



Covenant University

Raising a new Generation of Leaders

Green Hydrogen in Energy Transition: Lessons for SSA Presented at ABUAD ICCEA 2022

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Presentation Outline

- Protocol
- What energy is all about and its importance
- Africa's energy vision and sustainable development
- Energy, population, and development: Any link?
- Climate Pressure
- The case for hydrogen fuel
- Lessons for SSA
- Conclusion



Introduction: Energy Defined

- **Energy is a tool that enhances socio-economic development of a nation**
- **It is described as a force multiplier that converts raw materials to useful products**
- **Its access has contributed to industrialization, rural upgrade, high manpower development and improved livelihood**



Intro: Sectoral dependence on energy

All sectors
require
energy



Access
controls
migration



2015 Report of IEC of the World Bank:

- **A billion people lack access to modern electricity**
- **Another billion lack access to quality and reliable electricity**

Transition



Africa's energy vision & sustainable Dev

**Captured
in Agenda
2063**

**2 of 7
aspirations**

**10 of 20
goals**



Aspiration	Goals
<p>1) A Prosperous Africa, based on Inclusive Growth and Sustainable Development</p>	<p>(1) A High Standard of Living, Quality of Life and Well Being for All Citizens</p> <p>(2) Well Educated Citizens and Skills revolution underpinned by Science, Technology and Innovation</p> <p>(3) Healthy and well-nourished citizens</p> <p>(4) Transformed Economies</p> <p>(5) Modern Agriculture for increased productivity and production</p> <p>(6) Blue/ ocean economy for accelerated economic growth</p> <p>(7) Environmentally sustainable and climate resilient economies and communities</p>
<p>6) An Africa Whose Development is people driven, relying on the potential offered by African People, especially its Women and Youth, and caring for Children</p>	<p>(17) Full Gender Equality in All Spheres of Life</p> <p>(18) Engaged and Empowered Youth and Children</p> <p>(19) Africa as a major partner in global affairs and peaceful co-existence</p>



Balance between energy access, population density, and economic development

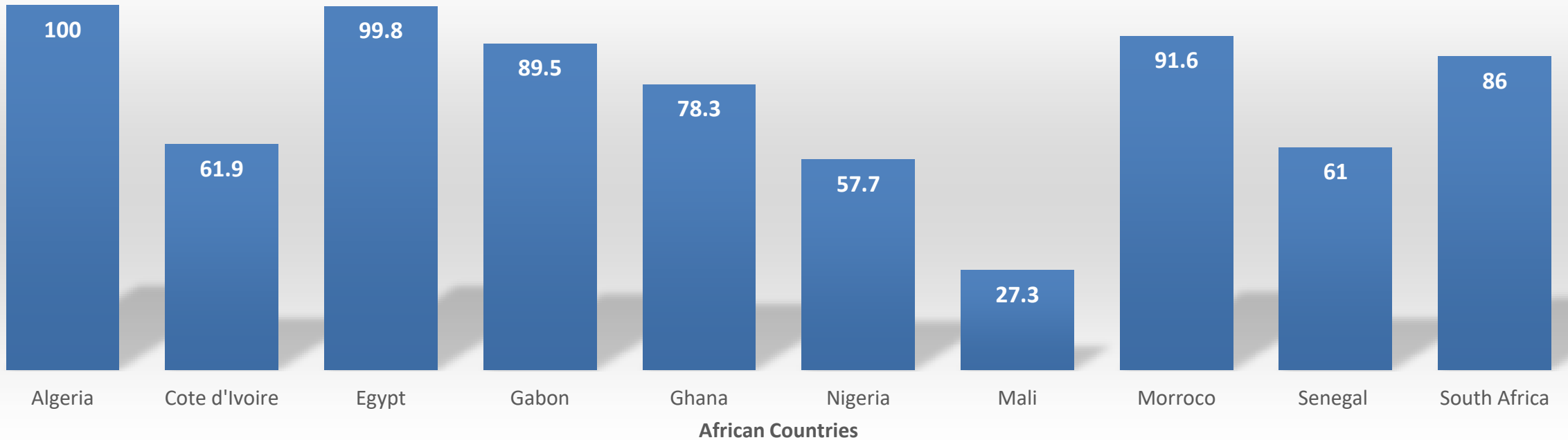
There's a causal relationship:

- Bhattacharya *et al.* (2016): energy availability \propto economic growth with renewable energy, the major driver of the economy
- Sheri *et al.* (2013): positive relationship exists between population, energy consumption, and economic growth



Benchmarking electricity access: comparing some SSA with some North African countries based on 2014 data

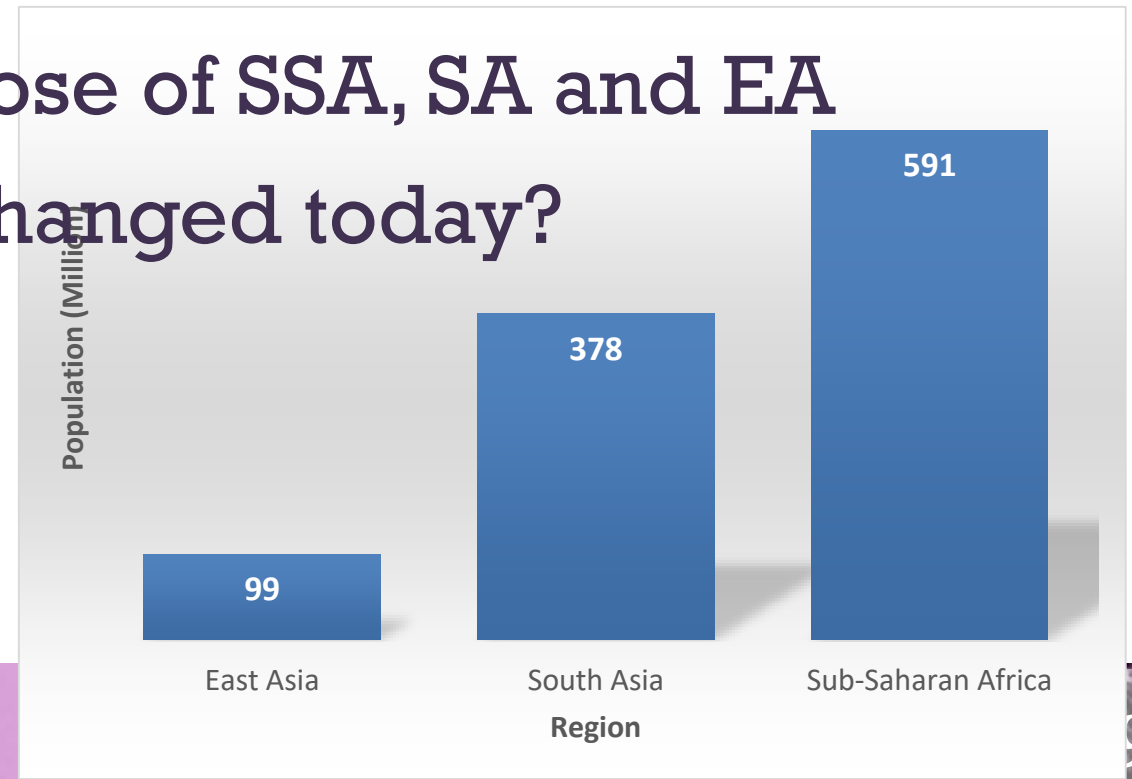
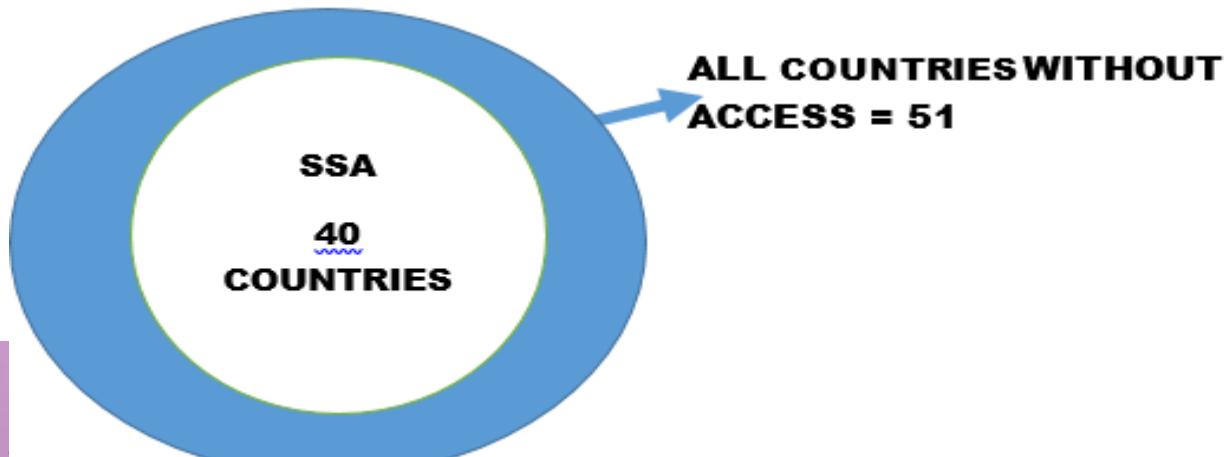
Electricity Access (%)



More so:

In 2014, global electricity access = 85.3%

- This indicate that over 1 billion people lacked access to electricity
- The 1 billion comprise those of SSA, SA and EA
- How has these statistics changed today?



- Based on 2020 statistics, the IEA posit that:
 - Richest countries in the world makes up about one billion people, consuming 50% of total world energy
 - The poorest 20% consume 4%
- World Bank's report of 2020 also states:
 - 9.1% of global population lack access to electricity
 - Majority of this population are still found in SSA, SA, & EA

With a 2.3% growth rate, SSA had about 1.1 billion people in 2019:

- 53% lack access to electricity
- Several people have access to unreliable electricity

Almost the entire countries of Europe, North America, New Zealand, and Australia have achieved 100% access

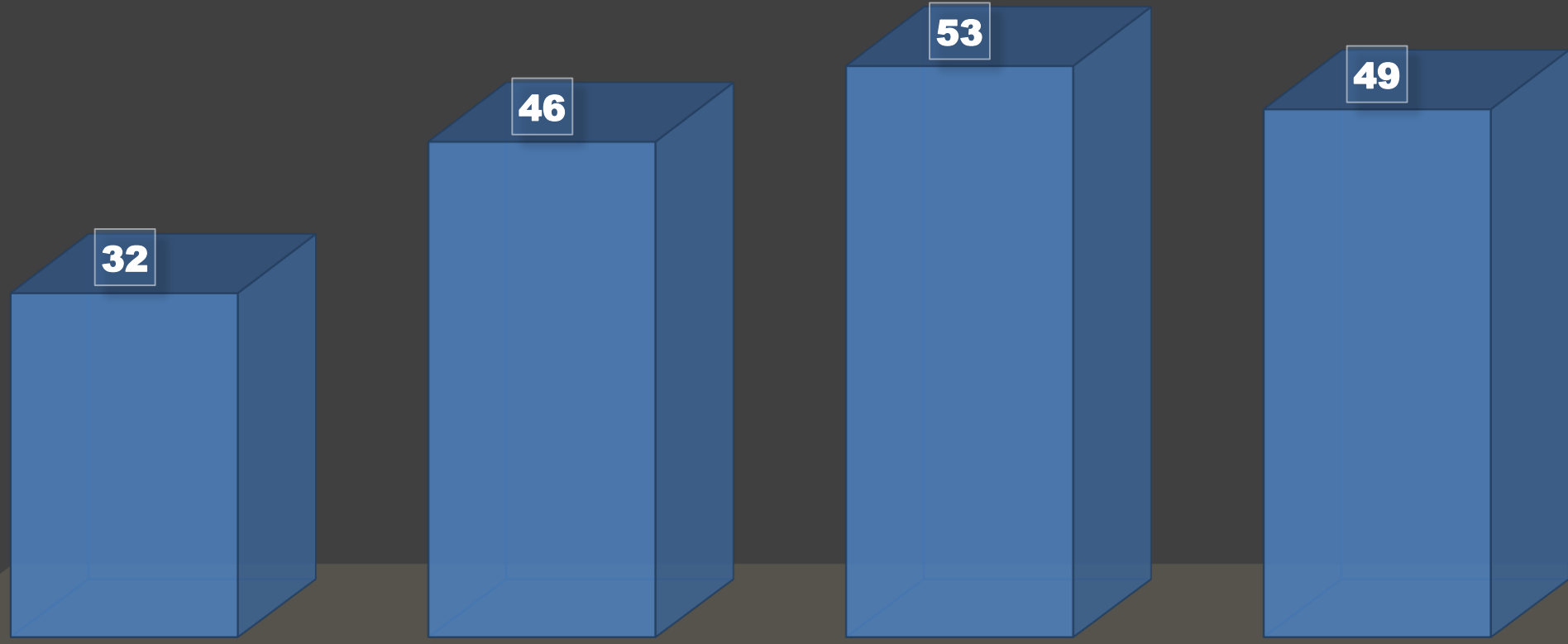
- **All North African countries have almost 100% access**



% OF POPULATION IN 2019

No Region is up to 60% electricity access

% of population in 2019



Central Africa

East Africa

West Africa

South Africa

Region



According to IEA reports of 2021 and 2022, and IRENA report of 2022:

- SSA is the least electrified region globally
- Access to electricity was 48%
- Clean cooking access was 17%

What are the bordering questions



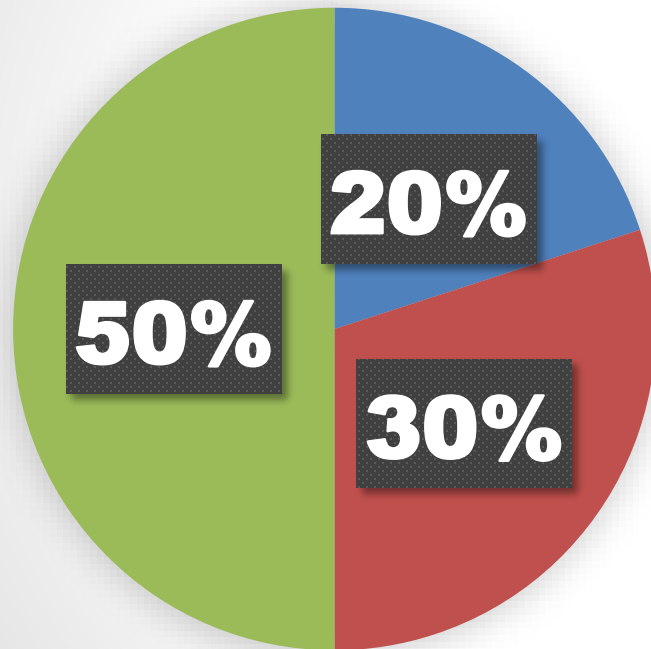
In the face of this energy deficit:

- What is the current energy mix?
- How sustainable is the current mix?
- What should SSA do?

What is the current energy mix?

According to 2022 reports of IEA and IRENA:

% in the mix



- Renewable energy (solar, wind, geothermal)
- Fossil Fuel (Coal, oil and natural gas)
- Biomass

How sustainable is the current mix??

- Primary energy is majorly traditional biomass
- The by-product of fossil fuel combustion
 - GHG emission; ozone depletion; global warming; climate change
- International crude oil prices and the effect on local consumption

Challenges of lack of (or poor) energy access:

- **Low productivity,**
- **Increased unemployment,**
- **Poor economic growth profile,**
- **High costs of living,**
- **Escalating cost of products, and**
- **Underperforming industrial sector**



What should SSA do?

- The region must walk the talk of fulfilling AU's agenda 2063 of "the Africa we want"
 - "to achieve inclusive and sustainable socio-economic development over a 50-year period" = centred on energy sustainability, infrastructural and economic development, robust education, climate action, etc.
- It is not enough to form regional alliances and collaborations on energy trading, it is right to pull resources together to develop the energy frontiers: **Niger & Benin Republics**, **Nigeria**, and **Ghana**; **Southern Africa energy distribution collaboration**

What should SSA do?

- Expand the energy frontiers

- Improve RE penetration & focus on grid-tied RE generation: Wind and solar is widely available across SSA countries.

- A study revealed that Africa's electricity needs could be met 250 times over by wind energy, which has an incredible technical wind potential of almost 180,000 TWh annually (Omata, 2023)

- Mensah et al. (2021) stated that “the total RE potential in the SSA region is estimated to be around 370 PWh, 560 PWh, and 330 PWh for CSP, PV, and wind. About 12% of the world's hydropower potential is held in Africa, with a technical potential of 1800 TWh/year. The biomass potential is estimated to be up to 1649 TWh”

What is the problem with complete RE?

- However, SSA is home to several remote villages and the cost of grid connection is huge. The variability in availability in space and time is another setback
 - The resources are not available 24/7.
-
- What then should be done?

Include hydrogen fuel in the mix

- What are its advantages?
- Is there capacity for green hydrogen in SSA?
- What are the lessons for an hydrogen economy?

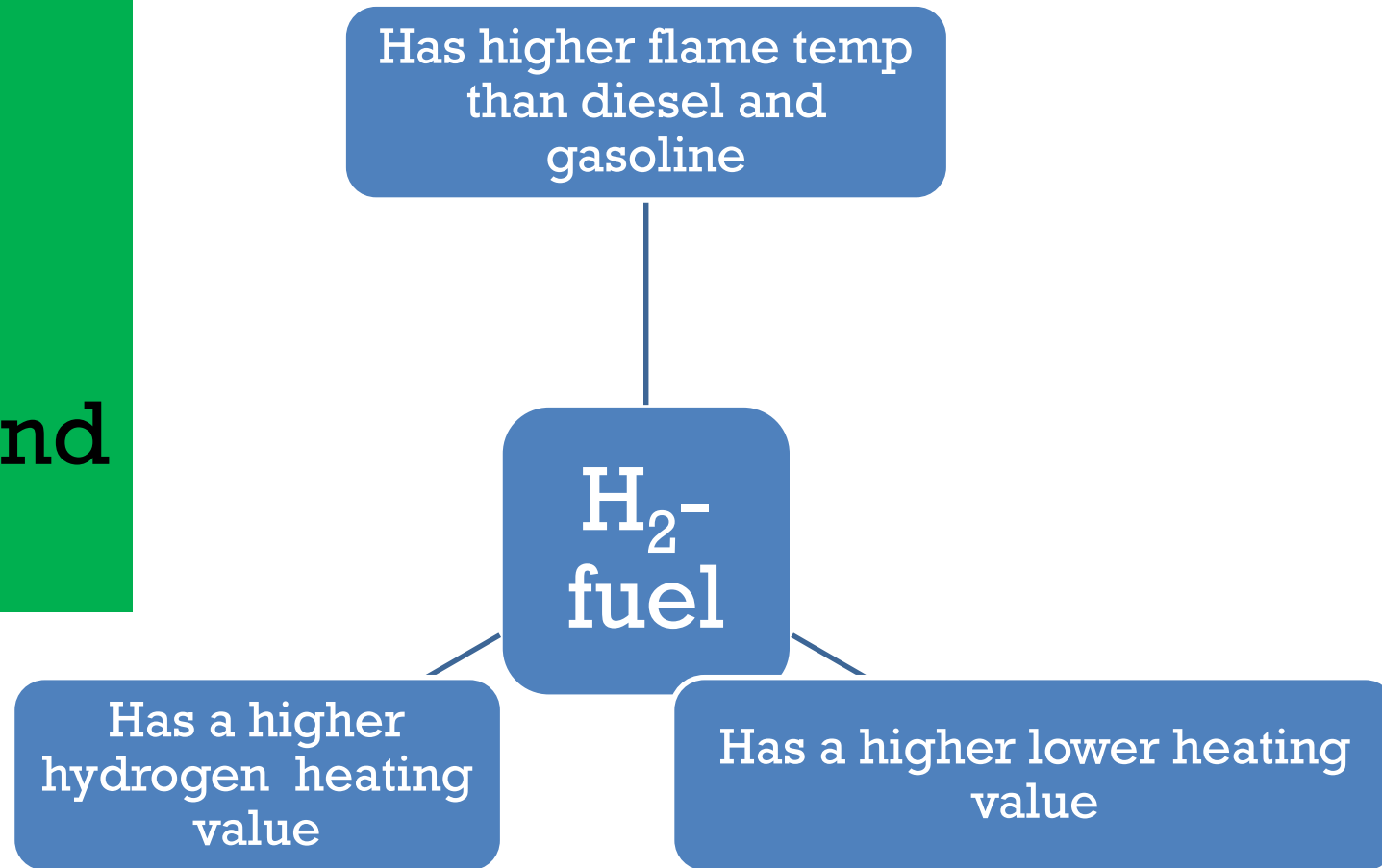
Hydrogen as fuel resources

- Can be produced via water splitting without CO₂ emission
- Can meet all energy requirements: domestic heating, cooling, and cooking, as fuel cell for vehicles, for power production, etc.
- Can serve as energy carrier: used to store energy

- Hydrogen is a clean fuel resource: no CO_2 as by-product of use
- Can be used to power electric vehicles
 - Hydrogen-fuel cell is supplied hydrogen from the H_2 -tank to generate electricity to power the vehicle
- Liquid hydrogen performs better than gasoline/jet fuel/fuel ethanol

Other advantages of hydrogen fuel

Hydrogen,
gasoline,
diesel,
methanol,
methane, and
propane



Is there capacity for green hydrogen in SSA?

YES!

- UNEP (2008) Report on West Africa
- SA solar capacity is twice that of Europe and 25% higher than USA
- The whole SSA enjoys more quality sunshine hours than anywhere else: Sudan tops the list

So what should SSA do to change the narrative?: Lessons to be learnt _____

- Create enough resource measuring stations to understand the potential viability of RE resources across the SSA: **actionable by national govts.**
- Follow the footsteps of other nations

- Btw 2019 and 2021, only 25 countries have well laid out hydrogen roadmaps: None in SSA.
 - If there must be any hope for energy sustainability & green H₂ market development across SSA, there must be clearly defined institutional, regulatory and infrastructural roadmaps
- It may amaze you to know that Japan published her basic H₂ strategy in 2017, and by 2019, the strategy was expanded to cover roadmaps for H₂ and fuel cells with a plan to synergise the industry, academia, and government to create H₂ society: can SSA do the same?

- The production of H₂ reached 90 Mt in 2020 of which only 0.03% is green H₂. The demand is projected to reach btw 110 and 140 Mt by 2030.
 - This means green H₂ economy is a budding industrial energy revolution and SSA can take advantage of its enormous potential for it to become a market leader.

- EU published its H₂ roadmap in 2020. It contains clearly defined targets, strategies for expansion and adoption, funding opportunities, and plan for green H₂ imports

- This clearly indicate there should be regional collaborations for SSA to define binding targets, jointly secure funding, and leverage on identified opportunities for green H₂ production

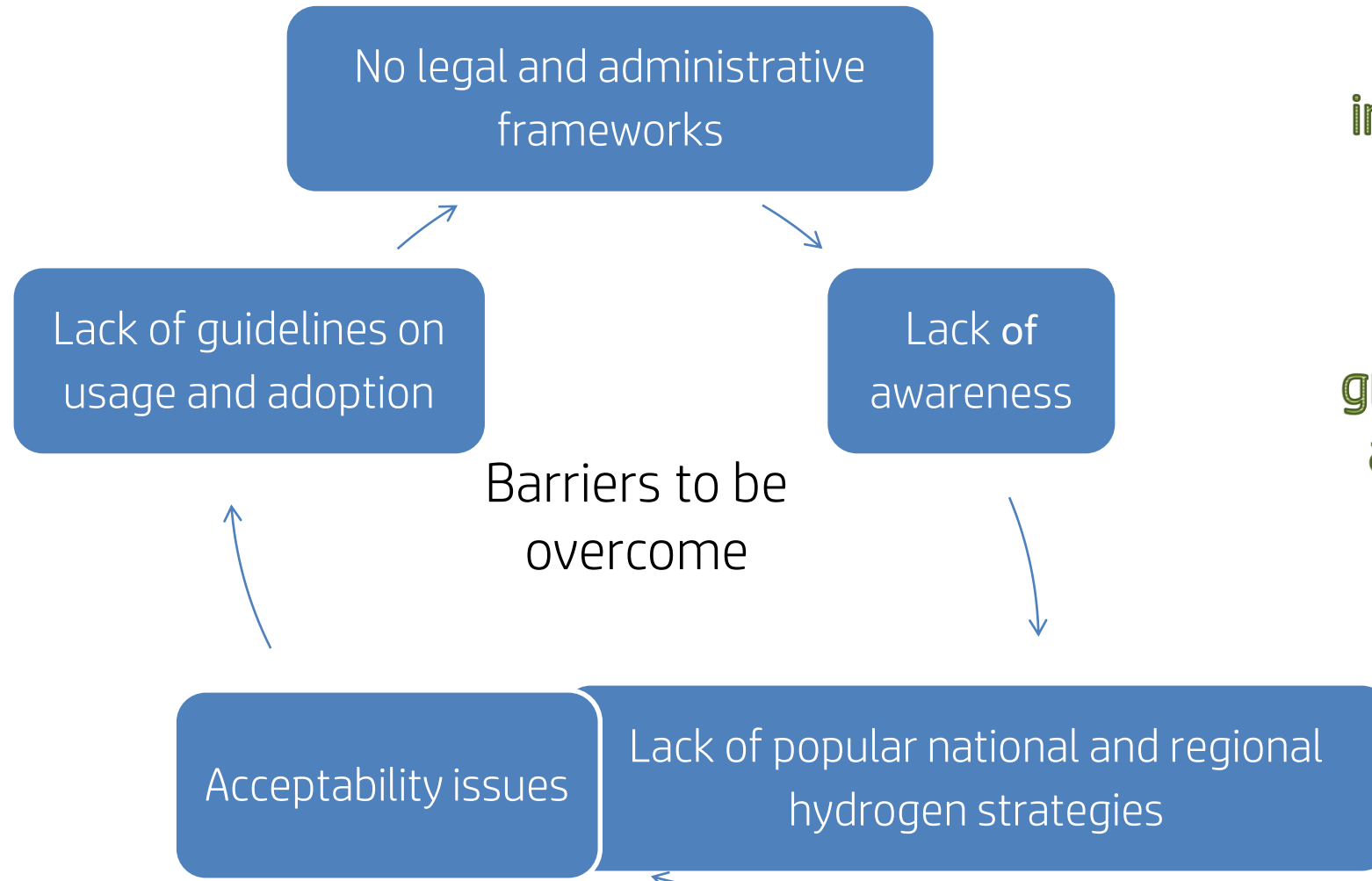
- Whereas many of the countries so far do not focus on green H₂ in their roadmaps/strategies because of lack of adequate RE capacities (they focus on imports), SSA have enormous opportunities for green H₂ production and can be a major global player beyond 2030.

- Though Agenda 2063 on the Africa we want alluded to climate action in goal 7 (environmental sustainability and climate resilient economies and communities), **not a single mention was given to hydrogen.**
- Only South Africa is making some progress in developing her H₂ strategy with funds committed to R&D, and industry-academia initiatives for the future, **no other SSA country is doing likewise as yet.**

Non economic barriers for hydrogen fuel adoption:

Similar Barriers were also identified in Europe for the deployment of hydrogen technologies and infrastructure in 2017

(Astiaso, 2017)



SSA must be intentional and set clearly defined roadmaps to green hydrogen adoption: 'GH Action Plan'

THANK YOU FOR LISTENING

