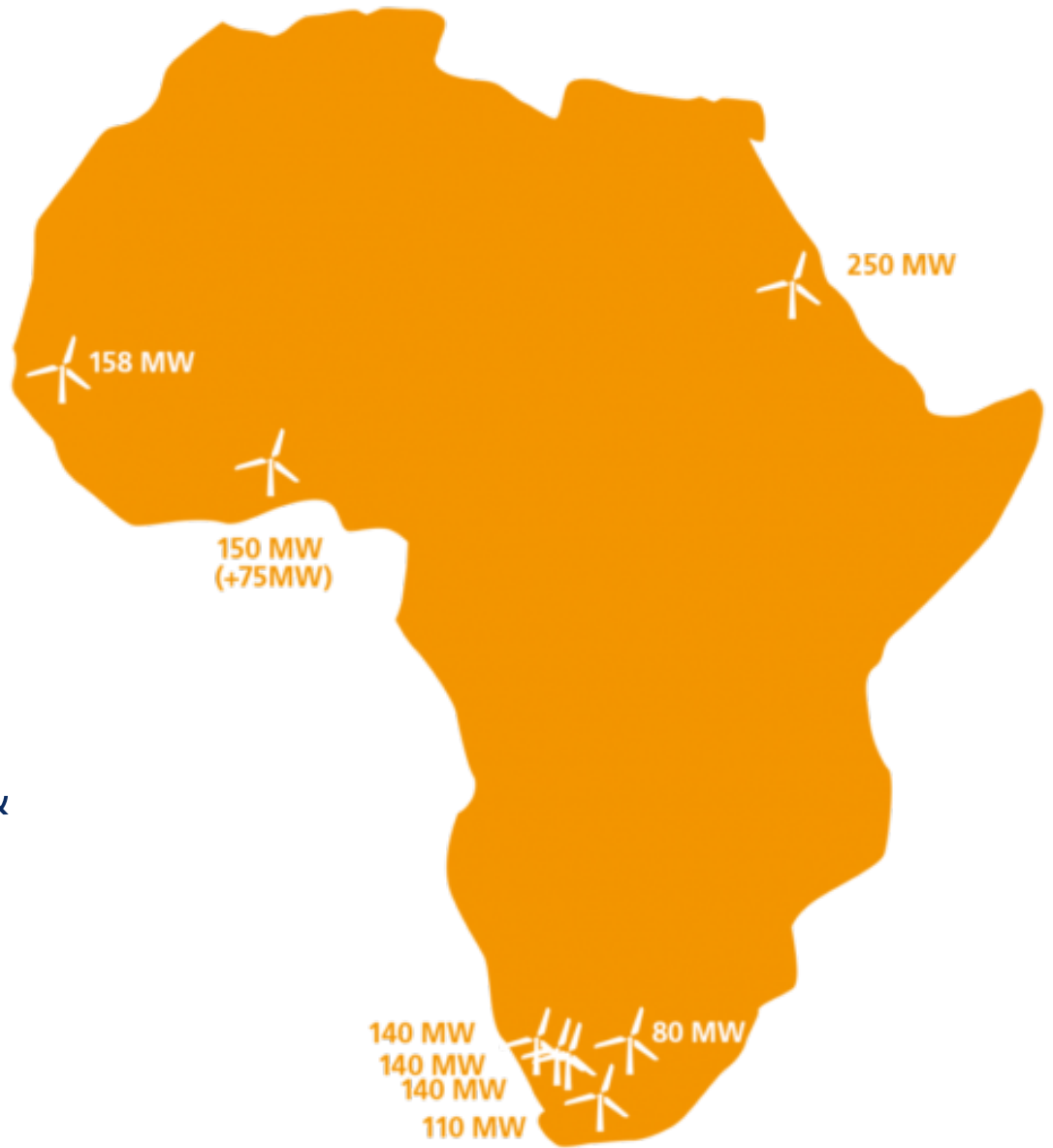


## Battery Storage Market Structure in Emerging Economies





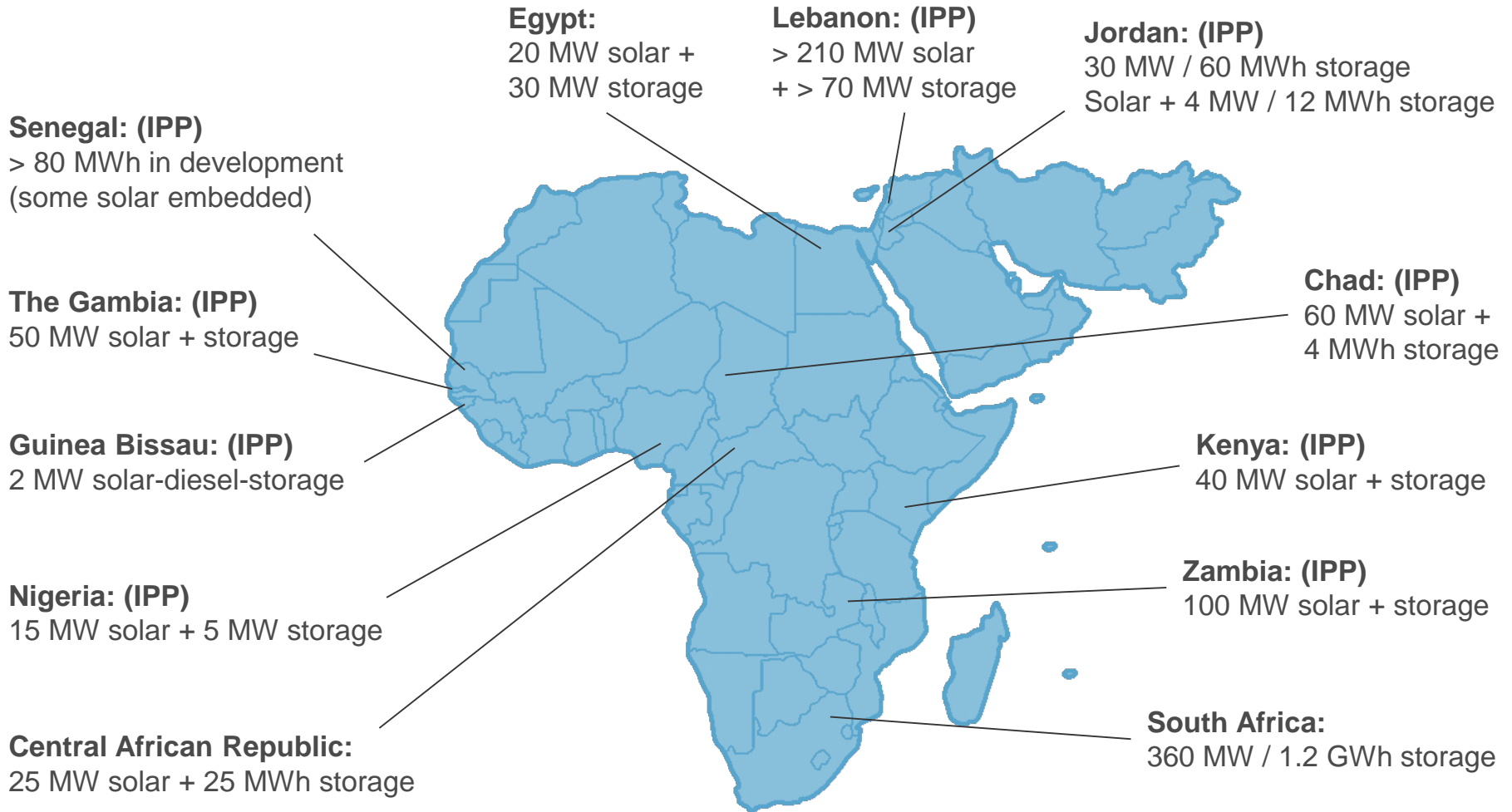
1018 MW in operation & construction



# Lekela in Senegal

- Parc Eolien Taiba N'Diaye (PETN):  
158 MW wind farm, commissioning starting this month
- Battery storage offering

# Utility-scale storage pipeline in Africa and the Middle East



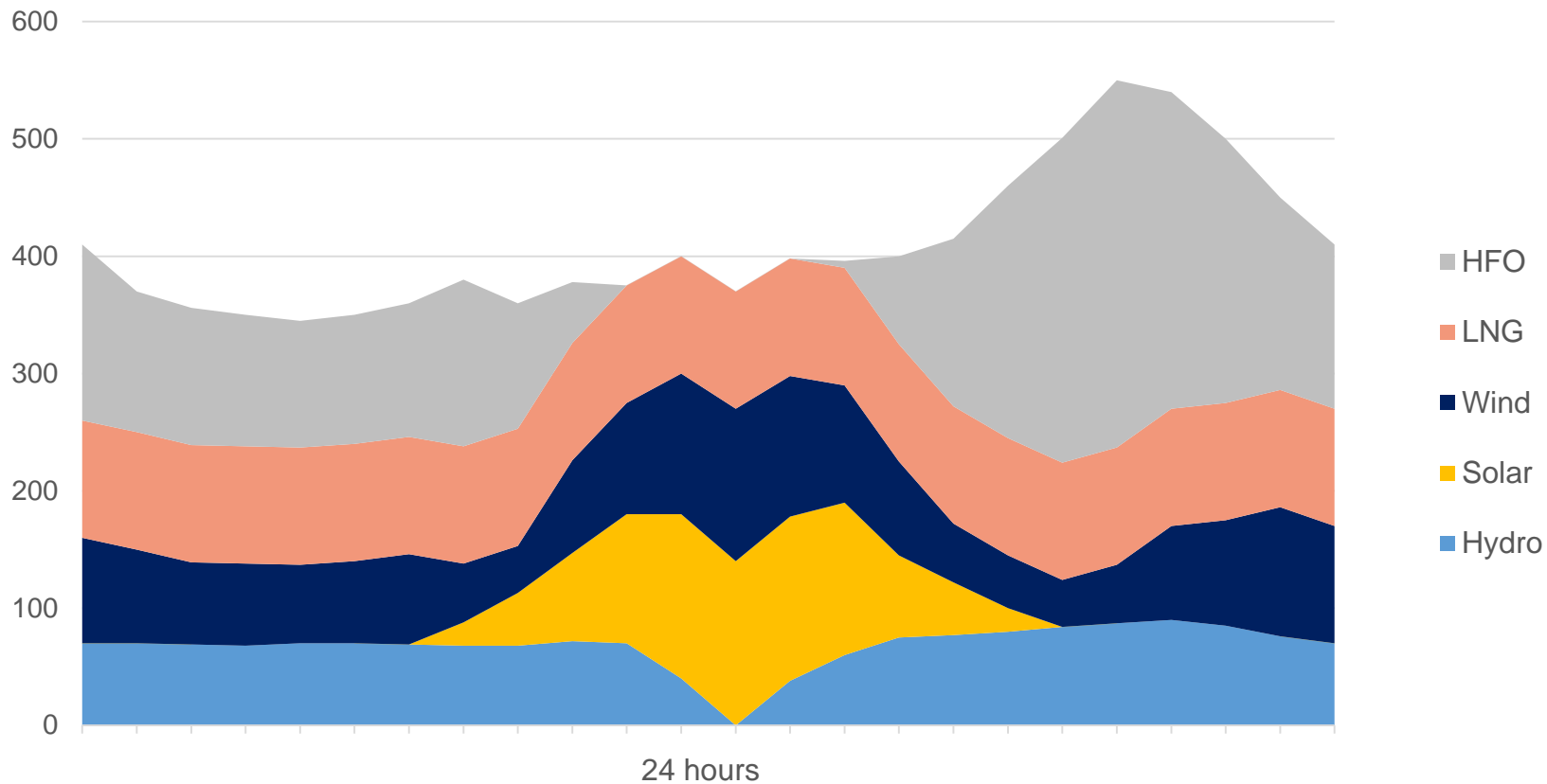
# Regulatory challenges for storage in Africa

- PPAs for existing generators contracted at 100% capacity
- No electricity markets
- No ancillary services markets
- High regulatory uncertainty and future power sector reform

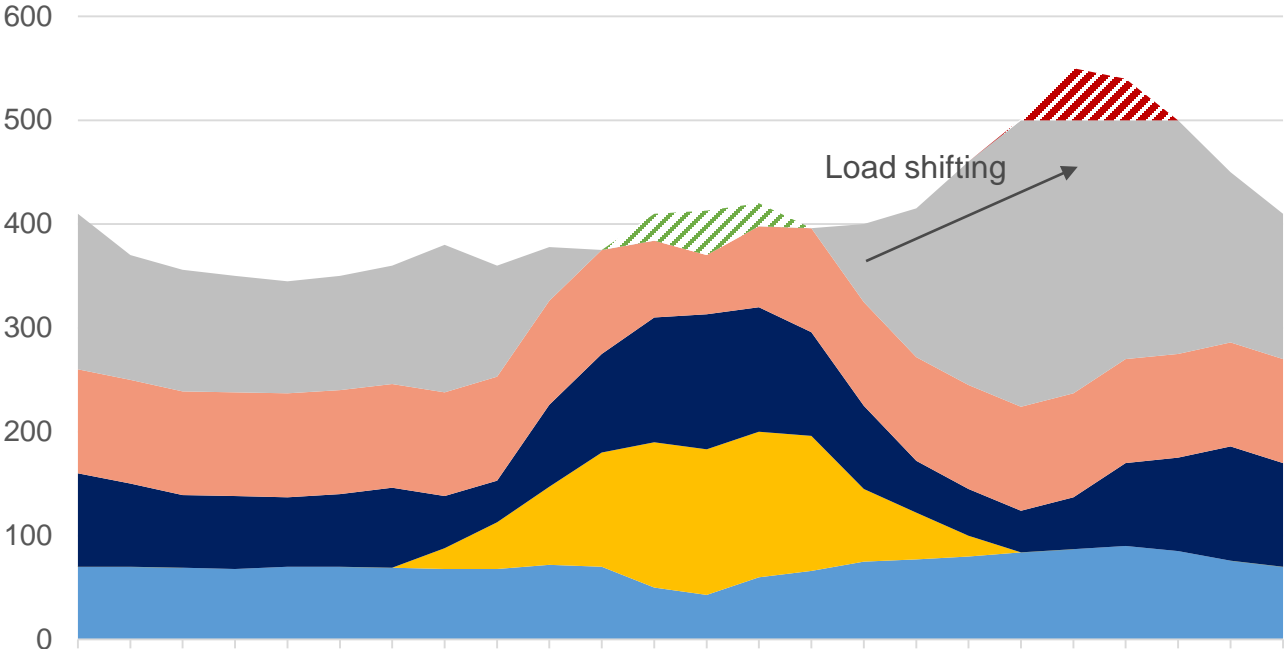
## In emerging markets, grid operator, not the market, decides storage strategy

- How many MWs?
- Allow degradation or fixed capacity?
- For how many years?
- What services needed?
- Who owns it?
- Who dispatches it?

Generation (MW)



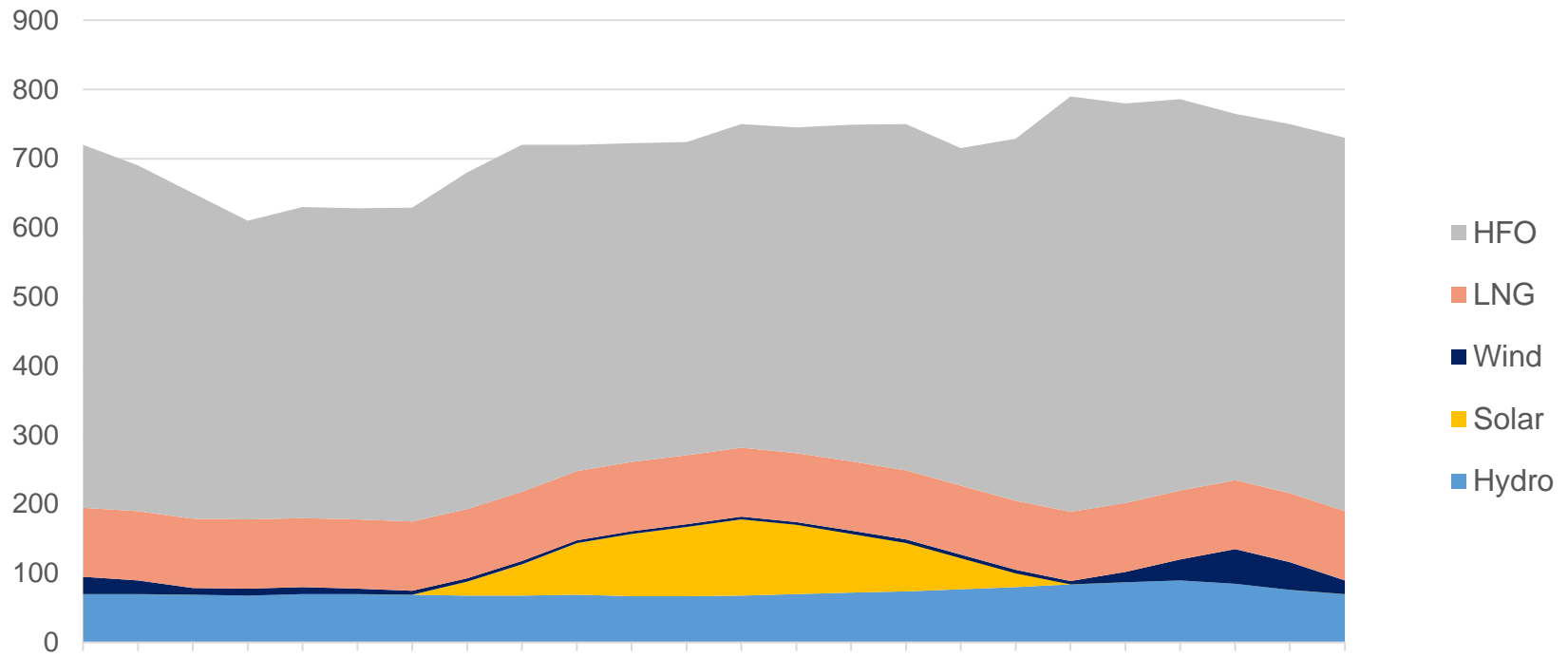
Generation (MW)



- Battery discharge
- Battery charge
- HFO
- LNG
- Wind
- Solar
- Hydro



Generation (MW)



24 hours

# Storage in fully liberalized power sectors

Possible revenue streams for battery storage:

|                 |  |
|-----------------|--|
| Network value:  | Cost recovery via regulated revenues of the SO |
| Market value:   | Revenues from bidding into competitive markets |
| State subsidies | (mainly for pilots)                            |

Storage regulation is only evolving. Challenges include:

- Classification of storage
- Valuing revenue stacking
- Grid code design
- Creating markets for storage to bid into

# Storage business models



Market design, ownership and contractual structure determine which value storage may add:

| Owner           | System operator                               | IPP<br>(capacity sales, tolling agreement, merchant)          | IPP<br>(hybrid models, storage-as-a-service) |
|-----------------|---|---|--|
| Value harnessed | T&D deferral<br>System and ancillary services | Capacity for provision of T&D services contracted with the SO | –  |
| Network value   | –   | Energy arbitrage<br>Bidding into ancillary services markets   |  |
| Market value    | –   | Energy arbitrage<br>Bidding into ancillary services markets   |  |

# What policies and regulations are needed now?

- Start the first projects quickly!
  - Grid instability costs Senegal > \$100m per year
- Long term capacity leases if market opportunities are absent
- Update grid codes
  - Create market instruments that capitalise the fast response speed of batteries
  - Incentivize storage to replace expensive peak generation