



Caribbean Telecommunication Union  
Twenty-Second Ministerial Strategic ICT Seminar  
**Bridging Technologies for a Sustainable and Inclusive Future**

**ACHIEVING A JUST ENERGY TRANSITION IN AN  
INCREASINGLY COMPLEX WORLD:**

**Opportunities for Modernizing and Digitalizing Power Systems  
in Small Caribbean Economies**

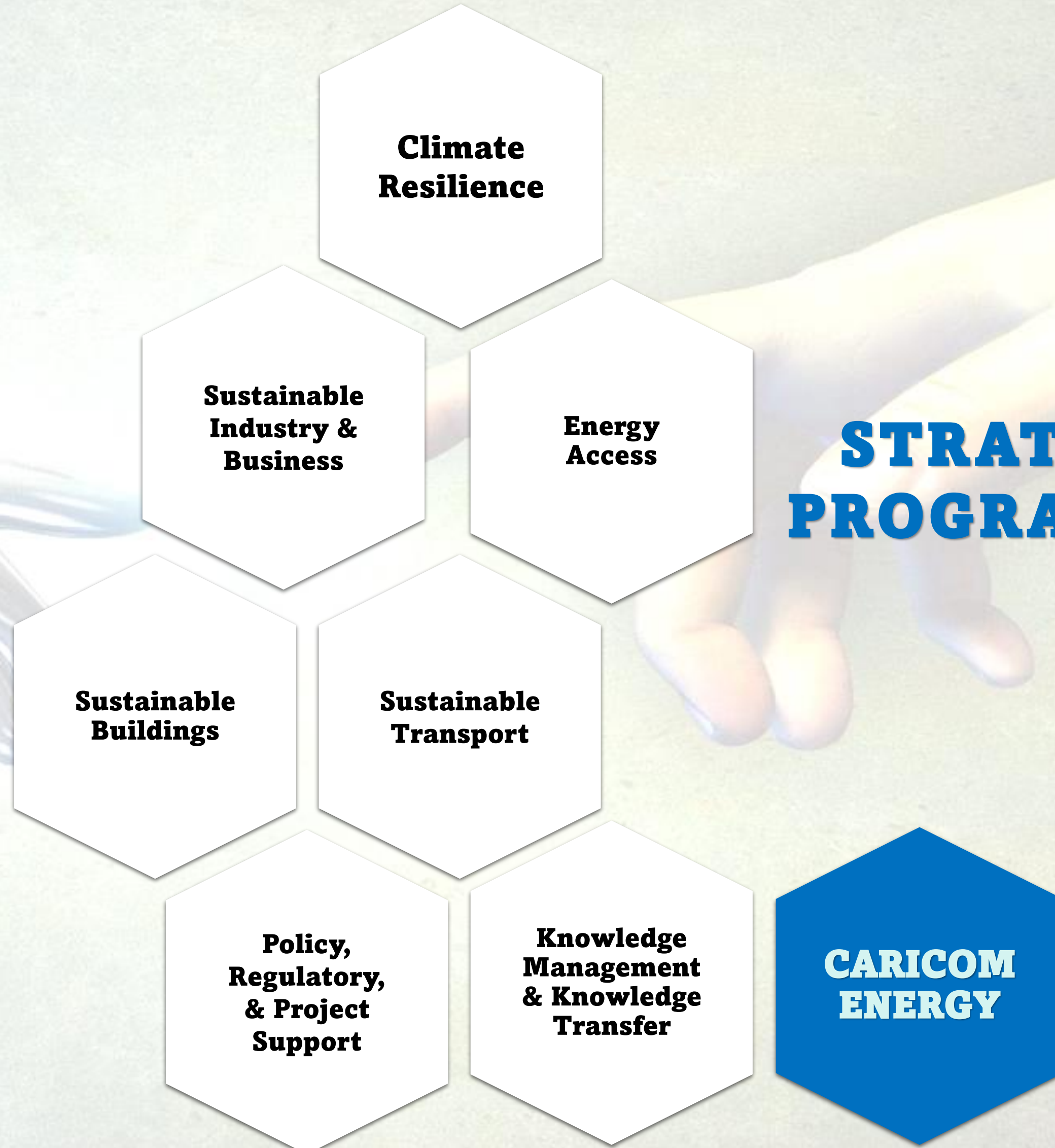
Devon O. Niel Gardner  
Caribbean Centre for Renewable Energy and Energy Efficiency

Frigate Bay, St. Kitts and Nevis  
30 September 2024



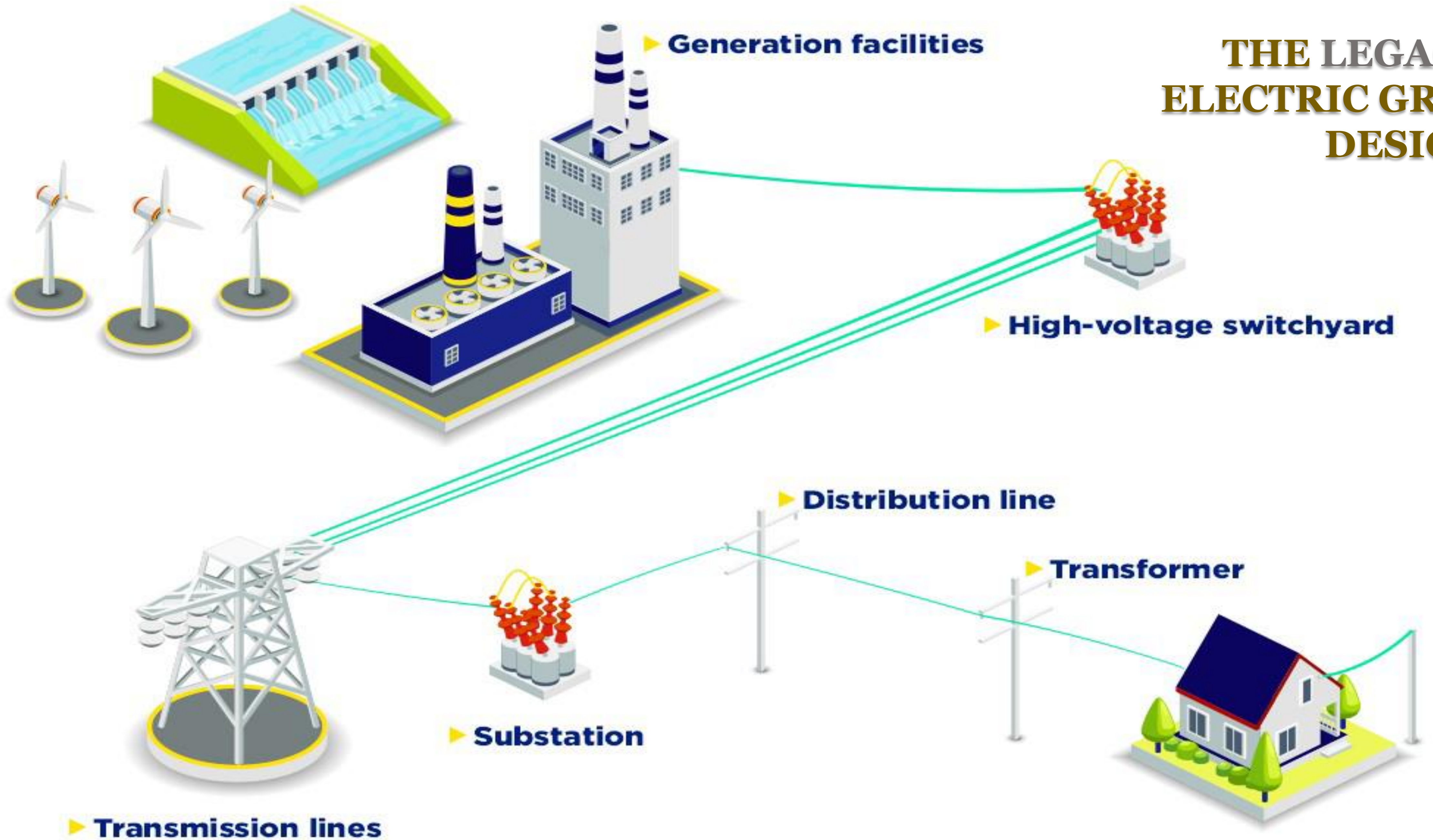
### Territories Served:

- Anguilla
- **Antigua and Barbuda**
- **The Bahamas**
- **Barbados**
- **Belize**
- Bermuda
- British Virgin Islands
- Cayman Islands
- **Dominica**
- Grenada
- **Guyana**
- Haiti
- **Jamaica**
- **Montserrat**
- **St. Kitts and Nevis**
- **Saint Lucia**
- **St. Vincent and the Grenadines**
- **Suriname**
- Trinidad and Tobago
- **Turks and Caicos Islands**



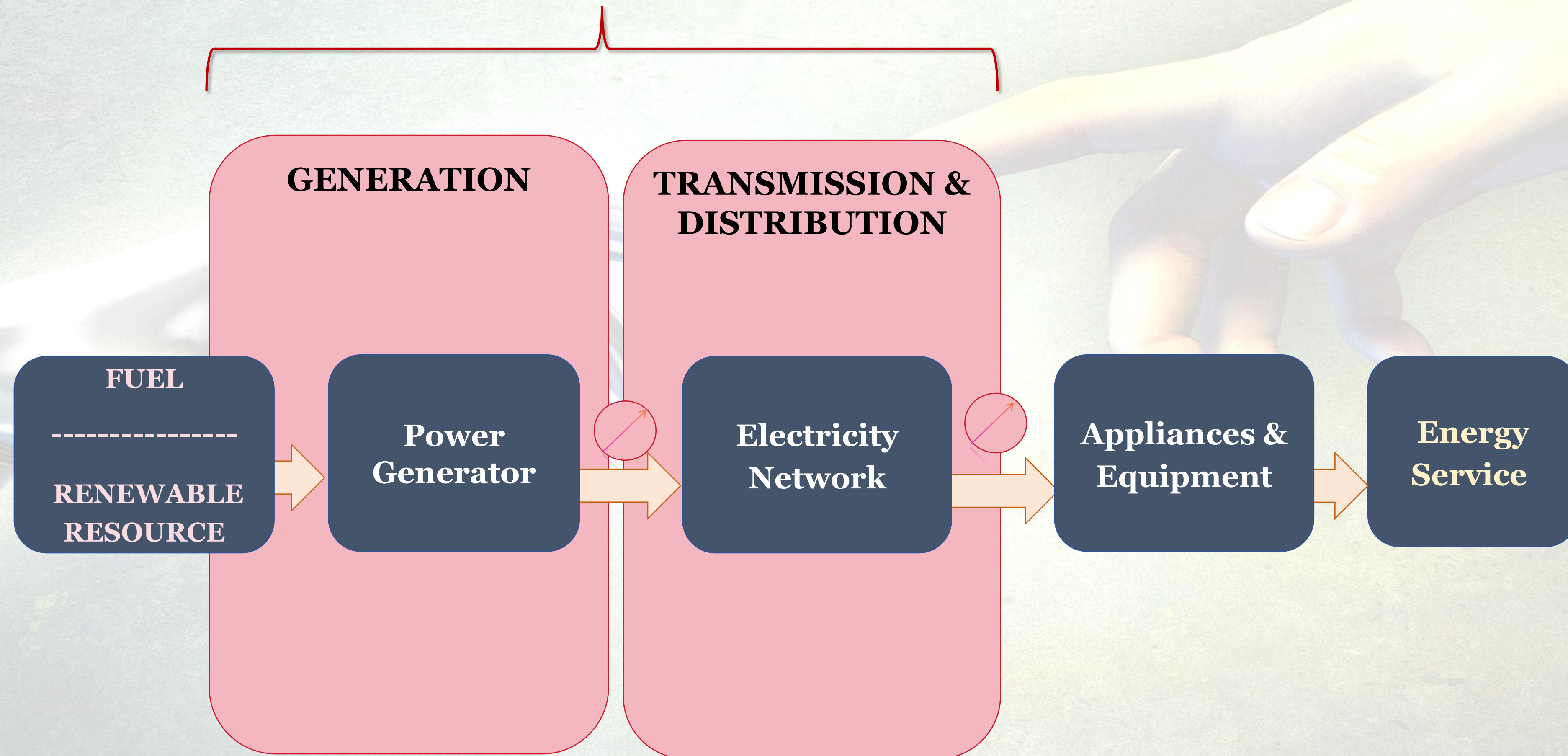
# STRATEGIC PROGRAMMES

# THE LEGACY ELECTRIC GRID DESIGN



# THE TRADITIONAL POWER SECTOR ARCHITECTURE

The “Utility-centric” **SUPPLY APPROACH**



# CARICOM ELECTRICITY GENERATION STATUS (2022)

- Installed power capacity 6,500 MW
- Installed renewable capacity 740 MW
- Annual electricity production 19,700 GWh
- Annual demand growth rate 3.6%
- RE Penetration 11.4%

Though RE penetration, within the power sector, has doubled in the last decade, the rate of penetration is **way below** optimum

## CARICOM (EXCLUDING HAITI AND MONTSERRAT) ANNUAL LIQUID FUEL CONSUMPTION (2022)

Country	Liquid Fuel Consumption (000's barrels)			
	Total	Power Generation	Transportation	
			Gasoline	Diesel Oil
Antigua and Barbuda	1,251.1	560.2	304.5	386.4
The Bahamas	9,408.2	4,750.2	1,692.0	2,966.0
Barbados	2,726.3	1,241.6	811.7	673.0
Belize	1,148.9	142.9	354.7	651.3
Dominica	328.8	74.9	106.4	147.5
Grenada	647.8	202.5	163.4	281.9
Guyana	3,403.0	744.0	747.5	1,911.5
Jamaica	14,602.9	6,225.9	4,398.0	3,979.0
St. Kitts & Nevis	548.8	187.4	132.1	229.3
St. Lucia	1,390.2	456.4	351.4	582.4
St. Vincent & The Grenadines	666.5	155.6	167.3	343.6
Suriname	2,073.4	493.0	634.6	945.8
<b>Trinidad and Tobago</b>	<b>5,056.6</b>	<b>18.7</b>	<b>3,101.3</b>	<b>1,936.6</b>
<b>Total CARICOM</b>	<b>43,252.5</b>	<b>15,253.3</b>	<b>12,964.9</b>	<b>15,034.3</b>

# ENERGY IMPORT SITUATION, CARICOM (2022)

Country	Dependence on imports, %	Imported energy resources
Antigua and Barbuda	100% (2022)	Refined petroleum products
The Bahamas	98% (2022)	Refined petroleum products
Barbados	90% (2022)	<i>Small amounts of petroleum exported</i> , and Refined petroleum products imported, LNG
Belize	63% (2022)	Refined petroleum products, Electricity (Mexico)
Dominica	92% (2022)	Refined petroleum products
Grenada	93% (2022)	Refined petroleum products
Guyana	0% (2022)	<b><i>Petroleum exported</i></b> , and Refined petroleum products imported
Haiti	85% (2019)	Refined petroleum products
Jamaica	91% (2022)	Petroleum, Refined petroleum products, LNG
Montserrat	100% (2022)	Refined petroleum products
St. Kitts and Nevis	98% (2022)	Refined petroleum products
Saint Lucia	95% (2022)	Refined petroleum products
St. Vincent and the Grenadines	87% (2022)	Refined petroleum products
Suriname	Less than 5% (2021)	Petroleum
Trinidad and Tobago	0% (2022)	<b><i>Petroleum exported</i></b> , and refined petroleum products imported

**CARICOM Average**

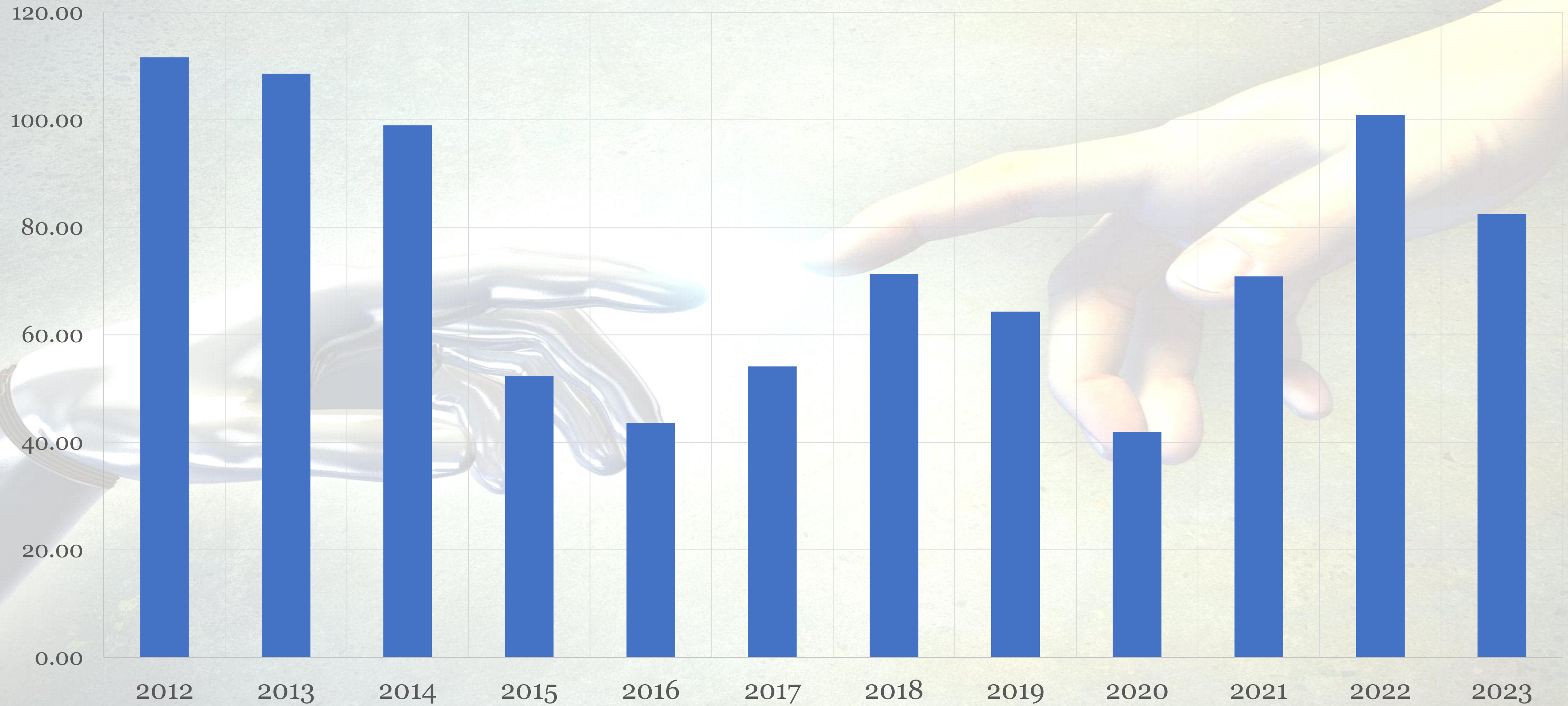
88%

**Global Average**

21%

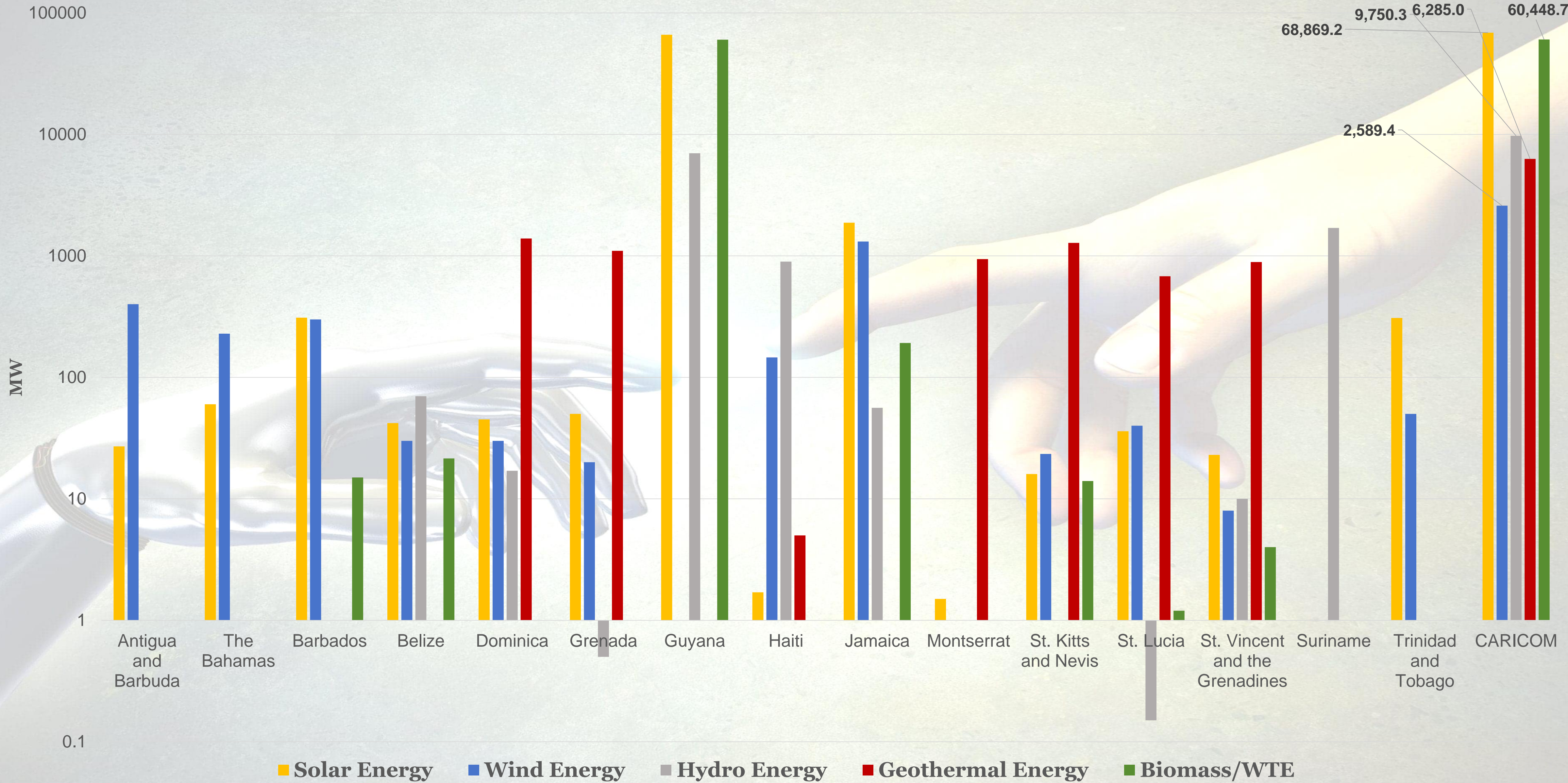
# ANNUAL AVERAGE GLOBAL OIL PRICE (USD/BBL)

## 2012 - 2023



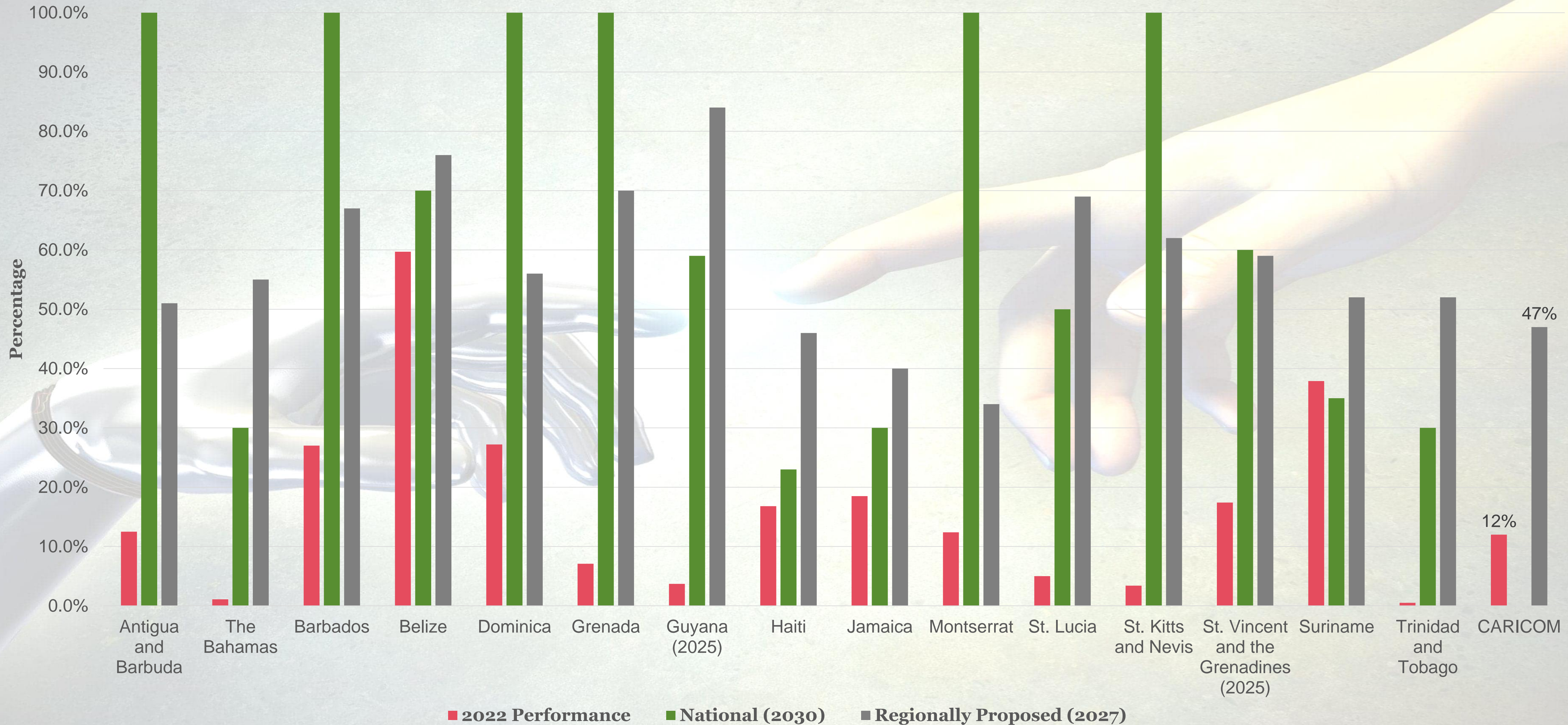


# RE POTENTIAL, CARICOM

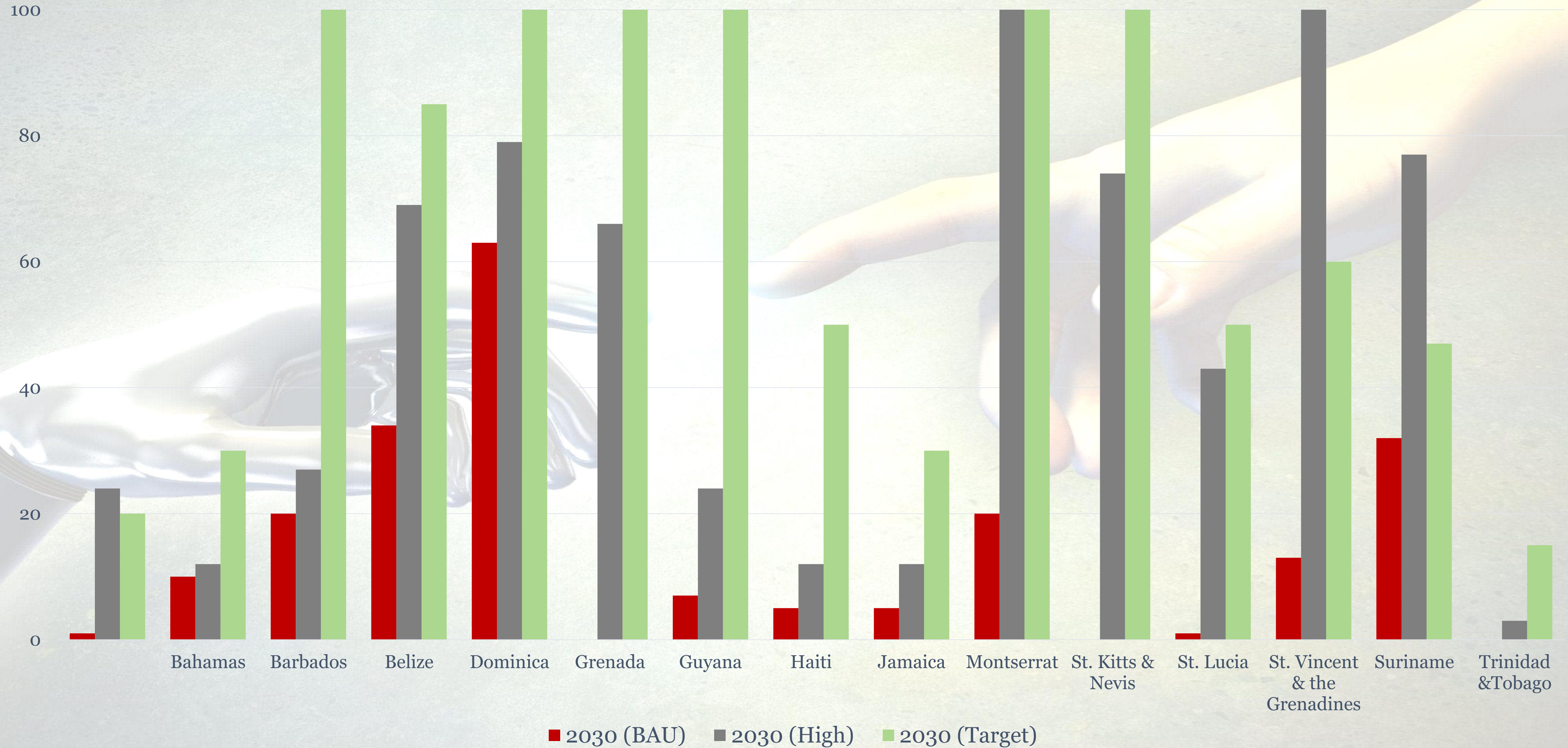


# CURRENT PERFORMANCE AGAINST TARGETS

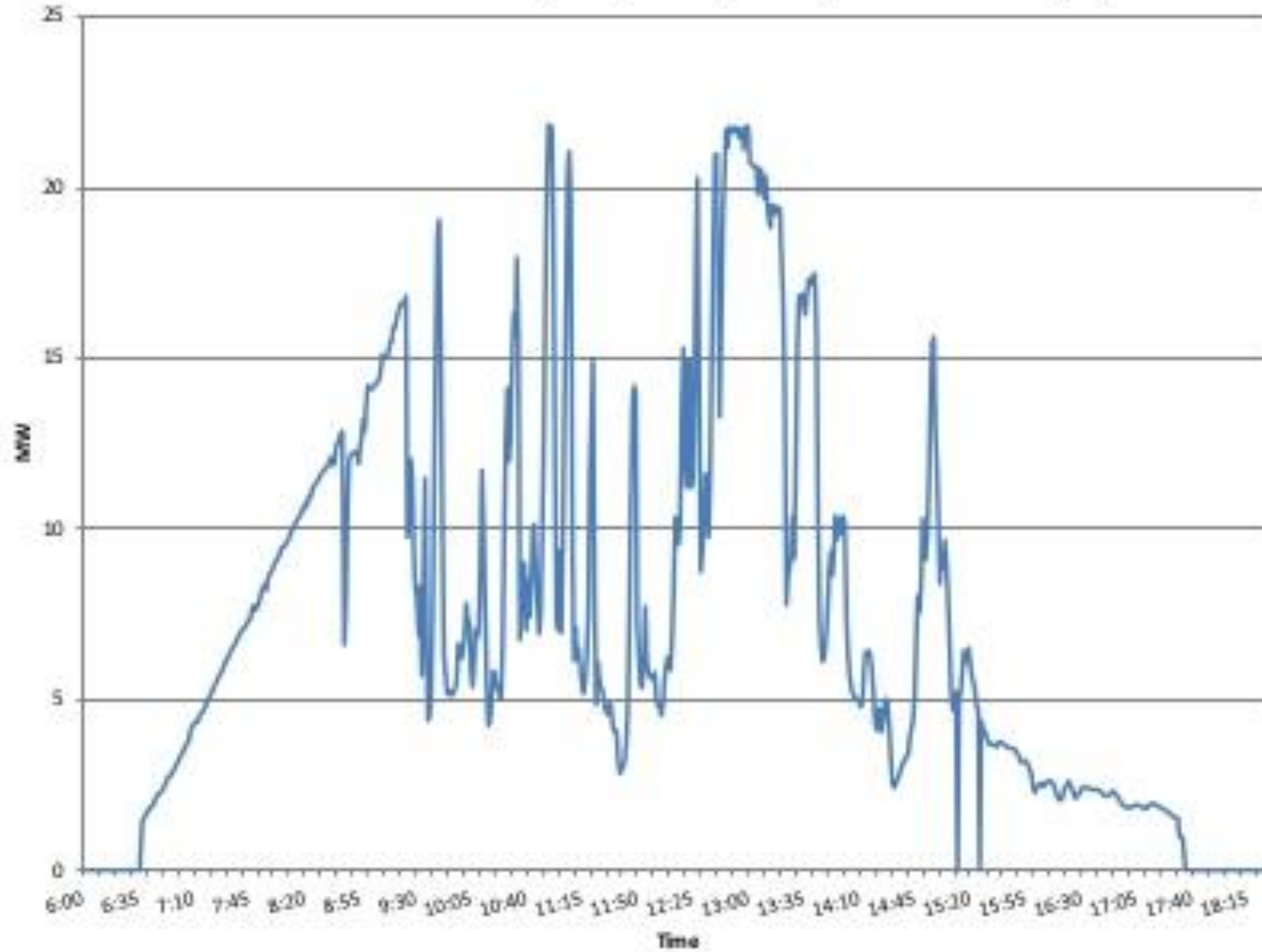
## Electricity Generated from Renewable Sources (2022)



# PROJECTIONS FOR ELECTRICITY GENERATED FROM RENEWABLE SOURCES (2022)



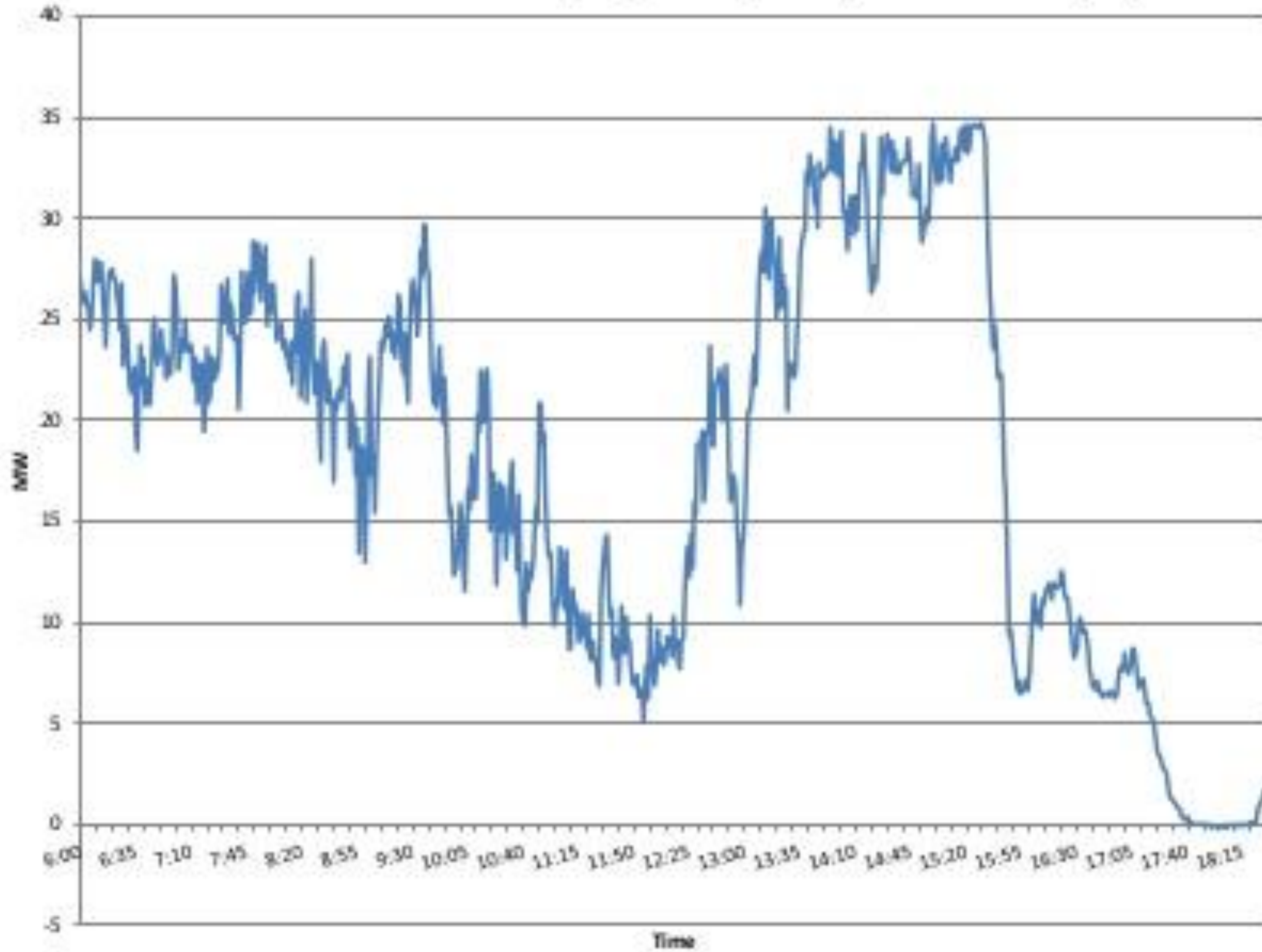
20MW PV Plant, August 18, 2016 (6:00am - 6:30pm)



**Content Solar PV  
Power  
18 August 2016**

— MW

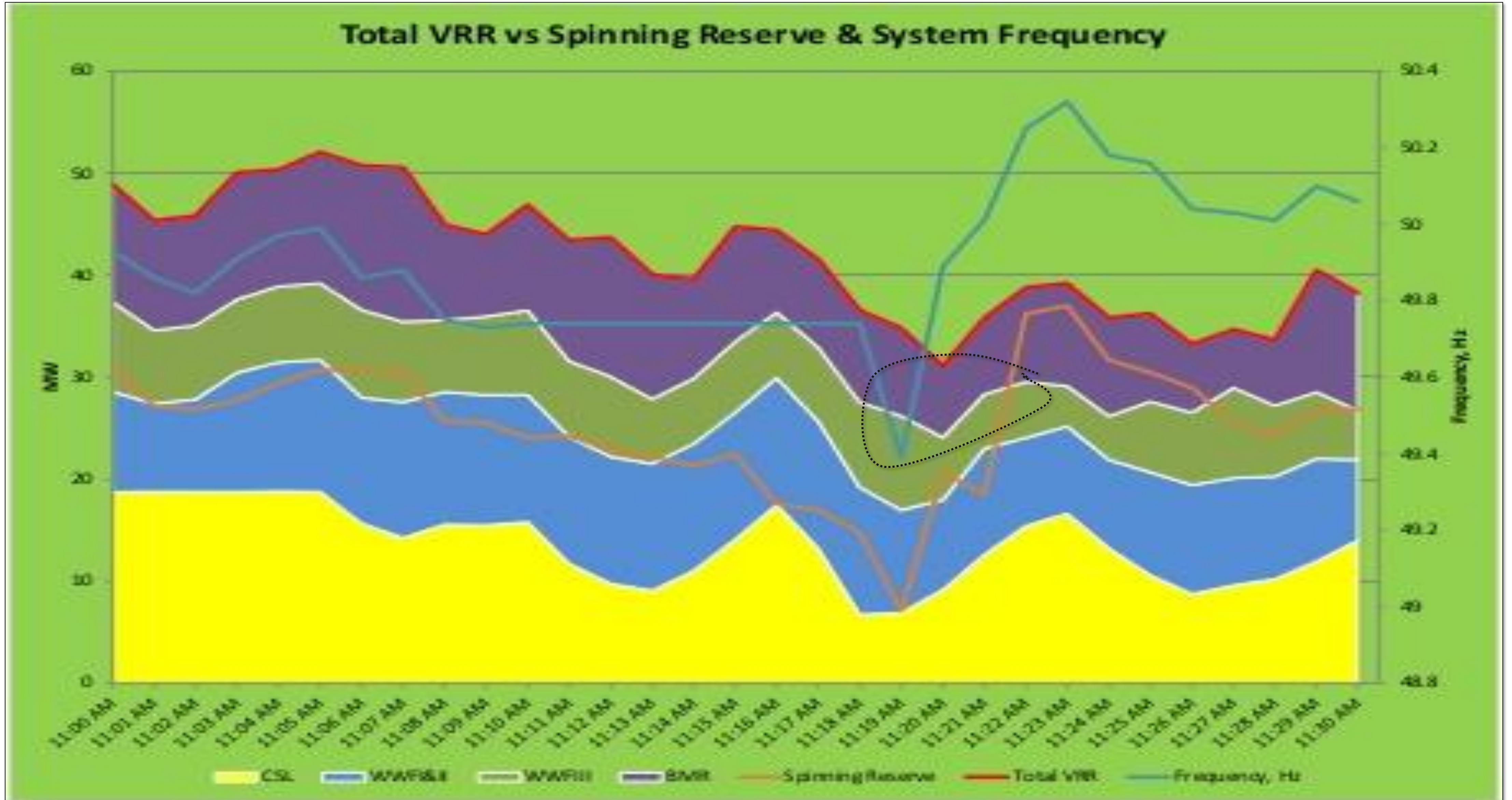
36MW Wind Farm, August 18, 2016 (6:00am - 6:30pm)



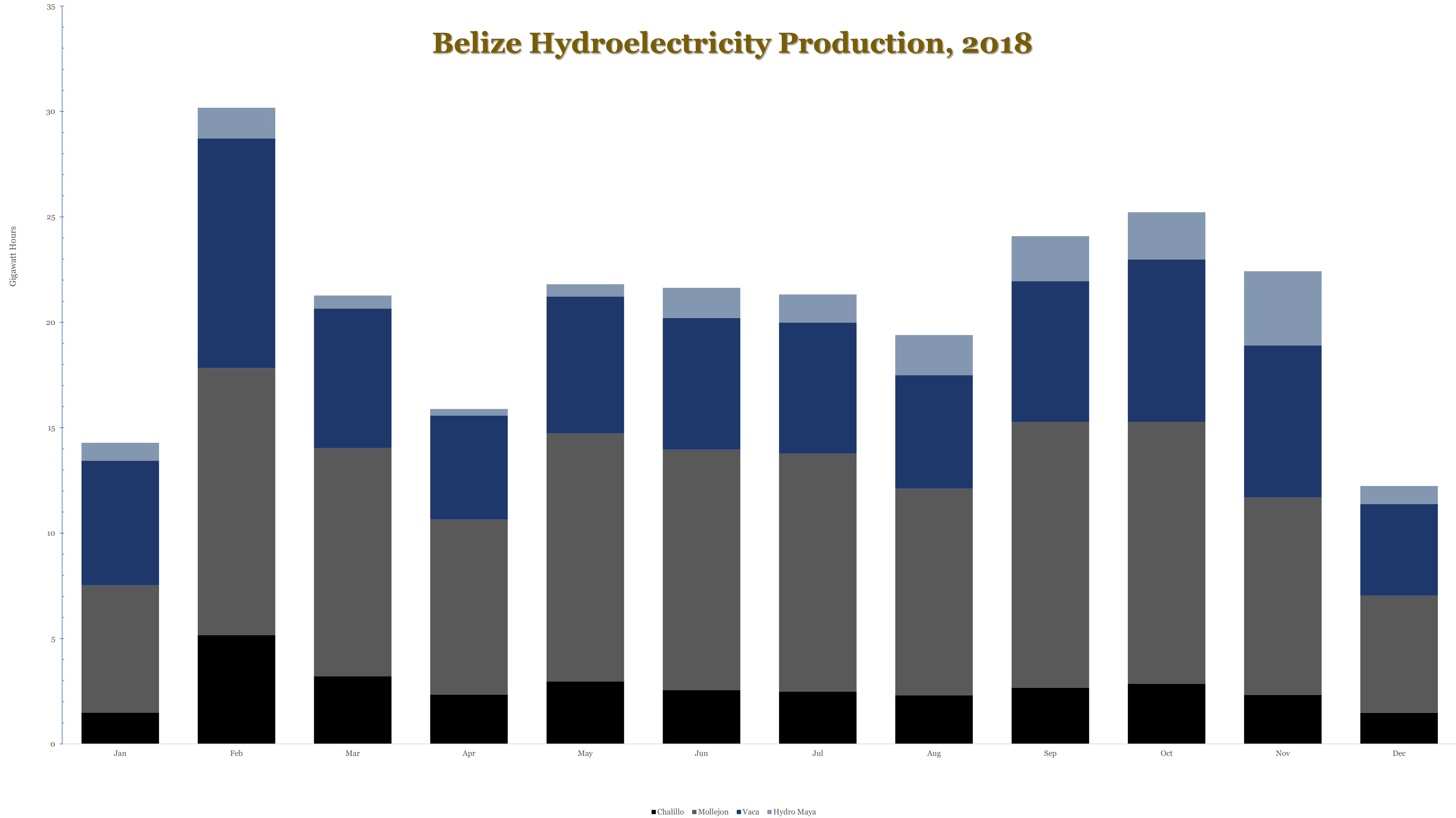
**BMR Wind Power**  
18 August 2016

— BMR

# TOTAL SYSTEM, JAMAICA [2016]



# Belize Hydroelectricity Production, 2018

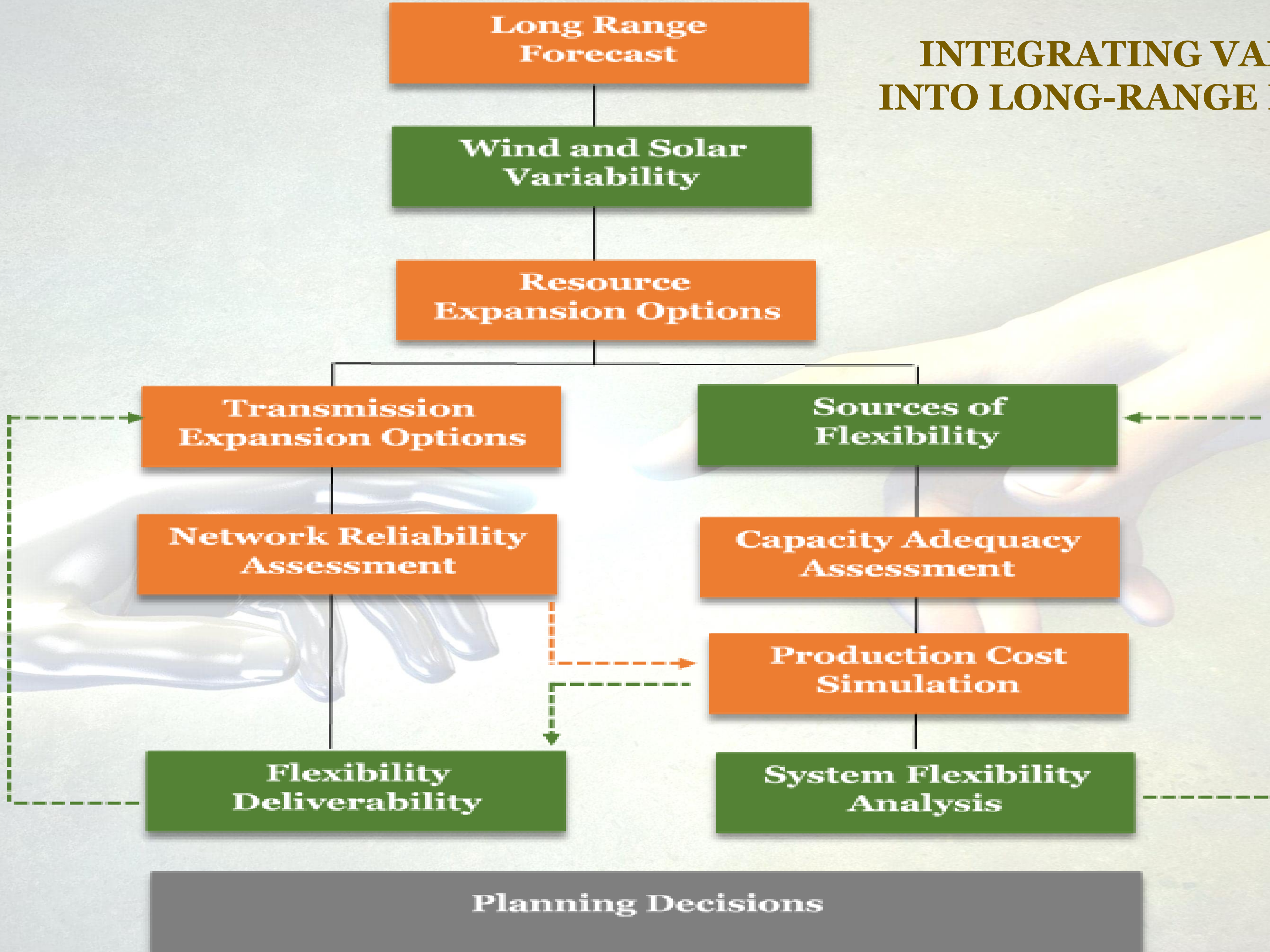


# **SYSTEM CHARACTERISTICS**

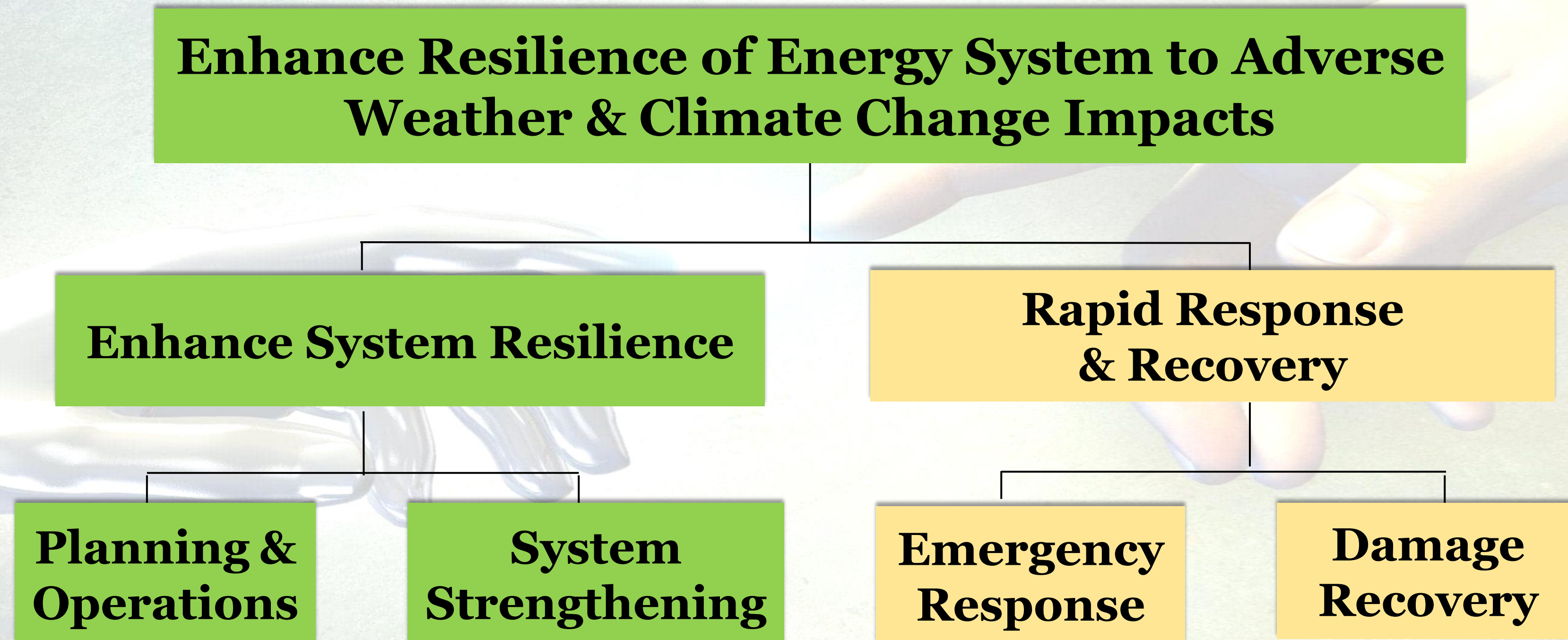
- **High dependence on imported fuels**
- **Low integration of renewable energy**
- **Low energy security**
- **Low efficiency**
- **Vulnerability to price fluctuations and supply disruptions**
- **Vulnerability to weather and climate**
- **Low resilience to disruptions, including natural disasters**
- **Significant reliability issues**
- **Expensive to operate and maintain**
- **High cost of electricity**



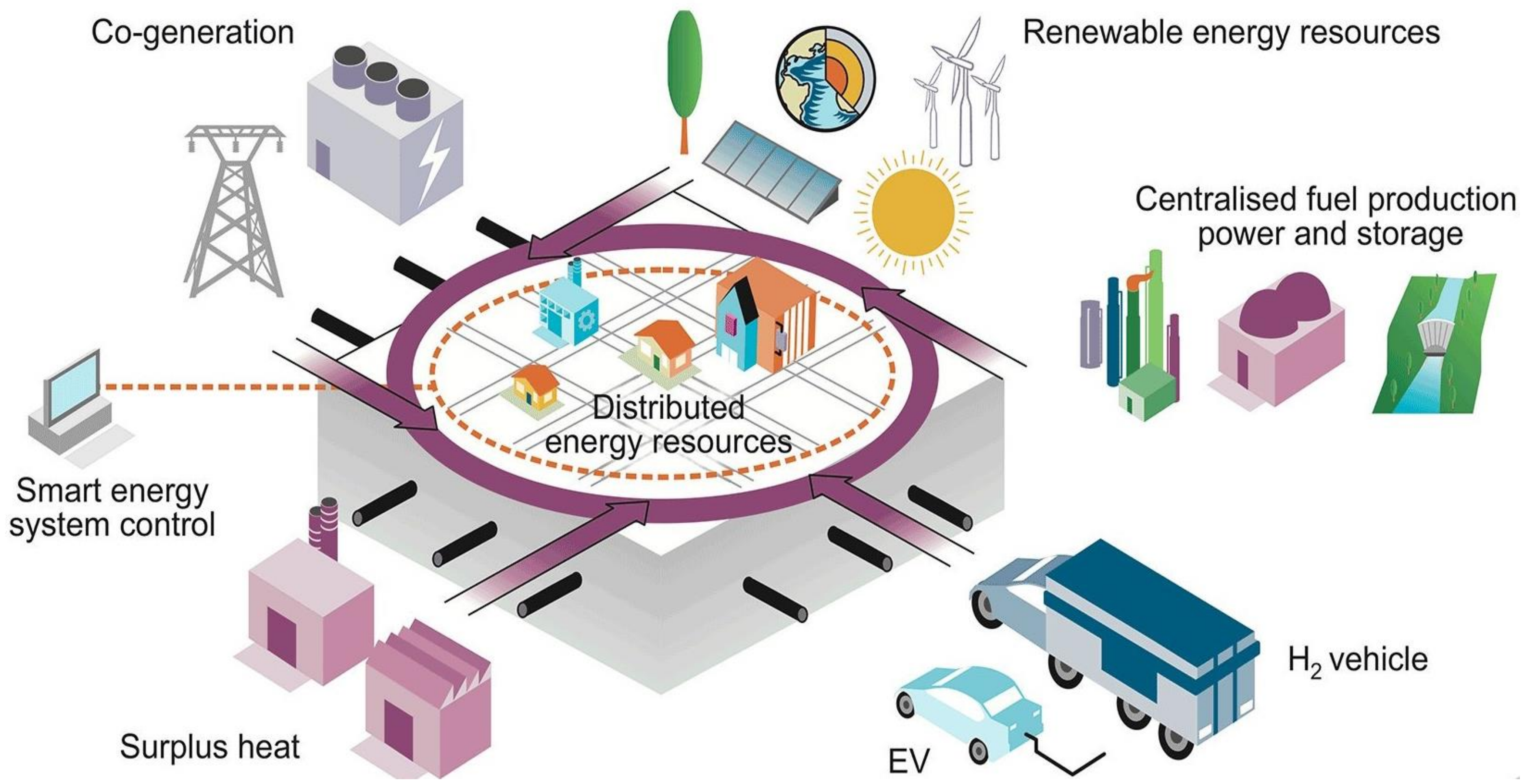
# INTEGRATING VARIABLE RE INTO LONG-RANGE PLANNING



# FRAMEWORK FOR ENHANCING ENERGY RESILIENCE FOR CLIMATE ADAPTATION

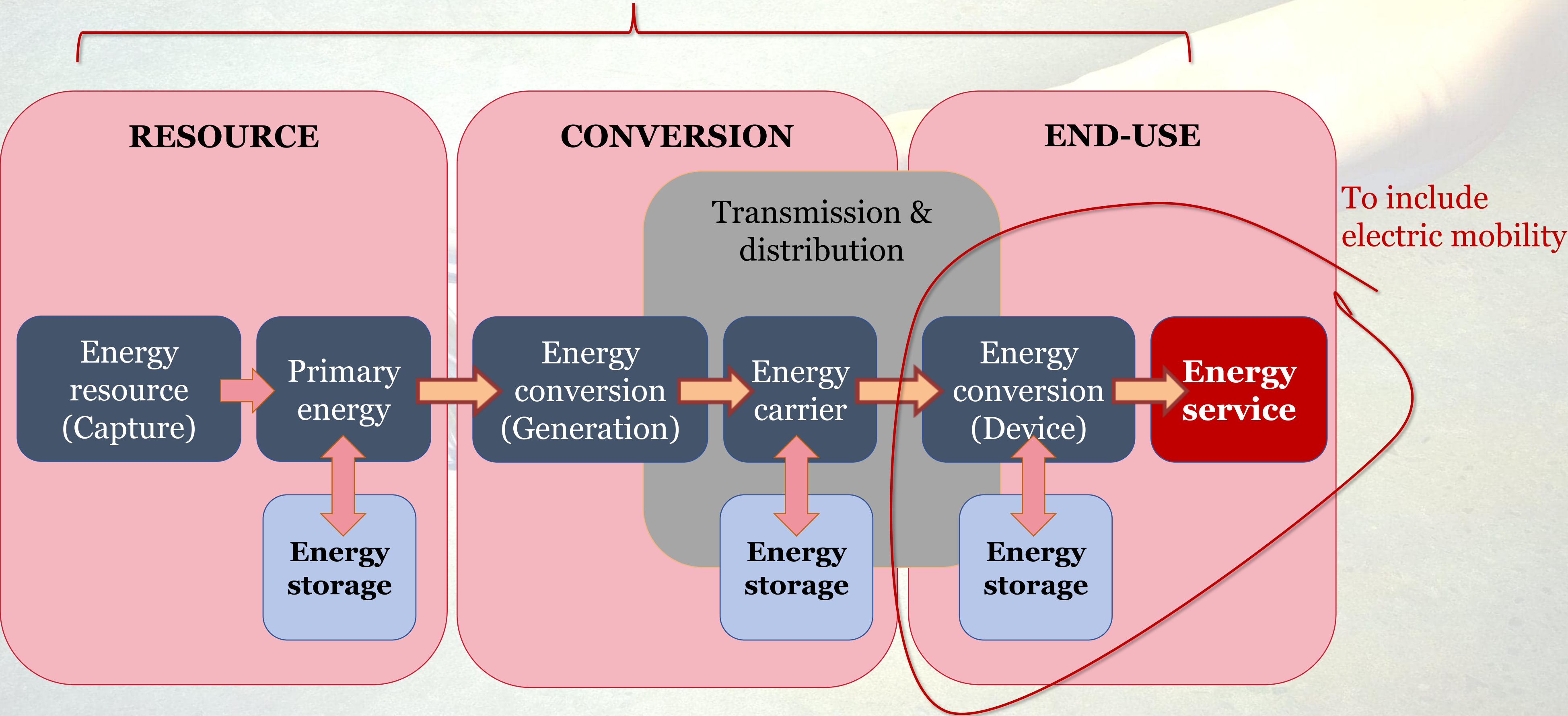


# THE FUTURE ELECTRIC GRID



# THE EMERGING POWER SECTOR ARCHITECTURE

## The Multi-actor DEMAND-DRIVEN APPROACH



# SYSTEM REQUIREMENTS

## •Smart Grids

- Real-time monitoring and control of energy flows
- Smart integration of renewable energy sources
- Improved outage-management
- Big-data analytics
- Machine learning, forecasting, and now-casting

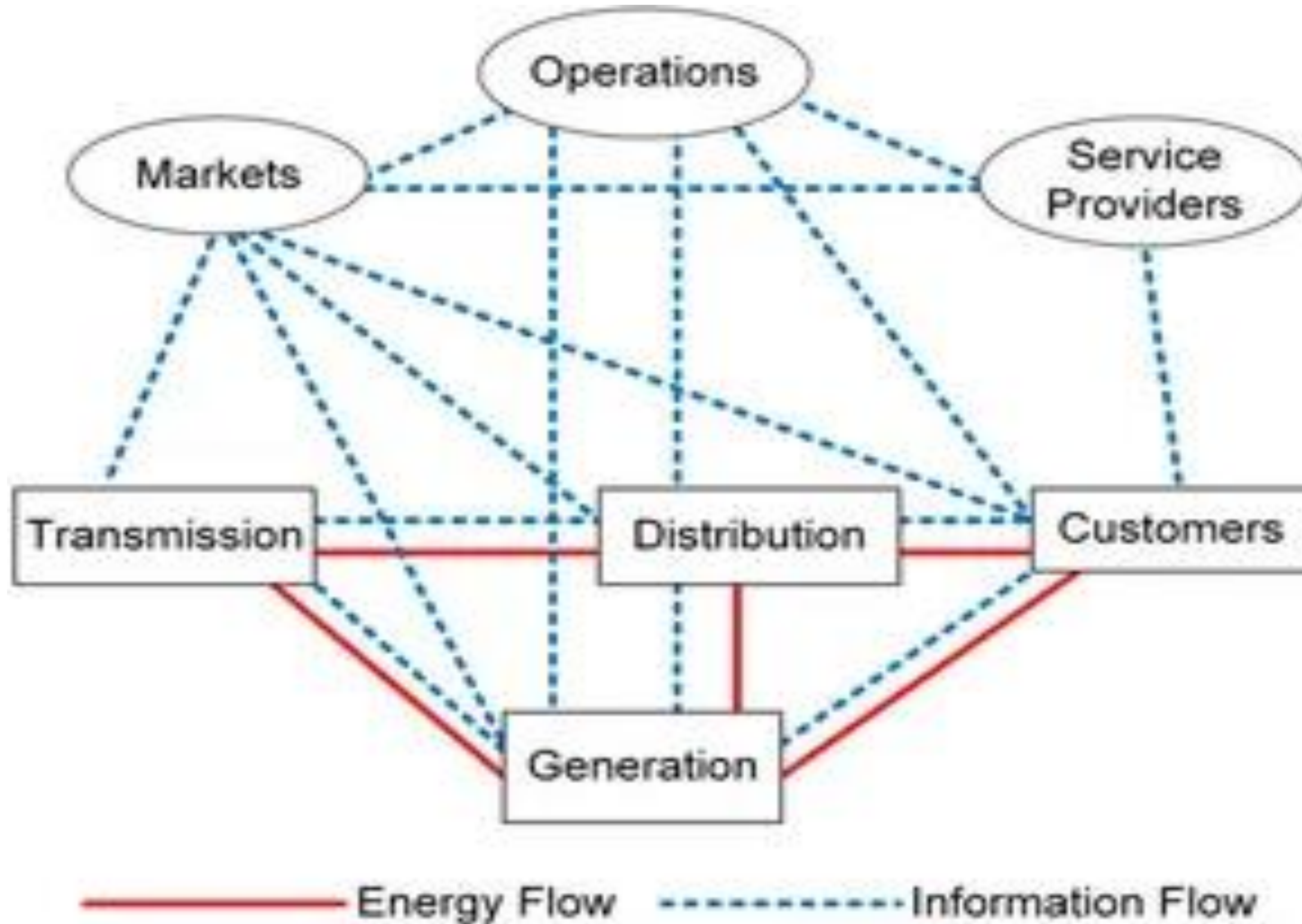
## •Distributed Energy Resources (DER)

- Solar, wind, and battery storage at the community-level
- Empowering local energy generation and consumption

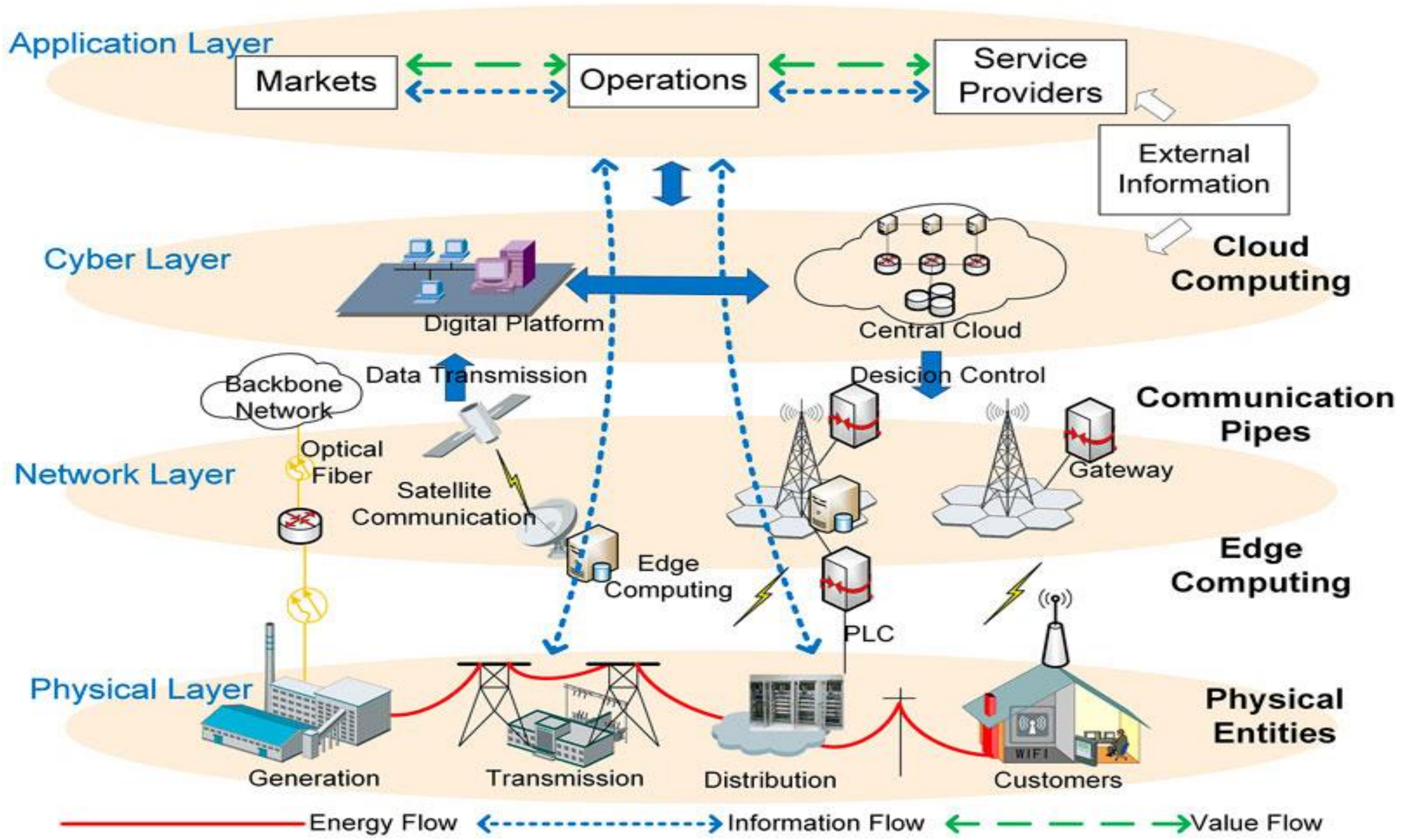
## •Energy Management Systems

- Tools for optimizing energy-use in homes and businesses
- Tools for optimizing energy-flows in the distribution system
- Demand response programs to *effectively manage* consumption patterns
- Internet of Things (IoT)

**Conceptual model of a smart grid**



**LAYERED  
ARCHITECTURE  
AND ENABLING  
TECHNOLOGIES**



*“For the things we have to learn  
before we can do them  
we learn by doing them.”*  
-Aristotle







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