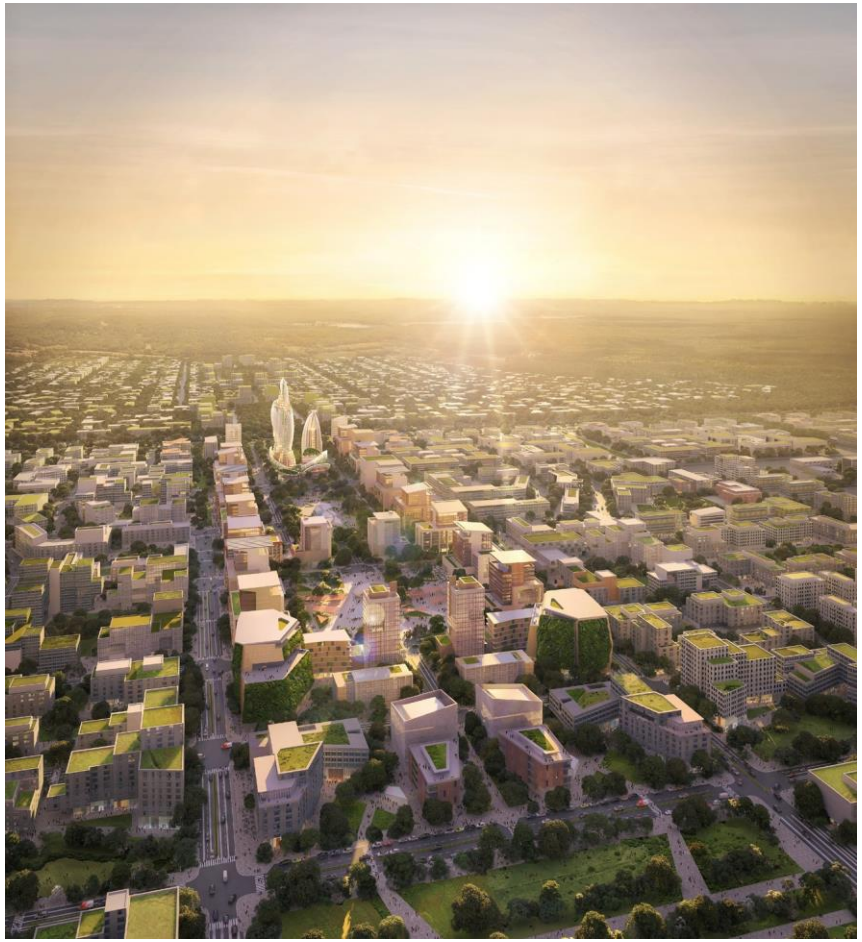
Infrastructure Design for Ibom Industrial City – Phase 1

Nigeria



Dar was commissioned to provide detailed design and tender document services for phase 1 of infrastructure design for Ibom Industrial City (IIC), Nigeria. The project consists of a 2,000 ha site, covering all infrastructure components related to sewage collection, stormwater drainage and flood protection measures, potable and firefighting water supply, landscape irrigation, power supply and distribution, street lighting, and others. The project also includes a solar photovoltaic hybrid system on top of the car parking shed structure with a capacity of 103 KWp, and diesel generator with capacity 400 KW and all related service buildings and structures, primary smart ICT infrastructure network, internal roads, accesses, parking areas, and others.

Services Provided

- off-grid, solar photovoltaic hybrid system

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Zayed City Commercial Districts and Federal Precinct

Zayed City – Abu Dhabi

The project involves the design of infrastructure systems within Zayed City Federal Precinct, Abu Dhabi. The new Zayed City is one of the major initiatives proposed to reflect the vision of the Abu Dhabi Plan 2030 and embody the principles of urban growth in a way that balances economic, social and environmental priorities in a sustainable manner that emphasizes human scale development within a pedestrian friendly environment enhanced by a multi-tiered public transportation system.

Our services included preparation of financial feasibility studies, detailed design and attain authority approval for standalone PV street lighting system installed on streets and access lanes within Federal Precinct. A total of 325 poles are designed to be installed over 15,500 km roads.

The system is designed to function as independent and capable of remaining operational for 24 hrs through stored energy.

Services Provided

- Integrated PV systems within Lighting Poles

THANK YOU

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