Towards a Net Zero 6G Era

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My gratitude goes to One6G for inviting me!

5G new capabilities and uses

Enhanced Mobile Broadband up to 20 Gbps

- ❑ Augmented and Virtual Reality
- ❑ Ultra-High Definition videos, Streaming etc
- ❑ Metaverse
- ❑ **Fintech**

Ultra-Reliable Low Latency Communications 1 msec

- ❑ Industry robotic automation
- ❑ Tactile internet
- ❑ **Fintech**
- ❑ Autonomous and Electric Vehicles communications,

Massive Machine Type Communications 50BN

- ❑ Grid smart meters, utility monitoring
- ❑ E-Health wearable devices
- ❑ Connected Sensors, cameras on factory floor.
- ❑ Logistics, assets monitoring, tracking
- ❑ **Fintech**

Consumer Market

Vertical Markers (Emerging)

FinTech Driving Applications

Insurance

Open banking

Smart City

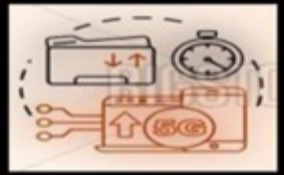
Smart Health

Entertainment

Smart Energy

FinTech Driving Trends

Low Latency



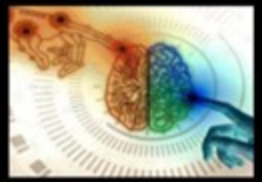
Extreme Data rate

Super Security

Metverse

Net Zero

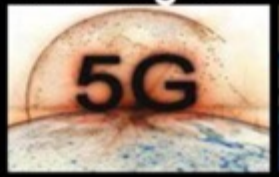
FinTech Enabling Technologies



AI

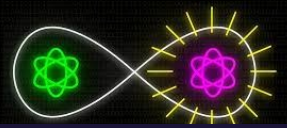
IoT

Block Chain



5G

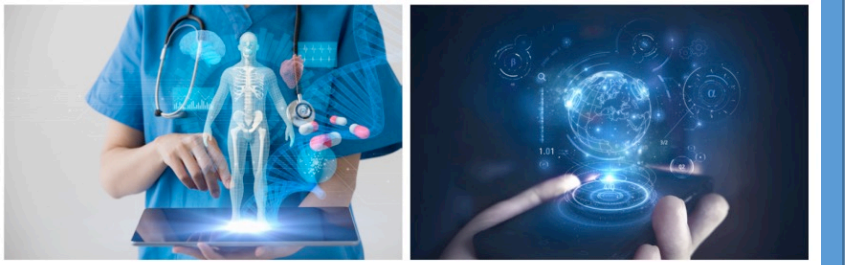
6G



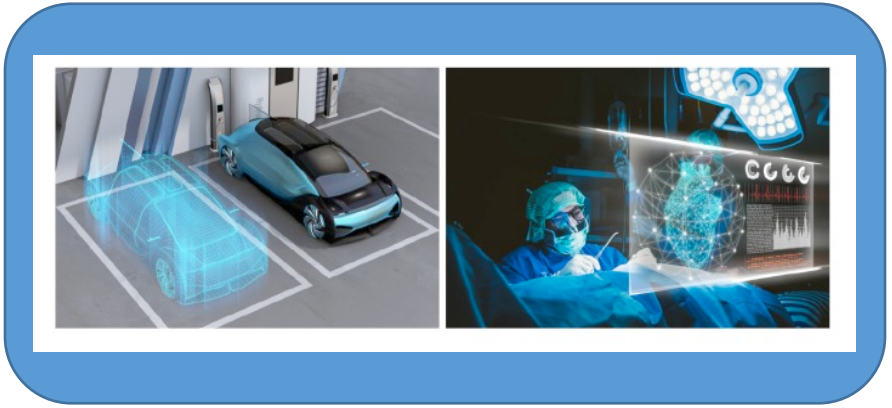
Quantum C&C

Source: Bhata, Nekovee, Al Qahtanib "FinTech enablers, use cases, and role of future internet of things, Journal of King Saud university, Elsevier Publishing, 2022, https://www.sciencedirect.com/science/article/pii/S1319157822003159
HSBC Digital Innovation and Artificial Intelligence Meeting, October 2022

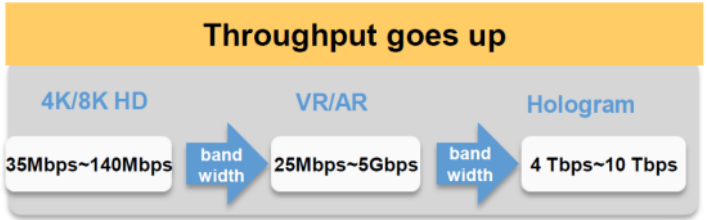
What we can expect from 6G (~2030)



Full holographic Communications/ Net generation Metaverse



Digital Twins/Digital Human

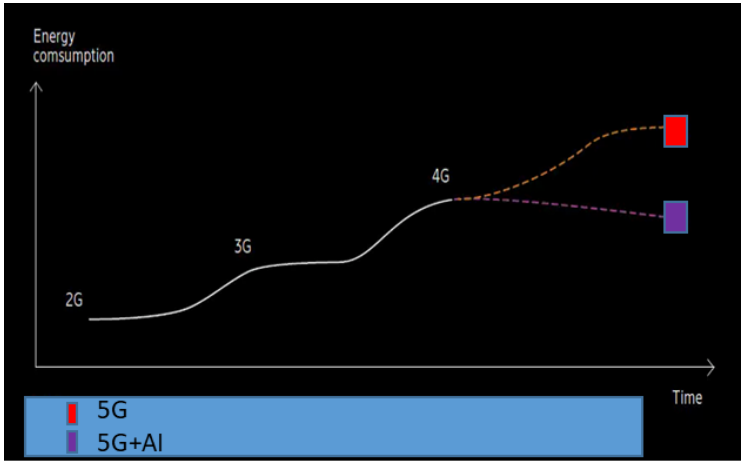


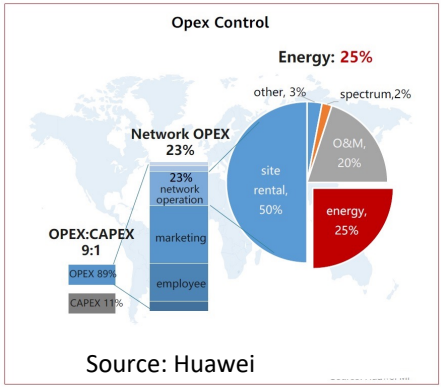
To duplicate 1mX1m area for digital twin we may need 0.8Tbps assuming 100ms periodic updates

Breaking the 5G energy consumption curve with AI

- Communication sector currently accounts for 0.4% of world's CO2 emission.
- 5G networks are designed to be 90% more energy efficient than previous generations.
- BT estimates that switching off 3G will reduce energy consumption of its wireless networks by about 30%.
- But this is counteracted by growth in the volume of mobile data due to new data-intensive applications in consumer and business sectors enabled by 5G.

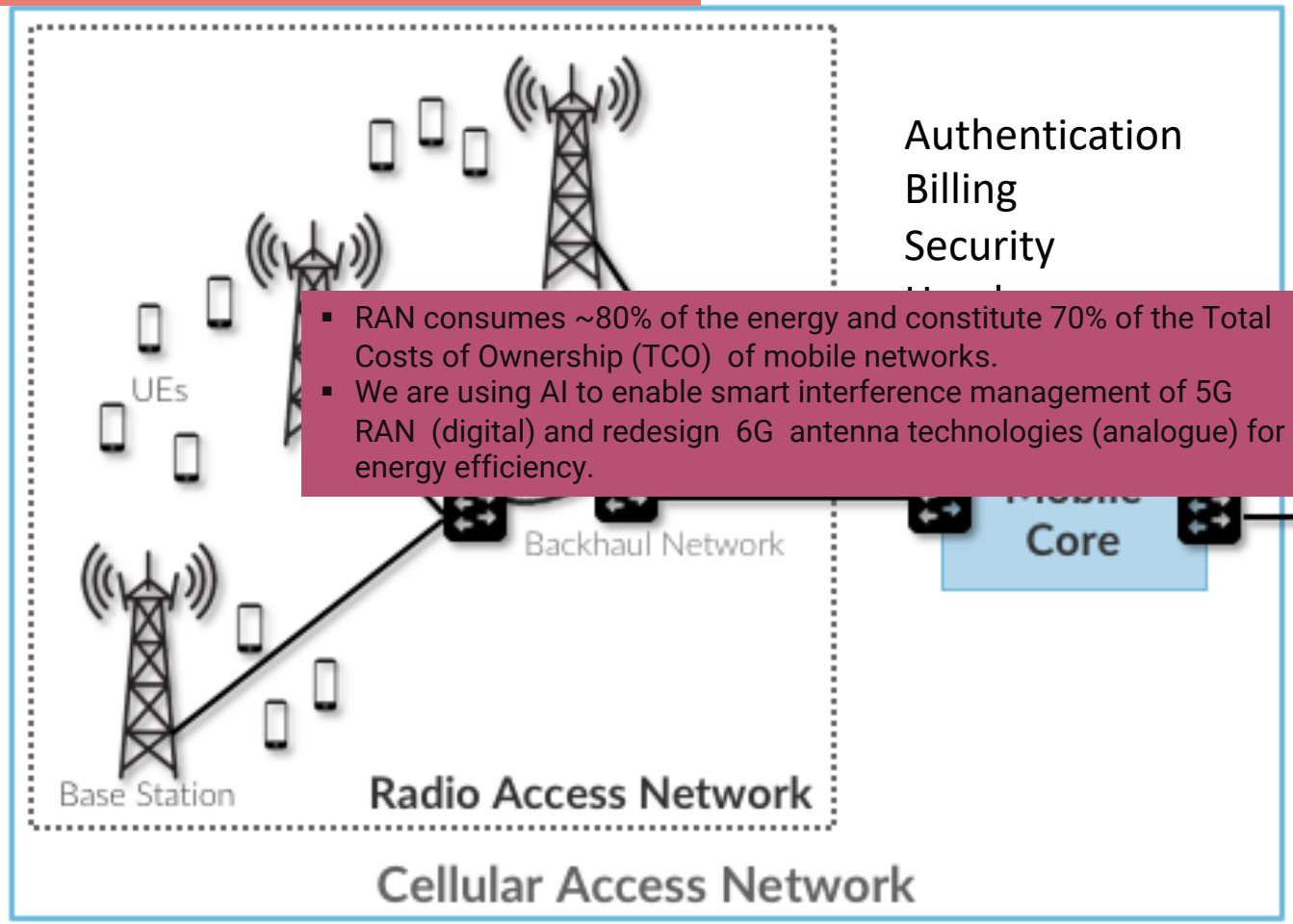
If 5G and 6G are deployed in the same way as previous generations to meet the increasing traffic demands, energy consumption and cost (OPEX) of mobile networks would increase significantly.





Wireless (RAN)

Fibre and Subsea Communication



Authentication
Billing
Security

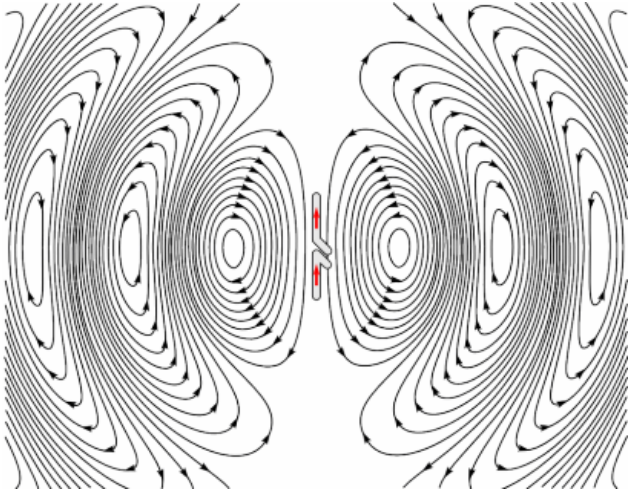
- RAN consumes ~80% of the energy and constitute 70% of the Total Costs of Ownership (TCO) of mobile networks.
- We are using AI to enable smart interference management of 5G RAN (digital) and redesign 6G antenna technologies (analogue) for energy efficiency.

NETFLIX

YouTube

TikTok

Intended user

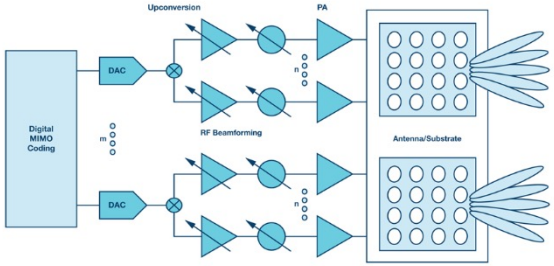


3G mast antenna radiation

4G mast with sectoral antennas

Energy Efficiency

MIMO and Beam-forming Key 5G and 6G technologies



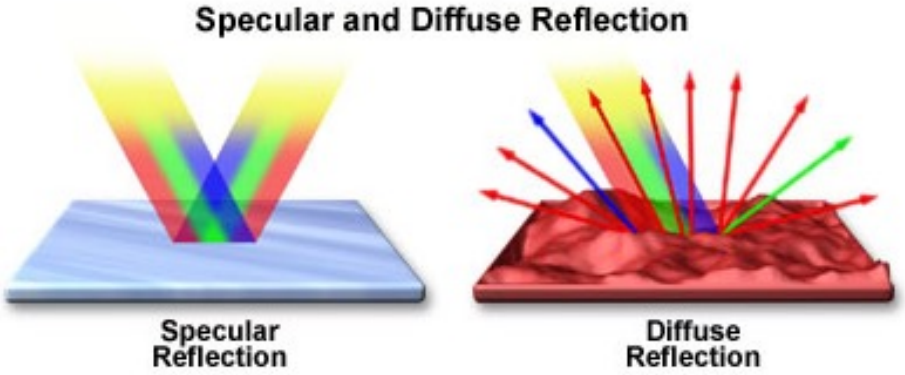
Hybrid beamforming/Digital beamforming

- **Scalability!**
- **Energy consumption**
- **Complexity**

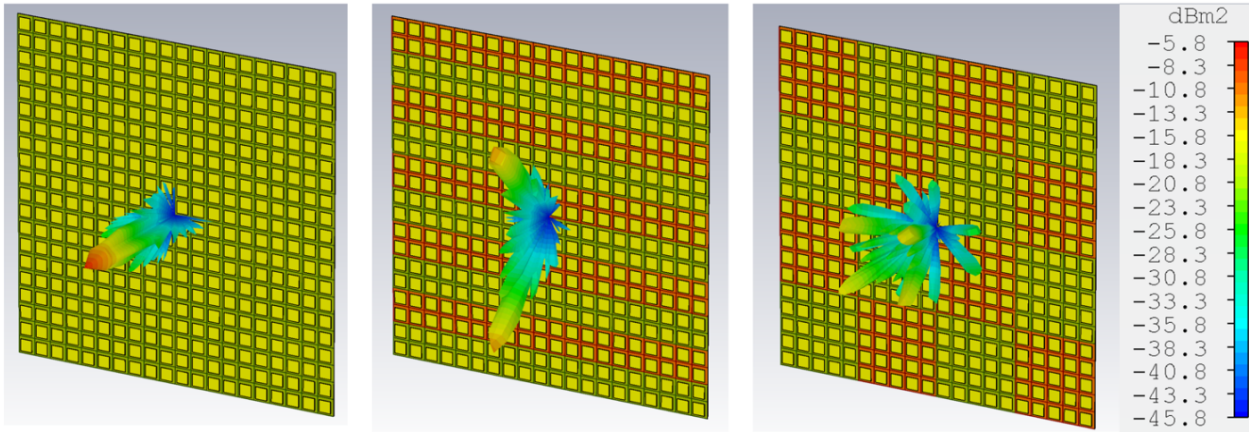
250m @28 GHZ

Frequency	Relative Pathloss	Antenna Gain (linear domain)	#Antenna Elements
2.8 GHz	1 (as reference)	1	~1
28 GHz	100	100	~1000
280 GHz	10000	10000	~100,000

Reconfigurable Intelligent Metasurfaces for energy efficient 6G/ ongoing research at Sussex



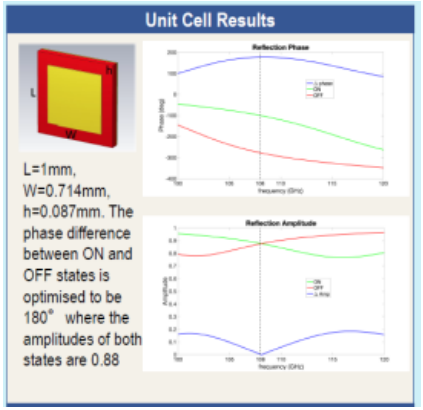
Conventional surfaces

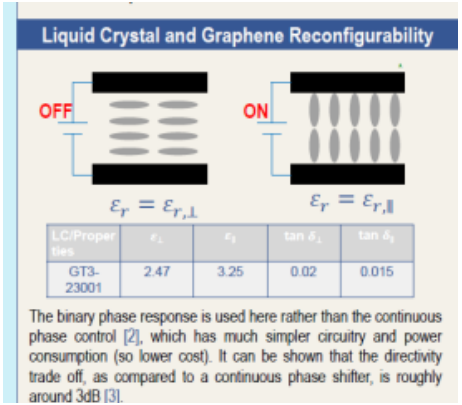


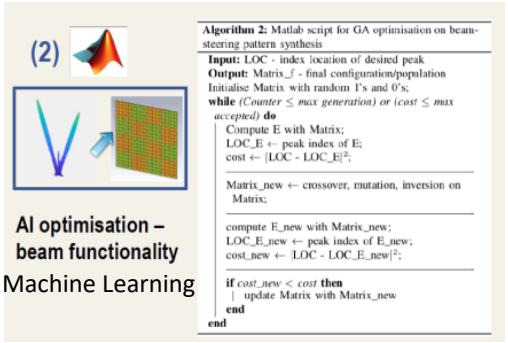
Metasurface

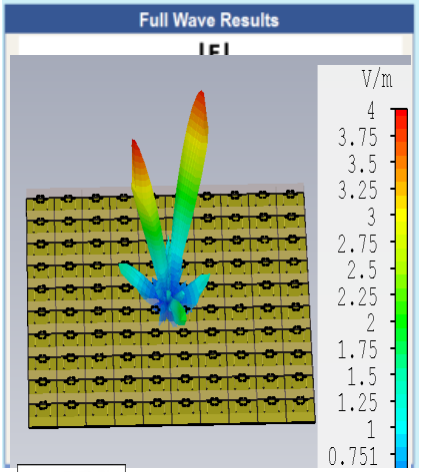
Sub-wavelength engineering of EM properties to intelligently manipulate light and radio waves at will

Liquid-crystal Reconfigurable Intelligent Surface (RIS) Technology for Energy Efficient Beamforming and Extreme MIMO









Up to 50% reduction in energy consumption in 6G frequencies

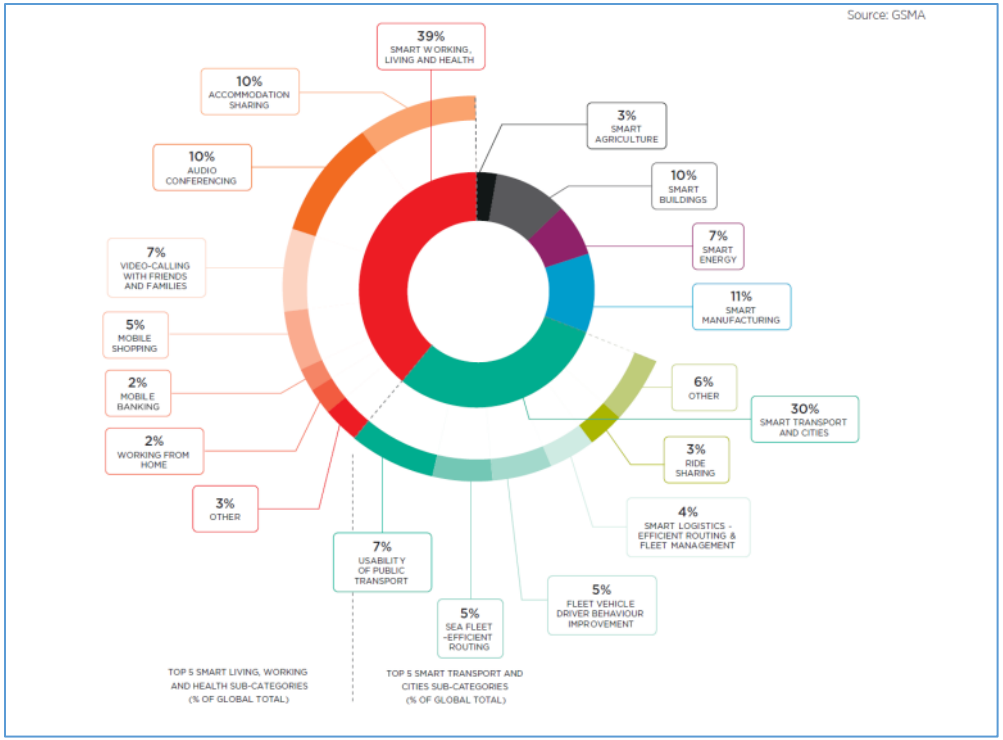
Electronically reconfigurable binary phase liquid crystal reflectarray metasurface at 108 GHz, 1 Dec 20192019 IEEE Globecom Workshops, GC Wkshps 2019 – Proceedings. Meng X, Nekovee M, Wu D, Rudd R

The design and analysis of electronically reconfigurable liquid-crystal based reflectarray metasurafce for 6G beamforming, beamsteering and beamsplitting, X Ming, M. Nekovee, and D. Wu, August 2021 , IEEE Access, 2021

Energy efficient beamforming for 6G THz communications with liquid-crystal based reconfigurable transmit arrays, in preparation.

Enabling vertical's net zero with 5G, IoT and AI

- ICT sector is at the forefront of taking urgent action to reduce its own emission. However, this is not the biggest contribution the sector can can make.
- The potentially biggest contribution of the sector to net zero is to help other industry and business sectors reduce their emission through digitalisation and "smartisation" (Artificial Intelligence).
- Research by GSMA and Carbon Trust indicates that by enabling smart and cognitive operations mobile communications and IoT together with AI enables carbon reduction in sectors that our 10 times larger than the communication sector, **equivalent to approximately 4% CO2 emission.**



Source: Mobile Net Zero, State of the Industry in Climate Action 2021, GSMA

- Challenges of UK 2050: Decarbonisation and decentralisation require multi-sector engagement and disruptive innovation to drive national and green deployment.
- Energy, telecommunications and mobility (ETM) sectors are increasingly inter-dependent, 5G-ICT offers fantastic opportunities to integrate effectively

A green, connected and prosperous Britain

UKRI Arts and Humanities Research Council

UKRI Engineering and Physical Sciences Research Council

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SUSTAINABLE URBAN SYSTEMS AND INFRASTRUCTURE (SUSI) - NETWORK PLUS

University of Sussex

Imperial College London

EST 1892 LSBU

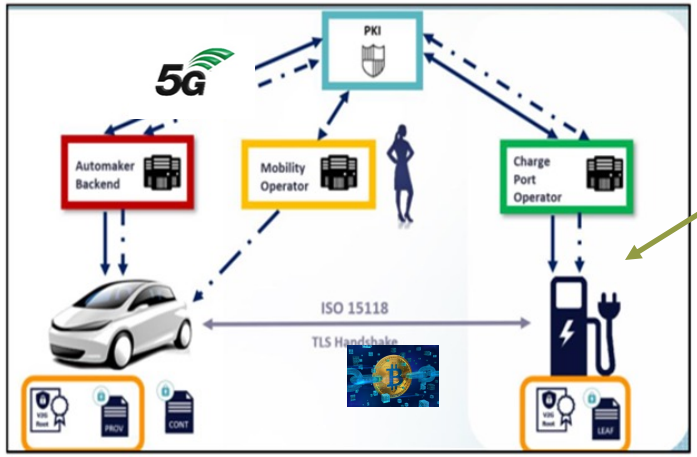
University of Essex

UK Power Networks Delivering your electricity

octopus energy

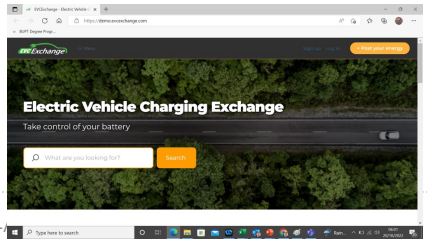
Smart platform for EV energy trading as a service

- The anticipated huge increase in electric vehicle ownership (an anticipated 28% of total sold vehicles will be battery-powered by 2030) and number of charging points near homes, offices and shops offers **mobile energy consumers** the chance to provide as well as consume energy at a large scale.
- Using bi-directional charging technology EVs can charge their batteries when required and can give back to the grid in case of high demand, when there is extra energy available in storage.
- 5G mobile connectivity, together with blockchain and AI enables **a secure Mobile Energy-as-Service (MEaaS) platform** for **net zero** EV operations.
- Blockchain supports a decentralised framework and secure transfer of energy and incentives via smart contracts between providers and suppliers, using Fintech.



Machine Learning

The energy sector benefit from MEaaS by using EV batteries as storage units during periods of high RE peak generation and discharge them during peak demand.



Software platform for EV energy trading

Research conducted in 2021 specialist energy consultancy Rethink Research found that such smart energy systems could prevent an overbuild of capacity worth 16,000 terawatt hours of annual generation.

Based on 2021 electricity prices, this could save $1.9 trillion per year by 2050, as well as saving 7.7 billion tons of CO2 emissions, equivalent to more than 23 per cent of global decarbonisation.

Thank You!

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