

Renewable energy potential and Nationally Determined Contributions (NDCs) in representative African countries

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Outline

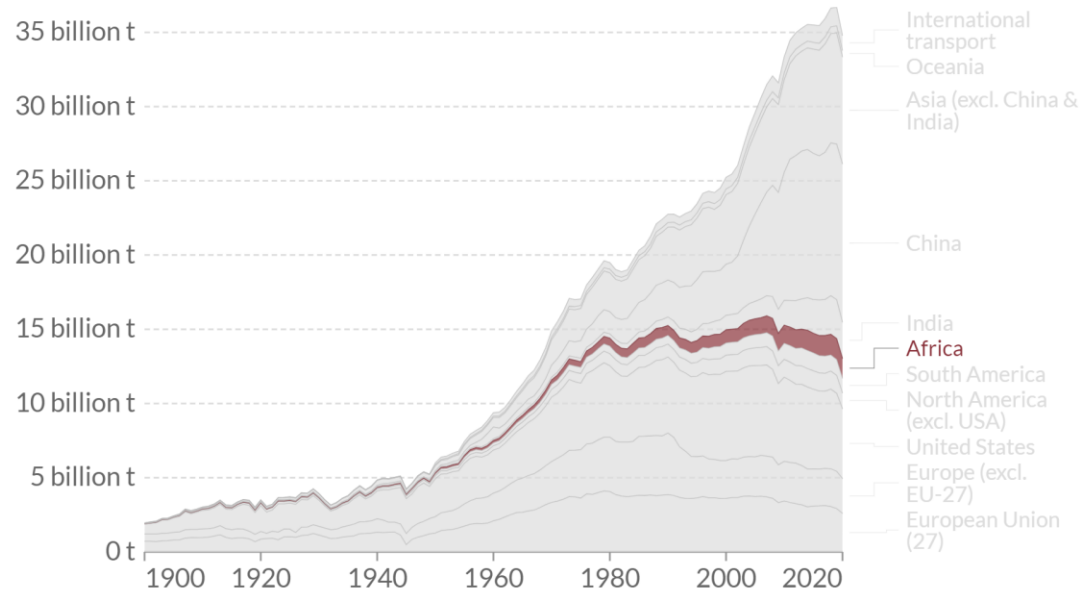
- Africa's share of World Emissions
- Access to electricity in Africa
- Net Zero targets of Africa and selected country
- Nationally Determined Contributions (NDCs) 国家自主贡献
- Resource Potential: Solar and Wind in Africa
- Energy model and synthesis result based on it
- Conclusions

Share of Emissions

- 非洲整体化石能源排放占全世界5%左右，
- 化石能源排放占世界的比重方面，南非不到2%，埃及不到1%，其他国家都不到0.5%
- 现阶段，非洲国家的减排对全世界整体的减排来说，效果和贡献是很有限的

Annual CO₂ emissions from fossil fuels, by world region

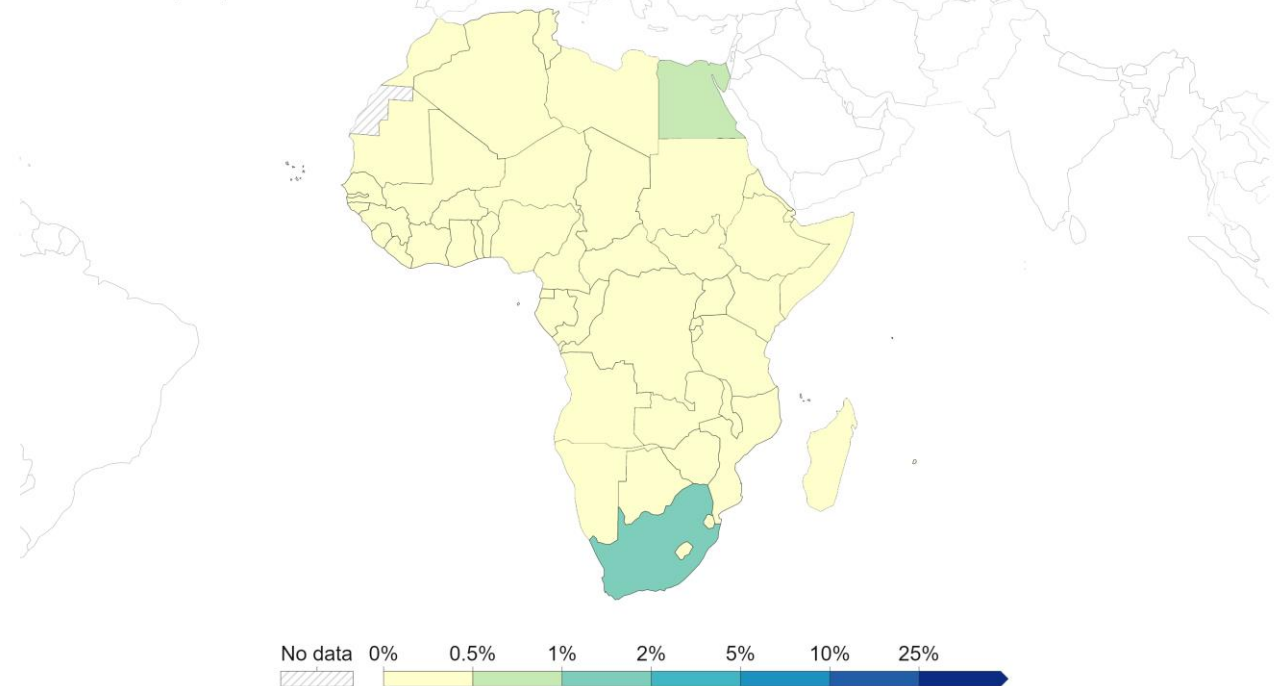
□ Relative



Source: Global Carbon Project OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY
Note: This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included.
'Statistical differences' (included in the GCP dataset) are not included here.

Annual share of global CO₂ emissions, 2020

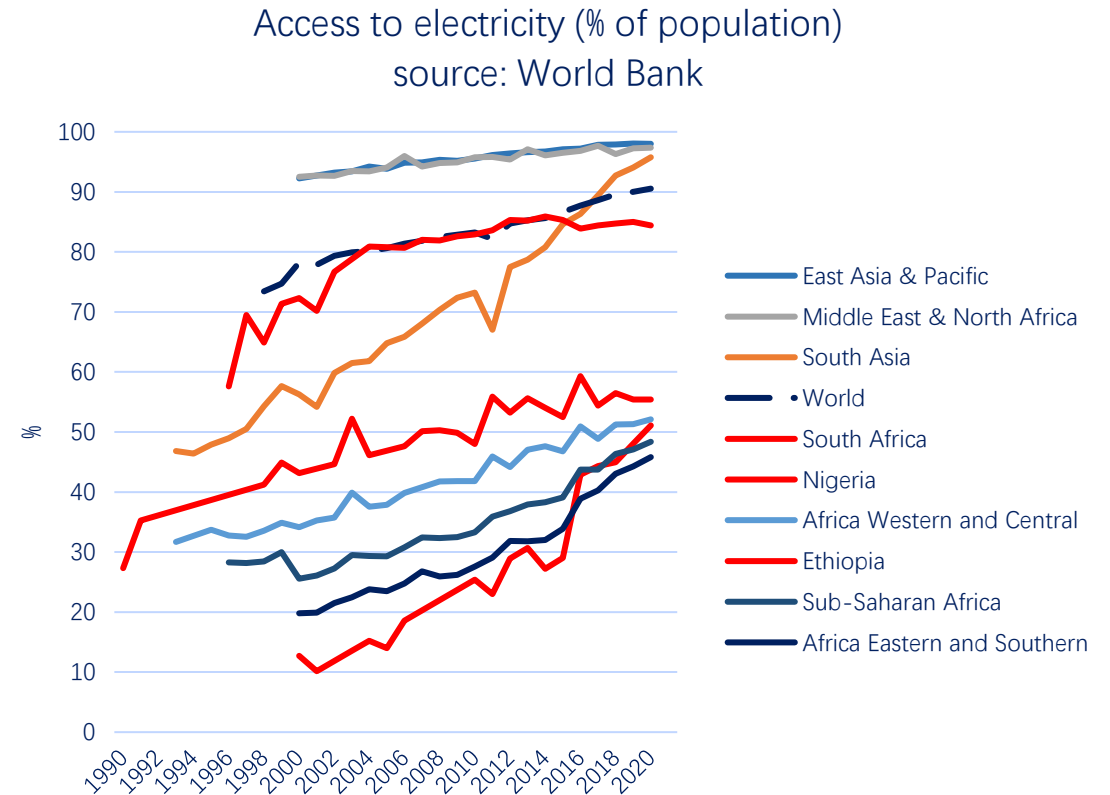
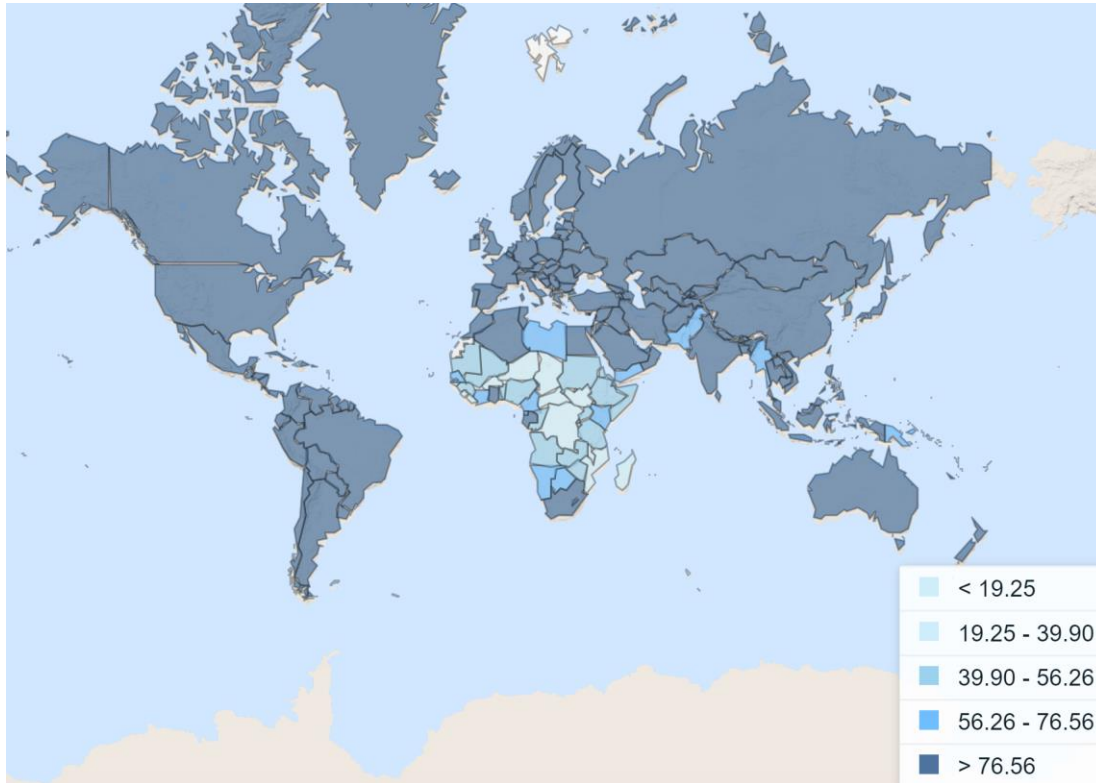
Carbon dioxide (CO₂) emissions from fossil fuels and industry. Land use change is not included.



Source: Our World in Data based on the Global Carbon Project OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY
Note: This is measured as each country's emissions divided by the sum of all countries' emissions in a given year plus international aviation and shipping (known as 'bunkers') and 'statistical differences' in carbon accounts.

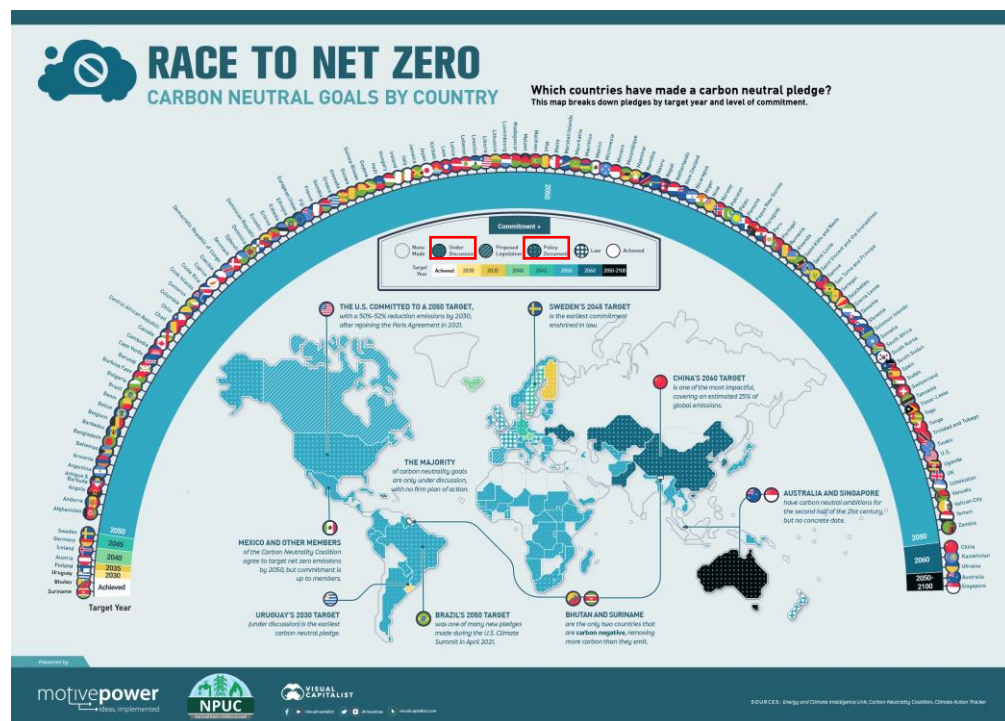
Access to electricity

- 非洲电力可及性在全球范围是一片洼地（左图）
- 非洲国家的电力可及性都在世界平均水平以下，很多国家远远落后（右图）
- 有南亚的参照，可及性提高速度可以更快
- 中国和非洲在电力生产、输电、配电及相关基础设施建造方面潜力巨大



Net Zero

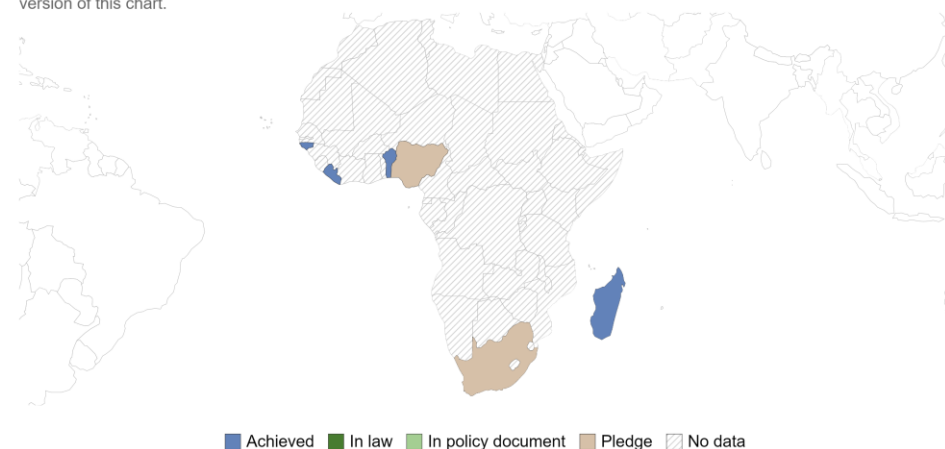
- 绝大多数非洲国家净零排放目标正在讨论中，只有南非给出了政策文件，去年年底尼日利亚也给出了一定的宣示。
- The vast majority of African countries have net-zero emission targets under discussion, and only South Africa has given a policy document. Last year Nigeria also gave a pledge.



Status of net-zero carbon emissions targets

The inclusion criteria for net-zero commitments may vary from country to country. For example, the inclusion of international aviation emissions; or the acceptance of carbon offsets.

To see the year for which countries have pledged to achieve net-zero, hover over the country in the interactive version of this chart.



Source: Net Zero Tracker. Energy and Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero. Last updated: 2nd November 2021.
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY

净零目标的比较

SOUTH AFRICA Comprehensiveness of net zero target design		
TARGET INFORMATION INCOMPLETE		
— Scope —		
Target year: 2050		
 Emissions coverage No information on the target's emission coverage	 International aviation and shipping No information on the target's intention to cover international aviation and shipping	 Reductions or removals outside of own borders Provides no information on intention to use international offset credits to meet net zero
— Architecture —		
 Legal Status Net zero target announced	 Separate reduction & removal targets No information on intention to separate emission reduction and removal targets	 Review Process Country provides no information on its intention to establish a review cycle for its net zero and intermediate targets (note: this option applies to countries that have only announced a target, with no accompanying law / policy)
— Transparency —		
 Carbon dioxide removal No information on intention to communicate transparent assumptions on carbon dioxide removals	 Comprehensive planning Country provides no information on anticipated pathways or measures	 Clarity on fairness of target Country provides no information on its intention to explain the target's fairness.

climateactiontracker.org September 2022 Update

NIGERIA Comprehensiveness of net zero target design		
AVERAGE		
— Scope —		
Target year: 2050-2070		
 Emissions coverage Target covers emissions / sectors partially (above 95% coverage)	 International aviation and shipping The target excludes both international aviation and shipping	 Reductions or removals outside of own borders Plans to reach net zero through domestic actions and no removals outside borders
— Architecture —		
 Legal Status Net zero target in proposed legislation or in a policy document	 Separate reduction & removal targets No separate emission reduction and removal targets	 Review Process Legally binding process to review the net zero target
— Transparency —		
 Carbon dioxide removal No transparent assumptions on carbon dioxide removals	 Comprehensive planning Some information on the anticipated pathway or measures for achieving net zero is available, but with limited detail.	 Clarity on fairness of target Country makes no reference to fairness or equity in the context of its net zero target

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南非仅仅提出了到2050年净零排放的目标，其他信息并不明确

South Africa states its intention to commit to a **net zero CO2 target** ("**net zero carbon emissions**") **by 2050** as part of a visionary statement in its LTS (Republic of South Africa, 2020).

尼日利亚一开始提出了到2060年净零排放的目标，后更改为2050-2070年实现净零排放的目标。

After announcing a **2060 net zero target** at the Cop26 climate talks in Glasgow, president Muhammadu Buhari signed into law a climate bill committing his government to produce a sweeping plan to reduce emissions, adapt to climate change and set annual and five-year carbon budgets.

During COP26, Nigeria committed to achieve net-zero by 2060, and barely a week after the conference, President Muhammadu Buhari signed into law the Climate Change Act, 2021 (the Act), which was passed by the National Assembly in October 2021.

In November 2021, Nigeria passed the Climate Change Act, which seeks to achieve low greenhouse gas emission green and sustainable growth by providing a framework to set a net zero GHG target **between 2050 and 2070.**

国家自主贡献 NDC

- 目前，绝大多数撒哈拉以南非洲国家的NDC给出的是相对量减排，只有三个国家给出绝对量减排目标，两个国家给出的是排放峰值目标，另外七个国家只报告了政策和行动。
- Currently, the vast majority of Sub-Saharan African countries' NDCs give relative emission reductions, only three countries give absolute emission reduction targets, two countries give peak emission targets, and seven other countries report only policies and actions.

地区	country	减缓类型	减缓目标
Sub-Saharan Africa	Angola	相对量减排	无条件35%，有条件50%
Sub-Saharan Africa	Benin	相对量减排	无条件：3.5%； 有条件：17.9%
Sub-Saharan Africa	Botswana	绝对量减排	15.00%
Sub-Saharan Africa	Burkina Faso	相对量减排	无条件：11.6%； 有条件：18.2%
Sub-Saharan Africa	Burundi	相对量减排	无条件：3%； 有条件：20%
Sub-Saharan Africa	Cabo Verde	政策和行动	30%的可再生能源目标，得到国际支持后100%
Sub-Saharan Africa	Cameroon	相对量减排	32.00%
Sub-Saharan Africa	Central African Republic	相对量减排	到2030年将达到5%，到2050年将达到25%；在国际支持下增加
Sub-Saharan Africa	Chad	相对量减排	无条件：18.2%； 有条件：71%
Sub-Saharan Africa	Comoros	相对量减排	84.00%
Sub-Saharan Africa	Congo	相对量减排	2025年减排48%，2035年减排55%
Sub-Saharan Africa	Congo_the Democratic Republic of the	相对量减排	17.00%
Sub-Saharan Africa	Cote d'Ivoire	相对量减排	28.00%
Sub-Saharan Africa	Djibouti	相对量减排	40.00%
Sub-Saharan Africa	Equatorial Guinea	绝对量减排	20.00%
Sub-Saharan Africa	Eritrea	相对量减排	无条件：39.2%； 有条件：80.6 %
Sub-Saharan Africa	Ethiopia	相对量减排	64.00%
Sub-Saharan Africa	Gabon	相对量减排	至少50%
Sub-Saharan Africa	Gambia	相对量减排	2025减排44.4%，2030减排45.4%
Sub-Saharan Africa	Ghana	相对量减排	无条件下比BAU减排15%，有条件下比BAU减排45%
Sub-Saharan Africa	Guinea	绝对量减排	13.00%
Sub-Saharan Africa	Guinea-Bissau	政策和行动	N/A
Sub-Saharan Africa	Kenya	相对量减排	30.00%
Sub-Saharan Africa	Lesotho	相对量减排	与照常情景相比减排10%，在获得支持条件下，减排35%
Sub-Saharan Africa	Liberia	相对量减排	2030年减排10%，2050年实现碳中和
Sub-Saharan Africa	Madagascar	相对量减排	32.00%
Sub-Saharan Africa	Malawi	政策和行动	N/A
Sub-Saharan Africa	Mali	相对量减排	农业方面排放减少29%，能源31%，森林21%
Sub-Saharan Africa	Mauritania	相对量减排	无支持条件下减排10%，在获得支持条件下，减排35%
Sub-Saharan Africa	Mauritius	相对量减排	30.00%
Sub-Saharan Africa	Mozambique	政策和行动	N/A
Sub-Saharan Africa	Namibia	相对量减排	89.00%
Sub-Saharan Africa	Niger	相对量减排	无支持条件下减排3.5%，有支持条件下减排34.6%
Sub-Saharan Africa	Nigeria	相对量减排	无条件减排20%，有支持条件下减排45%
Sub-Saharan Africa	Rwanda	政策和行动	N/A
Sub-Saharan Africa	Sao Tome and Principe	相对量减排	24.00%
Sub-Saharan Africa	Senegal	相对量减排	无条件下减排5% 有支持条件下减排21%
Sub-Saharan Africa	Seychelles	相对量减排	2025减排21.4%，2030减排29%
Sub-Saharan Africa	Sierra Leone	碳排放峰值	排放量不超过7.58 MtCO2e
Sub-Saharan Africa	Somalia	政策和行动	N/A
Sub-Saharan Africa	South Africa	碳排放峰值	2025-2030年排放峰值在398 Mt CO2-eq和614 Mt CO2-eq之间
Sub-Saharan Africa	Sudan	政策和行动	N/A
Sub-Saharan Africa	Swaziland	政策和行动	可再生能源占比增加200%
Sub-Saharan Africa	Tanzania_United Republic of	相对量减排	10-20%
Sub-Saharan Africa	Togo	相对量减排	无条件减排11.14%，有支持条件下减排31.14%
Sub-Saharan Africa	Uganda	相对量减排	与BAU相比，2030的温室气体减少22%
Sub-Saharan Africa	Zambia	绝对量减排	无支持条件下减排25%，有支持条件下减排47%
Sub-Saharan Africa	Zimbabwe	碳强度下降	碳强度降低33%
Sub-Saharan Africa	South Sudan	政策和行动	N/A



NDC: South Africa

第二次的提交在2021年9月，包含了所有温室气体的定量目标

 South Africa	South Africa First NDC (Updated submission)	English		2	Active	27/09/2021
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SOUTH AFRICA'S LOW-EMISSION DEVELOPMENT STRATEGY 2050

February 2020

- **The National Development Plan (NDP):** With an overarching objective of eliminating poverty and reduce inequality by 2030, the NDP outlines a set of goals and actions to meet the country's environmental sustainability and resilience needs, and dedicates a full chapter to "Environmental Sustainability – An equitable transition to a low-carbon economy".
- **The National Climate Change Response Policy (NCCRP)** represents government's comprehensive policy framework for responding to climate change, including provisions for adaptation and mitigation.
- **The Climate Change Bill** (forthcoming) will form the legislative foundation for the climate change adaptation and mitigation response. With respect to mitigation, the Bill provides for future review and determination of the national greenhouse gas emissions trajectory; determination of sectoral emissions targets for emitting sectors and subsectors; and allocation of carbon budgets. It also makes provision for the development of plans to phase down or phase out the use of synthetic greenhouse gases – in line with the Kigali Amendments to the Montreal Protocol.

Table 2 - South Africa's updated NDC mitigation targets

Year	Target	Corresponding period of implementation
2025	South Africa's annual GHG emissions will be in a range from 398-510 Mt CO ₂ -eq.	2021-2025
2030	South Africa's annual GHG emissions will be in a range from 350-420 Mt CO ₂ -eq.	2026-2030

Targets have been set on the assumption that support will be provided to South Africa as a developing country as set out in the Paris Agreement's Articles 9, 10, 11 and 13 for implementation of the targets, for the required just transition policies and measures, and for both developing capacity to report on implementation and achievement of the targets.

SOUTH AFRICA FIRST NATIONALLY DETERMINED CONTRIBUTION UNDER THE PARIS AGREEMENT

Updated September 2021



NDC: Nigeria



cut emissions by **20%** below the “business as usual” levels by **2030**.

The reductions can be increased to **47%** if the country gets “financial assistance, technology transfer and capacity building from the more advanced and more willing international partners,”

临时目标Type of interim target

BAU REDUCTION

Other information

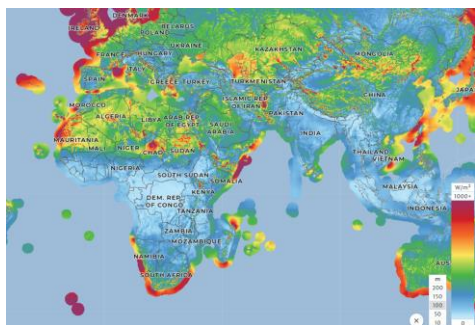
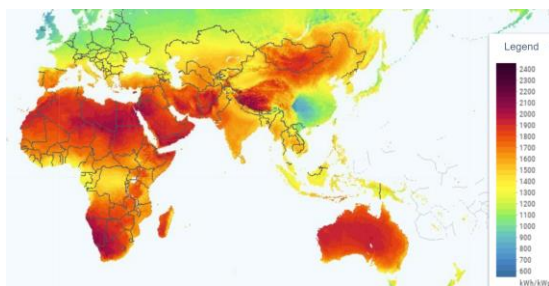
NOT SPECIFIED

Form: PLEDGE 形式: 宣示

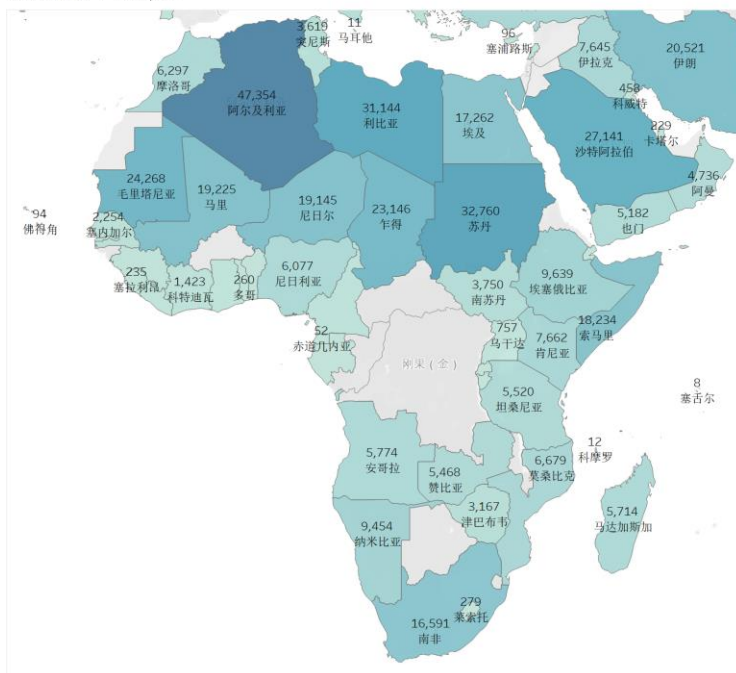
Resource Potential: Solar and wind

Source: WRI and GEIDCO.
Wind Atlas, Solar Atlas.

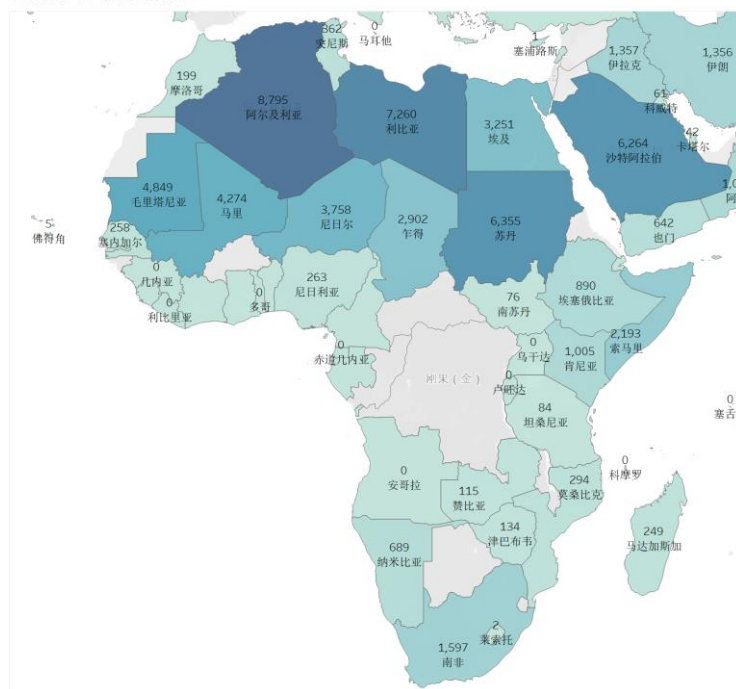
北非资源最丰富，但是撒哈拉以南非洲也有不错的资源，开发可再生能源有不错的前景。



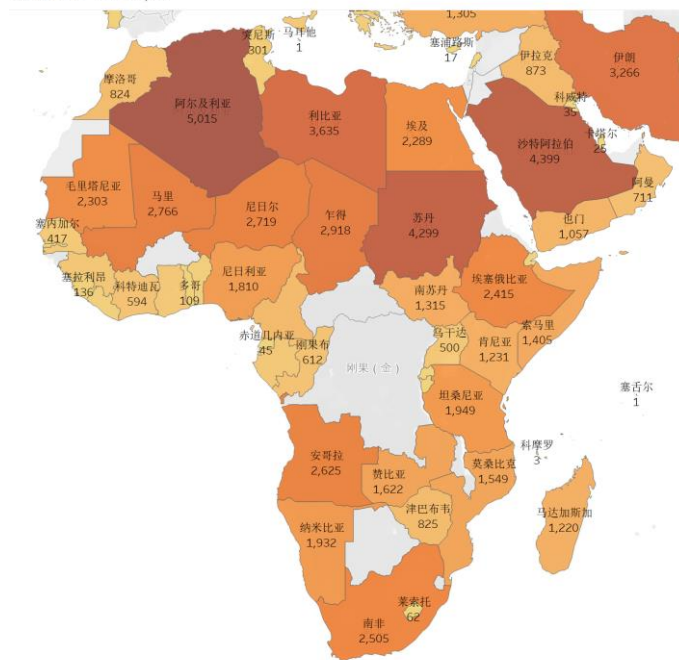
风蕴藏量 (TWh/a)



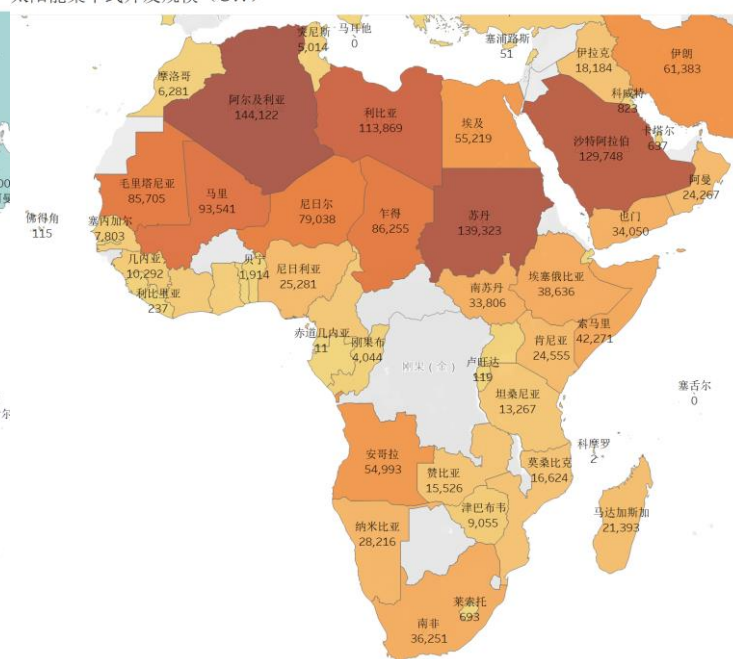
风电集中式开发规模 (GW)



光蕴藏量 (TWh/a)



太阳能集中式开发规模 (GW)

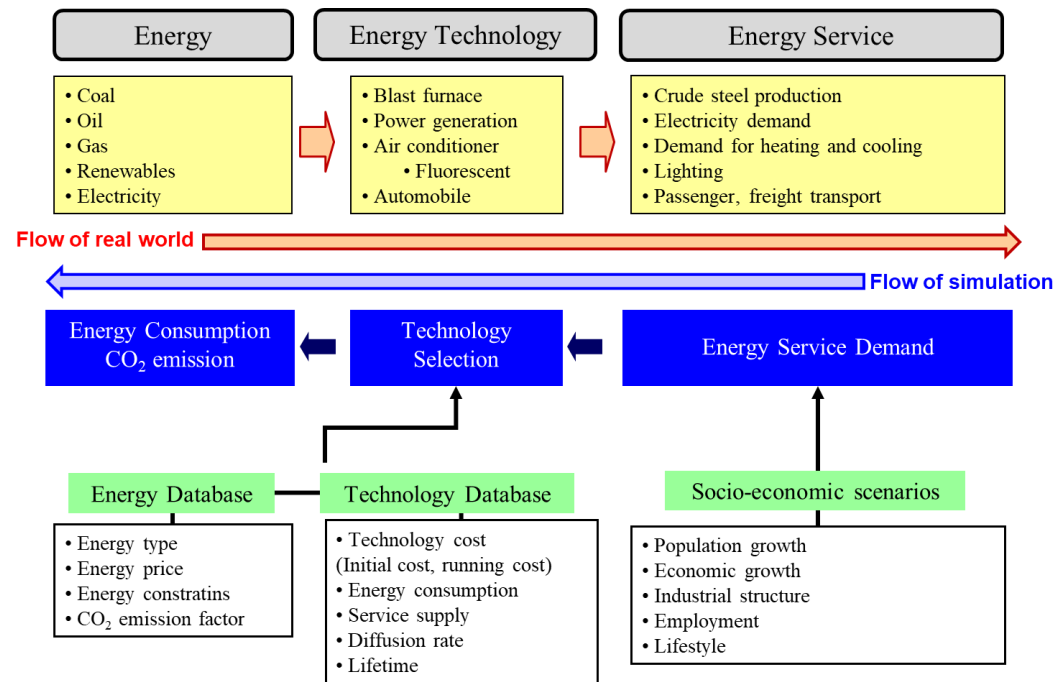


研究及方法学

One research and its methodology

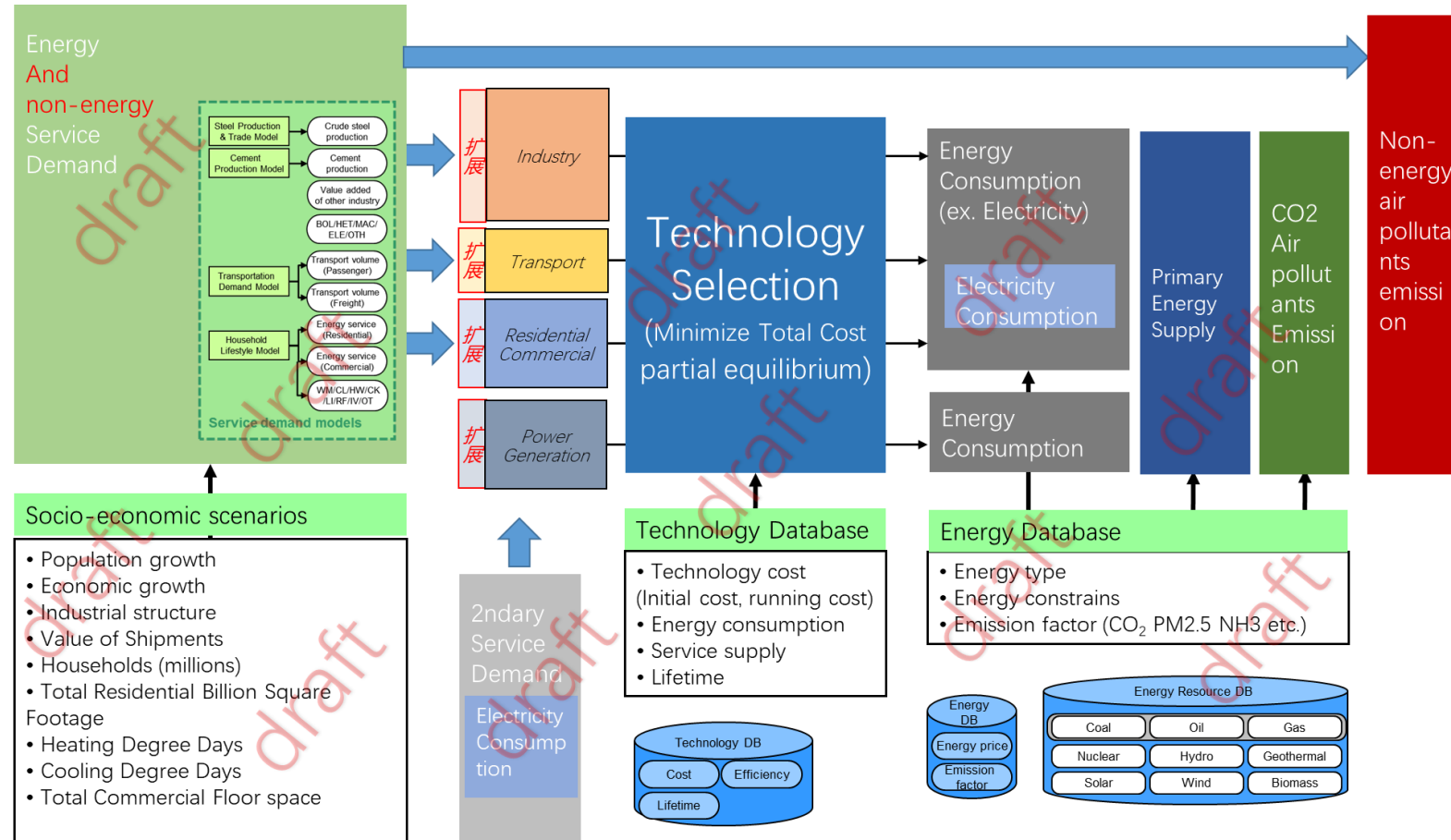
- 寻找现有的学术机构、智库关于某个国家能源情景的研究
- 从情景中提取数据（各能源品种的发电量）
- 通过对比观察，发现可能的结论
- Find existing studies made by academic institutions, think tank on energy scenarios for a given country
- Extract data from the scenarios (generation of electricity by fuel)
- Discover possible conclusions through comparative observations

Overview of one model's logic: AIM/Enduse



- 在真实世界，逻辑顺序是从左往右，能源经过能源的技术转化为能源服务。
- 而模型中的逻辑，是通过社会经济的情景，去匡算能源服务的需求，通过选择技术，再得到能源消费和二氧化碳的排放。

Overview of one model's structure: IPAC/RENAM

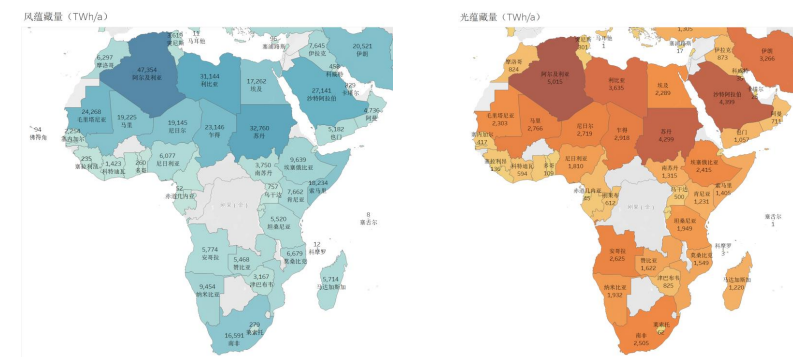
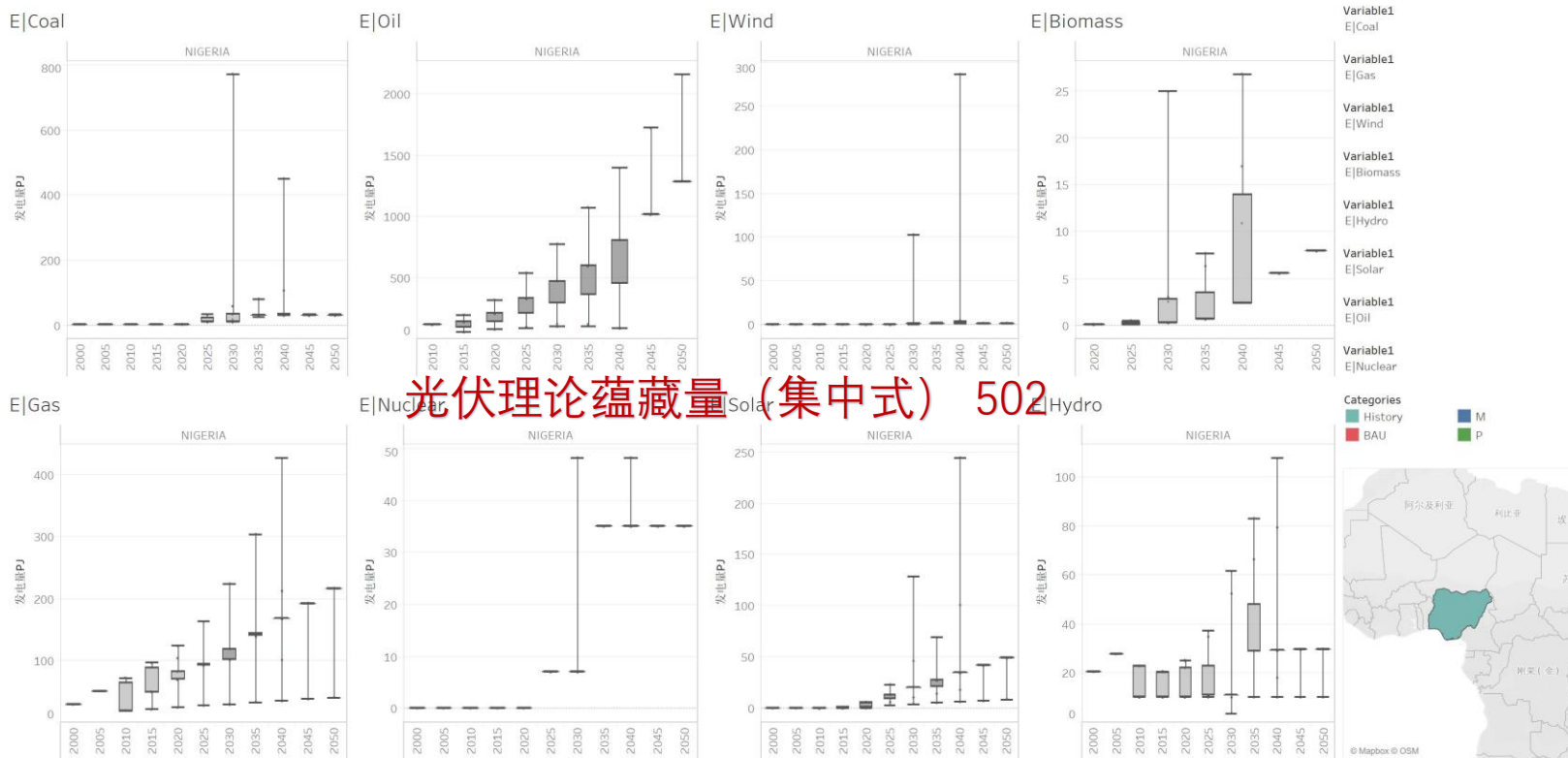


模型结果综述(发电量): 尼日利亚

Synthesis of model results: Nigeria

风电理论蕴藏量 (集中式) 1688

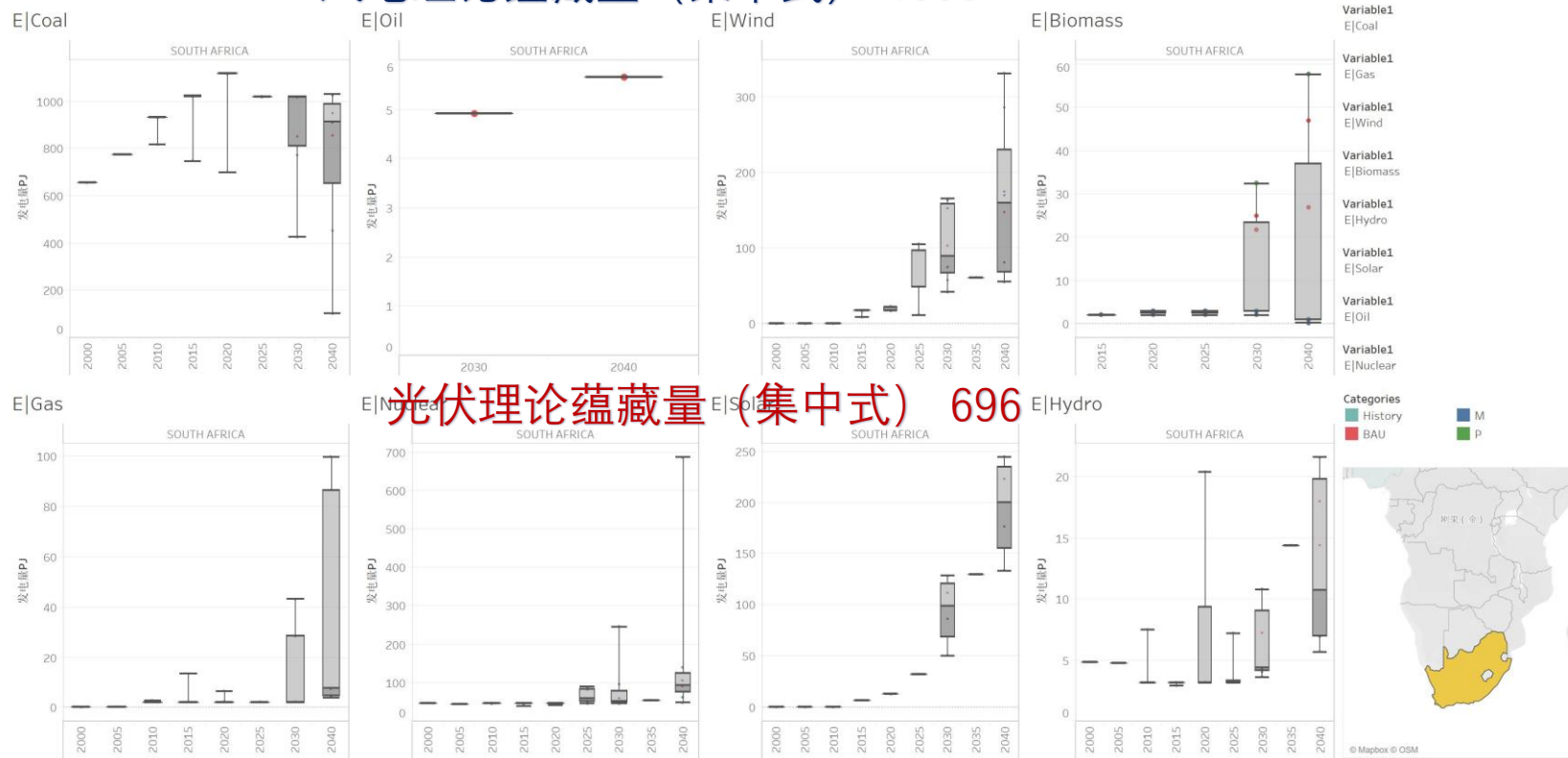
- 油电是主导能源品种，这对实现NDC是一个重要的挑战。
- 风电光伏资源虽然相比其他国家不丰富，但是，可开发的量仍然很多。
- 对于风电，只有个别的情景认为到2040年可以发展到300PJ左右，其余的情景都没有太多风电的预期。
- 对于光伏，只有个别情景认为2040年可以发展到250PJ，其他情景均不超过50PJ，可见发展空间还是非常大。



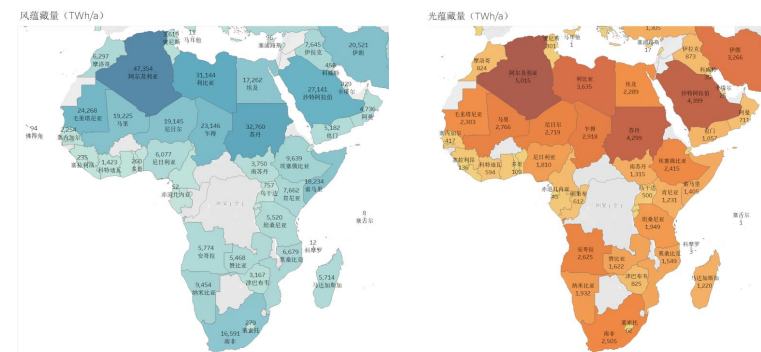
模型结果综述(发电量): 南非

Synthesis of model results: South Africa

风电理论蕴藏量 (集中式) 4608



- 得益于未来预期中煤电的大幅度下降, 南非有望实质性的实现NDC。
- 但是电力的缺口, 包括电力可及性缺口和因为控制煤电带来的存量缺口, 将靠光伏、风电来完成。
- 与南非较丰富的风电资源相比现有预期都比较保守。光伏发电最乐观的估计2050年也仅仅到理论蕴藏量的四成。



结论

key takeaways

- 非洲整体正处于经济、社会、电力系统发展较为初级的阶段
- Africa as a whole is at a relatively early stage of economic, social and power system development
- 非洲国家当前的第一要务是发展、公平发展、可持续发展
- The current first priority of African countries is development, equal development, and sustainable development
- **对多数非洲国家来说，现阶段NDC并不适合有太多的约束**
- **NDC should not set too many constraints for most African countries at this stage**
- 要实现可持续发展，能源系统（尤其是电力系统）非常关键
- Energy systems (especially power systems) are critical to achieving sustainable development
 - 能源系统的发展可以提高电力的可及性，这是生活、工业、电力交通等部门的基础
 - Improving access to electricity: the basis for domestic, industrial, and electric transportation
 - 采用风、光等可再生能源，减少化石能源使用以及由此带来的碳排放
 - Adopting renewable energy sources such as wind and solar, reducing fossil energy use and the resulting carbon emissions

结论 (续)

key takeaways (continued)

- 对尼日利亚、南非来说
 - 随着技术的进步，可以更加激进的光伏、风电部署
 - 有利于NDC的实施，做出更有雄心的承诺
 - 有利于经济和能源发展
- For Nigeria, South Africa
 - More ambitious deployment of PV and wind power is possible
 - Facilitates more ambitious commitments by NDC
 - One good economic and energy system develop driver



Thank you for your attention!