Energy systems in Israel, Palestine and Jordan

Understanding the potential for regional cooperation

Aman Majid, Nurit Gal, Suleiman Halasah, Michael Gilmont, Jim Hall

Oxford Martin School, University of Oxford

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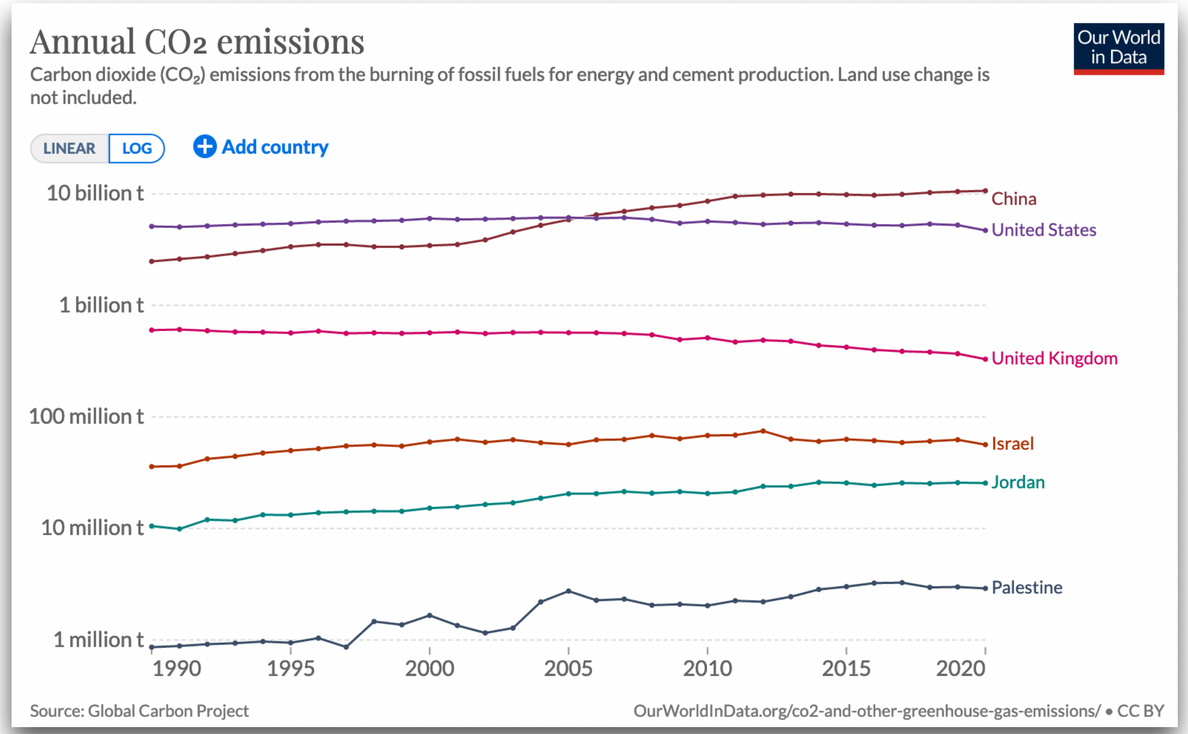
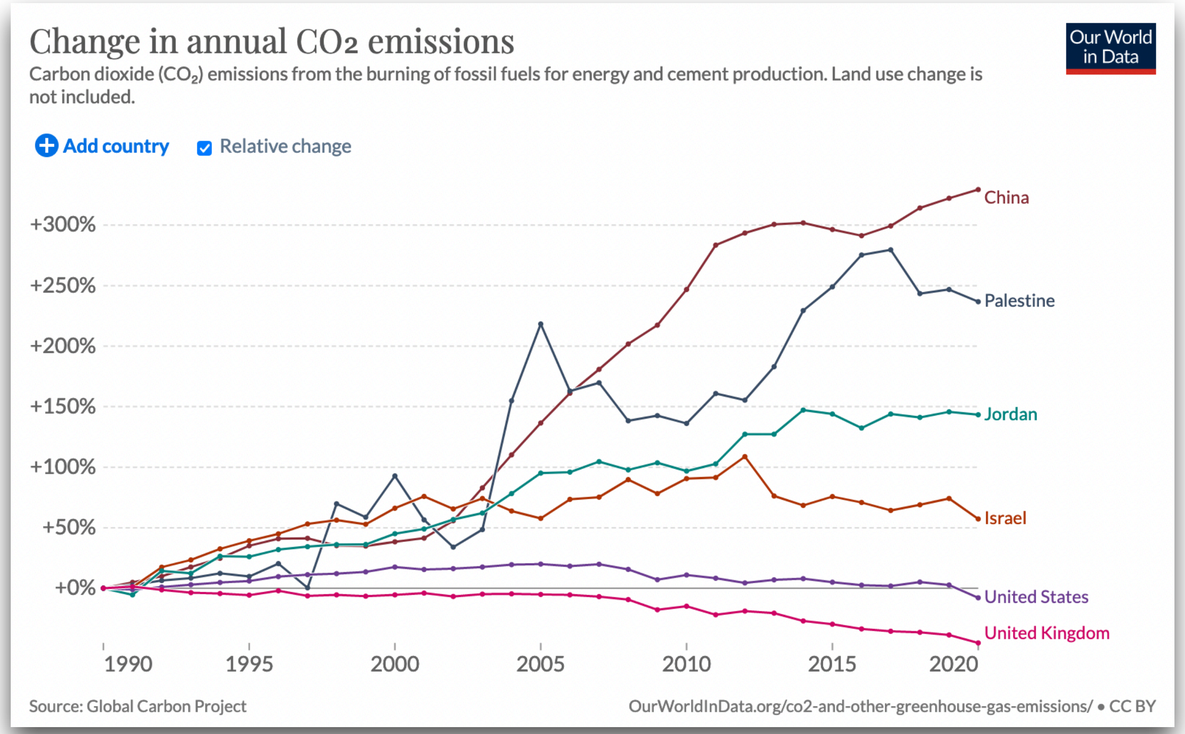
Background

Background

Historical emissions





Background

Climate commitments

- Israel to phase-out coal by 2026
- Israel to increase renewable shares to 25% and 30% in 2025 and 2030
- Palestine plans to convert Gaza diesel plant to gas
- No specific renewables targets for Palestine

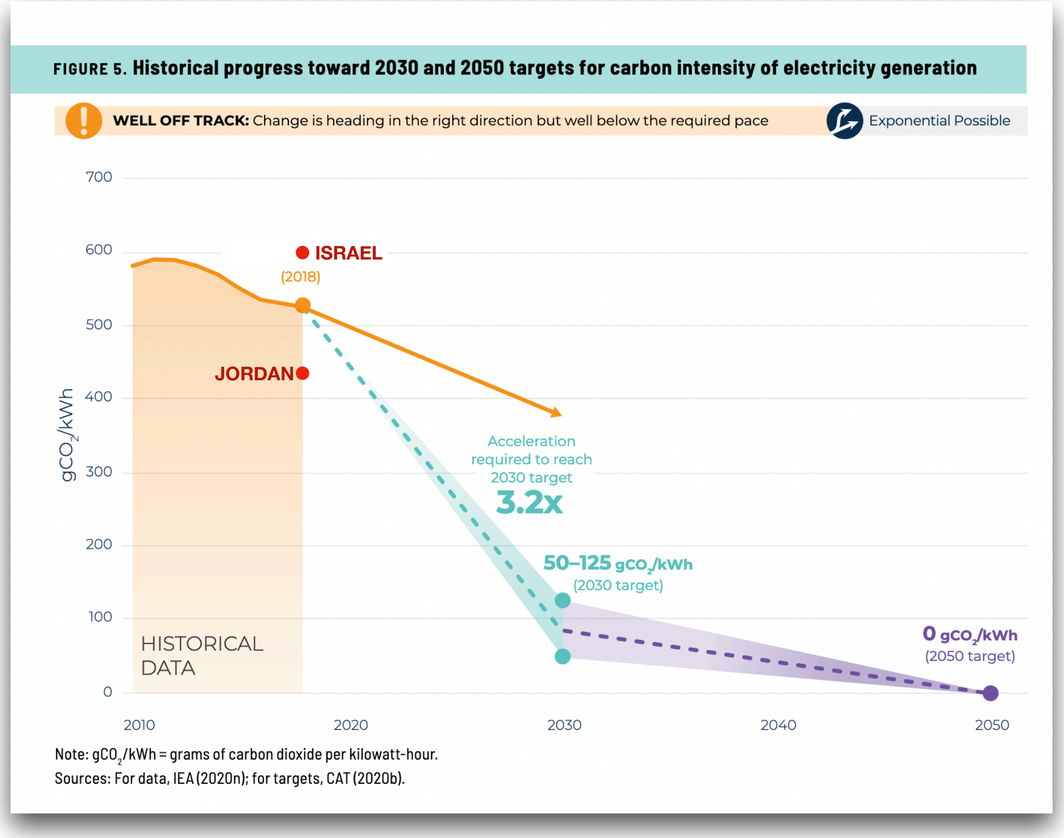
NDCs: GHG reductions	Israel	Jordan	Palestine
2030	27%	31%	-
2040	-	-	26.6% or 17.5%
2050	100%	-	-

Renewable targets	Israel	Jordan	Palestine
Today	8.5%	20%	5%
2030	30%	50%	20%

Speed and scale

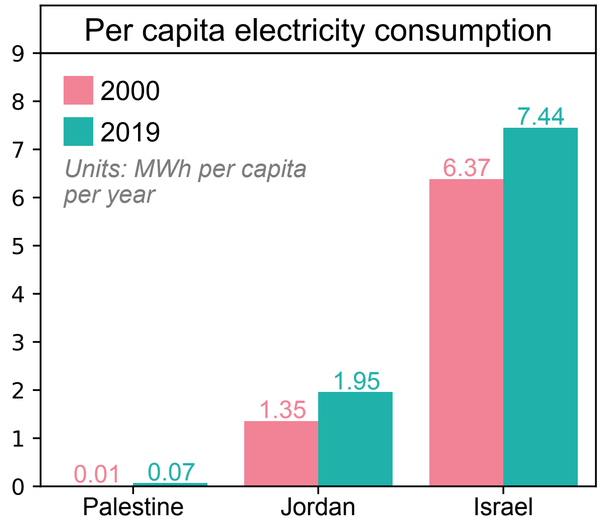
Could level of ambition to decarbonise be increased?

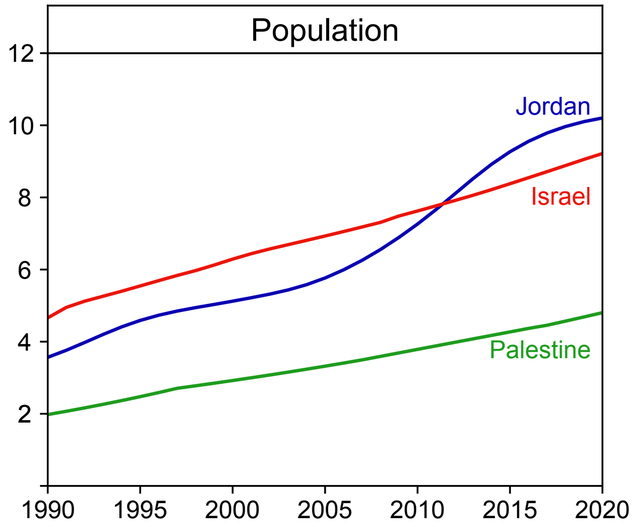
- The global power sector is not aligned with the Paris agreement
- Numerous institutions (e.g., IPCC, IEA, CAT) calling for rapid and massive scale-up of renewables to 2030
- Investing in fossil assets risks carbon lock-ins and stranded assets
- Could cooperative energy policy could unlock deep decarbonisation in the region?



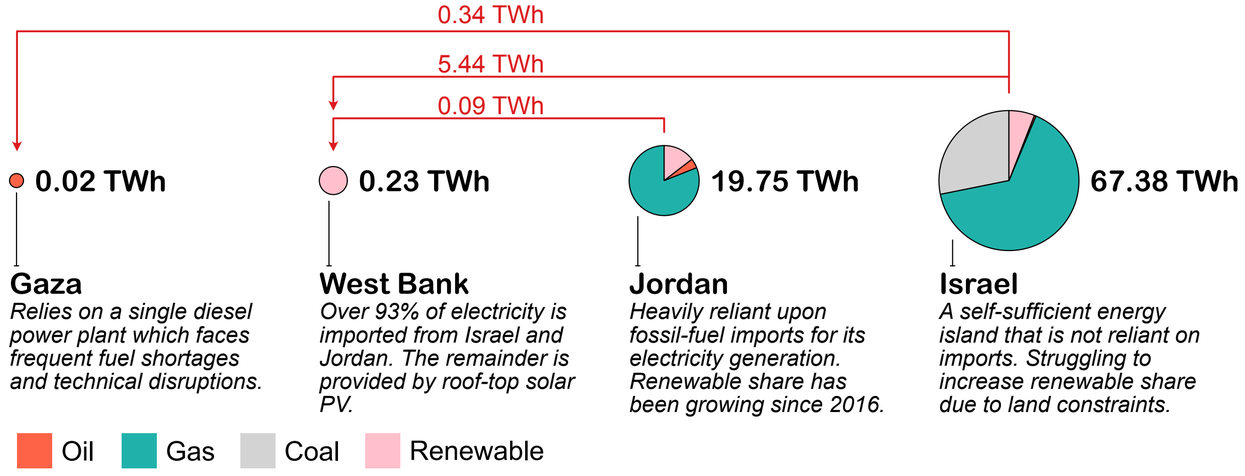
The regional energy landscape

West Bank: 1.16 MWh/person
Gaza:

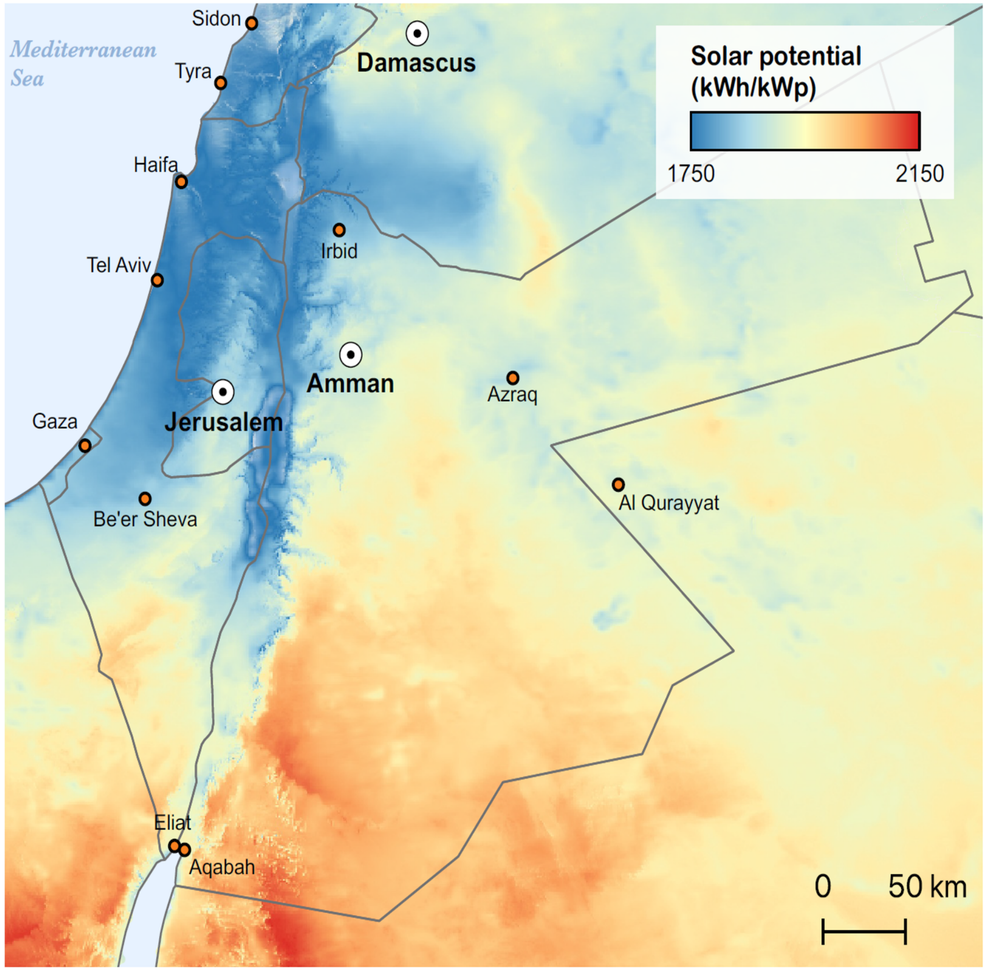


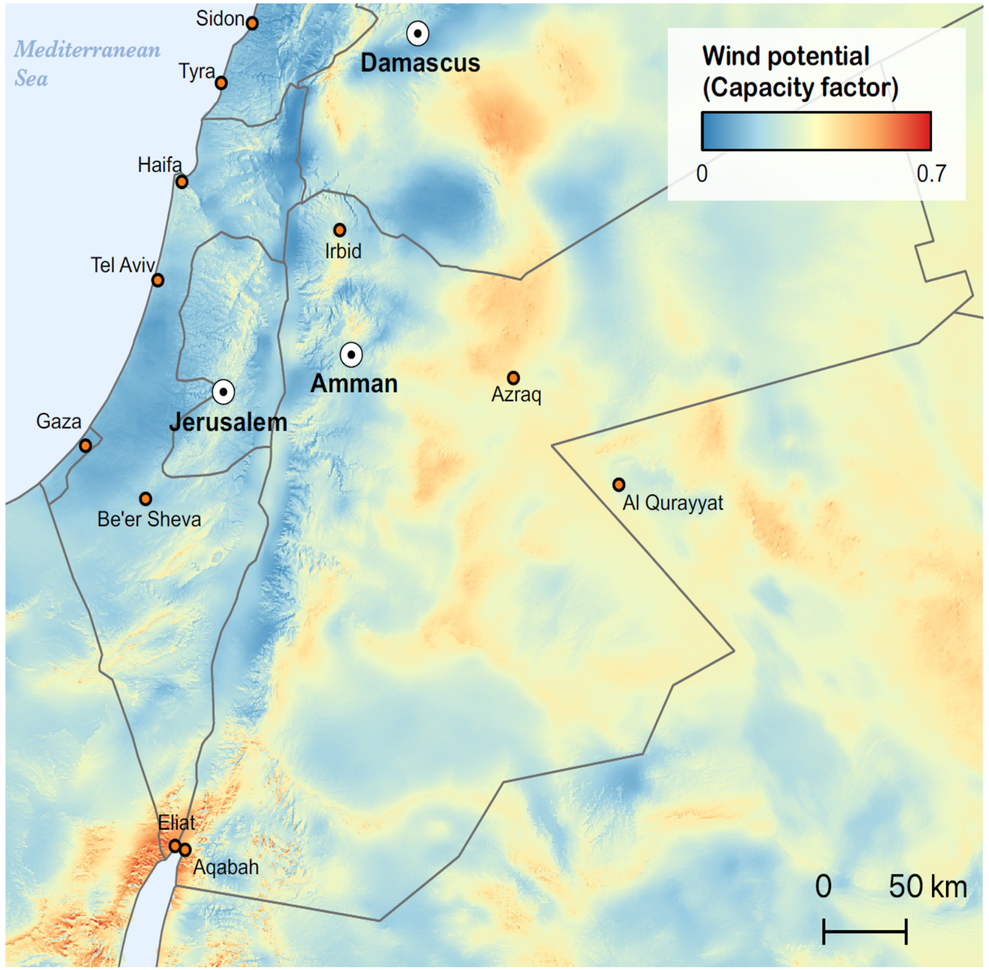


Energy supply and imports in 2019



Solar and wind potential

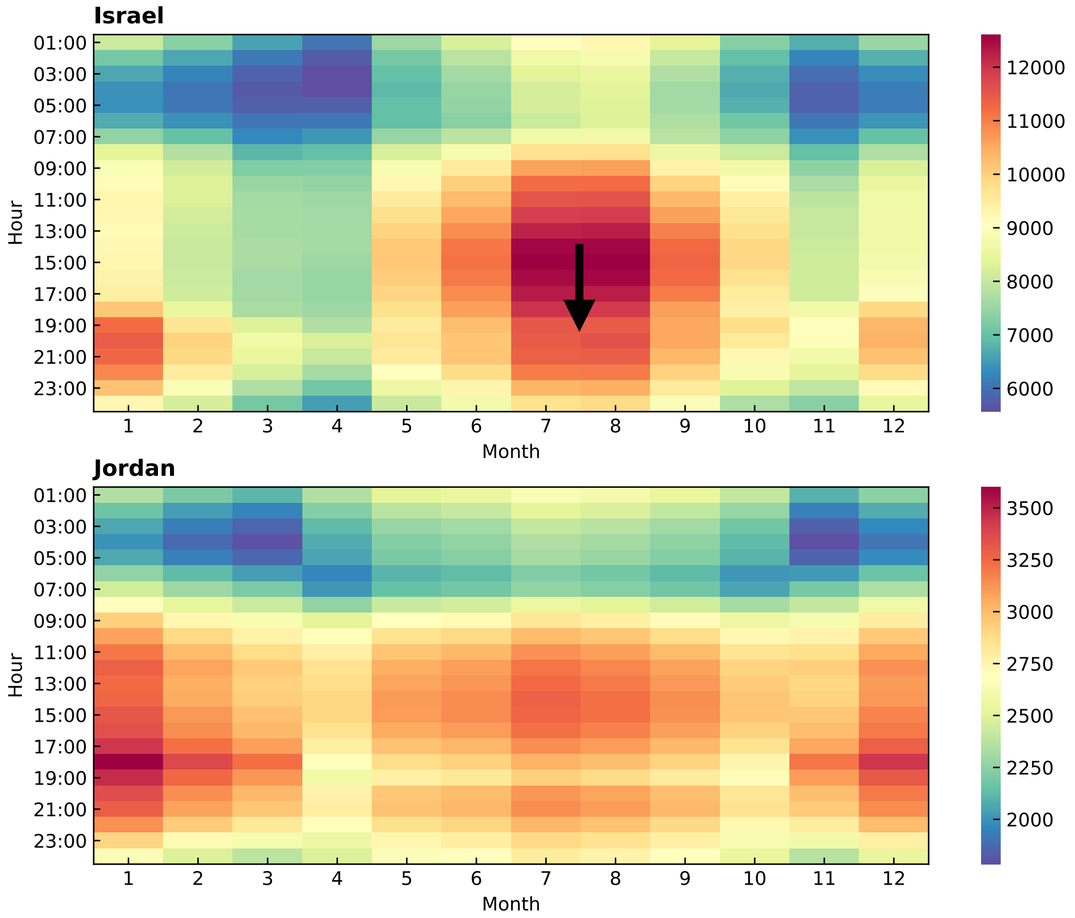




Trends

- Costs of renewable energy technologies declining
- Carbon reduction commitments (NDCs)
- Varying potential of wind and solar across the region
- Power demand patterns vary seasonally due to differences in cooling/heating demands and in energy-intensity
- Increasing demand for desalination and air conditioning
- Palestine still lacks reliable electricity supplies
- Consideration of transboundary energy transfers (Prosperity Green project)

Energy demands



Issues

- Israel:
  - Struggling to increase renewable capacity
  - Land allocation permits for renewable difficult to obtain
- Jordan:
  - Demand does not match solar generation curves
  - Could have excess curtailment
  - Grid stability issues
- Palestine:
  - Power supplies still unreliable
  - Gaza electricity access is poor
  - Wants to increase self-sufficiency

Our project

Plan energy systems to 2030 while considering:

1) Decarbonisation goals
2) Renewable goals
3) Regional cooperation

Methods

Model Inputs

- Growth projections
- Hourly demand
- Wind generation
- Solar generation
- Operational rules
- Technical constraints

Scenarios

Level of Cooperation	Self-sufficiency targets *Applies only to Palestine*
Emissions targets	Renewable targets

Model

CAPACITY EXPANSION MODEL

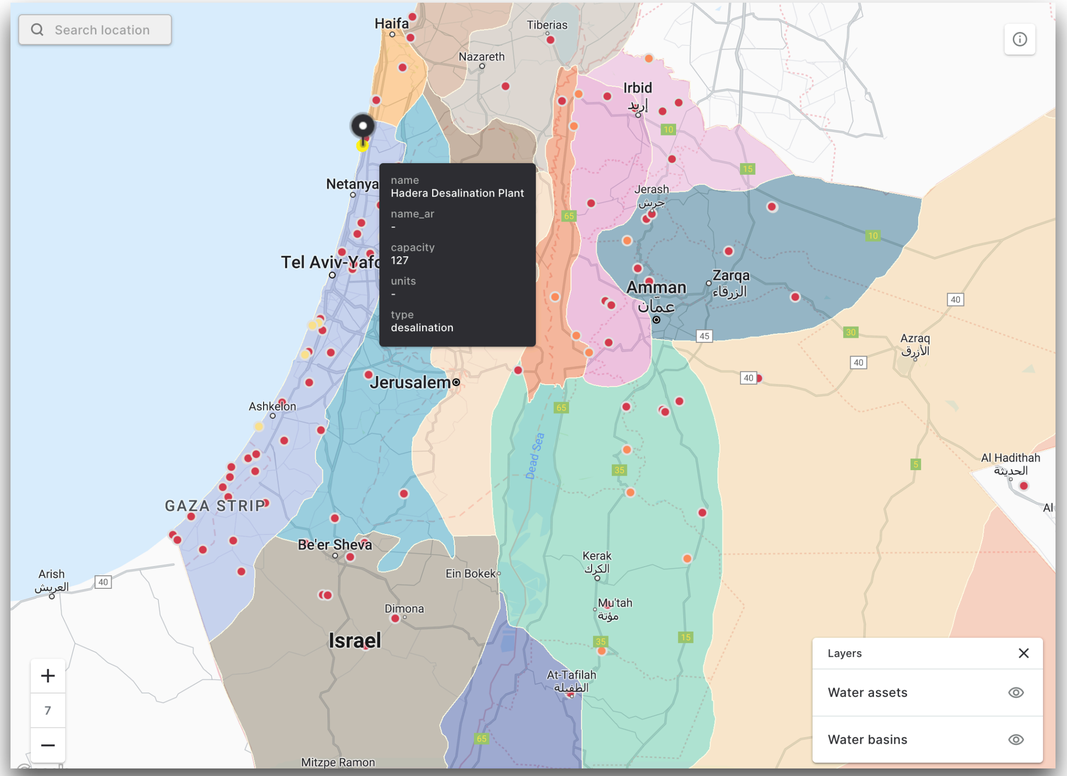
Optimisation algorithm chooses a mix of technologies that meets targets at lowest cost

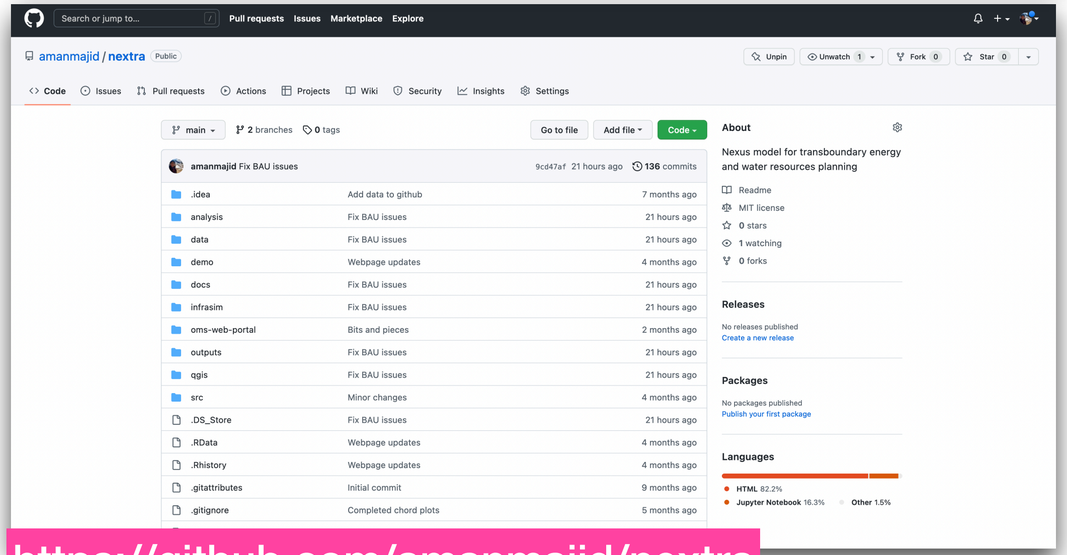
SIMULATION MODEL

Computer model simulates how system would perform under new technology mix

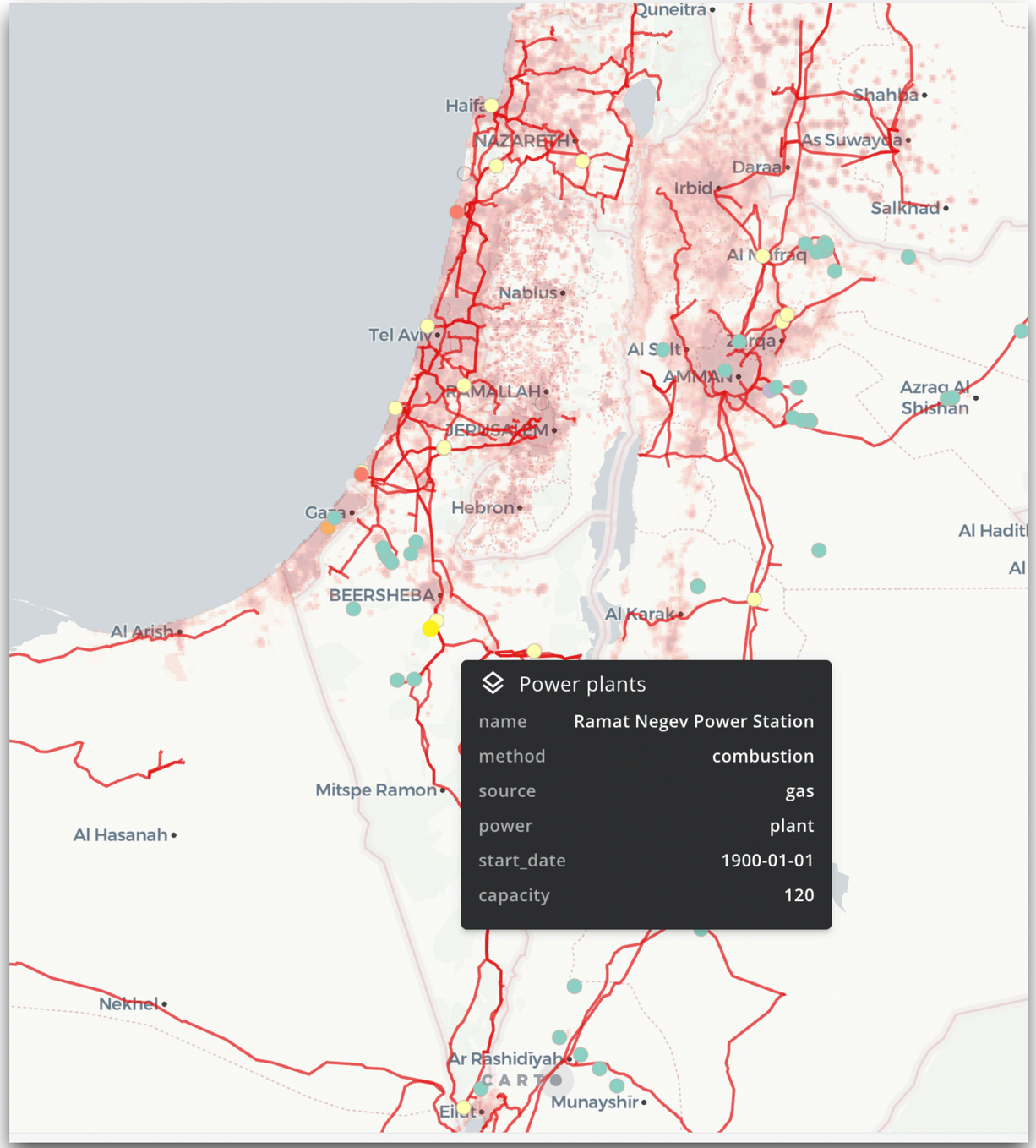
Results

- Capacities
- Dispatch curves
- Renewable curtailment
- Costs
- Technology mix
- Emissions

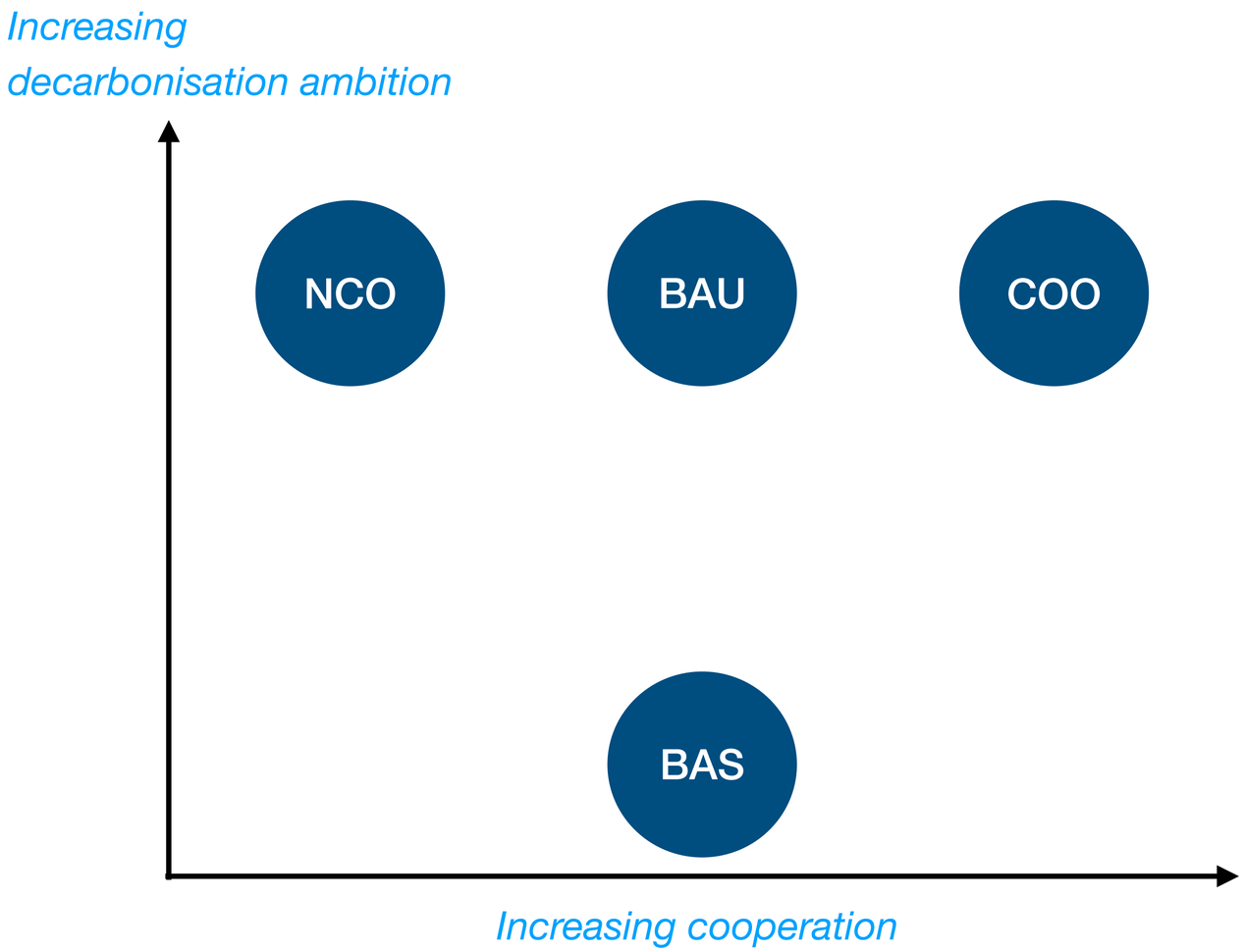




https://github.com/amanmajid/nextra



Scenarios

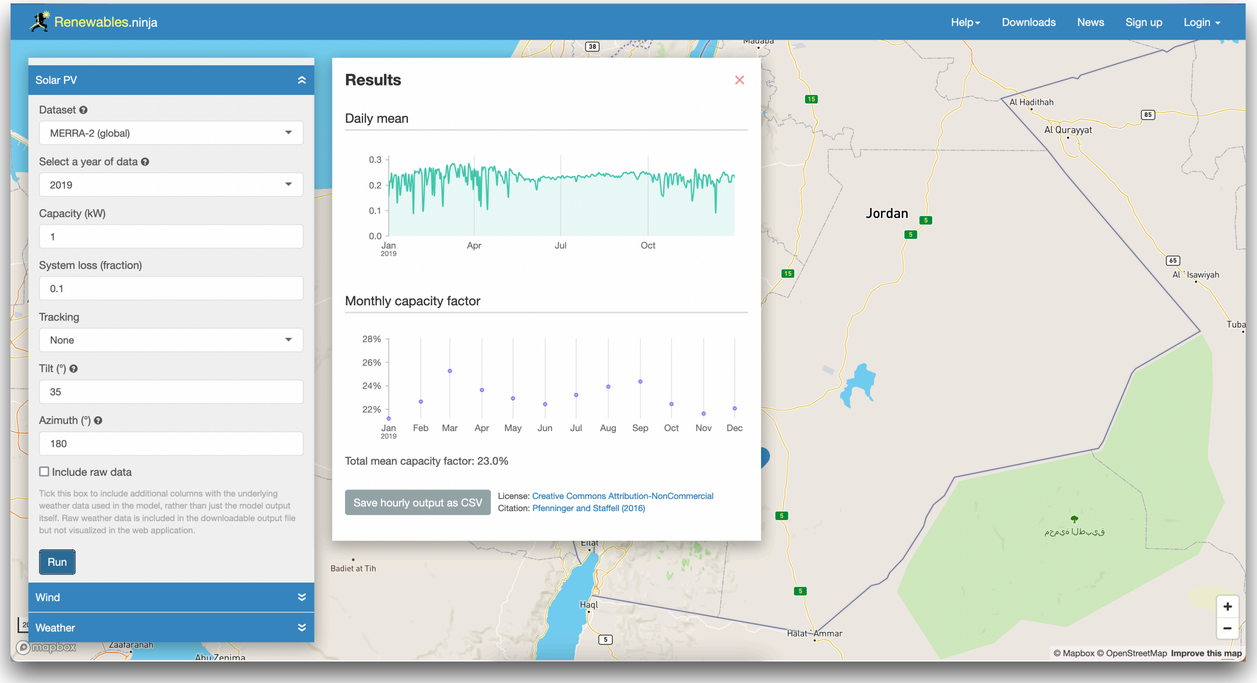


All scenarios meet:

- Future demands
- Renewable targets
- Palestinian self-sufficiency

Limitations

- **Estimated data for Jordan and Palestine**
  - Electricity demand curves
  - Generation curves
  - True RES capacity factors
- Transmission constraints
- System features (e.g., efficiencies and losses; operational rules etc.)

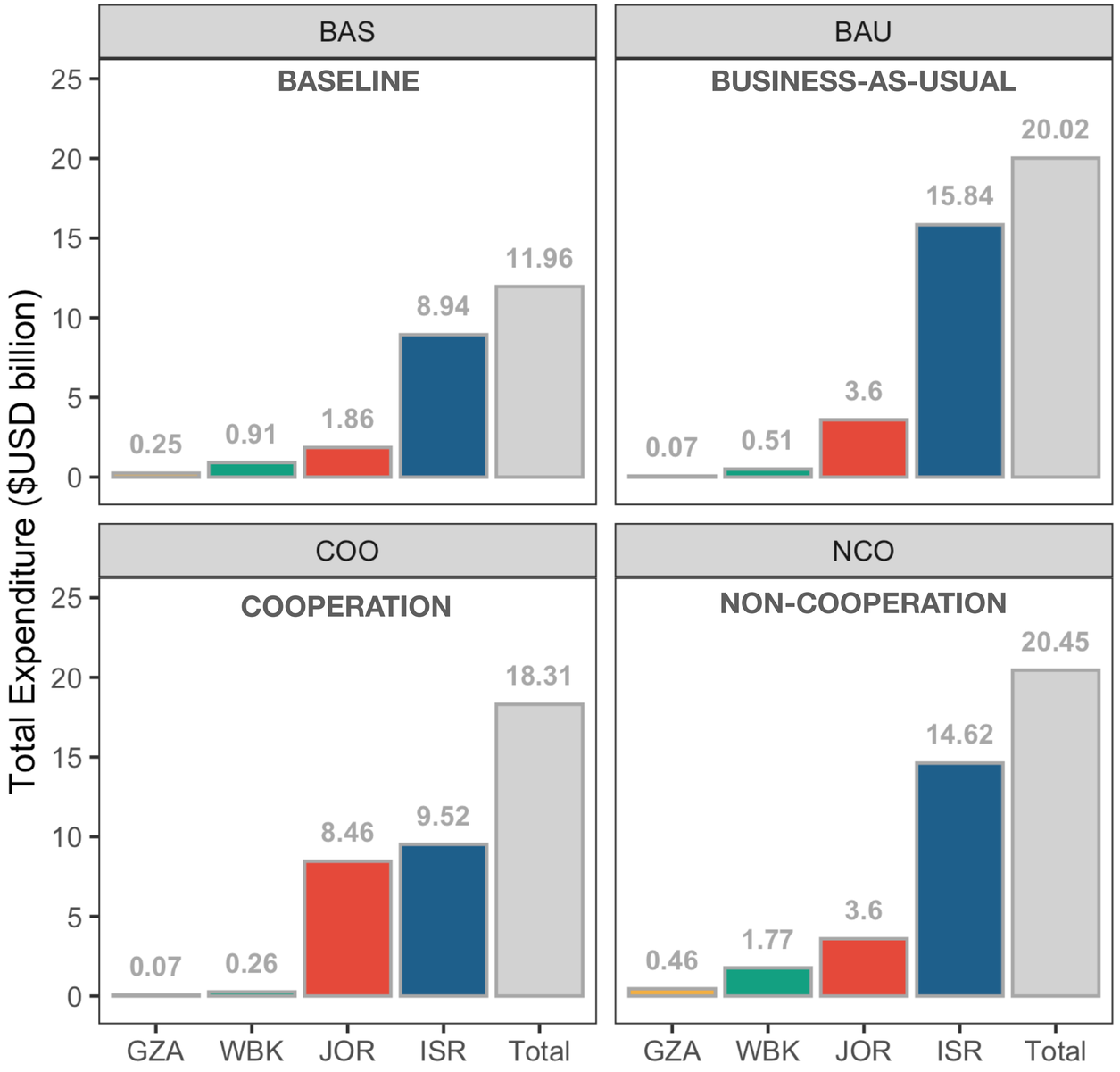


Modelled outputs presented here will be different from bottom-up estimates within countries

Preliminary Results

These results are still under development. Please do not cite or quote.

Costs



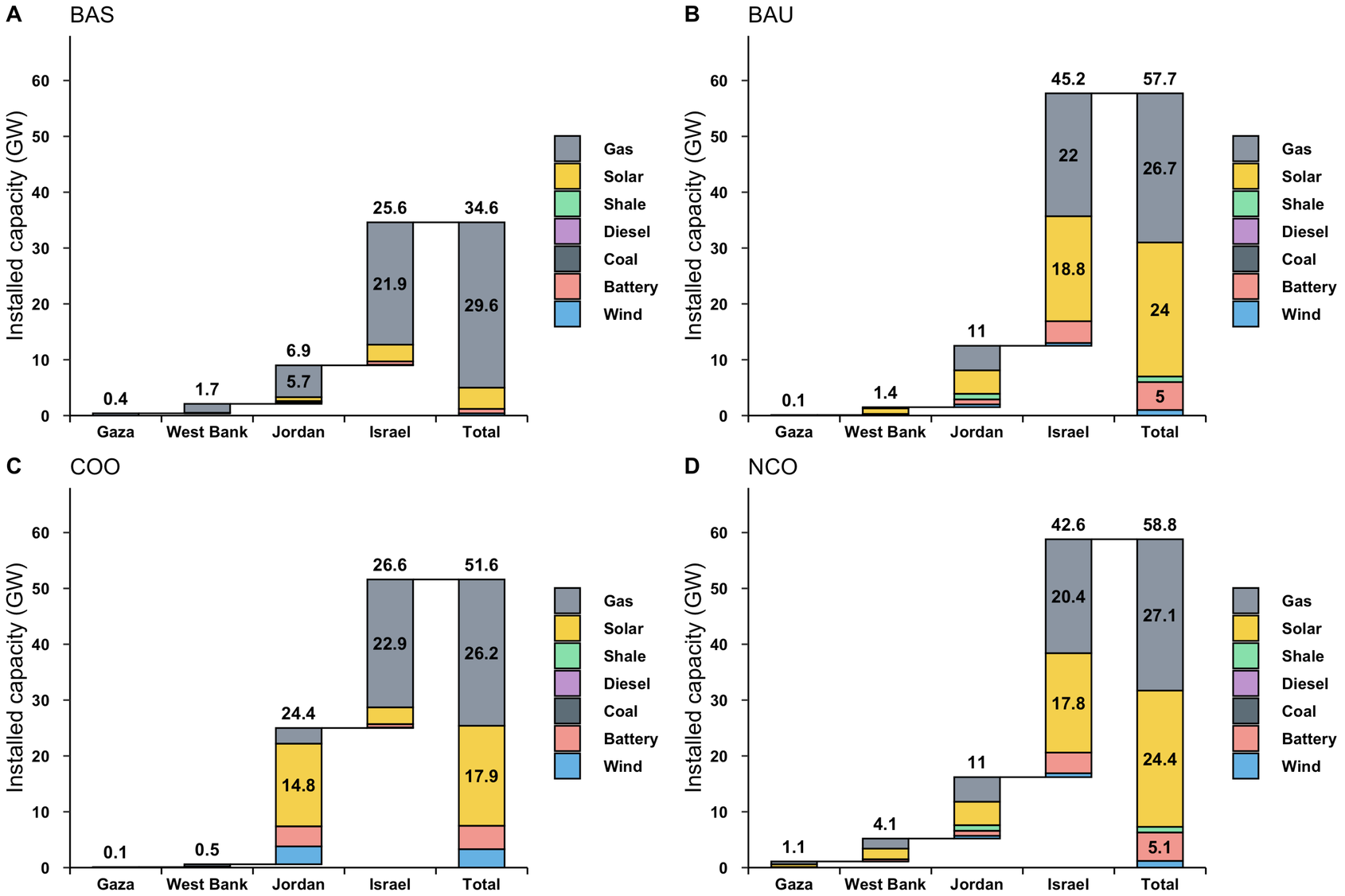
9.4%

Reduction in costs relative to current plan (BAU)

x2.4

Investment in Jordan increases relative to current plan (BAU)

Capacities



24%

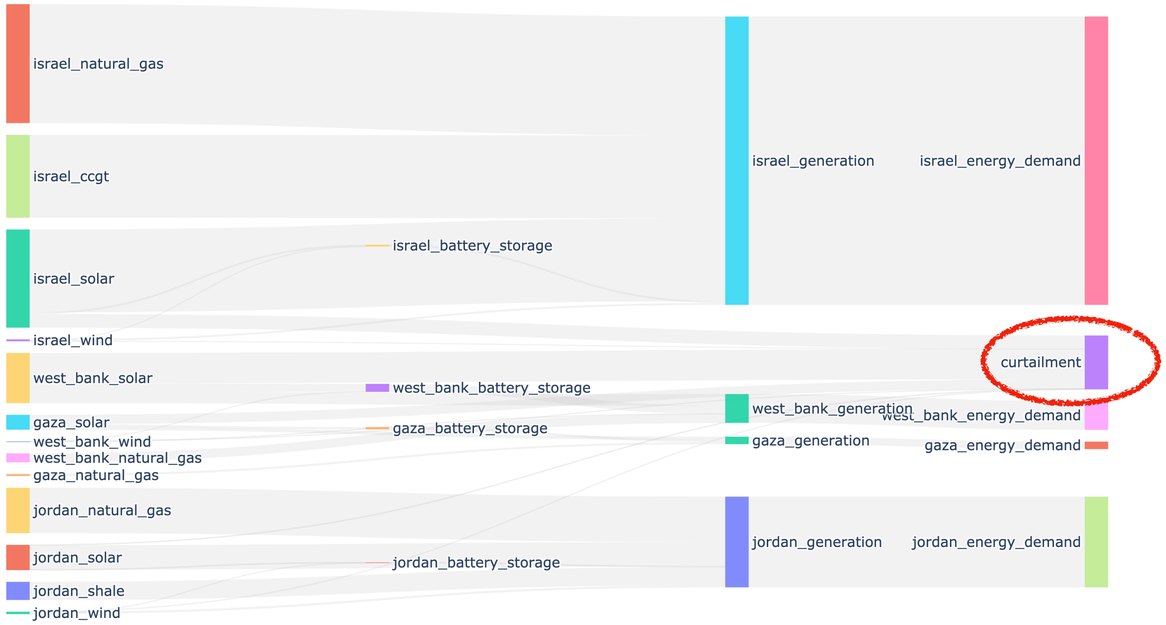
Reduction in build-out of solar and battery storage compared to current plan (BAU)

x2.2

Total capacity needed in Jordan compared to current plan

Electricity flows

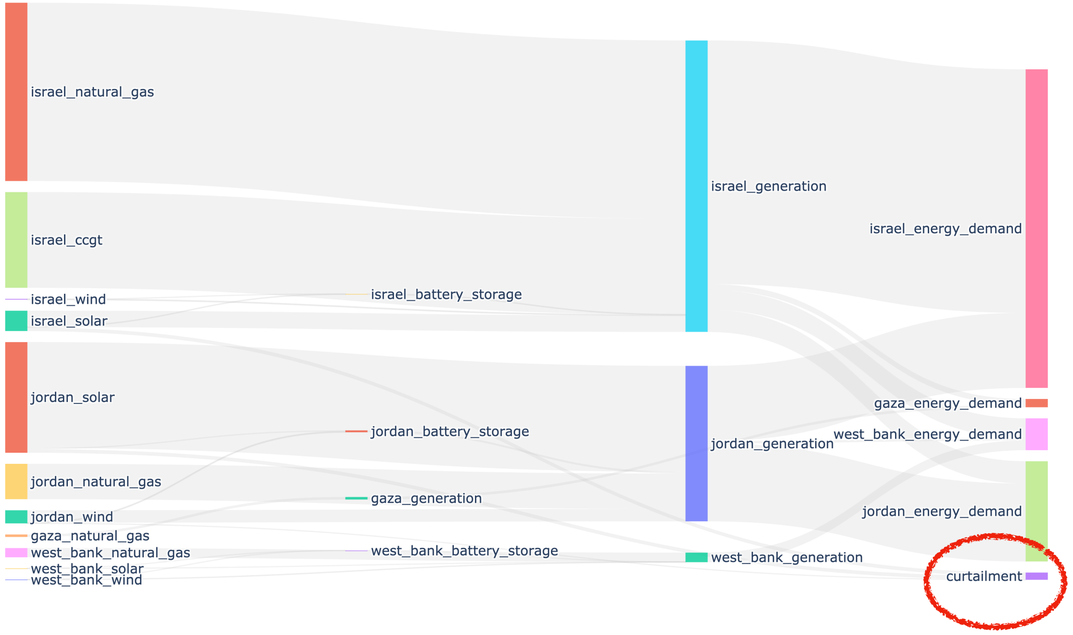
NCO



x20

More renewable curtailment in non-cooperative (NCO) operations compared with cooperative (COO) case

COO

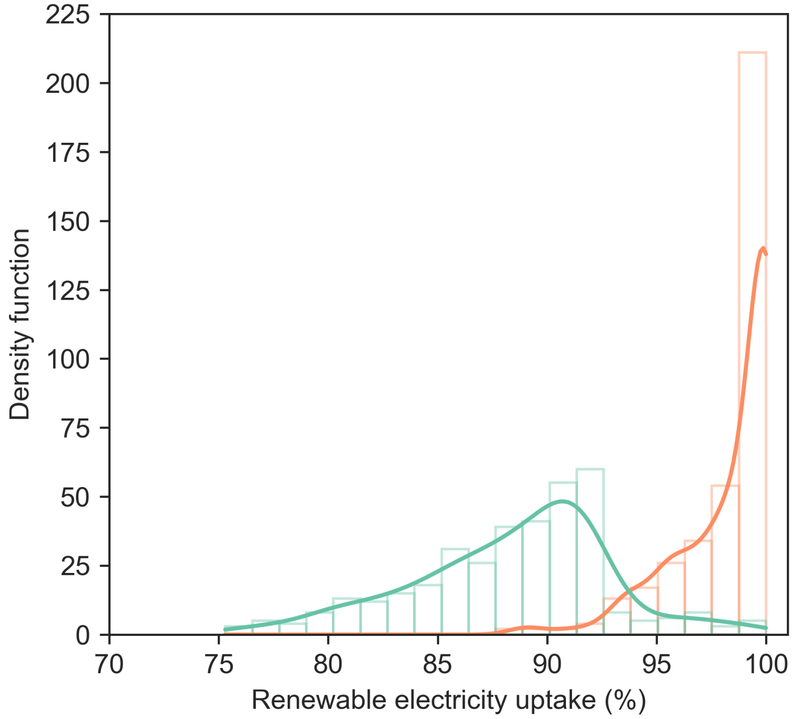


Renewable uptake

Utilisation under non-cooperative and cooperative operations

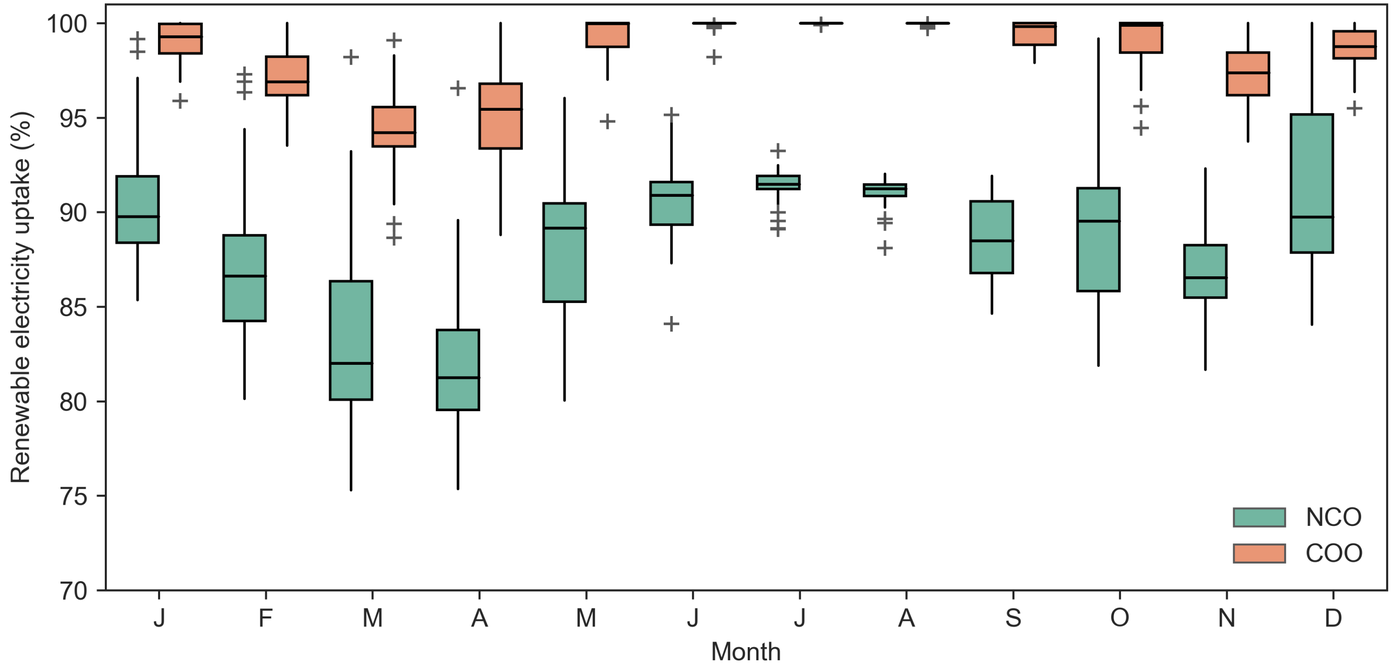
>90%

Daily renewable utilisation under COO



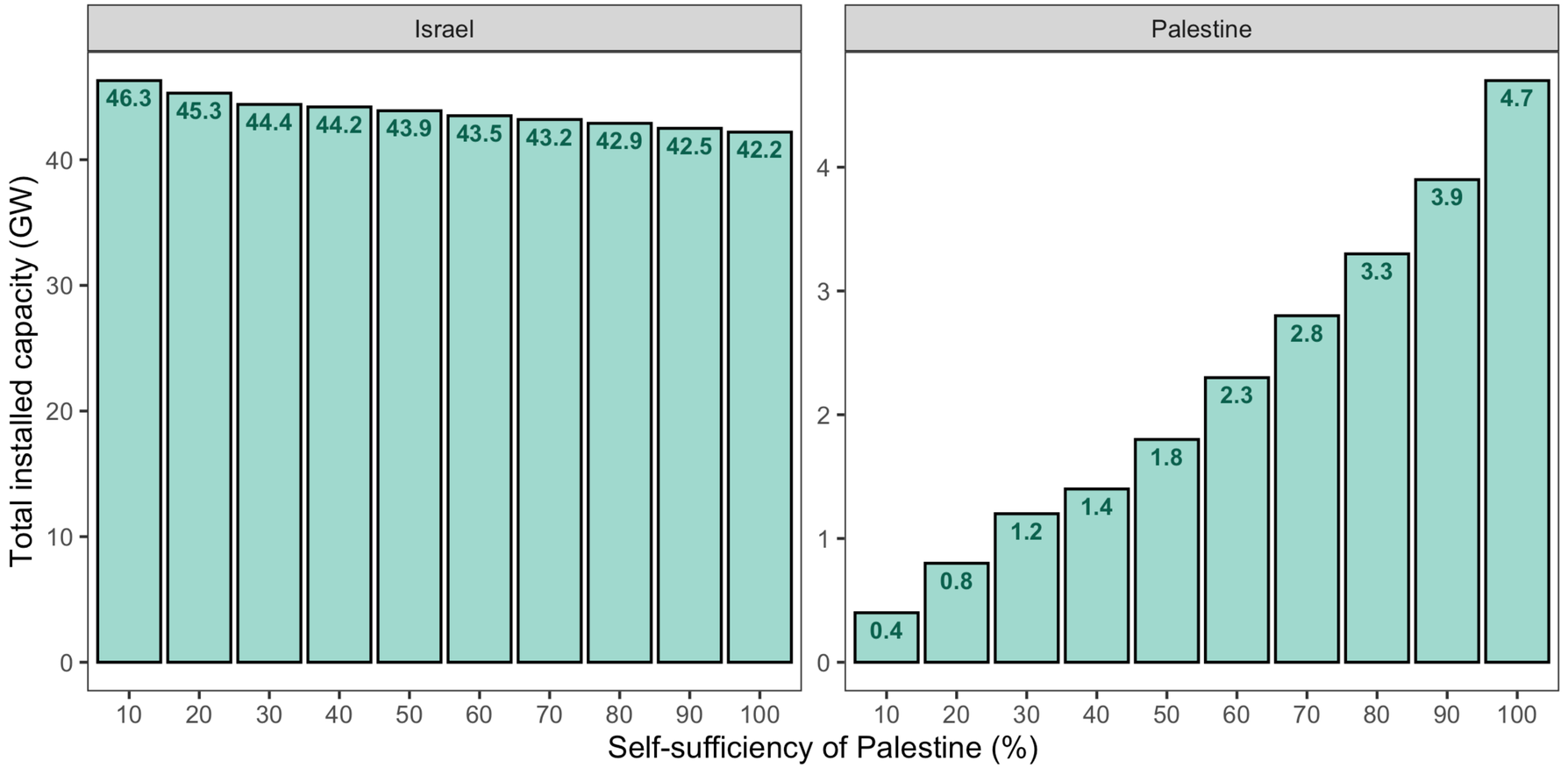
Jun-Aug

Generally exhibit greatest levels of renewable uptake. Excess supplies during Feb-Apr.



Self-sufficiency

Capacity changes due to Palestine's self-sufficiency targets



8%

Reduction in Israel's total capacity requirements between 10-100%

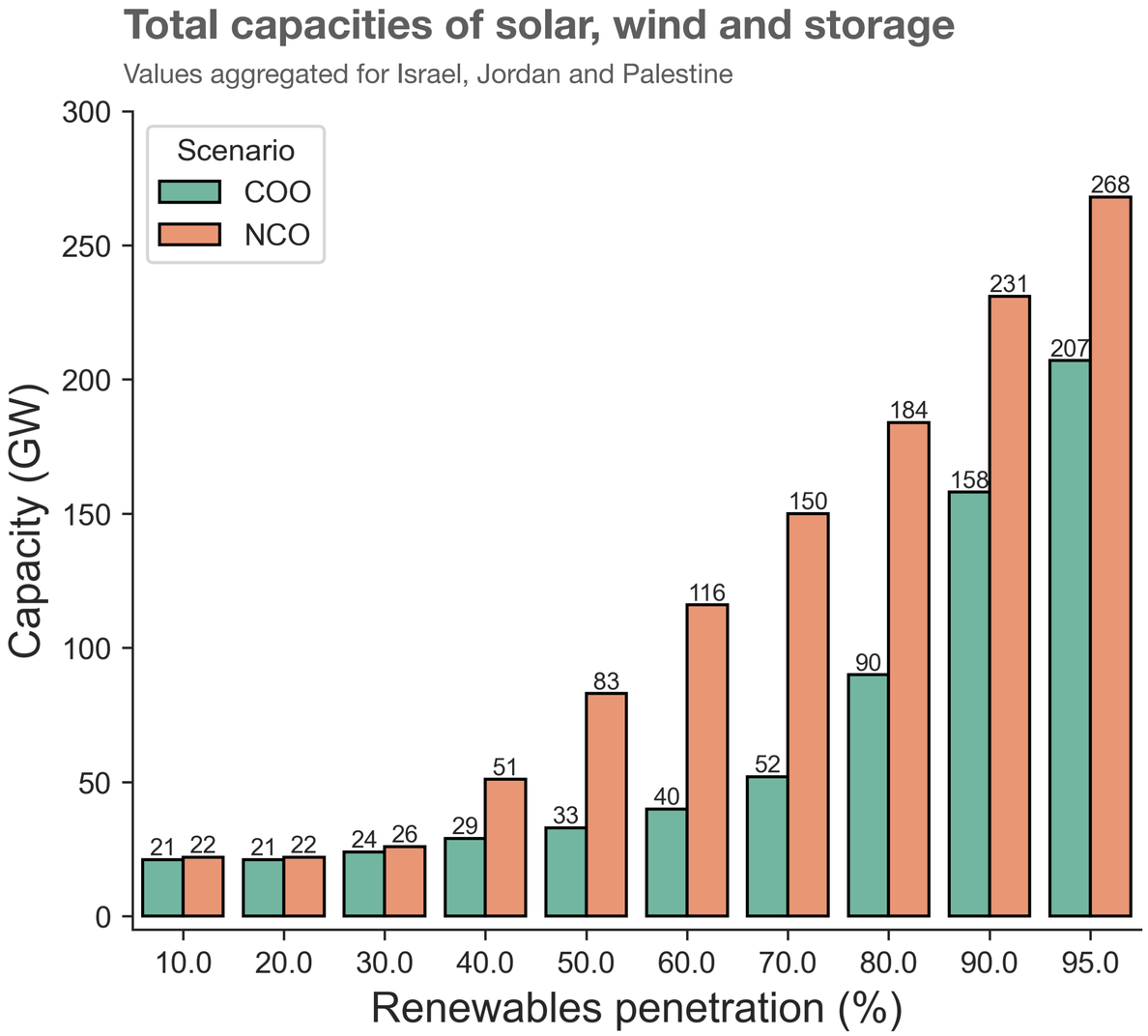
x12

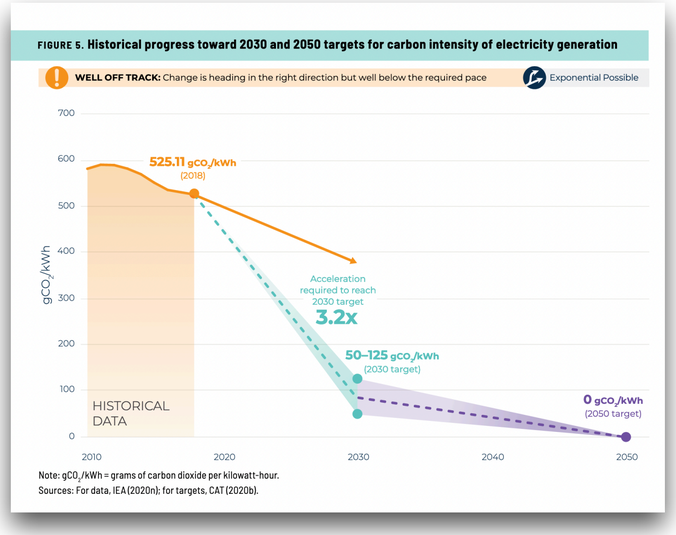
Total capacity increase in Palestine between 10-100% self-sufficiency

Based on current operational configurations (BAU)

Deep decarbonisation

How could cooperation deliver net-zero?





22%

Less capacity of renewables and storage needed under cooperative (COO) system

$47 billion

Total saving to achieve net zero by 2030 under cooperative (COO) energy policy

Conclusions

Results

Summarising our findings

Cooperative (COO) energy planning and management has significant benefits:

- Reduce costs by 28% compared to current plan (BAU)
- Improves renewable energy uptake and reduces curtailment

Pursuit of self-sufficiency (NCO) is challenging:

- Much higher renewable build-out with greater curtailments
- Costs a lot more than the cooperative case (COO)
- Very large costs for Palestine

Scale and ambition could be increased:

- To align regional power sector with Paris agreement
- Working to net zero cooperatively (COO) is much more economical

Supporting slides

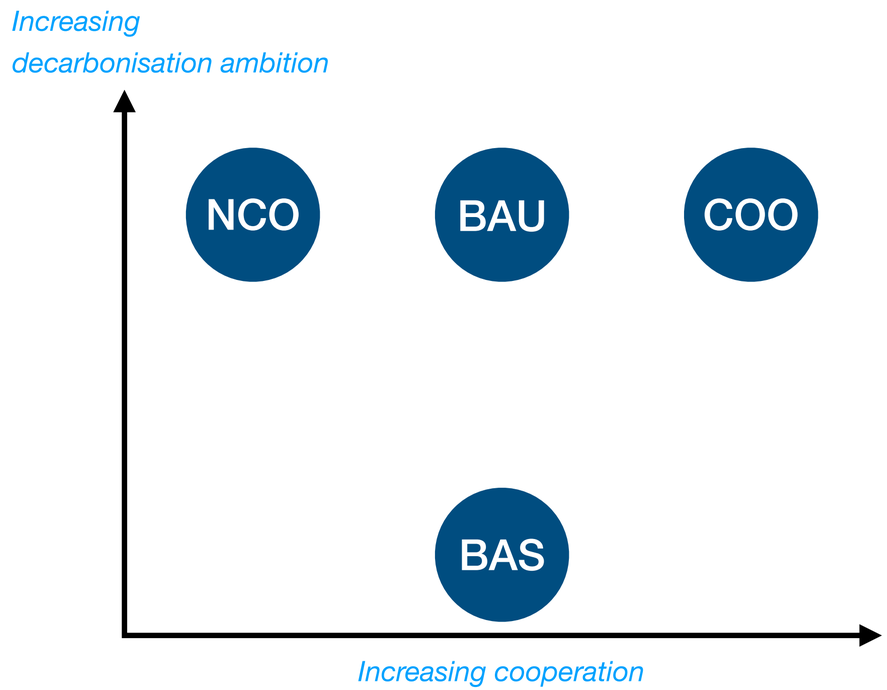
Scenarios

- **Baseline (BAS):**
  - No consideration of sustainable development goals;
  - Continue with business-as-usual practices;
  - Quantifies minimum infrastructure needed without sustainable transitions

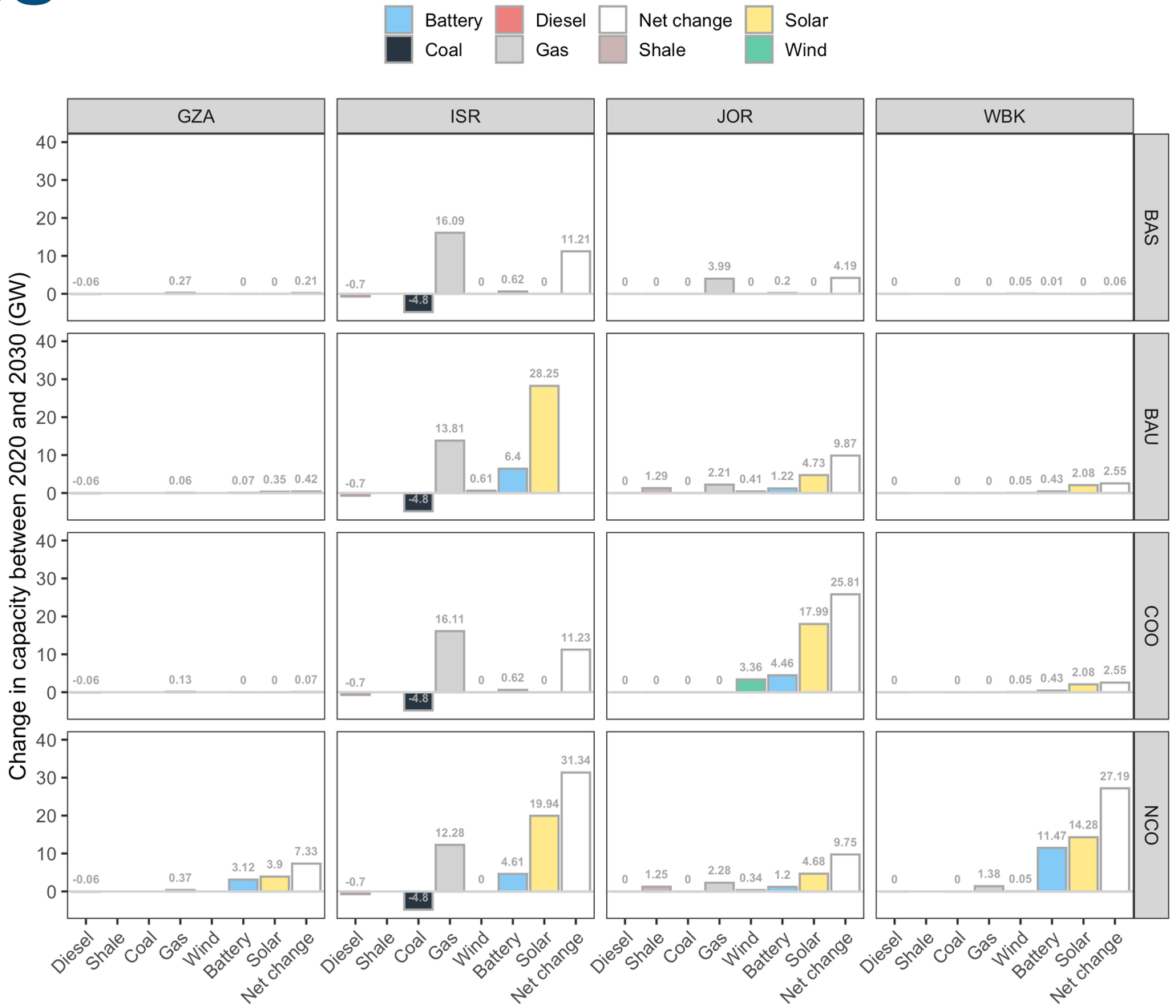
- **Business-as-usual (BAU):**
  - Continue with current practices;
  - Develop sustainably: observing renewable/carbon targets;
  - Palestine aims for minimum level of self-sufficiency (30%)

- **Non-cooperation (NCO):**
  - Develop sustainably: observing renewable/carbon targets;
  - Zero cooperation between regions;
  - Each region acts as an energy island

- **Cooperation (COO):**
  - Develop sustainably: observing renewable/carbon targets;
  - Complete cooperation between regions (i.e., unlimited energy trading);
  - Palestine aims for minimum level of self-sufficiency (30%)



Capacities

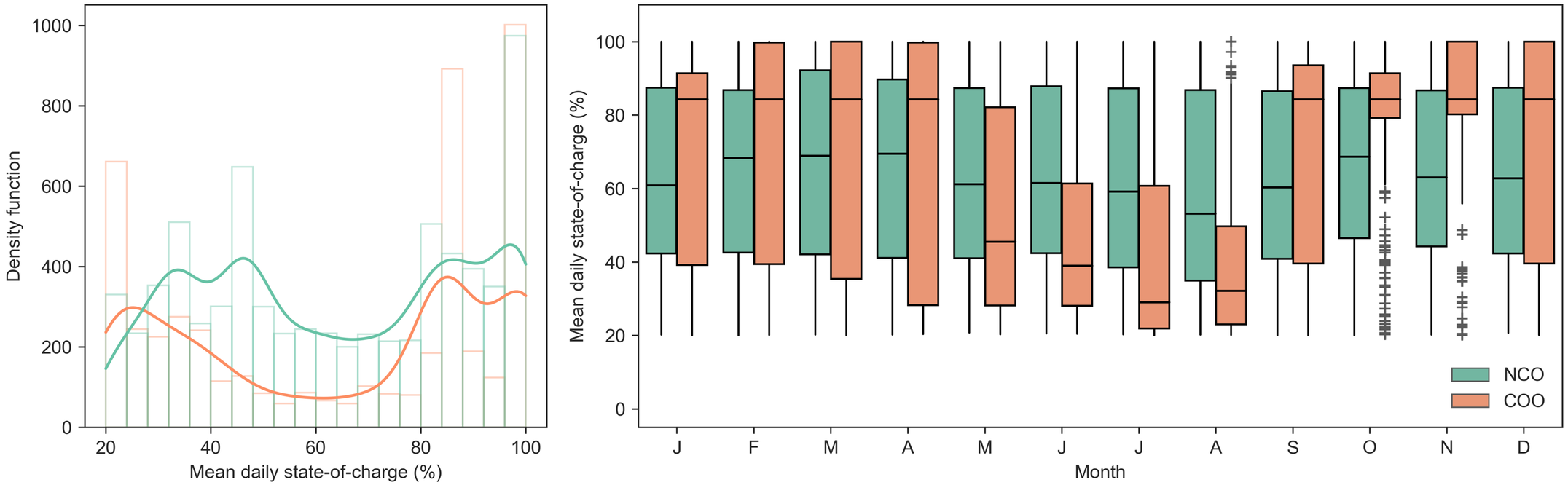

Battery
Coal
Diesel
Gas
Net change
Shale
Solar
Wind
GZA
ISR
JOR
WBK
BAS
BAU
COO
NCO
Change in capacity between 2020 and 2030 (GW)
Diesel
Shale
Coal
Gas
Wind
Battery
Solar
Net change

Next steps

- Sense-check our scenarios and results
- Arrange a workshop with regional participants to promote model uptake (with a view to forming a cross-party planning group)
- Scope feasible options for cooperative energy management
- Further opportunities to explore: e.g., the role of green hydrogen

Battery usage

State-of-charge (SOC) under NCO and COO



Need to further analyse:

The daily SOC under COO is generally lower; particularly around summer months. This helps RES uptake to increase — why does this not happen under NCO?

Renewable cost curves