

# KENYA ELECTRICITY TRANSMISSION COMPANY

Presentation on:

## ELECTRIFICATION OF SGG

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TRANSMISSION SYSTEM PLANNING

KENYA ELECTRICITY TRANSMISSION COMPANY

# Overview of presentation

- Brief on Kenya Electricity Transmission Company(KETRACO)
- Current status of Supply Electricity
- Vision 2030 and infrastructure
- Developments in railway infrastructure
- Reasons for electrification
- Requirements for electrification
- Q/A

# Brief on Kenya Electricity Transmission Company(KETRACO)

- ▶ incorporated on 2nd December 2008
- ▶ 100% Government owned state corporation
- ▶ mandated to **design, construct, operate** and **maintain** new high voltage electricity transmission infrastructure : the backbone of the National Transmission Grid.
- ▶ HV voltages are 132kV, 220kV, 400kV and 500kV HVDC
- ▶ Portfolio of 2,364 km of transmission Lines of the total 7174 km
- ▶ Plan to add 8,469km by the year 2038
- ▶ Associated infrastructure financing gap USD 4.6 Billion.

# Current status of Supply Electricity

- ▶ Kenya had a total installed generation capacity of 2,351MW as at June 2019 comprising of 66% renewable energy and 34% fossil fuels.
- ▶ Dispatch of renewable at 92 % in Jan 2020.
- ▶ The peak demand is 1912MW as recorded in 1<sup>st</sup> November 2019.
- ▶ system constraints due to rapid growth in generation capacity and growth
- ▶ Some delays in completion of planned transmission projects to remedy constraints

# Suswa 400/220 kV substation



# Vision 2030 and infrastructure

- ▶ GoK is accelerating infrastructure expansion for economic and social transformation of the country.
- ▶ critical foundations of the Vision 2030
  - adequate, reliable, and affordable power
  - reliable road and railway network.
- ▶ GoK plans to expand modernize railway transport infrastructure

# The old Railway train



- From Mombasa  
Kisumu  
Construction 1896  
-1901[1]
- commonly  
referred to as 'The  
Lunatic Line

Source : Nation

# Developments in railway infrastructure

- ▶ Phase 1 of the Standard Gauge Railway (SGR) 490 km from Mombasa to Nairobi completed in 2017
- ▶ Phase 2 A of the Standard Gauge Railway (SGR) from Nairobi Naivasha completed in 2019 .
- ▶ Eventually, the SGR will be extended to Kisumu and eventually to Malaba.
- ▶ Other railway lines proposed under the LAPPSET corridor : Lamu-Isiolo; Isiolo Nakodok and Isiolo Moyale



# The current SGR locomotive

Passenger train 120km/h

Freight train 80km/h



# Plans for Electrification of the railway

- ▶ The electrification of SGR Phase 1 was initially planned for 2022
- ▶ Electrify the entire railway network in the long run
- ▶ The Nairobi Commuter Rail Service (NCRS) development as proposed in Nairobi Metropolitan Transport Master Plan.

# Reasons for Electrification [2]

## a. Cost efficiency

- ▶ Low construction and lease costs (- 20 %)
- ▶ Low maintenance costs (-33% )
- ▶ Low energy costs (-45%) ( electricity vs diesel)
- ❖ Return trip of SGR MSA NRB cargo trip cost estimated b/n 0.35-0.4 M Kshs for electric vs 1 M Ksh for diesel
- ▶ Less wear and tear of tracks (-13%) (electric locomotives vs diesel): lower track maintenance cost

# Reasons for Electrification [2]

## b. Sustainability

- ▶ Reduced pollution during operation
- ▶ Electricity largely produced from Clean renewable sources
- ▶ 20-30% less carbon per passenger mile than diesel
- ▶ Quieter and comfortable with reduced vibration
- ▶ Reduced transit times
- ❖ Faster acceleration due to higher power-to-weight ratio (  $F=MA$  )
- ❖ Possibilities of quick reversal at train stations

# Power requirements for Electrification of SGR Phase 1 <sup>[3]</sup>

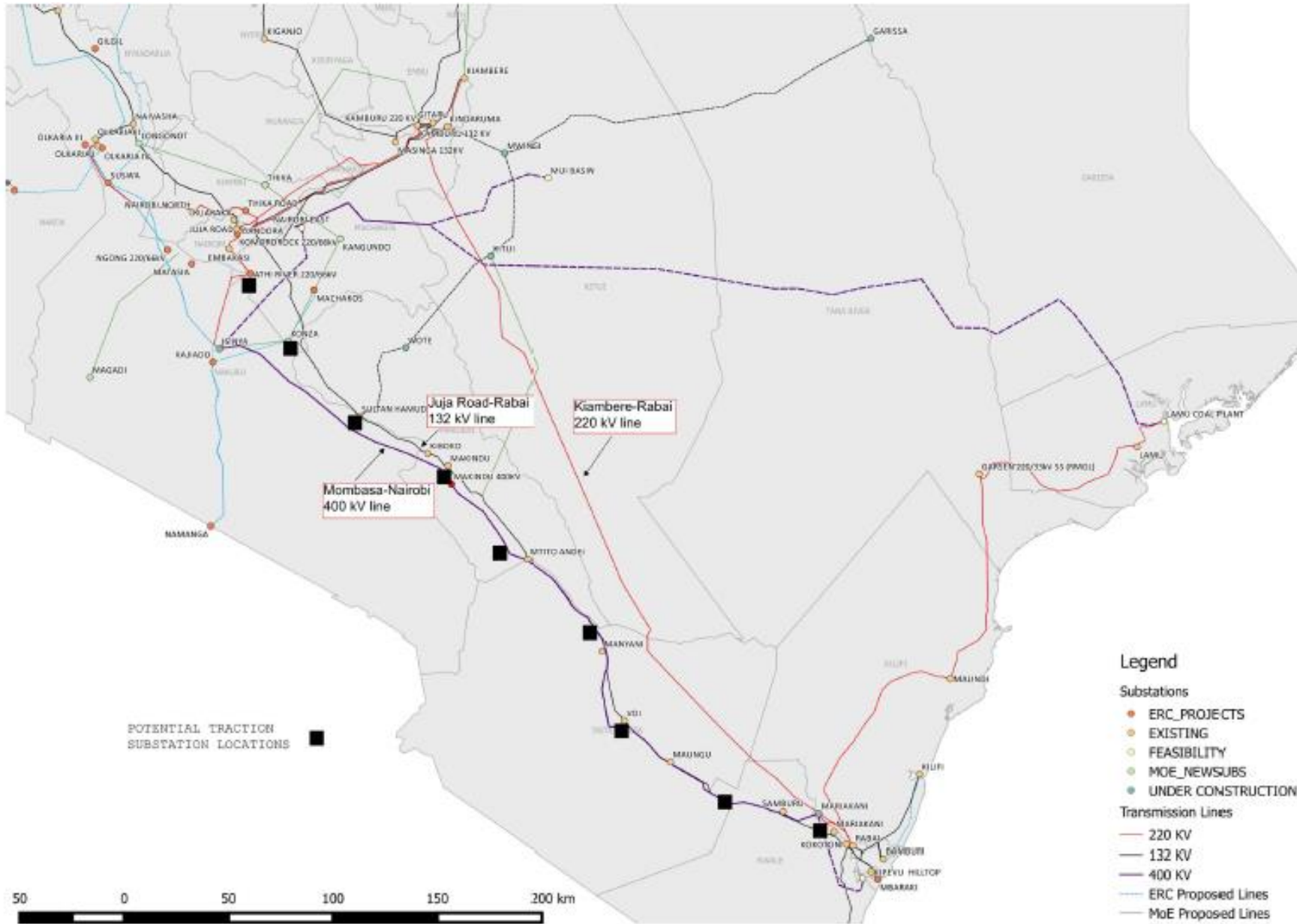
## ▶ Nairobi Commuter Railway Service Phase 1

- ❖ Peak expected power demand 10-15MW.
- ❖ Power delivery point : Kenya Railway Makadara or Syokimau Station.

## ▶ SGR Phase 1.

- ❖ Peak Expected Power demand 98 MW
- ❖ KRC projected 33 stations
- ❖ Power delivery points: Mariakani, Mackinnon Rd, Voi, Tsavo, Ndalasyani, Makindu, Sultan Hamud , Konza and Athi River

# Map showing proposed transmission infrastructure SGR 1 electrification



- takes advantage of existing 132 kV infrastructure
- Reinforces existing infrastructure with 400/132 kV SS

# Anticipated Technical Challenges and Solutions

## Challenges

- ▶ single phase - power imbalances
- ▶ low power factor
- ▶ harmonic distortion
- ▶ Voltage fluctuations

## Proposed Solutions

- ▶ Increase system short-circuit power
- ▶ STATCOMS- Static Synchronous Compensators
- ▶ Steady state dynamic load balancers

# Proposed Transmission Infrastructure

- ▶ A 66 kV traction supply from Athi River 220/66 kV substation.
- ▶ A 220 kV traction supply from Mariakani 400/220 kV substation ( currently under construction).
- ▶ 7 x 132 kV traction supplies from the existing Juja Road-Rabai 132 kV transmission line.
- ▶ 3 x 400/132 kV substations at Konza, Makindu and Voi respectively to support the traction supply system
- ▶ Estimated cost 210 MUSD



# Possible funding sources

- ▶ International Financial Development Partners (IFDS)
- ▶ Government of Kenya ( Right of Way acquisition component)
- ▶ Public Private Partnerships

# Future outlook: High Speed Train



Source: Wikipedia

- China Fuxing Hao CR400AF/BF: 350 kph [4]
- World's fastest non-maglev train in 2016 [4]
- 1,021 km Beijing Nanjing in 3 hours and 13 minutes[5]



**THANK YOU**

# References

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# Presenter Profile

- ▶ Valentine is a Transmission System Planning Engineer at KETRACO. He has worked in the development of electricity transmission infrastructure for the past eight years. He completed his Master of Science Degree from University of Kent in Advanced Electronic Systems Engineering in 2019 in the United Kingdom. He undertook a bachelor of science in Electrical and Electronic Engineering in Jomo Kenyatta University of Agriculture and Technology.
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