9th International Conference on Management Studies
(ICMS-2023,) September, 10

A Techno-economic Model for LTE Broadband Technology in Rural Areas (Egypt)

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Author's biographies



Prof. Dr. Mohamed Ezzat

Prof. Dr. Ezzat has extensive manufacturing and quality engineering experience in the automotive and hospitality industries as well as in-depth involvement in academia. His industrial background is based on establishing strong relationships between various disciplines within the organization and with suppliers. He has a proven record for systematic implementation of process improvement techniques in the US, Europe, and various countries in the Far East, and China. He has earned his Doctorate and master's degrees in industrial engineering from Texas Tech University at Lubbock, Texas. His B.Sc. degree was in Aeronautical Engineering from Cairo University. Dr. Ezzat has worked in the aircraft design field after his graduation both in Egypt and the US. He is a Certified Professional Engineer, Certified Quality Engineer and Certified Quality Auditor by the American Society for Quality, ASQ.

Author’s biographies

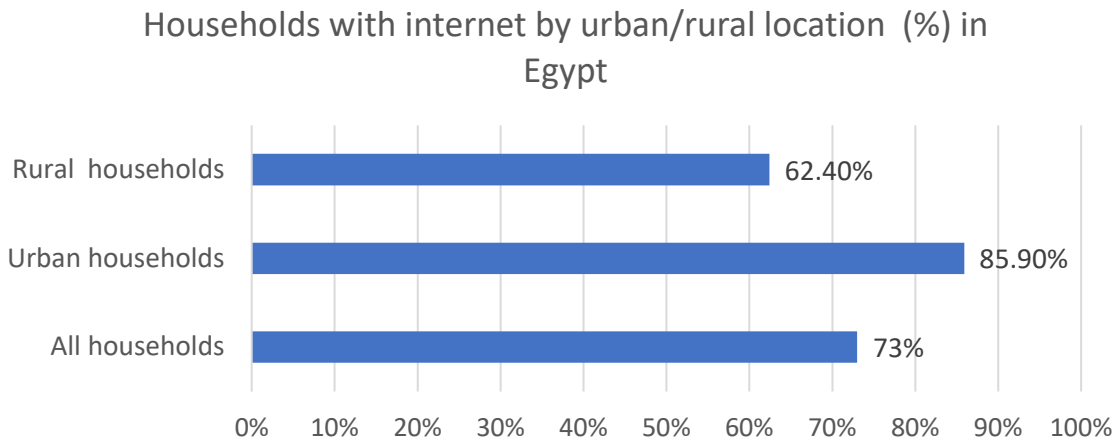


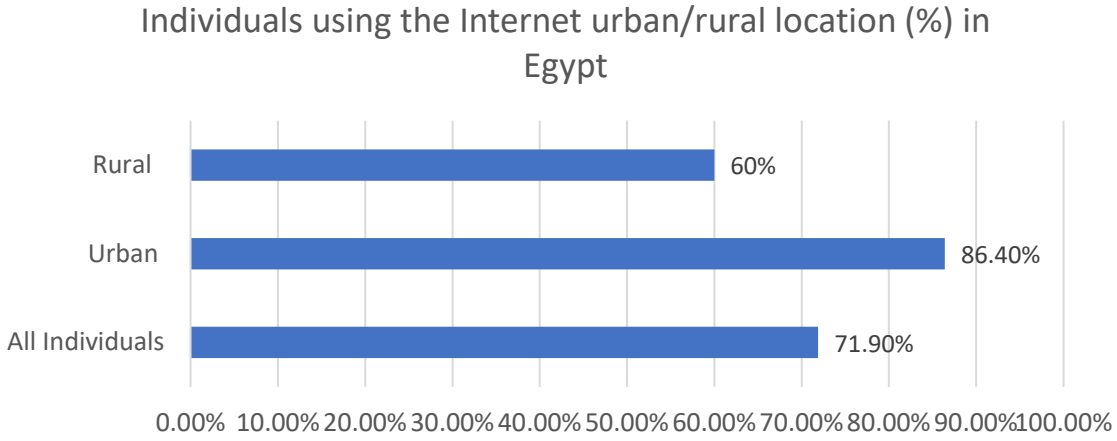
Rolla Hassan Hamza

Rolla Hassan is a Manager, International Regulation at the Egyptian National Telecom Regulatory Authority (NTRA). She has 17 years of experience, has been involved in various projects Global and Regional Trends and Policies, Analysis studies related to telecommunications regulations, digital security, and taxation of the digital economy. with experience working in an international organization. Ms. Hassan holds an MSc degree in electronics and telecommunication Engineering from Arab Academy for Science, Technology, and Maritime Transport (AAST) Egypt. And Ph.D. student in Management of Technology (MoT) at Nile University (NU).

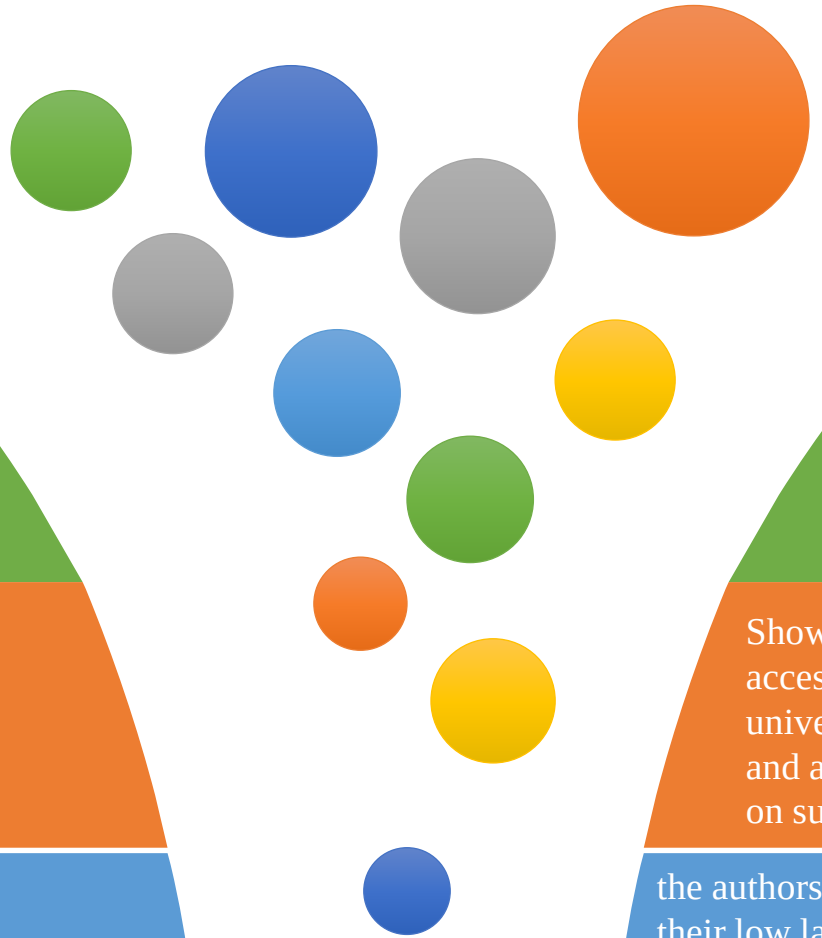
Introduction

- The “digital divide,” which is defined as the non-availability of high-speed connectivity in rural areas versus urban areas
- 40% of the individual not using the internet, while approximate to 40 % of households with no internet in rural areas were still offline and excluded from the benefits of the digital economy.
- Rural places have a lower population density, the cost of serving each customer rises, this results in either a much longer return on investment (ROI) period or a much higher price for services for the rural neighborhood. Not every operator can withstand a long return on investment (ROI).
- This research implementing techno-economic model taking onto consideration customers’ needs and the overall costs.





The Literature Review (1)



(Osoro & Oughton, 2021)

Authors identified the gap in an open source for assessing the techno-economic of satellite broadband, and assessing the three competing Low Earth Orbit (LEO) constellations; Starlink, OneWeb, and Kuiper.

Laitsou & Katsianis, 2021

Presented a techno-economic analysis to assess the feasibility of developing a 5G mobile network in different urban areas based on population density

Bendicho, 2021

Showed the state of the art of techno-economic modeling for access network technologies, presented the characteristics a universal techno-economic model should have, and classified and analyzed techno-economic models in the literature based on such characteristics

Lian et al., 2022

the authors research the Low Earth Orbit (LEO) satellites due to their low latency, large capacity, and less susceptibility to external environmental impact. Furthermore, they conducted a techno-economic model to evaluate the revenue capability and efficiency of the satellite constellation of Starlink and OneWeb.

The Literature Review (2)

Ioannou et al., 2020

estimated the Net Present Value (NPV) of establishing 30-Mbps broadband networks using Fixed Wireless Access (FWA) based on Fiber To The distribution point (FTTdp), Very high-speed Digital Subscriber Line (VDSL), and Long-Term Evolution (LTE) in the rural areas of Europe

Araujo et al., 2018

concluded that FTTC is the most inexpensive approach, which is more than 70% cheaper than 5G and more than 20% cheaper than Fiber To The Home (FTTH).

Oughton et al., 2019

Presented the research problem of the lack of openly accessible tools that integrate the engineering and cost aspects in a techno-economic assessment framework capable of providing geospatially-explicit network analytics



Research Question(s)

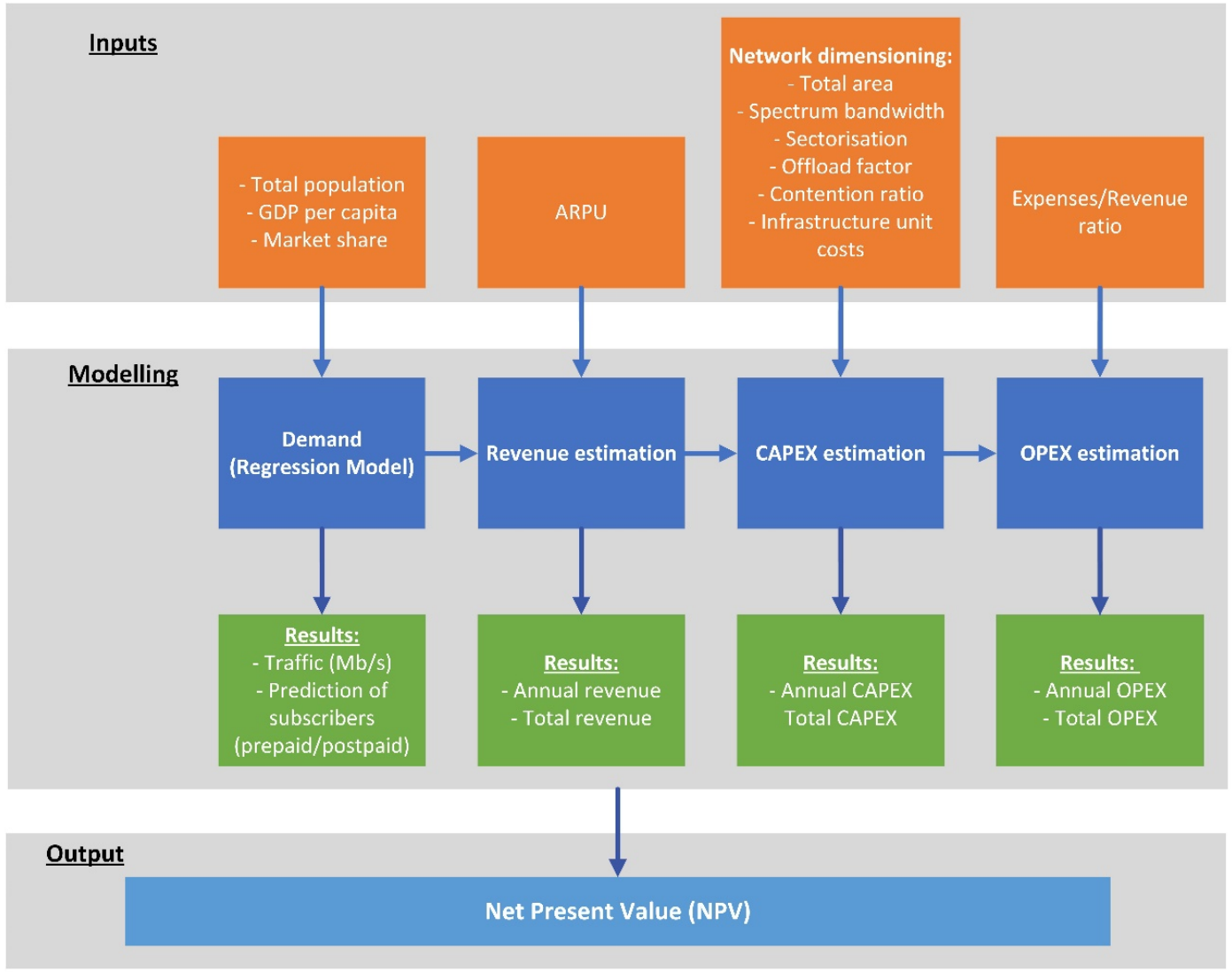


Three areas are considered when deciding whether a specific technology should be deployed: technical performance, economic issues, and financial attributes. Typical questions posed by policymakers and national regulators include: which technology is the most cost-effective? Which technology satisfies the user's need? How much financial risk is involved in the deployment?

In summary, this article focuses on the last mile technologies alternatives that consider customers' needs and overall costs.

Methodology

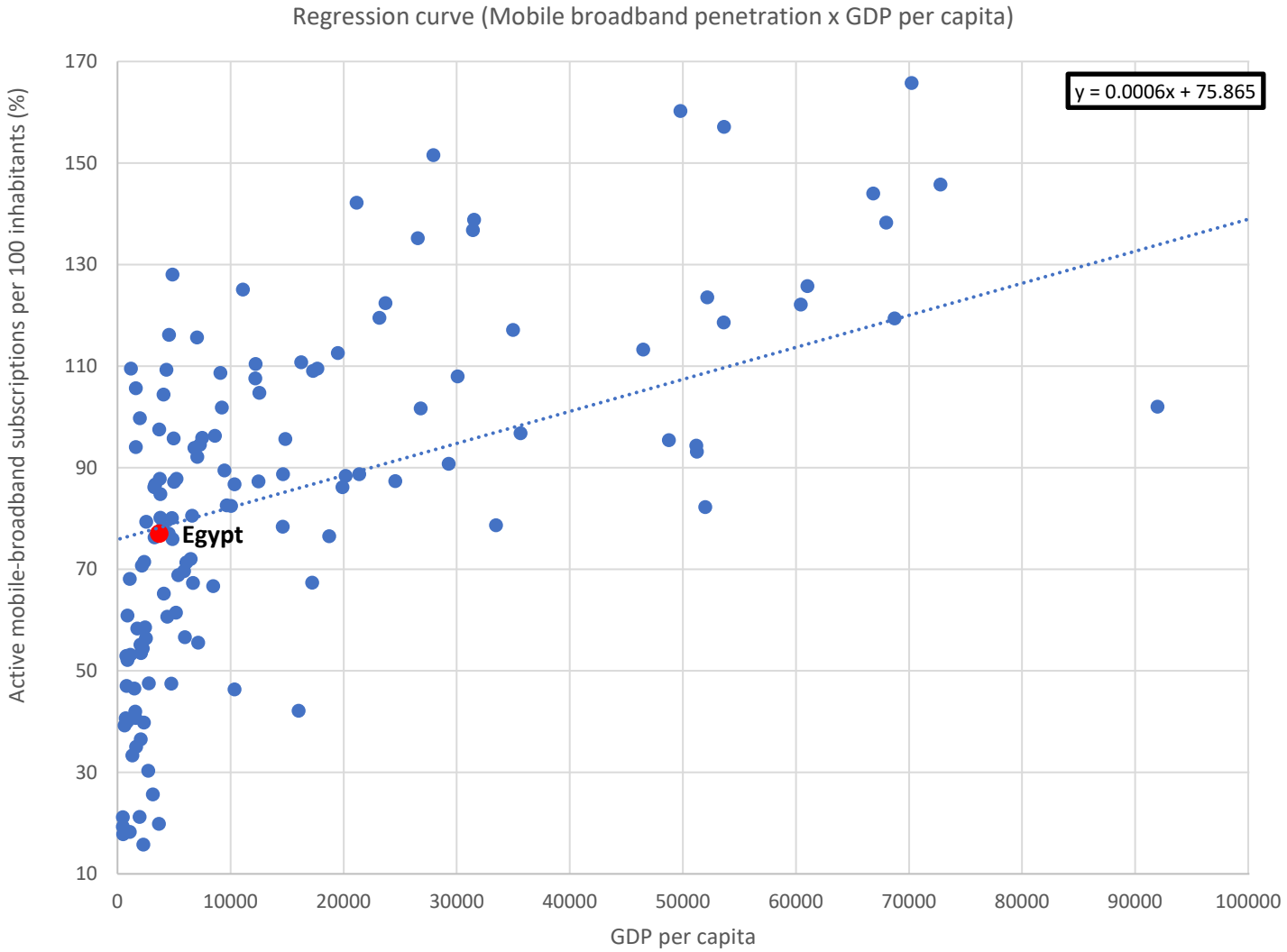
- The techno-economic model aims to dimension the total expenses and investments necessary to implement or expand communication networks in rural and remote areas, covering these steps, inputs, modeling, and outputs



Results

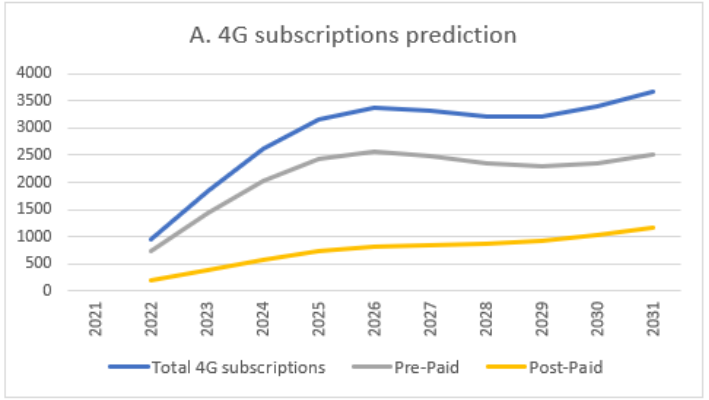
LTE Demand

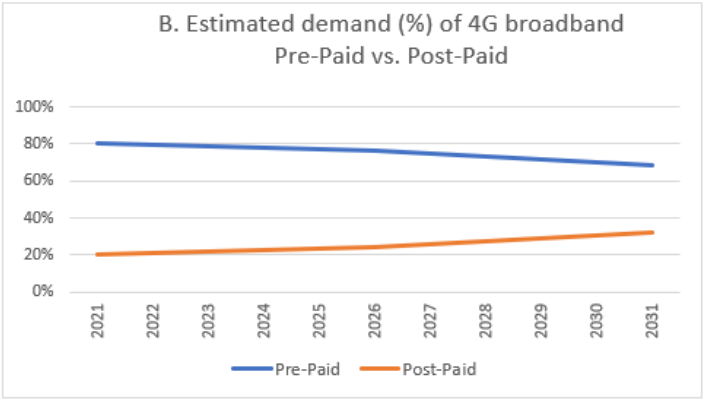
- Estimating the total demand for mobile Broadband services in Egypt that in 2021 has a GDP per capita of $ 3,698.83, with 12,816 inhabitants. The growth rate of its GDP is projected to be 1.6% a year. Its population will continue growing at a 1.1% rate a year.
- Using the regression model, the estimate of the mobile broadband demand for Egypt is 78.084%. The current mobile broadband subscription is 77.03%.

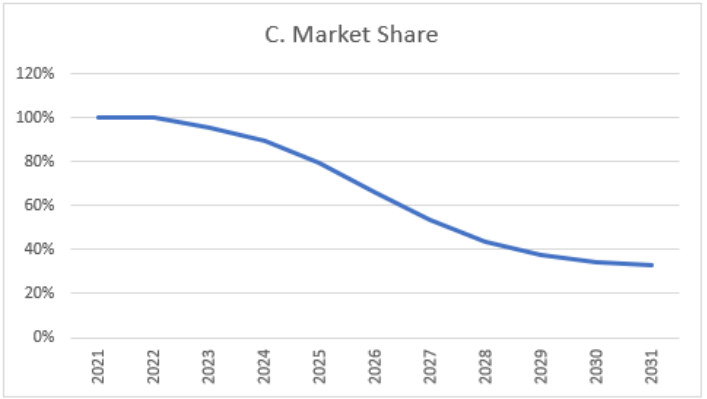


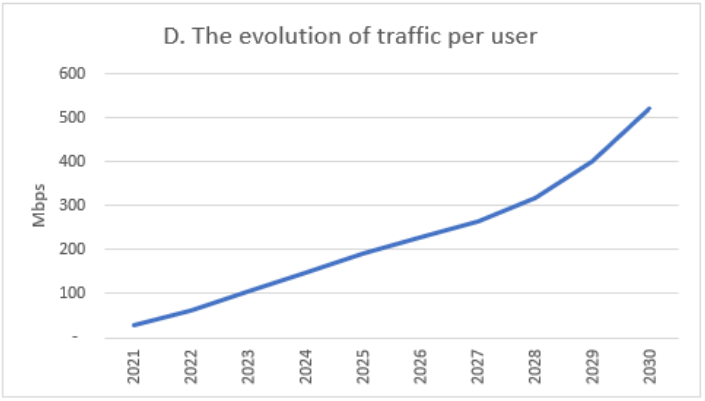
Results

- The total number of LTE subscribers is shown in Figure A, the estimated demand as a percent of the subscription segmentation is in Figure B, The market share is shown shown in Figure C and the traffic per user is shown in Figure D.





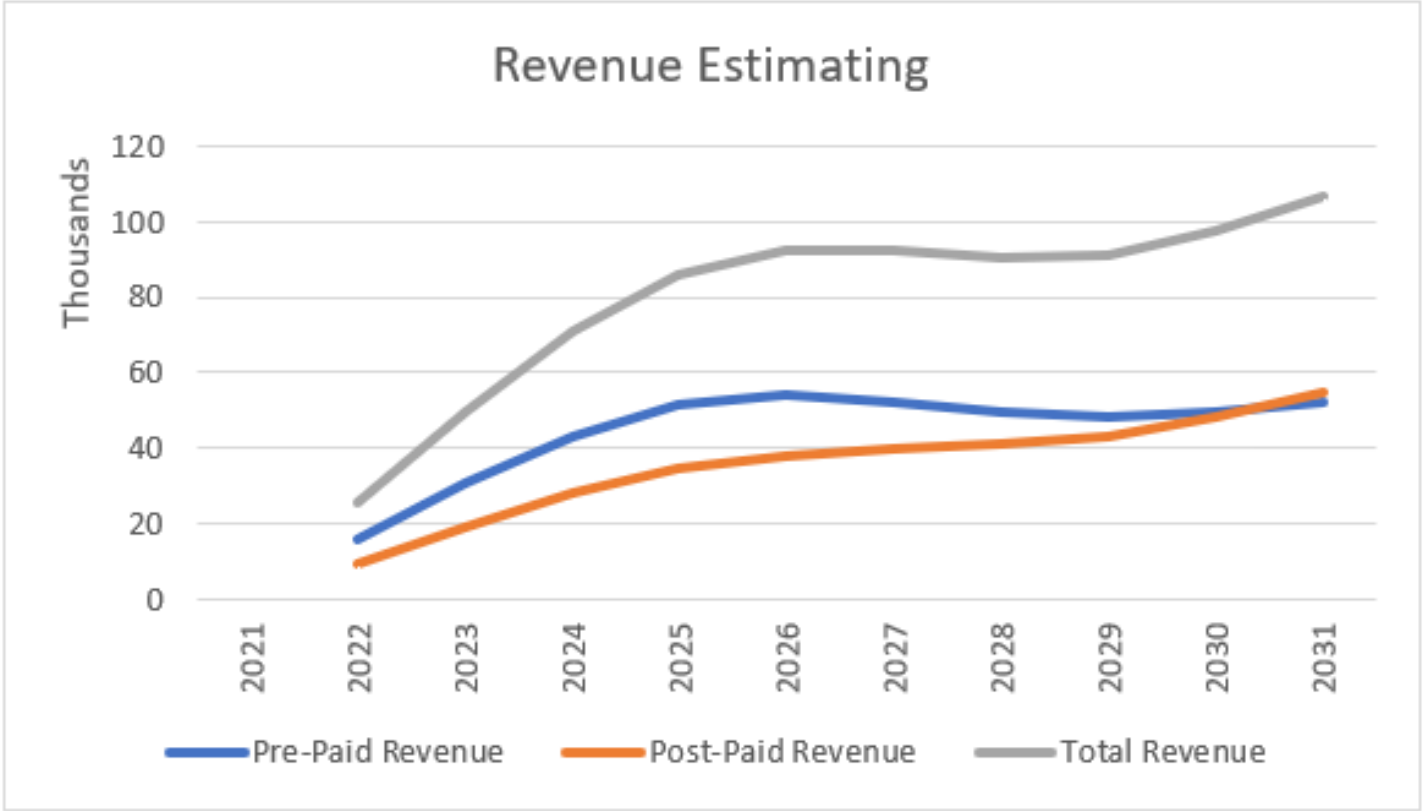




Results

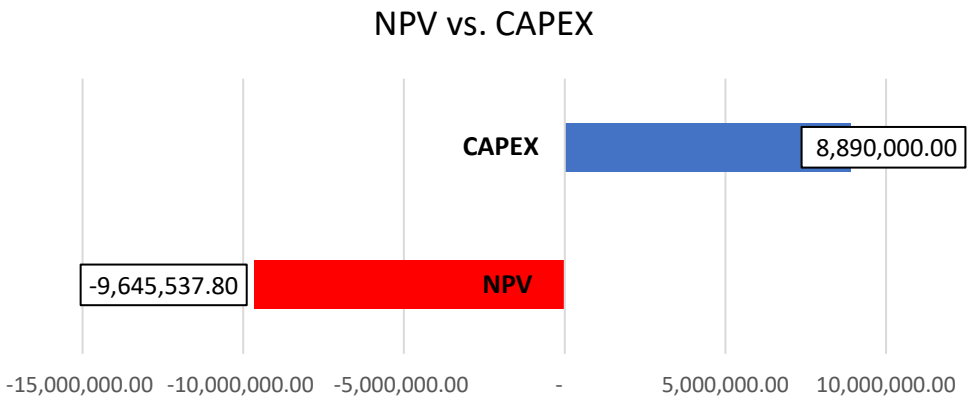
Revenue Estimation

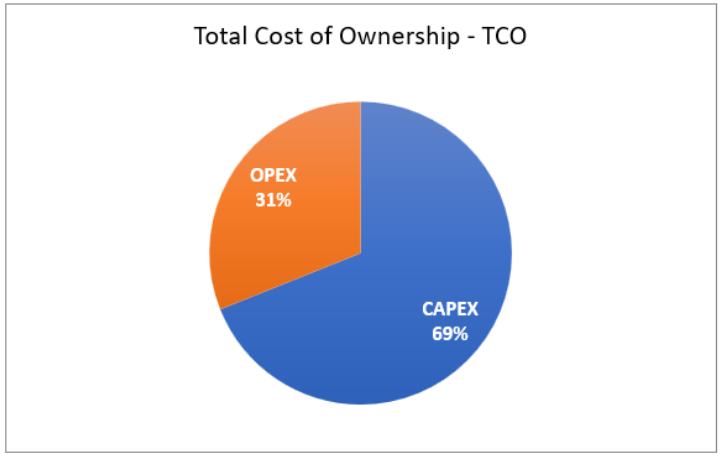
- Estimating net revenues is done by calculating Average Revenue Per User (ARPU) for the service segments (pre-paid and post-paid) provided under the revenue model. The average pre-paid ARPU (year) is 21.6 US$, and for post-paid is 48.12 US$. Therefore, the calculated total revenue is 802,507 US$.



Results

- Based on the net revenue, CAPEX, and OPEX calculation, considering depreciation, a WACC of 15%, and an income tax of 22%, the calculated final Net Present Value (NPV)





The techno-economic model goal is to expand broadband internet connectivity in rural areas in Egypt, considering the technical performance, economic issues, and financial attributes

This article employs a case study to demonstrate the implementation of the techno-economic model based on actual data obtained from a municipality located in New Valley Governorate.

The results showed that the gap between the existing mobile broadband subscriptions and the demand for mobile broadband is 1.37%.

There is an increase in the annual revenue, which will reach by the end of the tenth year to USD 106,683.

Discussion

The Net Present Value (NPV) is negative due to the low population in the rural area and requires the policymaker to consider subsidies.

the CAPEX, in the first year, the CAPEX will cost USD 7.11 million. The 9th year will cost USD 0.51 million, and by the end of the tenth year, CAPEX will cost USD 1.21 million.

The annual OPEX cost in the first year is USD 368,562, reaching in the tenth year to USD 484,791.

This article is work in progress, and will continue to investigate the different access technologies such as Fibre to The Home (FTTH) and Low Earth Orbit (LEO).


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