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EREP: Selected results

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Scenario approach

- **A set of results**
  - corresponds to a set of consistent assumptions, which are uncertain
  - does not give “the” answer
  - supports decision making under uncertainty
    - By exploring robustness with **sensitivity analysis**
    - By assessing social/economic/environmental impacts with alternative **policy scenarios**

Selected results

- **Reference scenarios**
  - Consistent with WAPP master plan
  - Decentralized options analyzed

- **Renewable policy scenarios**
  - Updated renewable technology parameters; resource potential, costs projections
  - Sensitivity assessment: No import from Central Africa
  - Policy scenario: Limiting import share for the energy security reason

Generation requirements by 2030

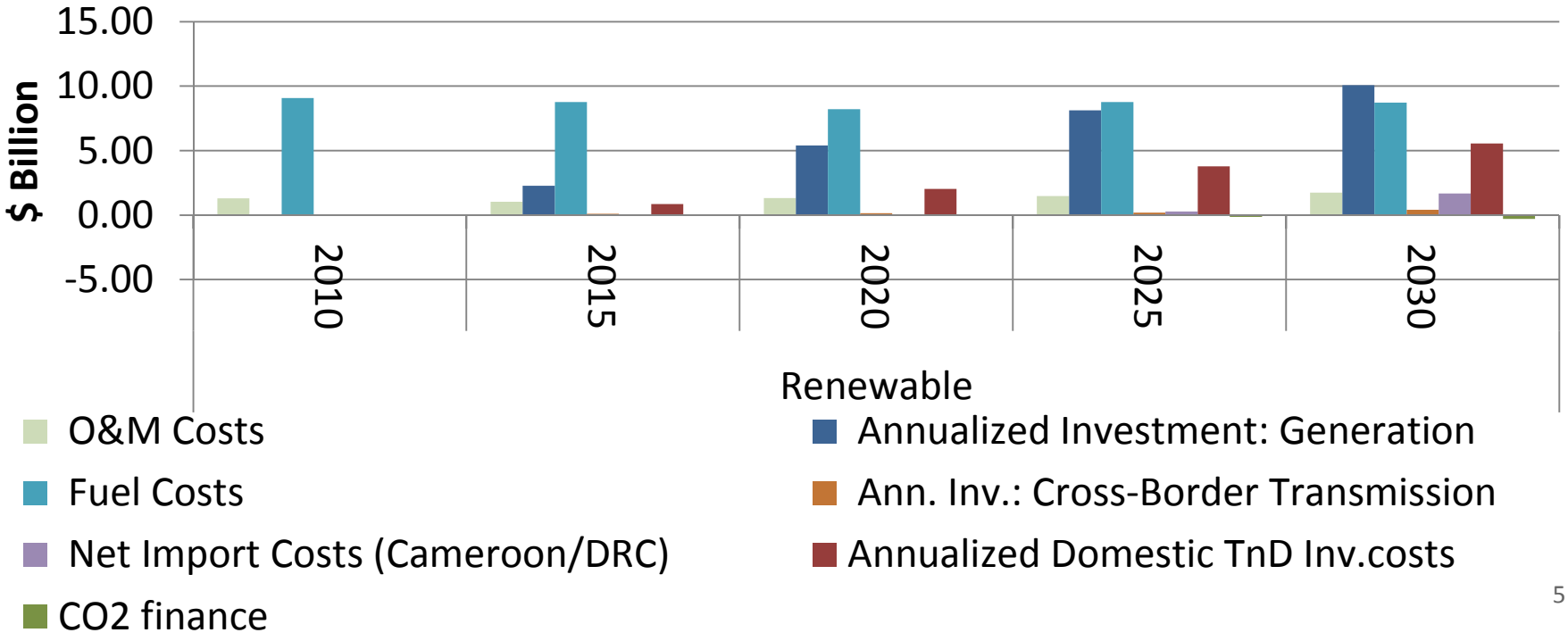
Under renewable scenario

- **50 GW** of new additional power generation capacity for grid connected system
- **11 GW** of off-/mini- grid system
- **12 GW** of interregional transmission
- **56 GW** of domestic T&D

Economic aspects

Under renewable scenario

- Investment needs: **150 billion dollar** (35% in T&D investment) between 2010-2030
- Average costs of electricity generation: 19 US cents/kWh → **12.5 US cents/kWh**



Alternative scenarios

If the trades would be limited:

- Import dependency in 2030: xx% → xx%
- Average generation costs in 2030: xx% → xx%

If the demand would be met by grid-connected electricity only:

- Investment costs in 2030: xx% → xx%
- Average generation costs in 2030: xx% → xx%

If the grand Inga project does not fly:

- Import dependency in 2030: xx% → xx%
- Average generation costs in 2030: xx% → xx%

If the renewable technologies do not get promoted:

- Investment costs in 2030: xx% → xx%
- Average generation costs in 2030: xx% → xx%

Regional generation mix

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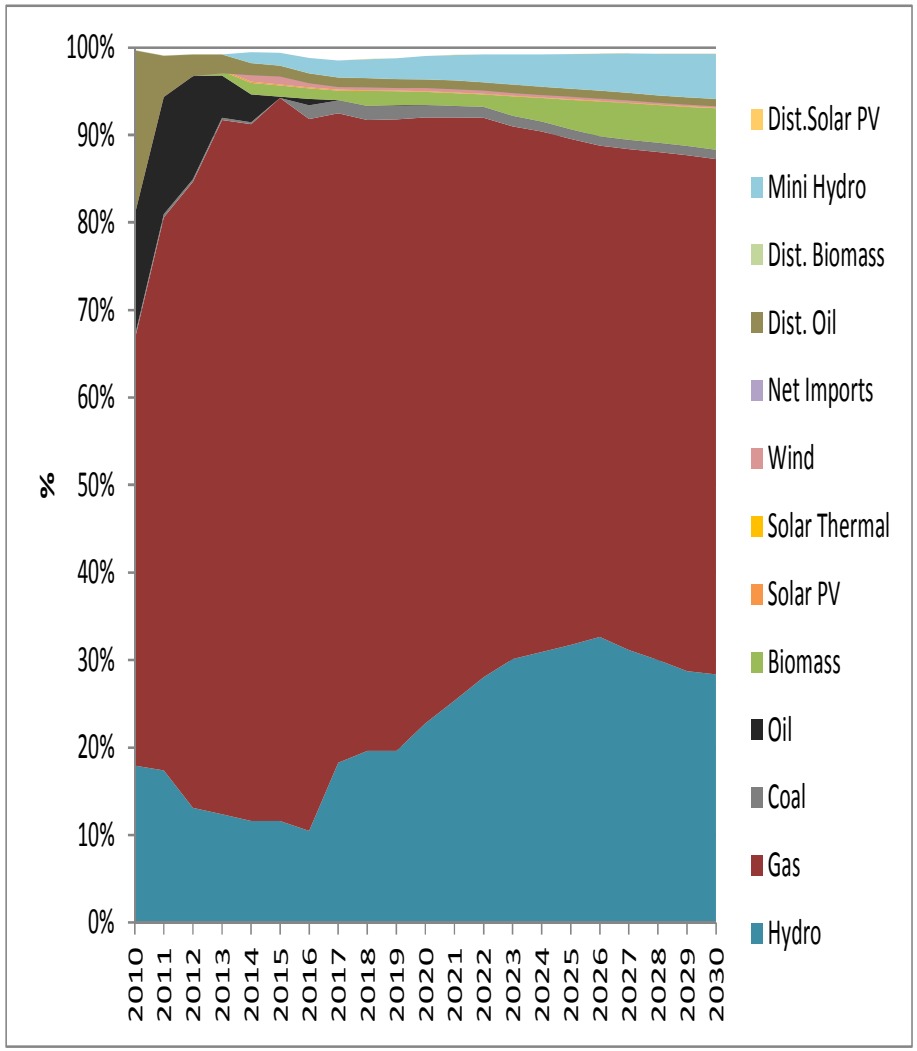
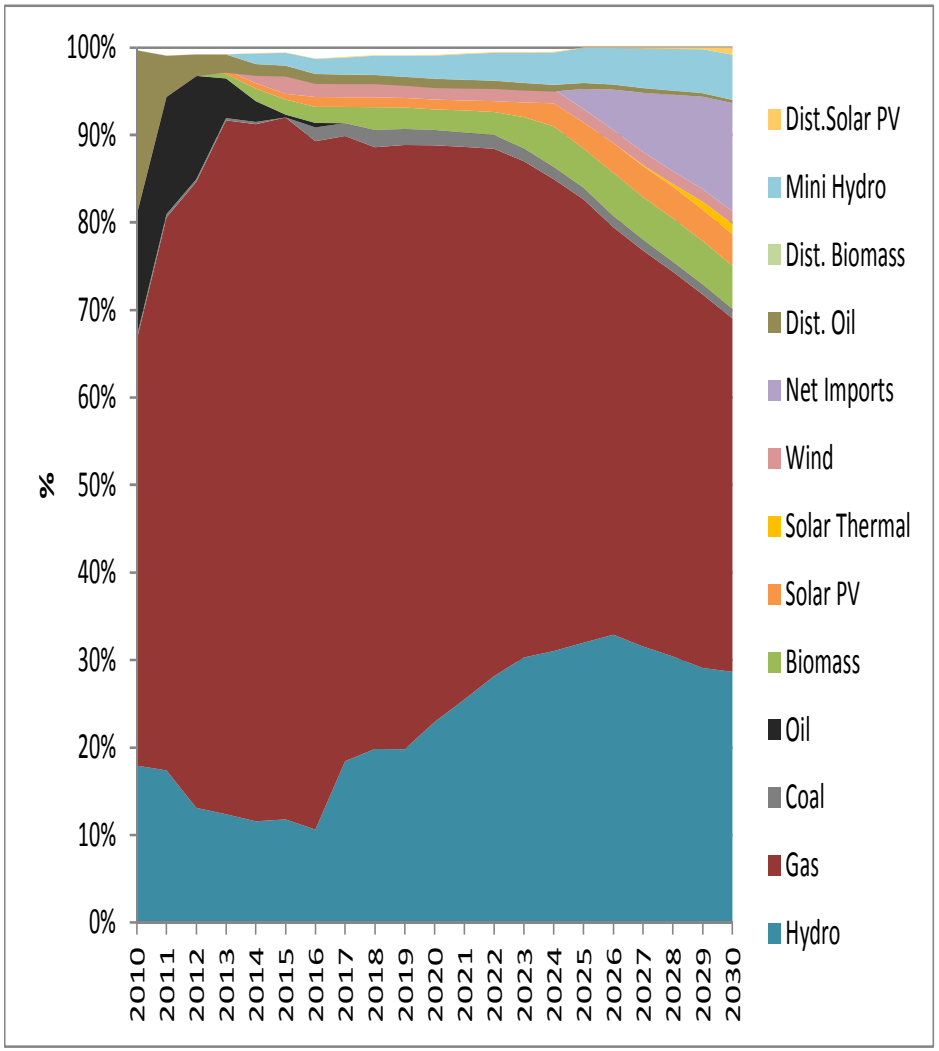
Reference



Renewable



Electricity trade

Export electricity from areas where cheap electricity can be produced

- Cote D'Ivoir
- Guinea

Import electricity into areas where cheap electricity is not available

- Nigeria
- Ghana
- Togo

Electricity trade

Renewable scenario:

2013 Ghana to Togo/Benin 655MW
2017 Cote d'Ivoire to Ghana 655MW
2015 Cote d'Ivoire to Liberia 338MW, Liberia to Guinea 338MW, Liberia to Sierra Leone 303MW, Sierra Leone to Guinea 334MW
2017 Senegal to Guinea 286MW, Senegal to Gambia 341MW, Guinea to Senegal 286MW, Gambia to Senegal 341MW
2012 Mali to Cote d'Ivoire 320MW
2013 Ghana to Burkina 332MW
2015 Ghana to Burkina 332MW
2016 Guinea to Mali 123MW
2026 Nigeria to Togo/Benin 17MW
2030 Nigeria to Togo/Benin 396MW
2025 Nigeria to Togo/Benin 26MW
2026 Nigeria to Togo/Benin 303MW
2025 Central Africa to Nigeria 1000MW
2026 Central Africa to Nigeria 1000MW
2027 Central Africa to Nigeria 1000MW
2028 Central Africa to Nigeria 1000MW
2029 Central Africa to Nigeria 1000MW
2030 Central Africa to Nigeria 1000MW

Limited trade scenario:

2013 Ghana to Togo/Benin 655MW
2017 Cote d'Ivoire to Ghana 655MW
2015 Cote d'Ivoire to Liberia 338MW, Liberia to Guinea 338MW, Liberia to Sierra Leone 303MW, Sierra Leone to Guinea 334MW
2017 Senegal to Guinea 286MW, Senegal to Gambia 341MW, Guinea to Senegal 286MW, Gambia to Senegal 341MW
2012 Mali to Cote d'Ivoire 320MW
2013 Ghana to Burkina 332MW
2015 Ghana to Burkina 332MW
2028 Guinea to Mali 49MW
2026 Nigeria to Togo/Benin 26MW
2030 Nigeria to Togo/Benin 101MW
2026 Nigeria to Togo/Benin 20MW
2030 Nigeria to Togo/Benin 309MW
2025 Central Africa to Nigeria 1000MW
2026 Central Africa to Nigeria 1000MW
2027 Central Africa to Nigeria 1000MW
2028 Central Africa to Nigeria 1000MW
2029 Central Africa to Nigeria 1000MW
2030 Central Africa to Nigeria 1000MW

Generation mix by country

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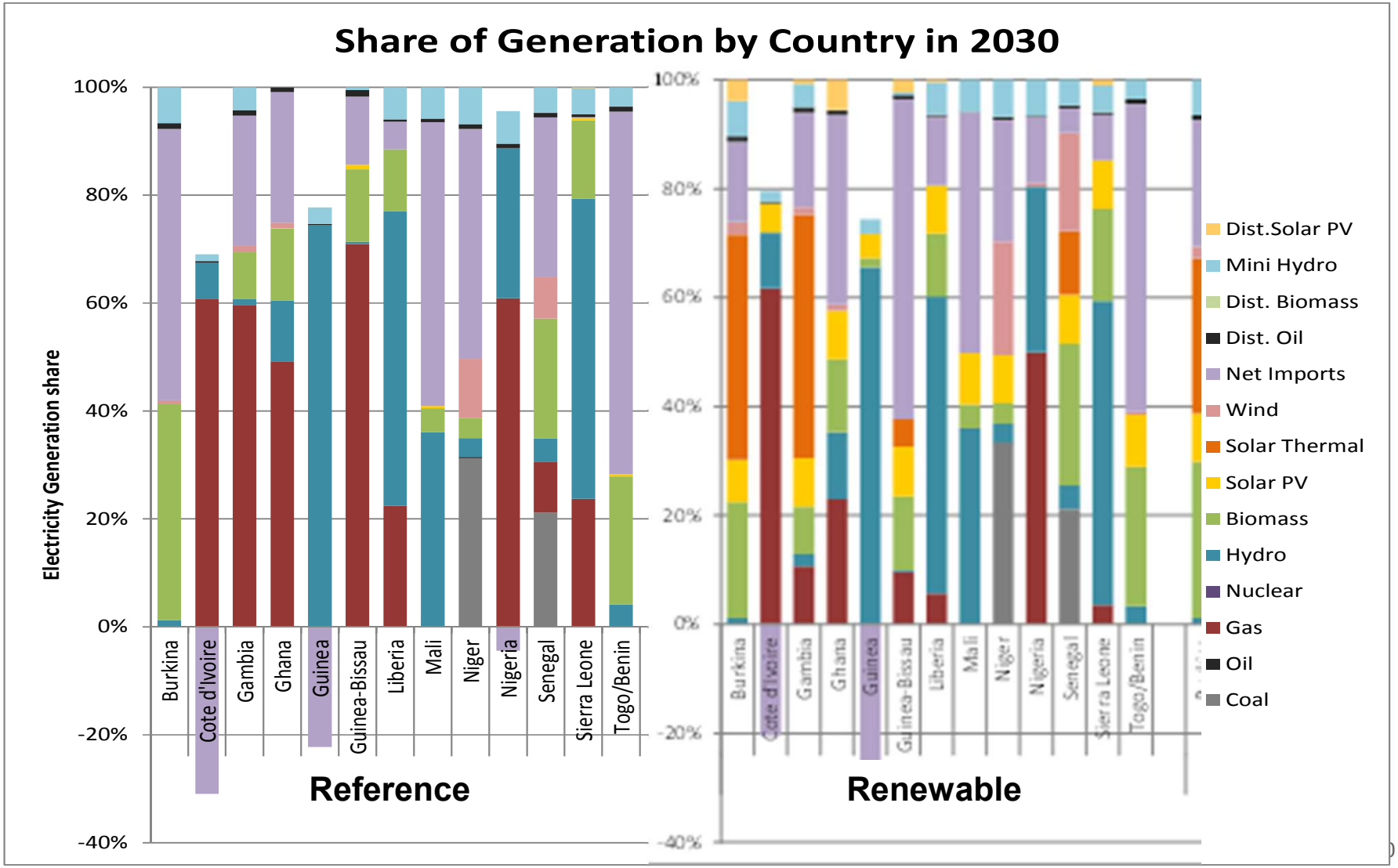
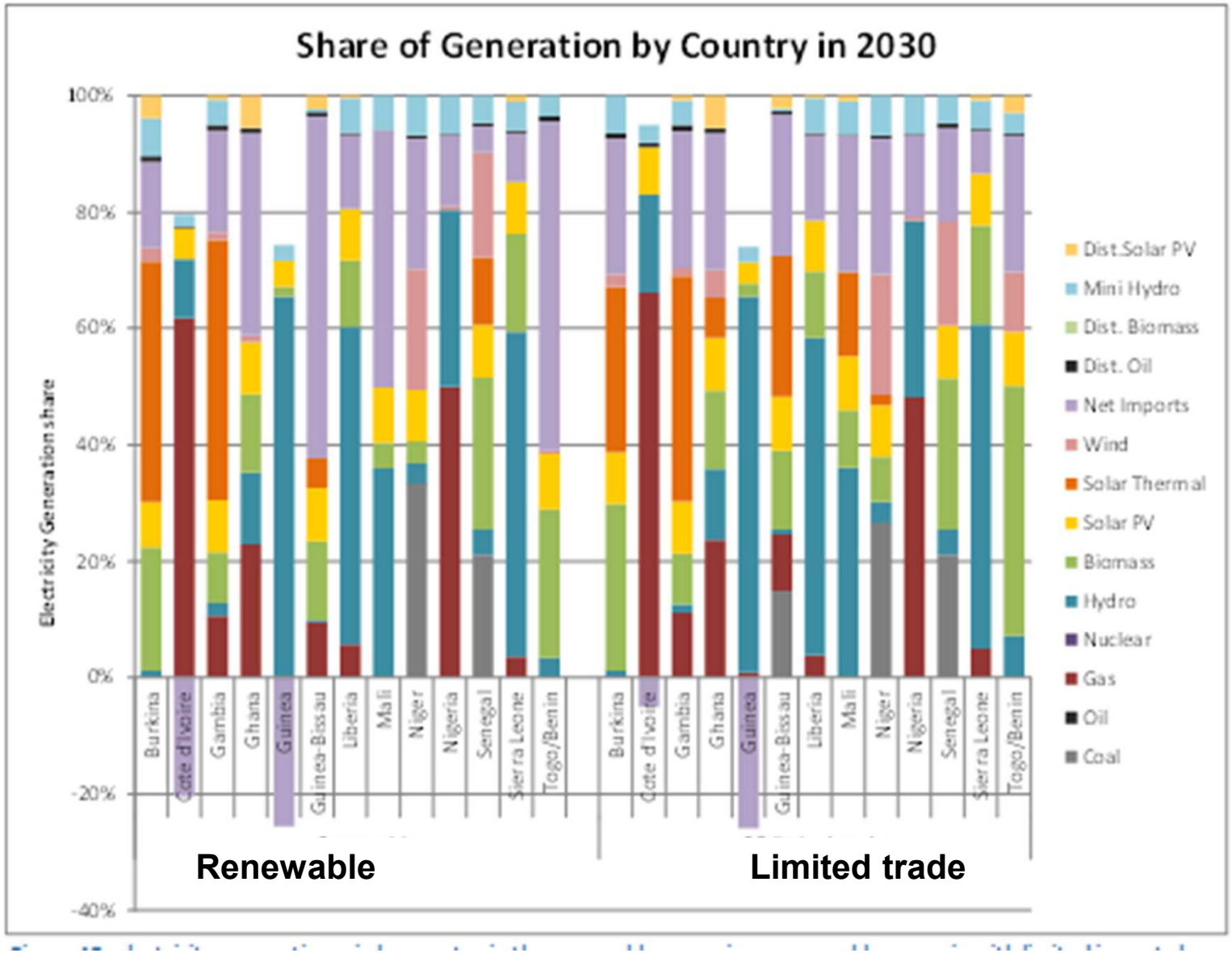
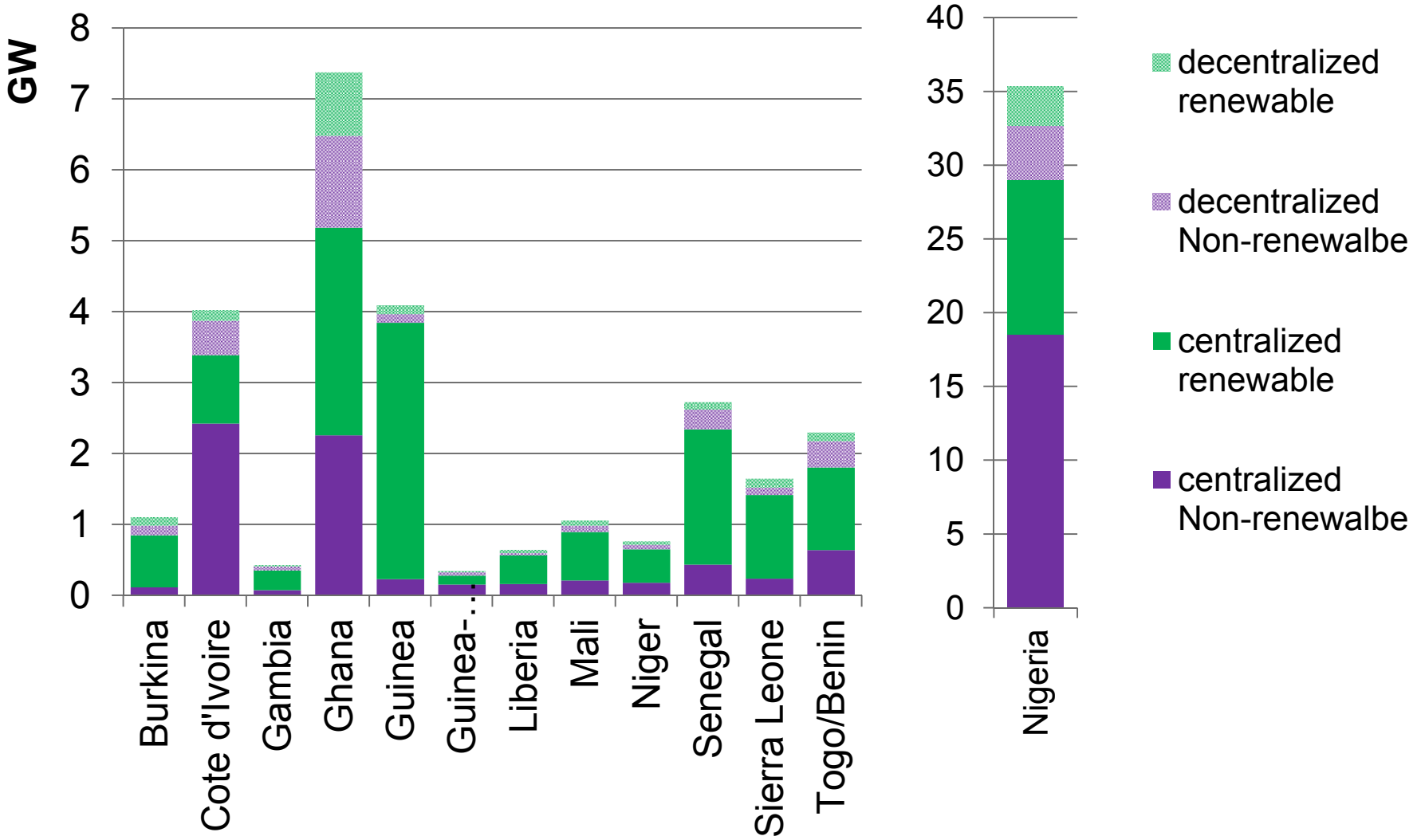


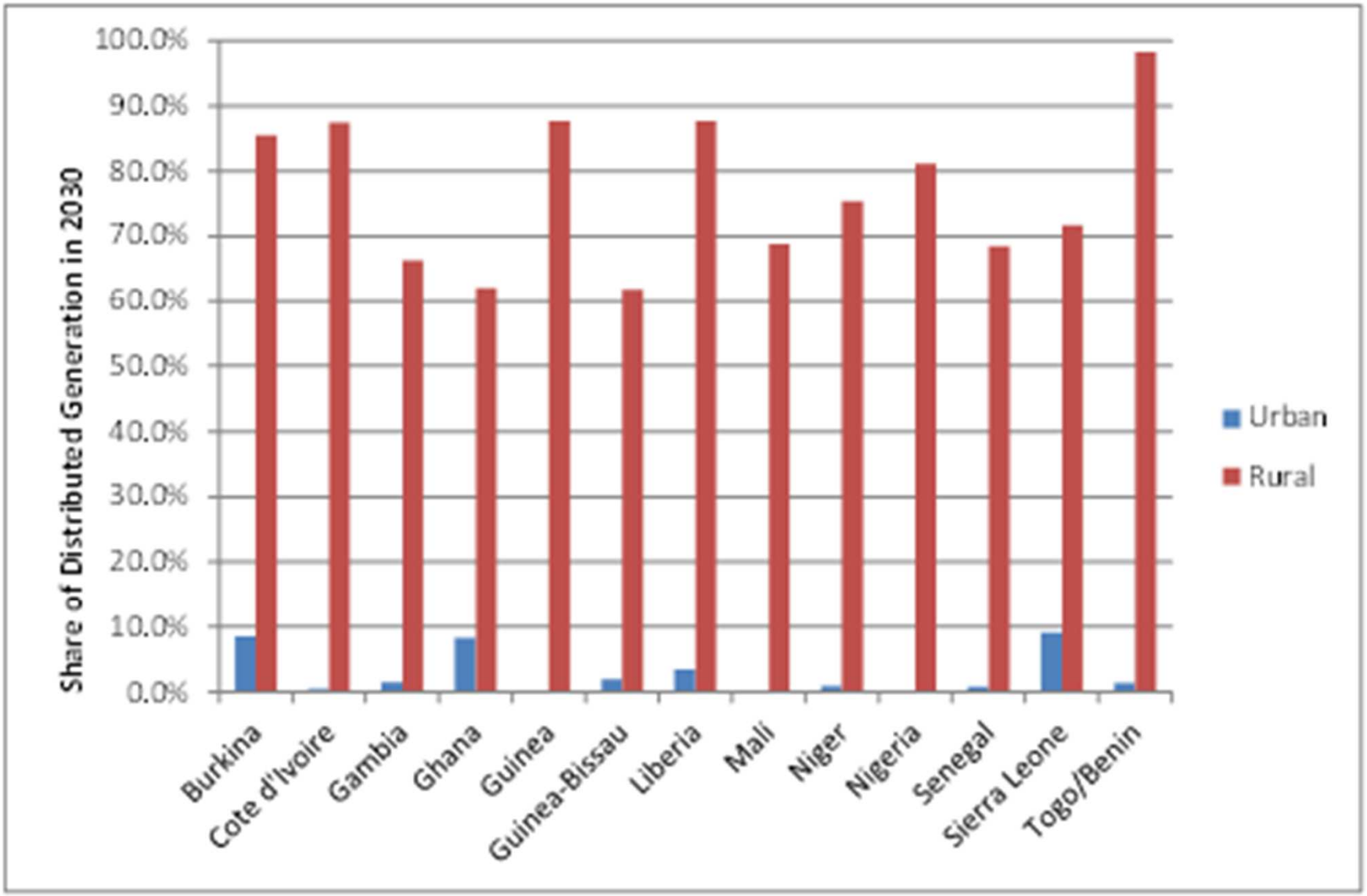
Generation mix by country



Capacity addition



Decentralized options



Country example

Senegal

Demand: 2,600 GWh → 9,000 GWh

Current system: mainly HFO

No major fossil resources

Hydro generation: 91 GWh → 192 GWh (identified)

Good solar PV potential: 75 TWh

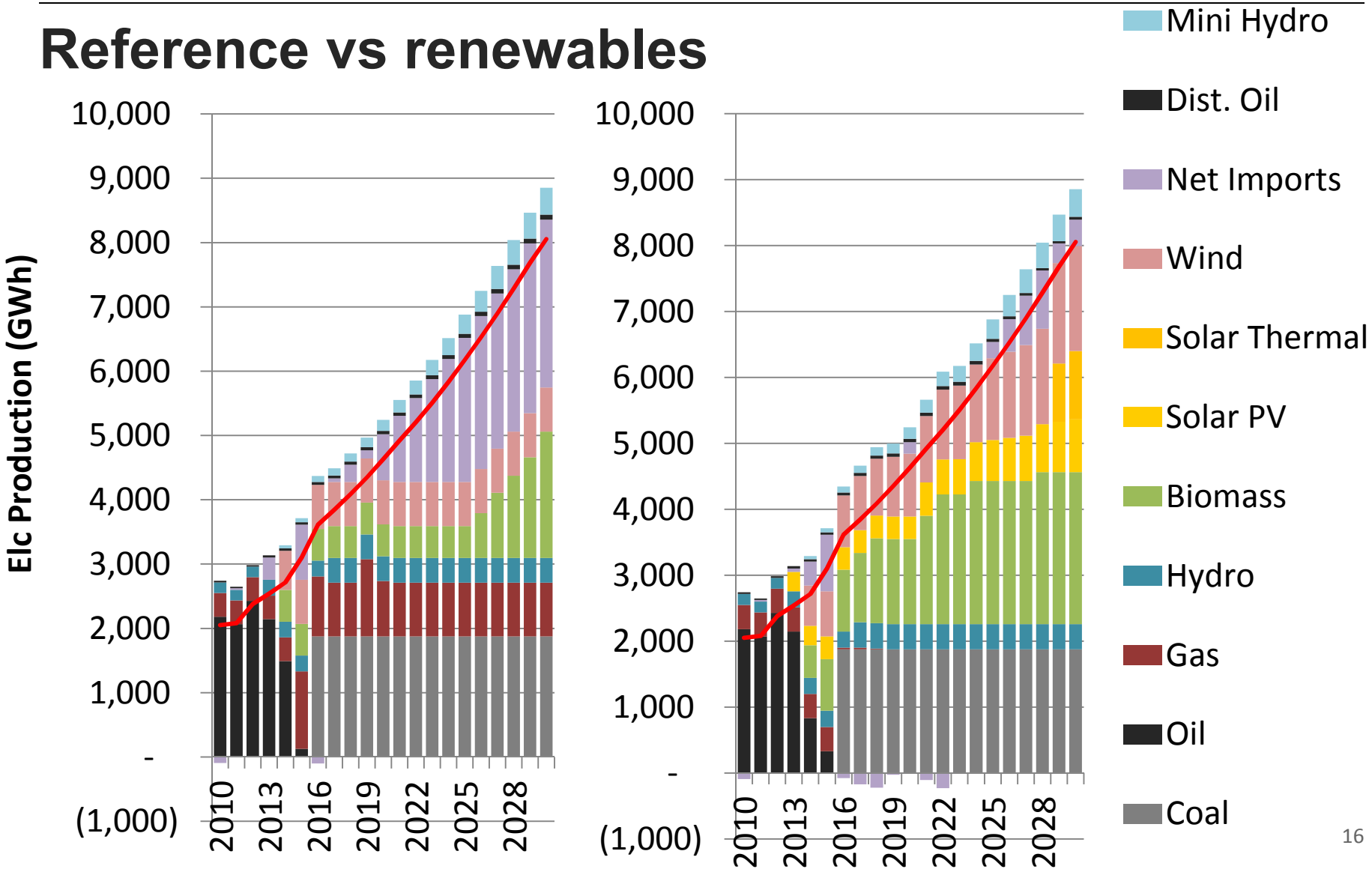
Good high quality wind potential: 17 TWh

Biomass: 790 GWh (highly uncertain)

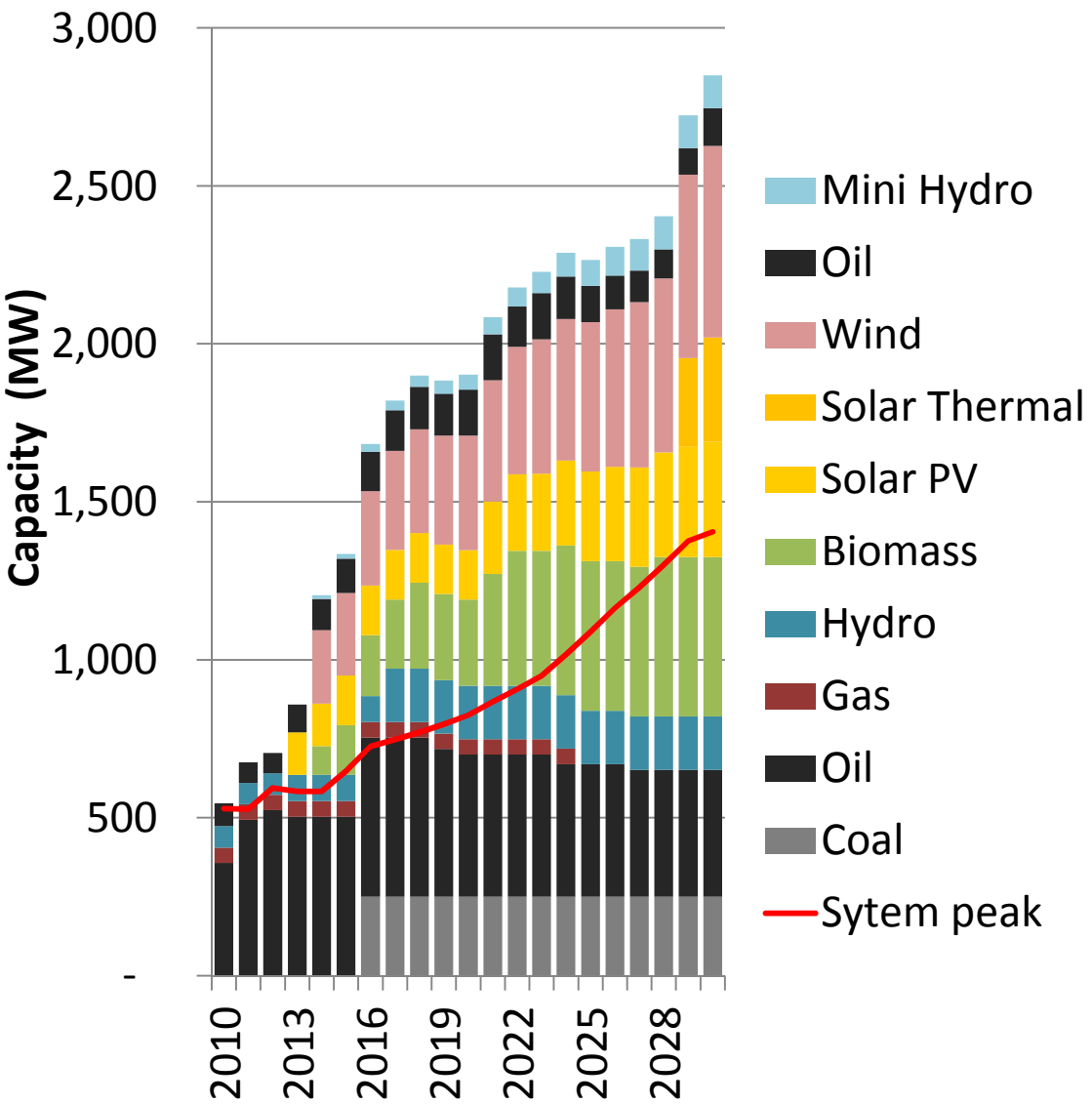
Mini-hydo: 450 GWh

Generations

Reference vs renewables



Capacity balance

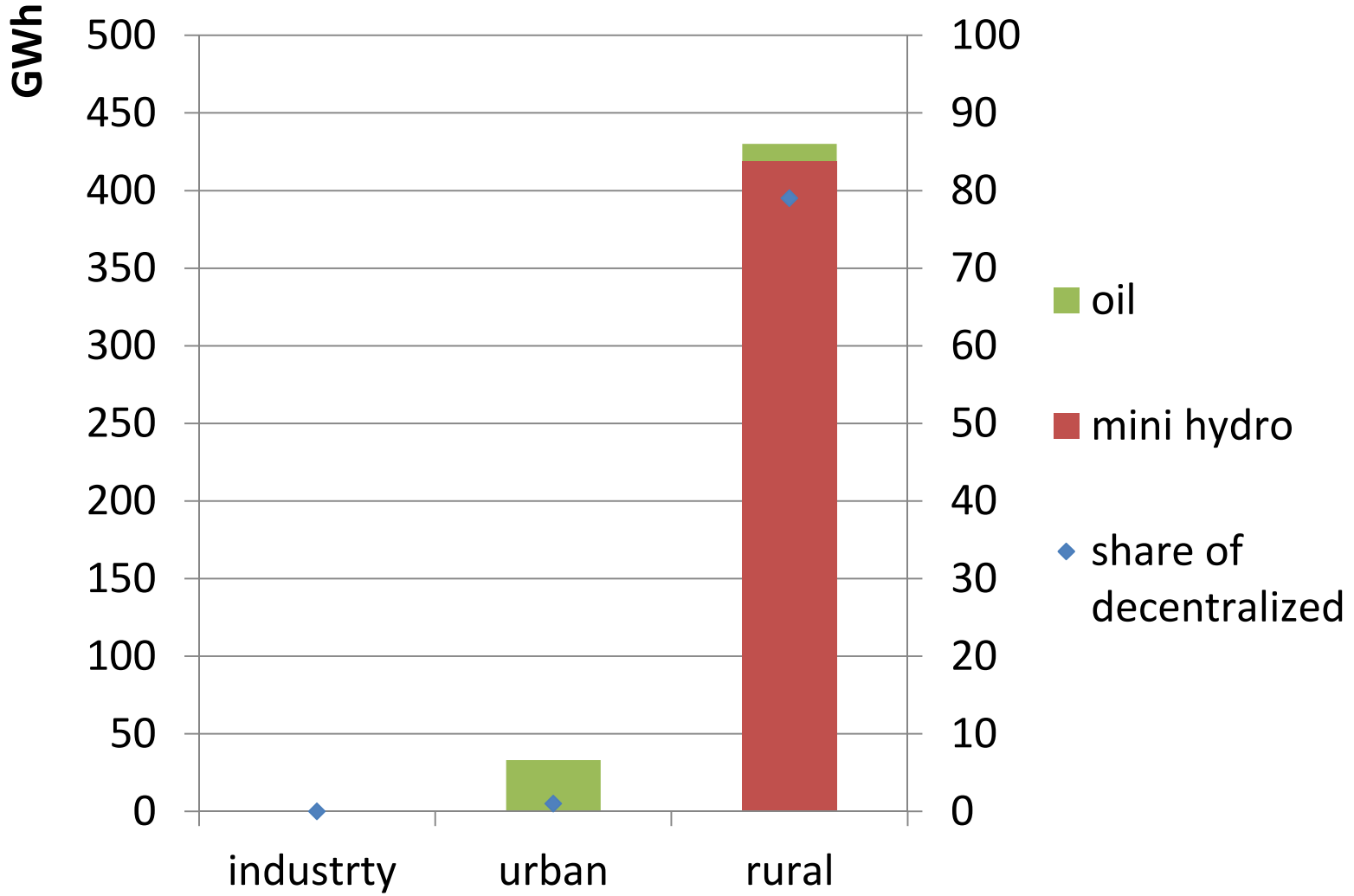


Projects:

In the pipeline 560 MW (diesel, coal, biomass, hydro)

Wind, solar PV, biomass

Decentralized solutions in 2030



Renewable policy scenario

- **Not IRENA's recommendation**
- **Robust basis for further analysis**
  - Evaluate alternative investment options from a system point of view under a given set of assumptions
- Validation/updates are needed to keep the model alive

Further analysis

- CO_2 emissions
- 2030-2050 period
- Different fuel prices
- Different technology costs assumptions
- No renewable cost reduction: cost of forcing renewables
- CO_2 finance
- Limitation on transmission projects
- Limitation on funds
- More transmission projects, etc

Energy planning is a continuous process!

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Financing requirements

Economic considerations

Investment costs

Average electricity generation costs