Zoning in the SPLAT Africa Model

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Role of long-term planning in Africa

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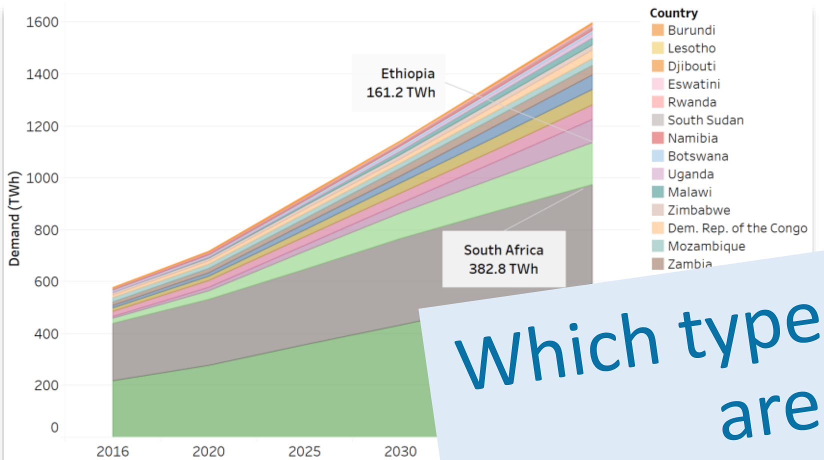
Demand **growth** in the region…

Electricity demand projections from 2015 to 2040, by country (GWh)

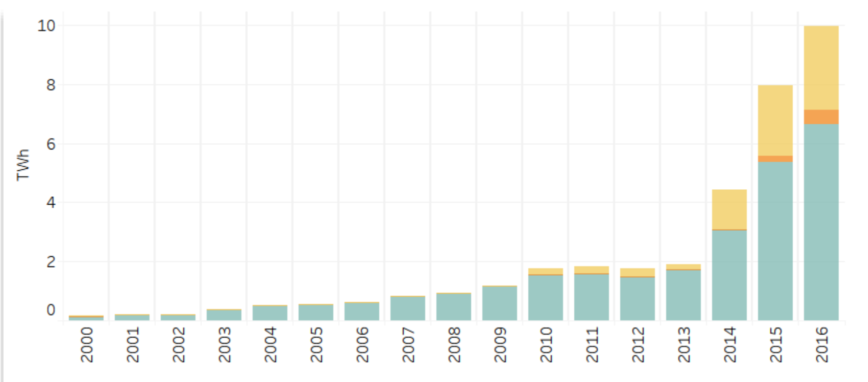


… a **deficit** in generation capacity

Peak demand and capacity mix timeline including committed plants and retirement schedule of existing plants, 2020-2040

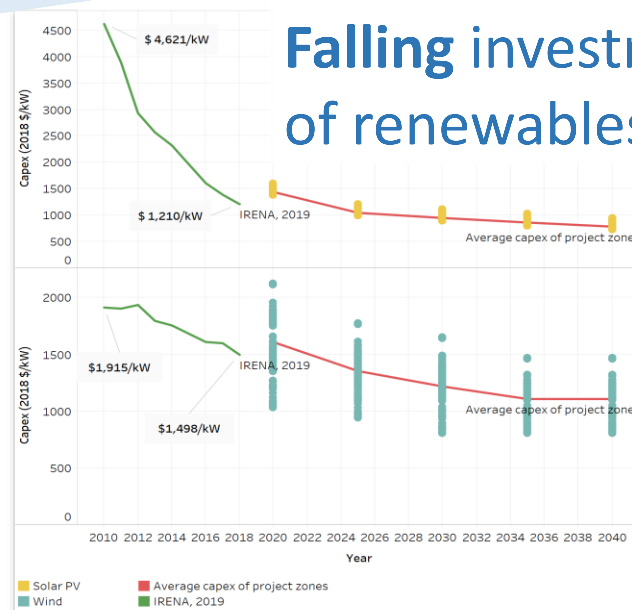
Which types of **investments** are needed?

Increasing power generation from solar and wind

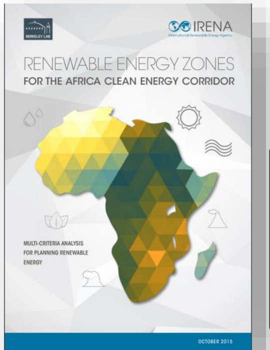


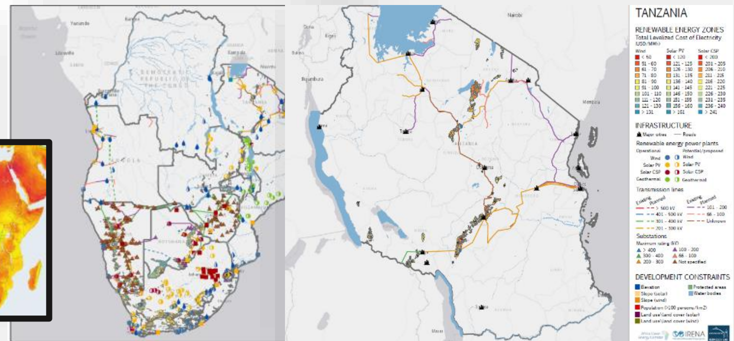
Electricity generation by VRE sources from 2000 to 2016.

Falling investment costs of renewables

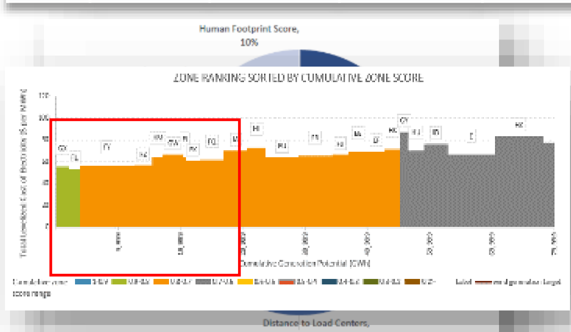


Identifying solar and wind investment options





ZONE name	Installed Capacity (MW)	Annual Electricity Generation (MWh)	Distance to transmission (m)	Distance to substation (m)	Distance to road (m)	Distance to load center (m)	Mean resource quality (W/m2)	Mean capacity factor
A	45	78,614	56,977	75,017	2,109	89,098	216	19.94%
B	40	70,411	6,113	1,952	2,023	32,998	219	20.22%
C	288	502,675	23,714	75,465	3,582	71,495	216	19.92%
D	127	221,837	13,143	50,908	5,906	46,123	217	19.98%
E	87	153,284	1,023	3,497	235	47,788	218	20.11%



Zoning

- Can develop clusters of VRE sites (or "zones") as explicit options for investment
- Currently covers wind, solar PV, CSP in East and Southern Africa
- 2,542 solar PV zones and 1,525 wind zones
- Includes a multicriteria scoring tool to evaluate the desirability of zones -> Identification of RE-zones with specific techno-economic parameters & generation profiles
- mapre.lbl.gov

Multicriteria scoring:

Distance to transmission
LCOE
Capacity value

186 solar PV zones
149 wind zones

Integrating investment options

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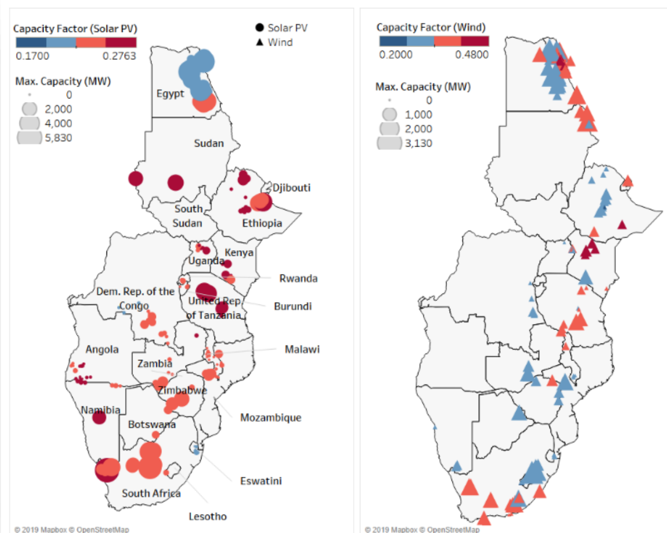
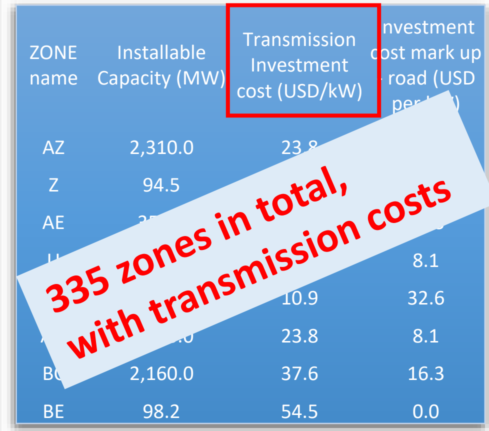
System PLAnning Test (SPLAT)

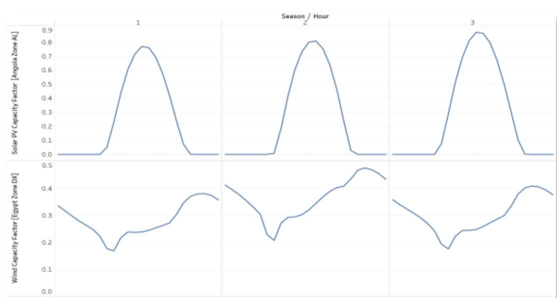
- Defines operation and investment schedule that minimise total discounted system costs (investment, O&M, fuel, other user-defined costs) over the planning period (to 2050)
- System output/configuration meets specified requirements (e.g. supply-demand match, capacity availability) and constraints (e.g. reserve margin, policy targets)
- Can be used to extend power sector analysis to cover the entire energy sector, including heat and transport
- Can apply linear and mixed-integer optimisation techniques

Zone-specific parameters and profiles





Temporal granularity – seasonal and diurnal



Example of a solar zone in Angola and a wind zone in Egypt

3 seasons, 10 time slices/day

The importance of spatial and temporal resolutions

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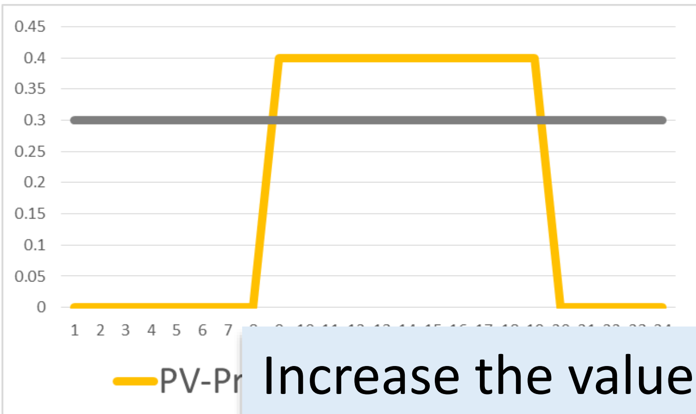
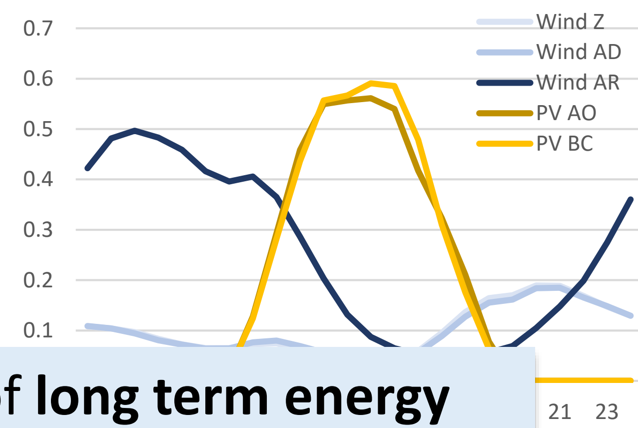
low resolution

HIGH resolution

Temporal

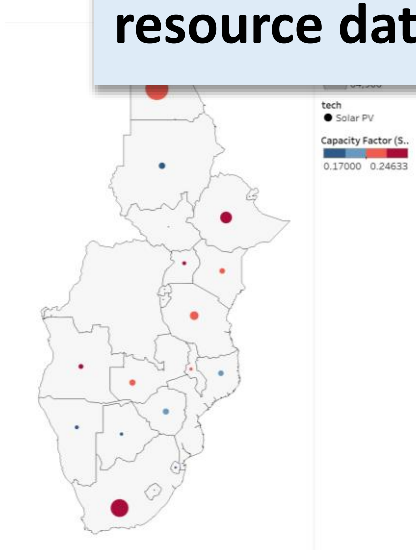


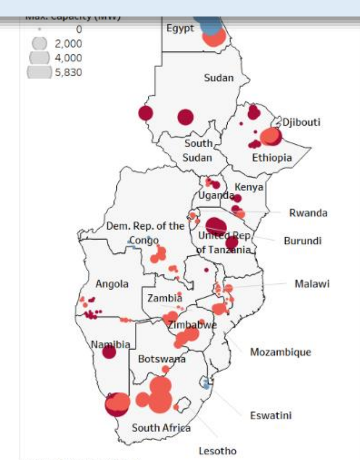


Realistic representation of VRE technologies

Increase the value of **long term energy system planning** using **more detailed RE resource data**

Geospatial





Detailed investigation of investment options

Visualising generation options in detail

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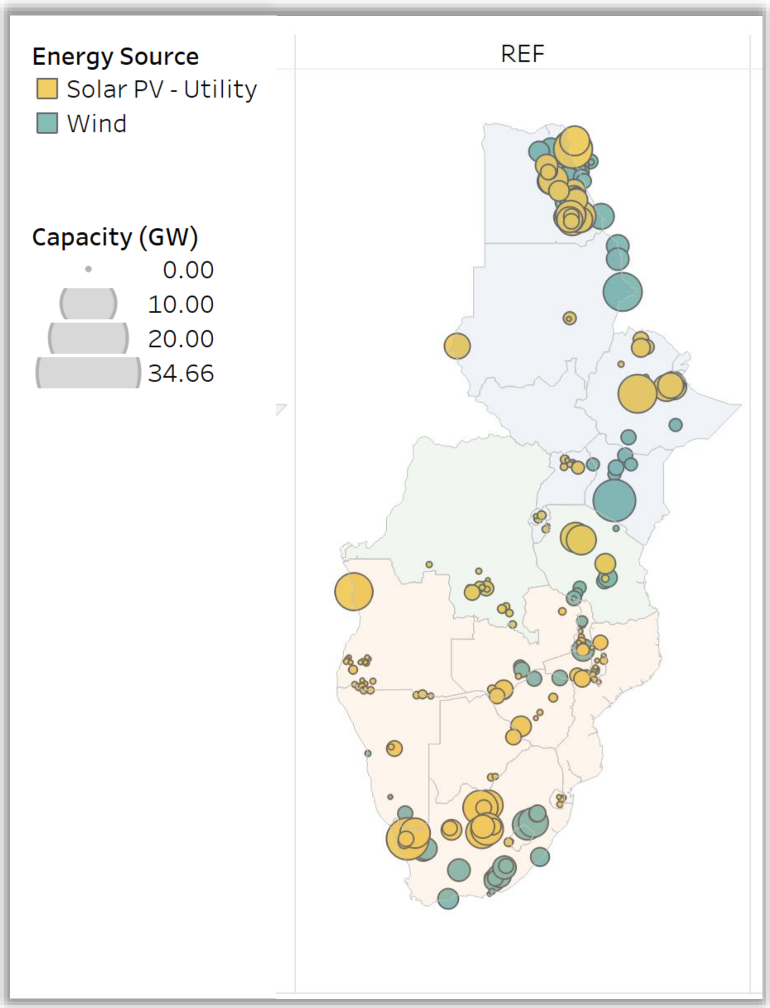
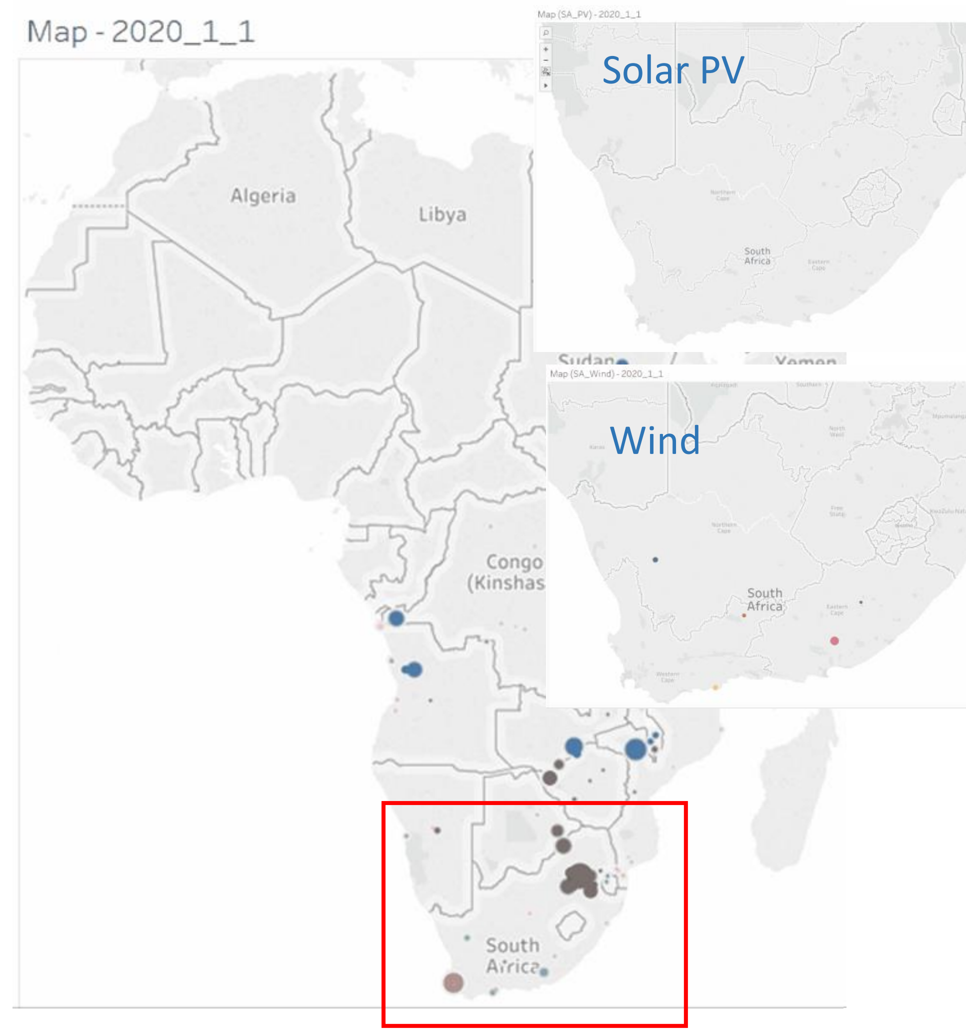
Capacity

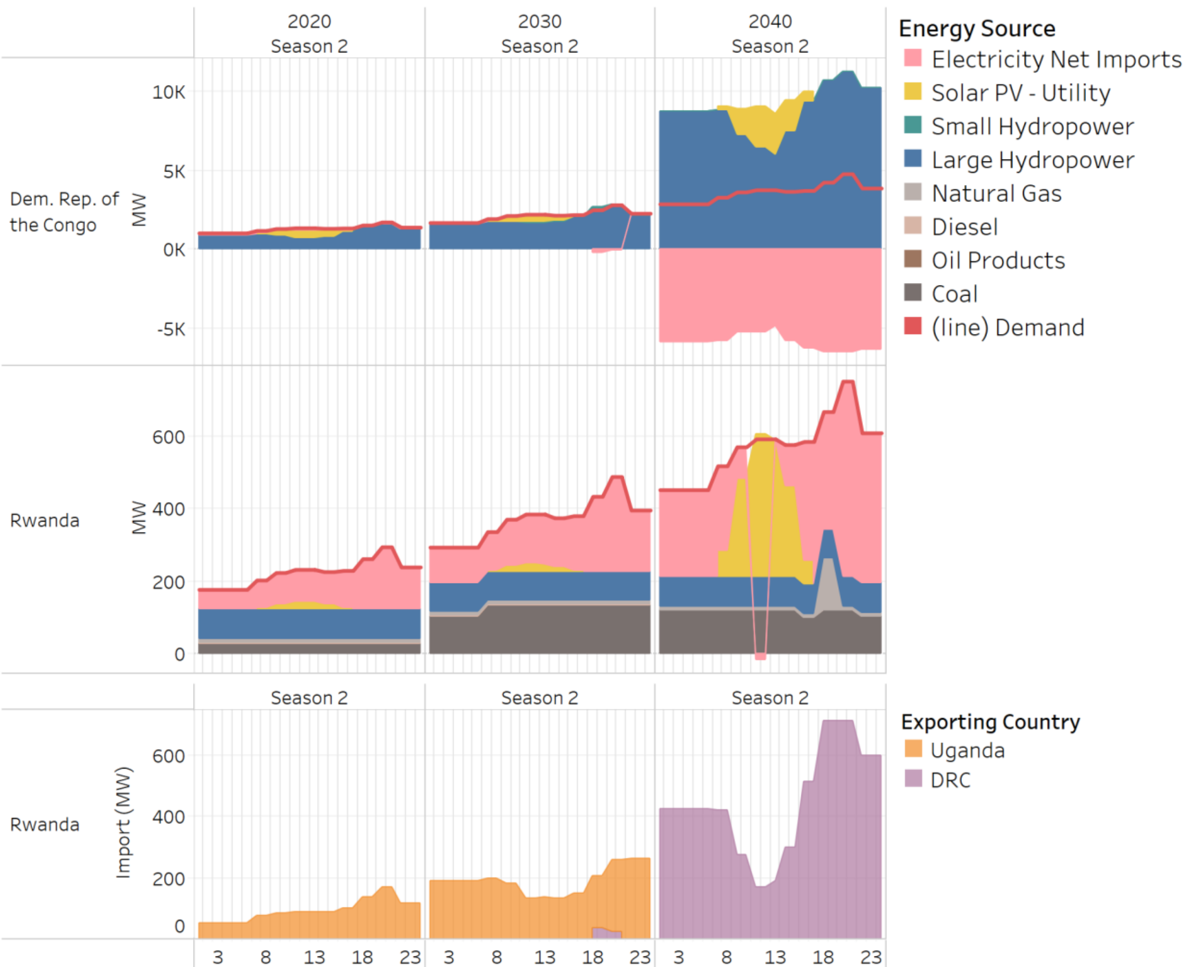


Generation



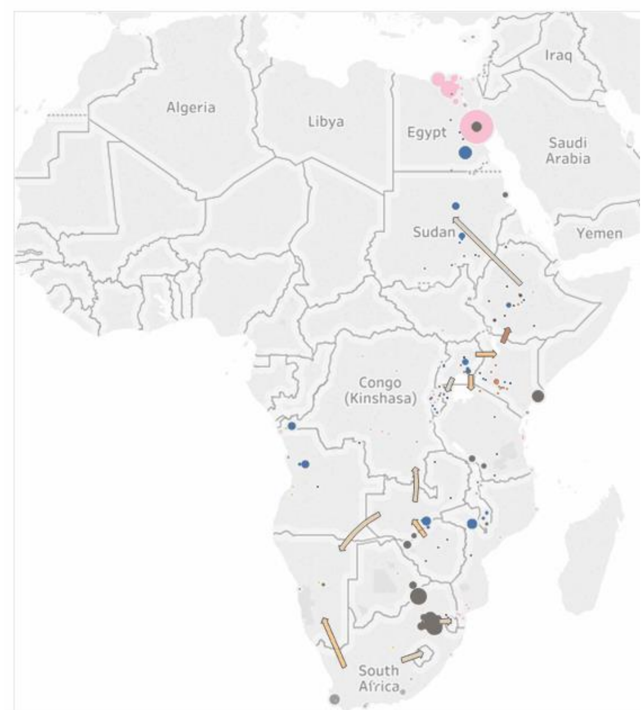
Cost-effective VRE projects are **geographically dispersed**

The temporal element: complementary profiles and trade



Rwanda – DRC example:
High volumes of hydropower production at night can be exported to Rwanda, when there is a supply gap in Rwanda from the absence of domestic solar power generation.

Generation and Trade - 2020_1_2



Thank you for your attention

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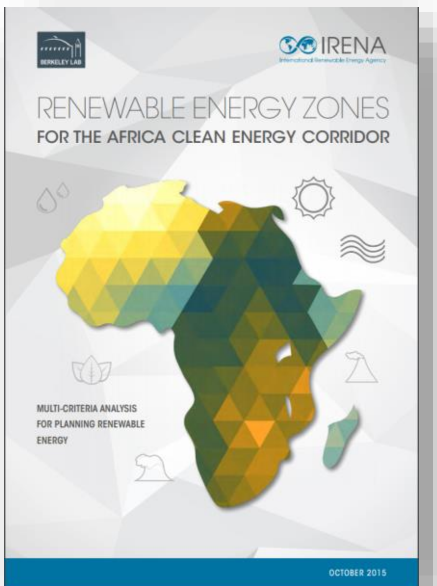
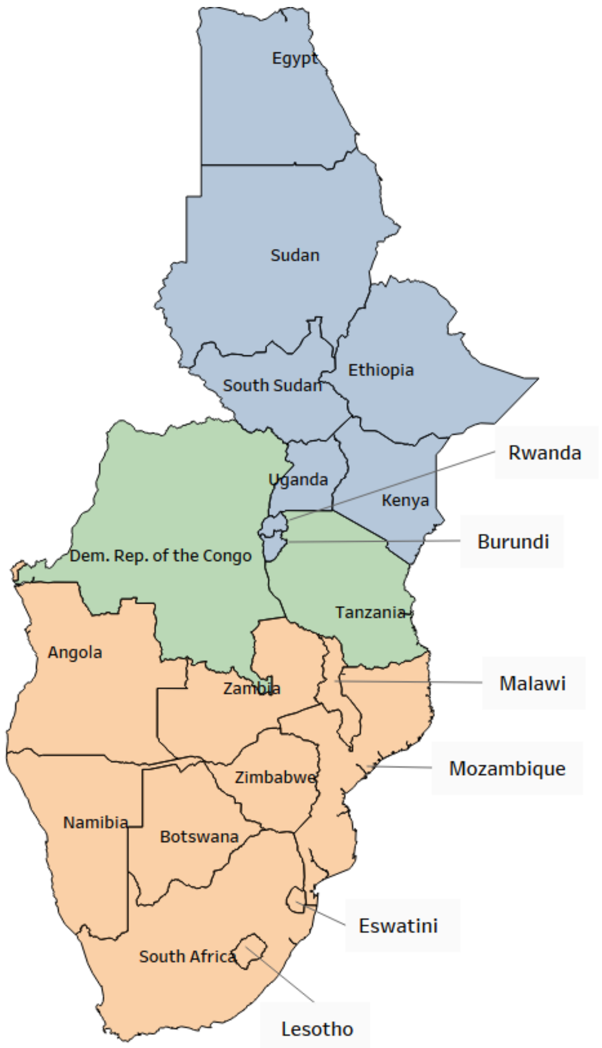
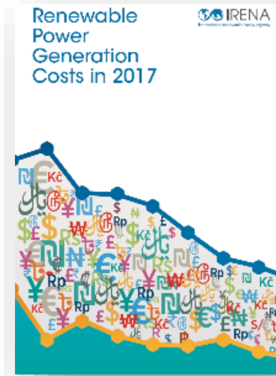
Appendix

SPLAT Model Inputs

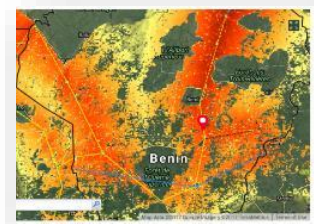
Renewable Energy Zones







Cost study



Global Atlas

Infrastructure data (master plans, Platts data)

ACEC scenarios analysis

The scenarios explore the implications of :

1. Varying degrees of variable renewable energy (VRE) share in regional power generation (20%/x%/50%),
2. Changes in the availability of hydro resources (delayed hydro, dry year), and
3. The degree of regional integration of power systems.

Results include:

- **General investment outlook**
  - capacity and generation mix
  - Transmission infrastructure needs
  - Resulting Carbon dioxide
  - System costs
- **Most robust project sites for solar PV and wind**
- **Interlinkages between trade and solar PV and wind penetration**

Model Development

Stepwise increase of the model detail to implement the RE Zones

The basic model

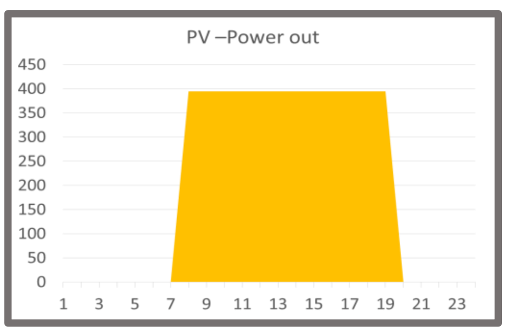
Simplified representation of demand profiles and RE resources

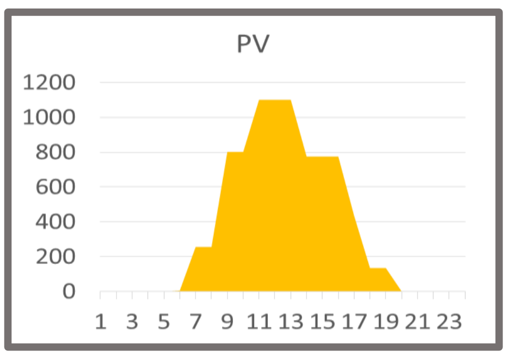
Increased temporal resolution

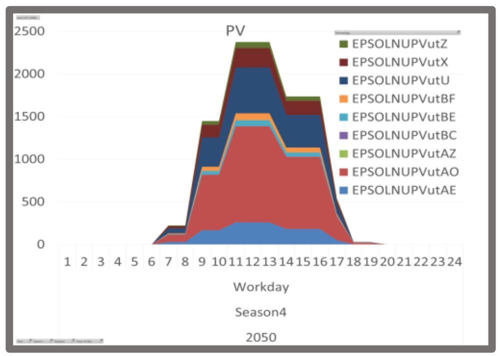
More detailed temporal breakdown of demand, PV and wind profiles

Geo-spatial planning

RE-Zones representing site specific characteristics







Vast opportunities of VRE

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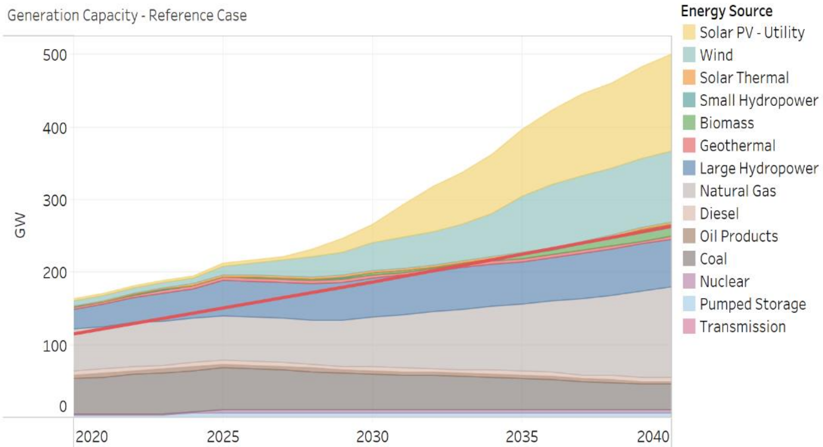
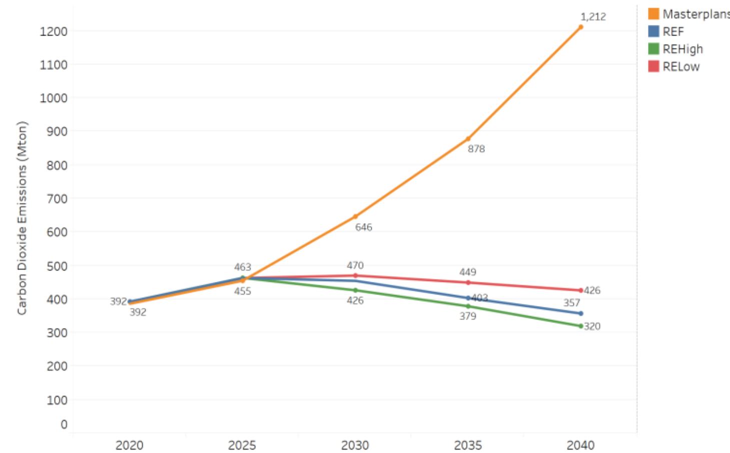
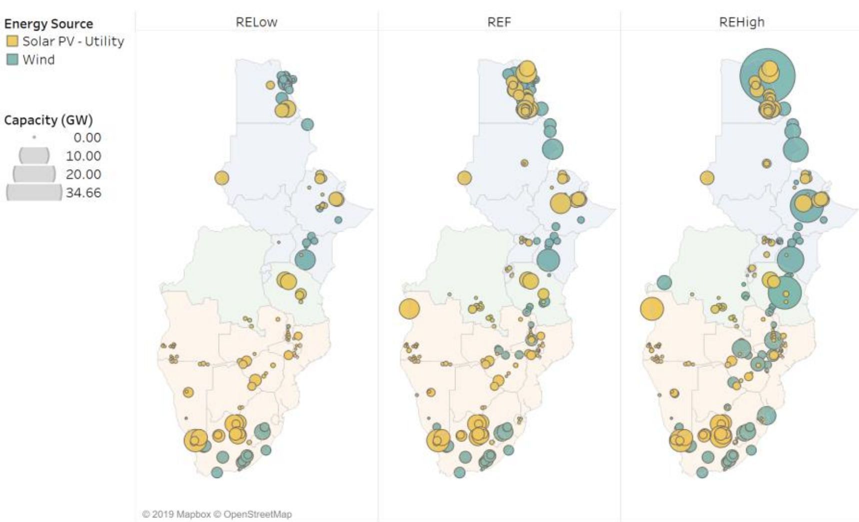


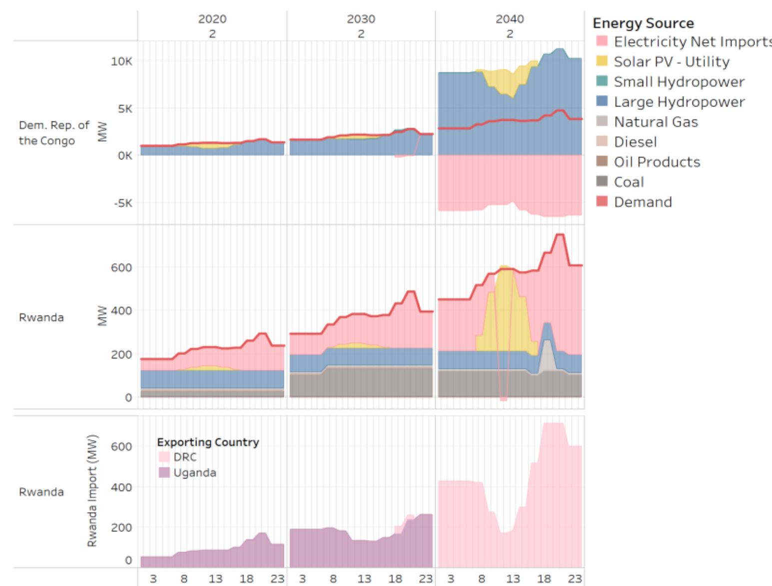
36% VRE penetration under the reference scenario



Reduction in carbon dioxide emissions



Cost-effective VRE projects are **geographically dispersed**



Complementary generation patterns

Vast opportunities VRE in the ACEC

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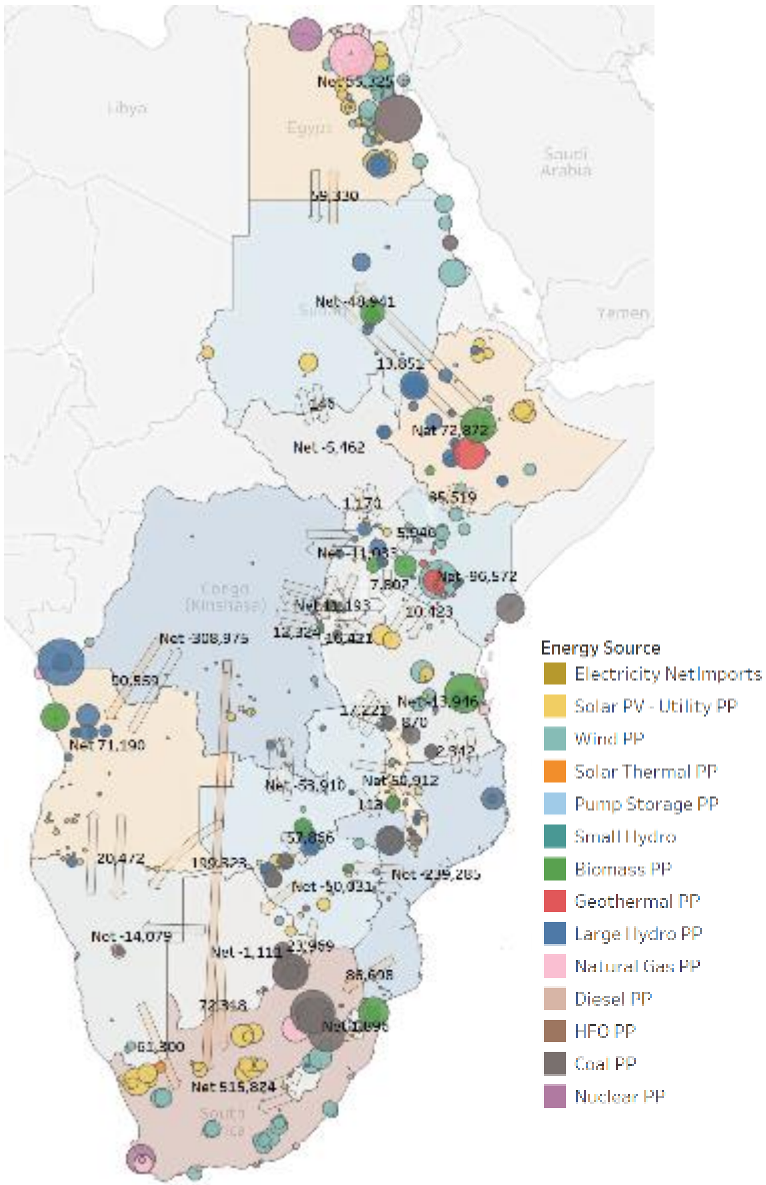
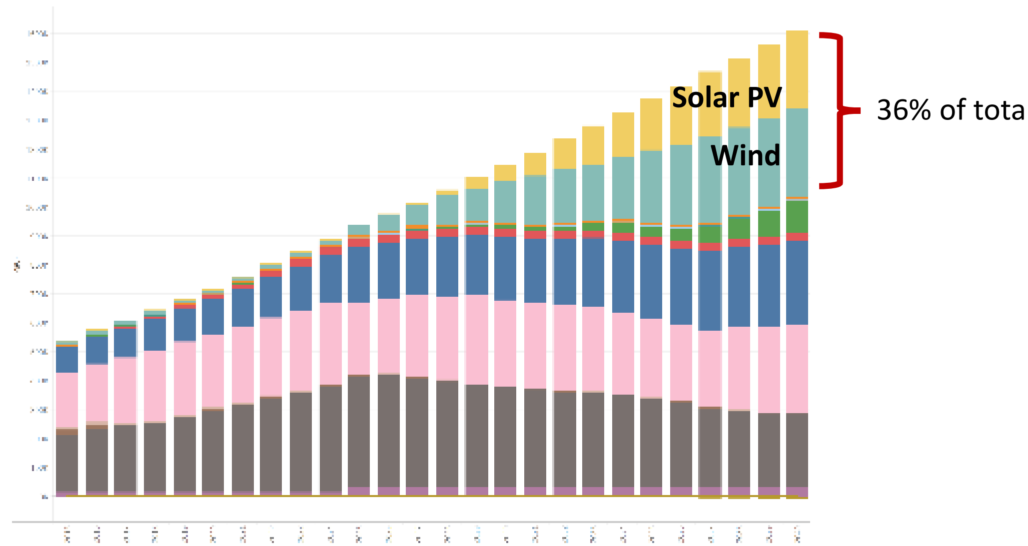
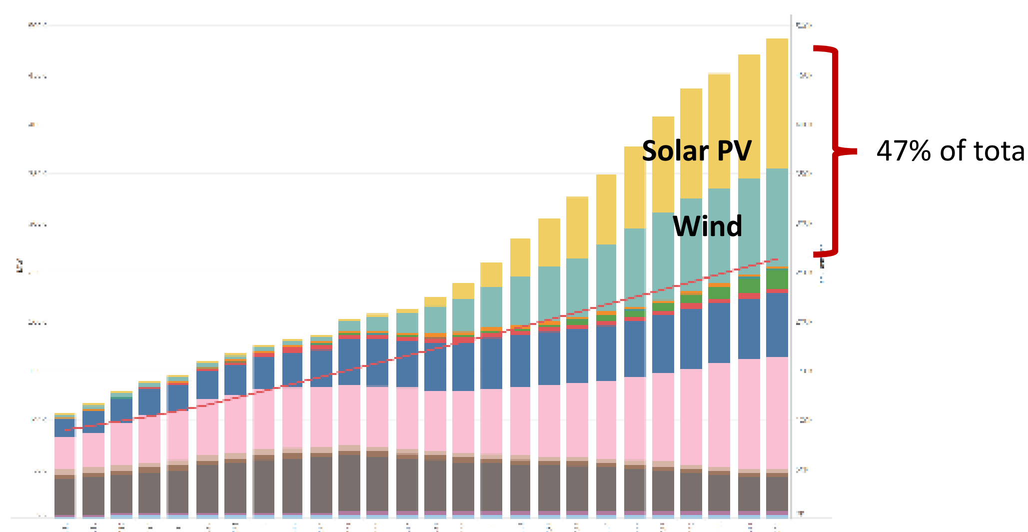


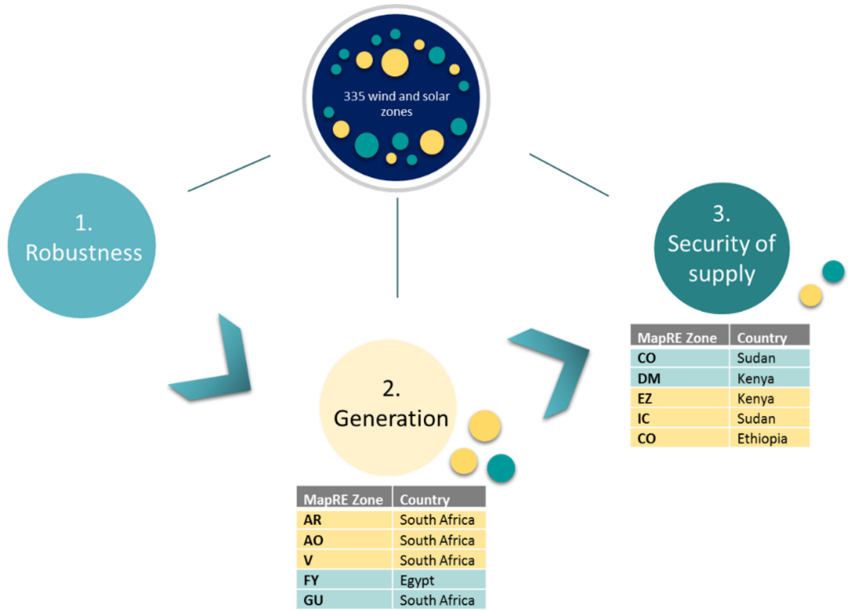
Electricity Production



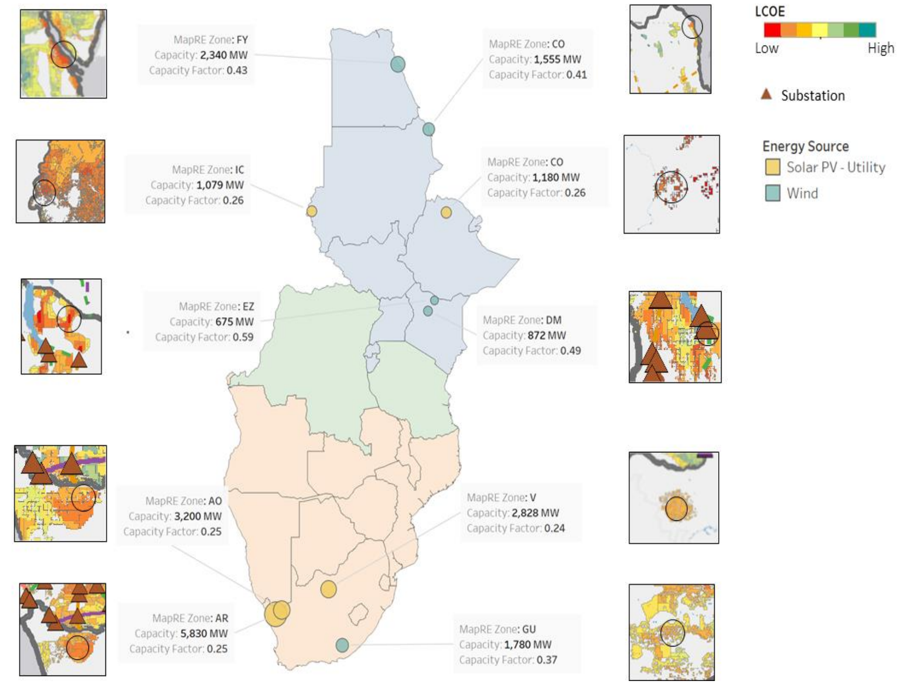
Installed Capacity



Infrastructure projects: generation capacity



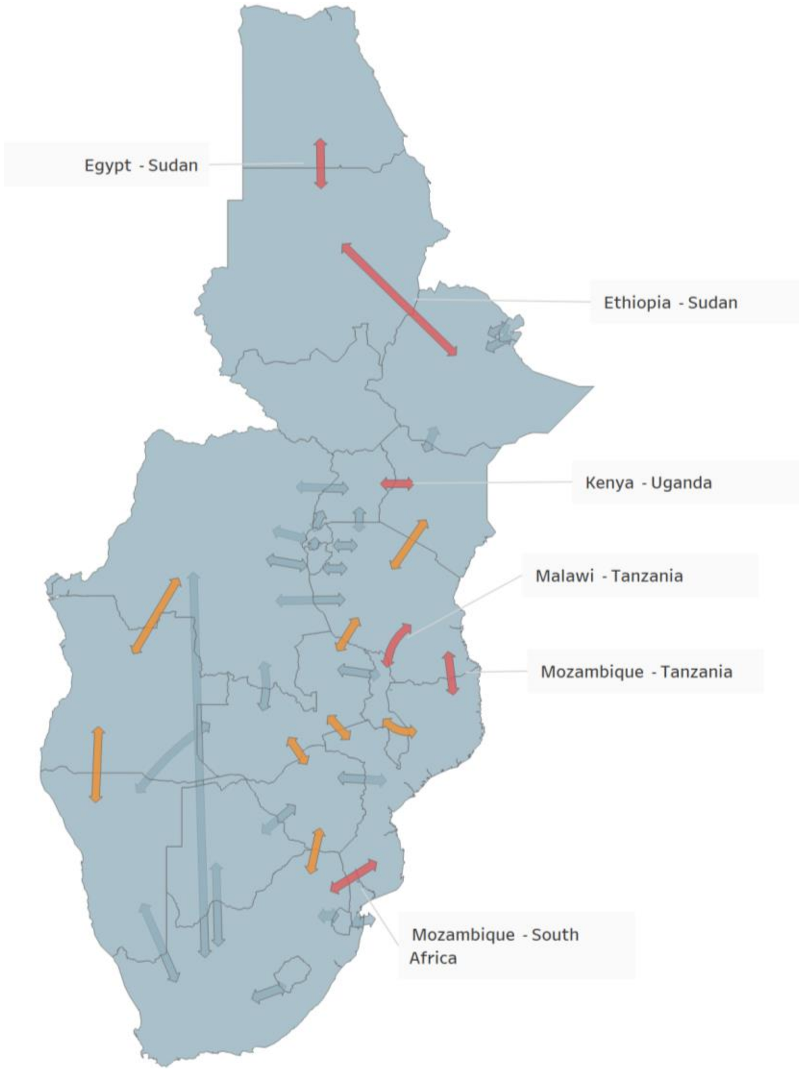
Attributes and process for identifying ten suitable generation projects.



Ten specific zones for generation capacity expansion are selected for consideration under the PIDA process.

- Note: the analysis is limited to the technology dimension. Additional factors need to be carefully evaluated for developing projects (e.g. an Environmental Impact Assessment).

Infrastructure projects: transmission capacity



- Currently, 41 power interconnector projects under PIDA PAP I are in various stages of development.
- Increased interconnection can lower system costs, enhance flexibility and complementarity.
- Interconnector projects are selected by comparing flows in the REF case to the high VRE and unconstrained interconnector scenario

Modelled interconnectors in the region. Suggested interconnectors are coloured red and interconnectors which are already identified as PIDA projects are coloured orange.