# Evidence-based approaches and holistic strategies to maximize co-benefits & minimize negative impacts of implementing NDCs

**Global Dialogue on the Impacts of the Implementation of Response Measures**
**Ghana, Accra, September 2024**

# Assessment of economy-wide impacts arising from implementation of response measures
# Maldives Case Study

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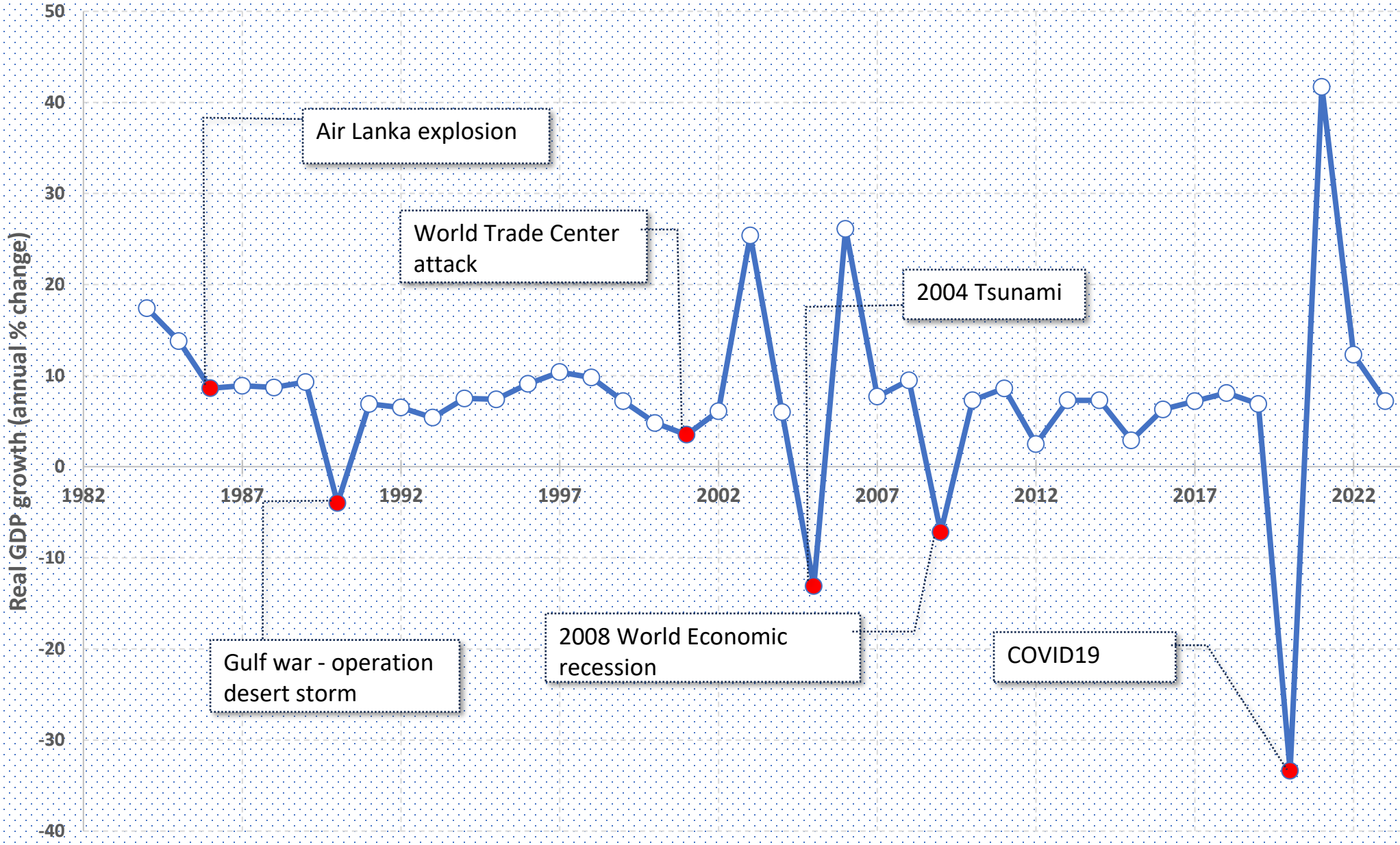
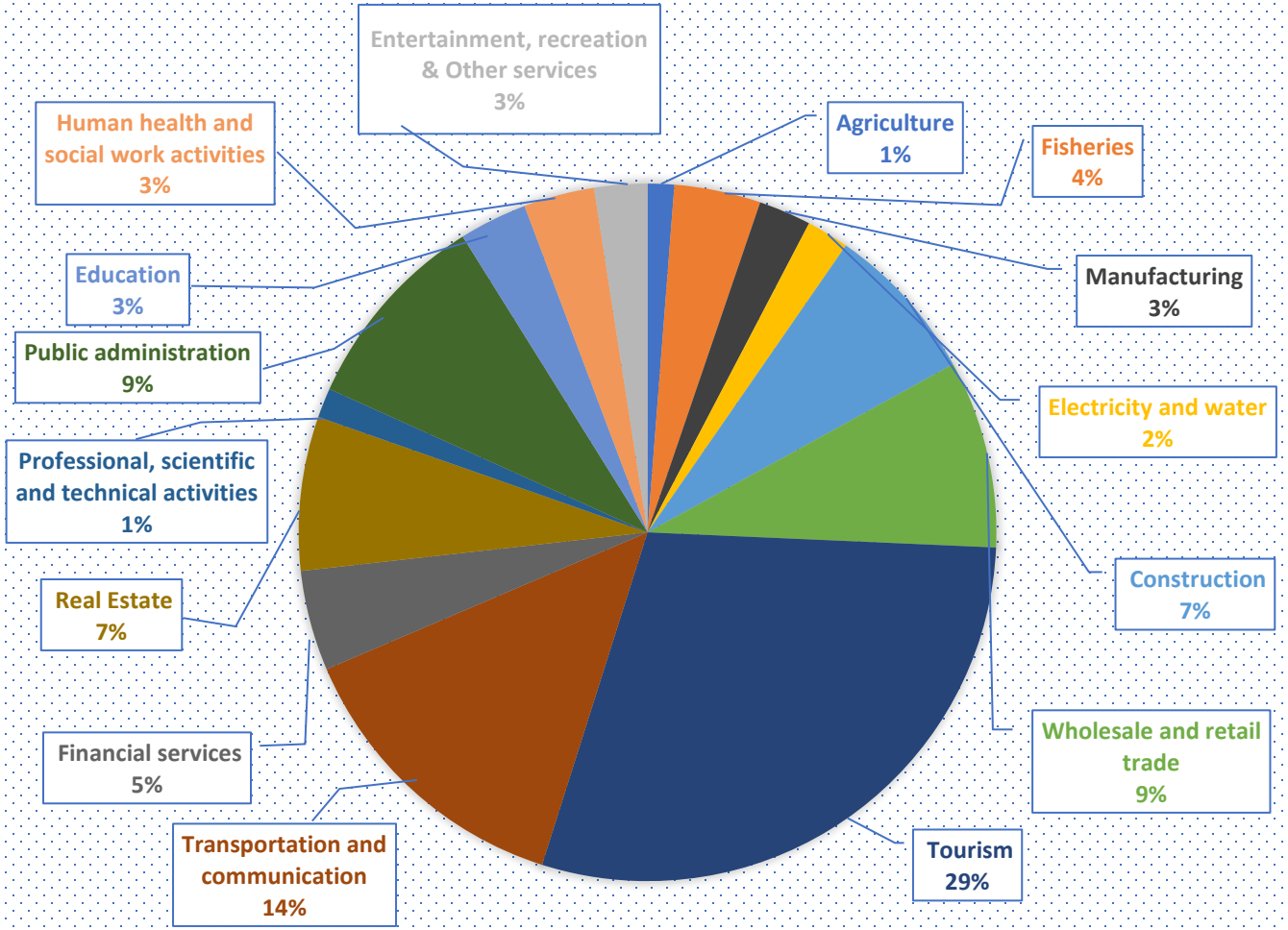
# Country context

- Population  - approximately half a million (515,132 - latest census in 2022)
- Geographically disbursed about 1200 islands
- Extremely vulnerable to climate change impacts
  - Sea level rise
  - Extreme weather events
  - Changes in sea surface temperature on coral environment
- High dependence on imports – vulnerable to external economic shocks


Real GDP growth (annual % change)
50
40
30
20
10
0
-10
-20
-30
-40
1982
1987
1992
1997
2002
2007
2012
2017
2022
Air Lanka explosion
World Trade Center attack
2004 Tsunami
Gulf war - operation desert storm
2008 World Economic recession
COVID19

# GDP share 2019



# Case Study

- A global Computable General Equilibrium (CGE) model linked to a national CGE model – MIRO-UNFCCC
- Changes in world markets due to global policies is used to assess domestic impacts (domestic to global feedback is not used since it’s a small and non-influential economy)
- Domestic impacts due to domestic response measures (based on NDC)
- Domestic impacts due to global response measures
- The national CGE model is calibrated to a 2019 Social Accounting Matrix (SAM)
- Impacts examined from 2020-2045

# Case Study

- Two domestic climate change response measures considered:
  - Alternative energy strategies for non-tourism
  - Alternative energy strategies for tourism
- Three global climate change response measures considered:
  - Generic carbon tax rates to achieve atmospheric carbon concentrations consistent with achieving 1.5, 2.0, and 2.5 degrees of global warming.
  - *Maritime transport*: response measures based on the (initial) IMO GHG Strategy.
  - *Air transport*: response measures based on proposals of ICAO climate change and Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

# The reference scenario

- A reference scenario is a simulation of one possible future
- Results are analysed relative to the reference scenario
- The reference scenario follows projections for **Shared Socio-economic Pathway 2 (SSP2)**
  - SSP2 is a middle of the road scenario with *intermediate mitigation and adaptation challenges*
  - The world follows a path in which social, economic, and technological *trends do not shift markedly* from historical patterns.
  - Global and national institutions work towards, but make *slow progress*, in achieving sustainable development goals.

- The reference scenario for this study:
  - Projections provide **forecasts of macroeconomic aggregates**: such as GDP, capital, labour force, population. (EconMap 3.1 database)
  - The projections are **aggregated to the regions** in this study using GDP or population weights as appropriate.
  - Includes **existing carbon prices** (sourced from World Bank carbon pricing dashboard, regional average)

# Domestic response measures

- Two domestic climate change response measures considered:
  - D1 - Alternative energy strategies for non-tourism
  - D2 - Alternative energy strategies for tourism
- Evaluated using a single country CGE model
- Both scenarios considers a change in the energy mix
- Diesel consumption is 80% of the total emissions, of which 90% is used for electricity generation and transport

# Domestic response measures

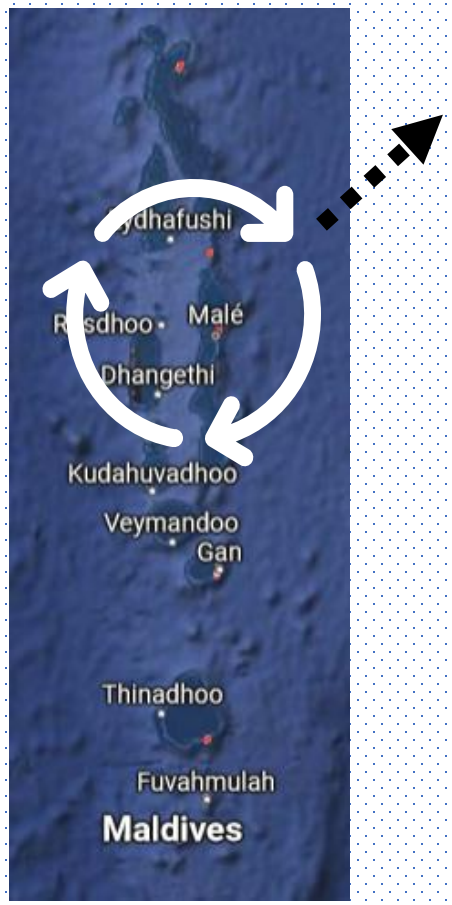
- D1 - Alternative energy strategies for non-tourism
  - Change in the energy mix towards renewables and LNG in non-resort electricity production which accounts for 18% of diesel demand in 2019
  - Increase RE (PV) share to 15%
  - Phase out electricity subsidy (9% in 2019)
  - Introduce 9% subsidy on PV-based electricity
  - Investment via Gov tax
- D2 - Alternative energy strategies for tourism
  - Change in the energy mix in resort electricity production which accounts for 7% of diesel demand in 2019
  - Increase RE (PV) share to 15%
  - Funded by additional private foreign investment

# Domestic response measures

**Policy scenario assumptions**

- As reference scenario with
- Government balance is fixed and additional revenue from GST (Non-resort)
- Additional investment in Resort PV comes from overseas

# Domain of impact



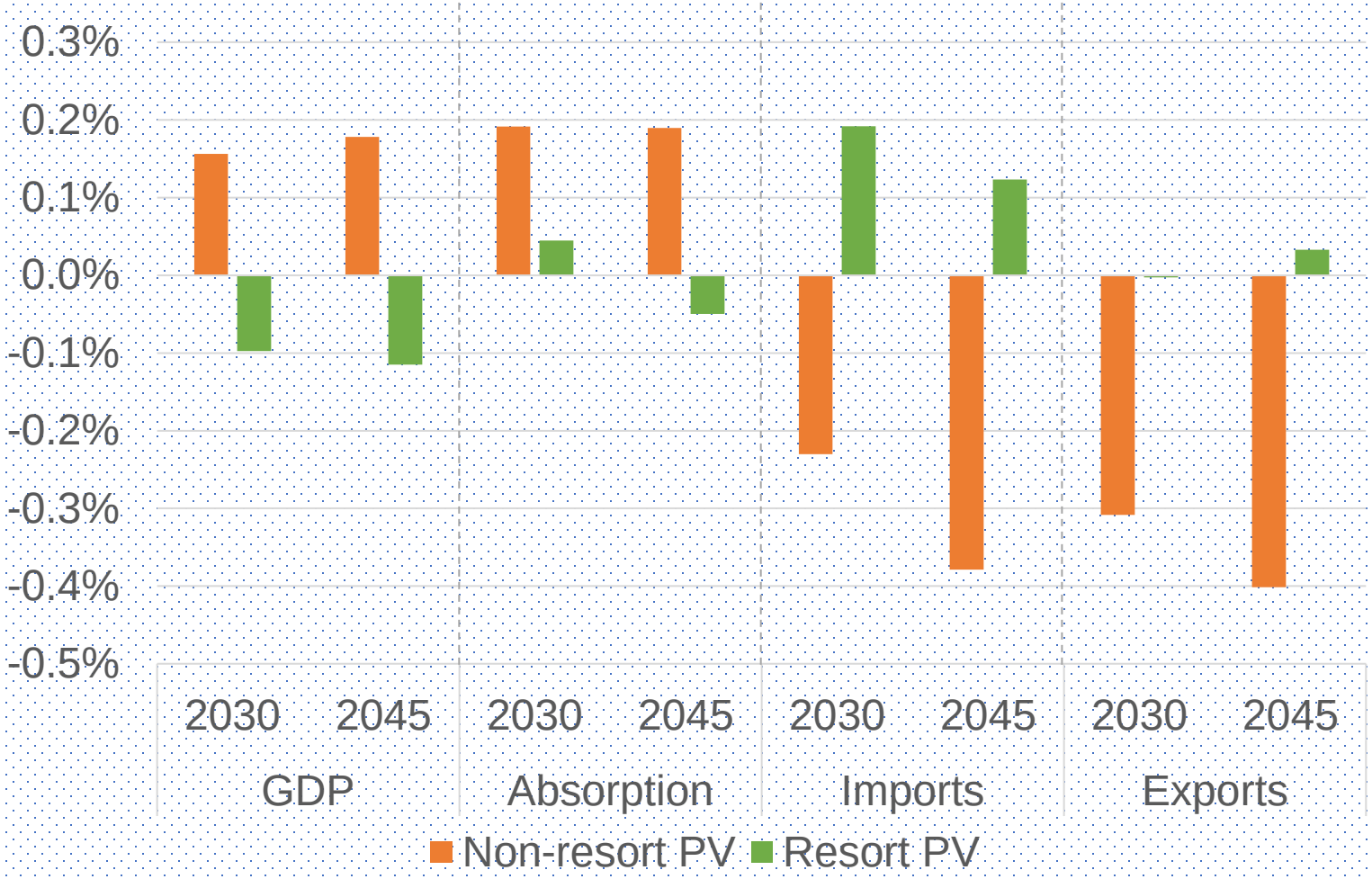

Domestic policy with domestic impacts


International policy with cross-border impacts

# IMPACTS OF CHANGING THE ENERGY MIX

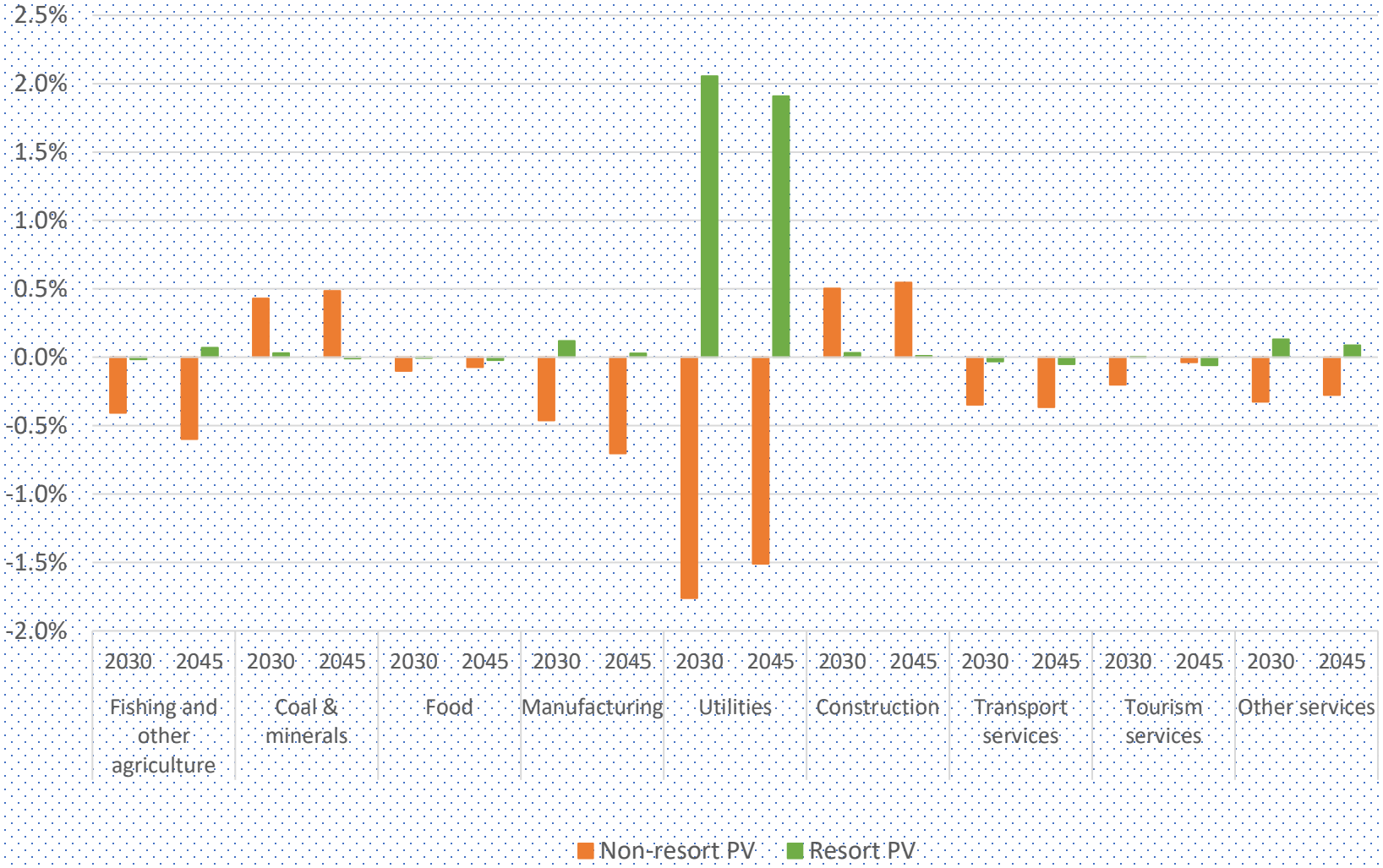
# Macroeconomic impacts

(real, % change from ref)



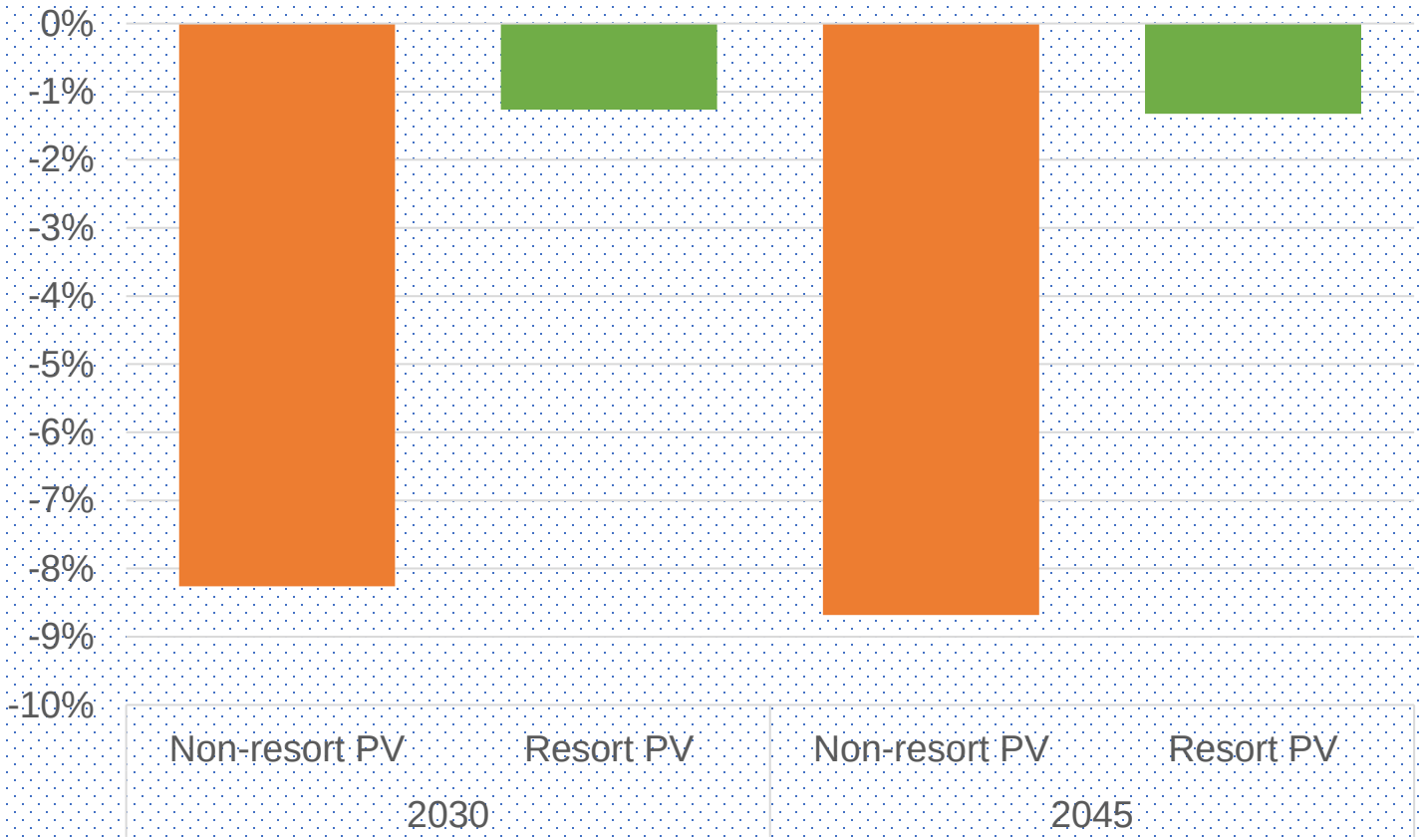

- Overall small macroeconomic effect
- Large effect in non-resort due to subsidy phase out.
- Imports fall in non-resort as electricity production becomes expensive with removal of subsidy, thus diesel import falls.

# Impact on commodity demand




- More impact on commodity demand than macroeconomic
- Decline in utility demand due to removal of fuel subsidy
- Construction appreciated with cheaper imports
- No major effect seen in resort other than utility due to RE infiltration.

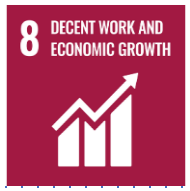
# Emissions (% change 2019-2045)




- Both scenarios shows a reduction in emissions in line with NDC objectives
- RE infiltration with subsidy removal have compounding effect on non-resort

# Impact on progress towards the SDGs (% change from REFERENCE SCENARIO IN 2045)








| SDG indicator | Non-resort PV 2045 | Resort PV 2045 |
|---|---|---|
| ***Goal 1. End poverty in all its forms everywhere*** | | |
| 121 Population below national poverty line (%) | | |
| ***Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all*** | | |
| 721a Renewable energy in electricity production (share) | | |
| 721b Renewable energy in non-resort electricity production (share) | | |
| 721c Renewable energy in resort electricity production (share) | | |
| ***Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*** | | |
| 811 Real GDP per capita (% change from 2019) | | |
| 821 Real GDP per worker (% change from 2019) | | |
| 842a Domestic Material Consumption (DMC, millions MVR) | | |
| 842b DMC per capita ('000 MVR per person) | | |
| 842c DMC per thousand MVR of GDP | | |
| 891a Tourism share of GDP (%) | | |
| 891b Growth in tourism share of GDP (% change from 2019) | | |
| ***Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*** | | |
| 921a Manufacturing value added in GDP (%) | | |
| 921b Manufacturing value added per capita ('000 MVR per person) | | |
| 922 Manufacturing employment (%) | | |
| 941a CO2 emissions (Gg) | | |
| 941b CO2 emissions (Gg per '000 MVR of GDP) | | |
| ***Goal 10. Reduce inequality within and among countries*** | | |
| 1011a Low-income household consumption (% change from 2019) | | |
| 1011b Average household consumption (% change from 2019) | | |
| 1041a Wages in GDP (share) | | |
| 1041b Wages and social transfer in GDP (share) | | |

**Non-resort PV**
**Social -**
**Economic -/+**
**Environmental +**

**Resort PV**
**Social -/+**
**Economic -/+**
**Environmental +**

Regression away from the goal

| < -50% | -10 to -50% | 0 to -10% |
|---|---|---|

Progress towards the goal

| 0 to 10% | 10 to 50% | >50% |
|---|---|---|

# Summary

- Market forces alone will not bring about move to renewables
- Policy interventions needed
- NDC emissions reductions achievable in both sectors of the economy
- Subsidy removal plays a key role

# Policy implications

## Caveats

- Low growth scenario SSP2: higher growth, more PV needed
- Stable world oil price: lower oil price reduces incentives to invest in PV
- Emissions reduction from subsidy removal *and* change in energy mix

## Further considerations

- Energy security
  - Renewables insulate country against volatile oil prices
  - ↑ extreme weather events, possible damage to PV
- Land for PV → role for FPV?

# Global or cross-border response measures

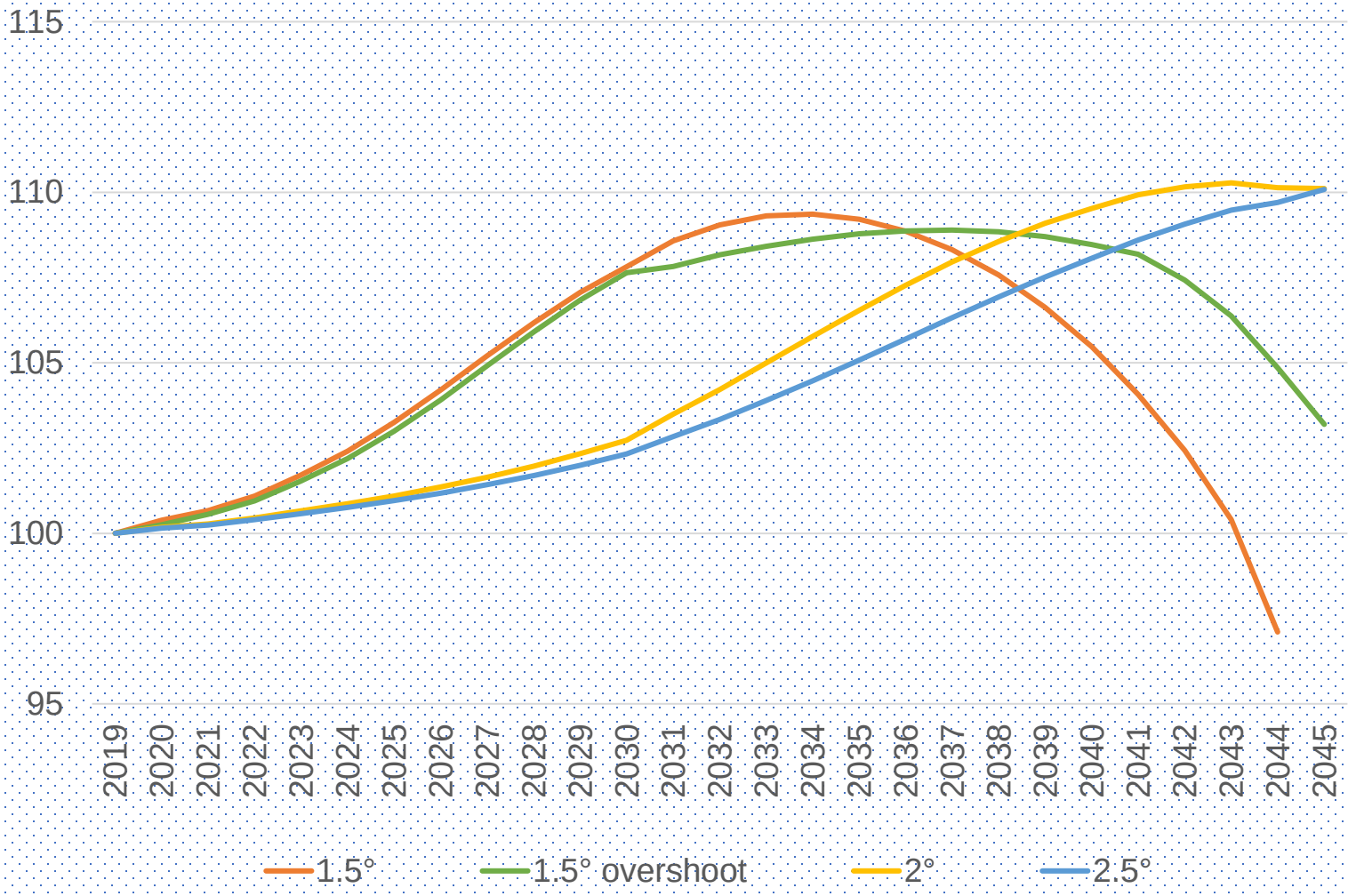
- Three global climate change response measures considered:
- **Generic carbon tax rates to achieve atmospheric carbon concentrations consistent with achieving 1.5, 1.5 overshoot, 2.0, and 2.5 degrees of global warming.**
- **Maritime transport: response measures based on the (initial) IMO GHG Strategy.**
  - IMO target 50% reduction by 2050 from 2008 level ➔ 3% reduction annually
  - Tax income to support water transport tech
  - 5% tax revenue to low-income and SIDS
- **Air transport: response measures based on proposals of ICAO climate change and Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).**
  - Emission reduction 50% reduction by 2050 from 2005 level ➔ 3% reduction annually
  - Offset cost as carbon tax on emissions associated with air transport services
  - Participating regions in the first (including pilot) phase, 2023-2026
  - All regions in the second phase, 2027-2035.

# TARGET GLOBAL TEMPERATURE RISE: IMPACT FOR MALDIVES

# Primary mechanism

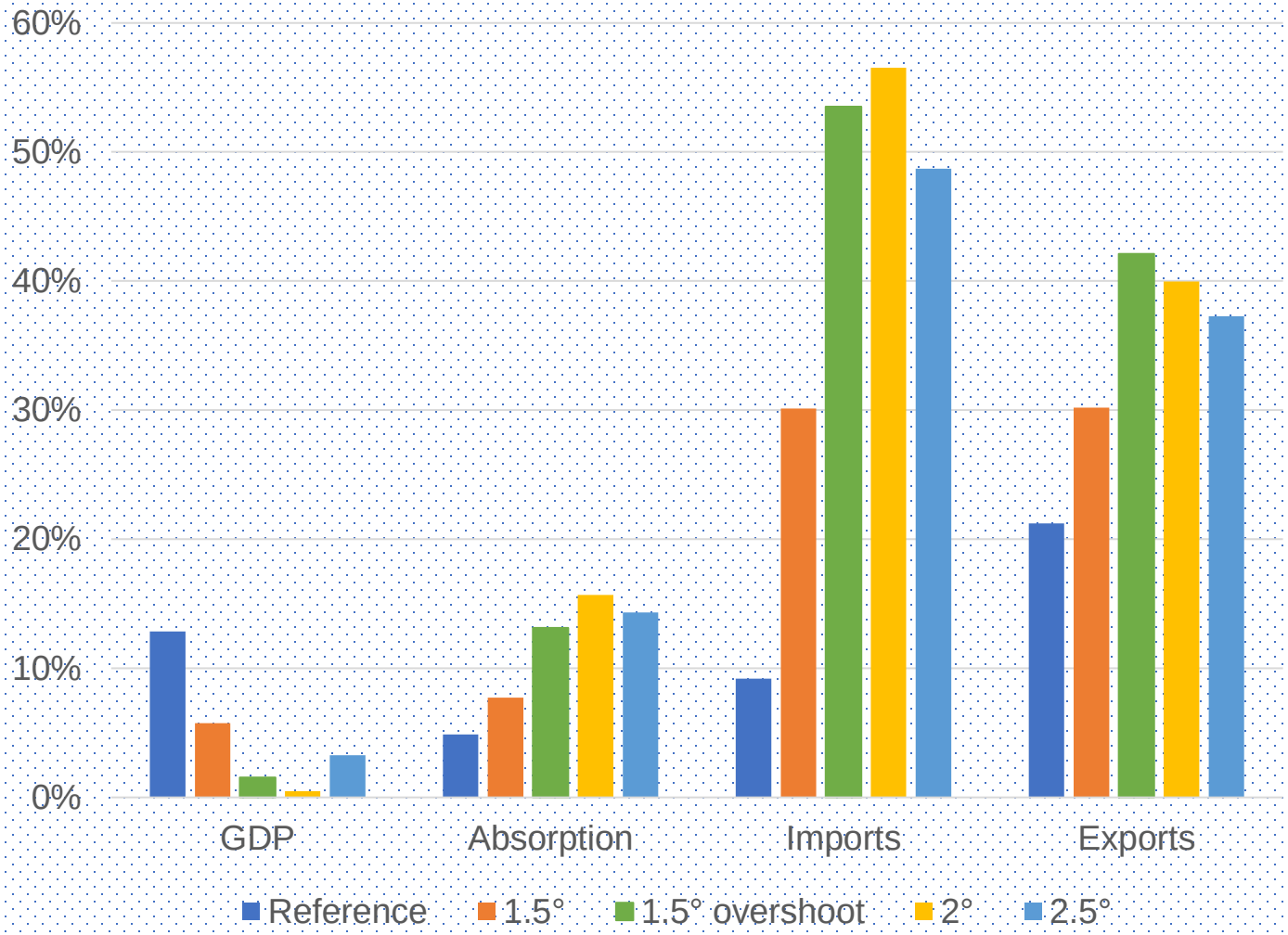
# Terms of trade for Maldives

(price of exports/price of imports)

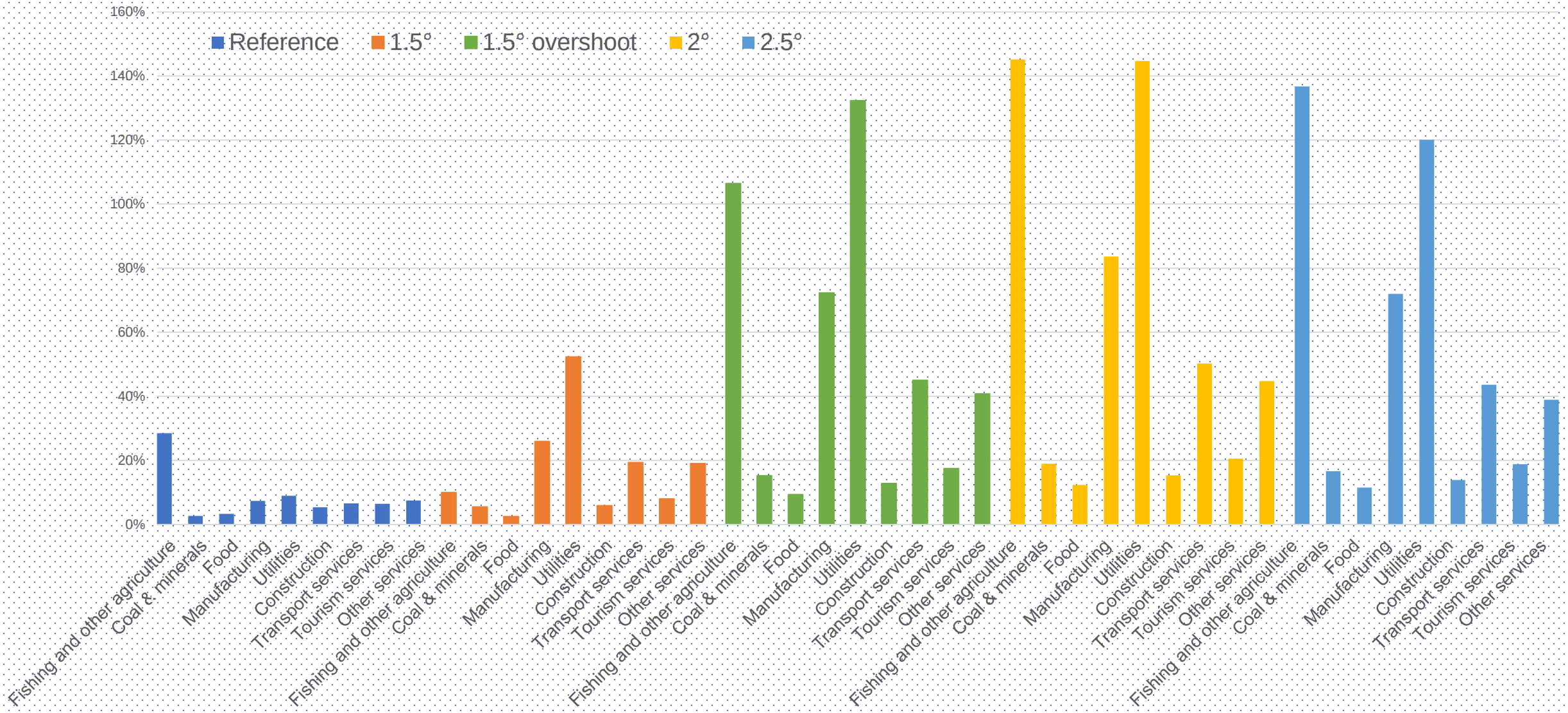



- General improvement in terms of trade, imports relatively cheaper
- Under 1.5 scenario, emission decrease is expensive after some time with import price increase

# Macroeconomic impacts (nominal, % change 2019-2045)

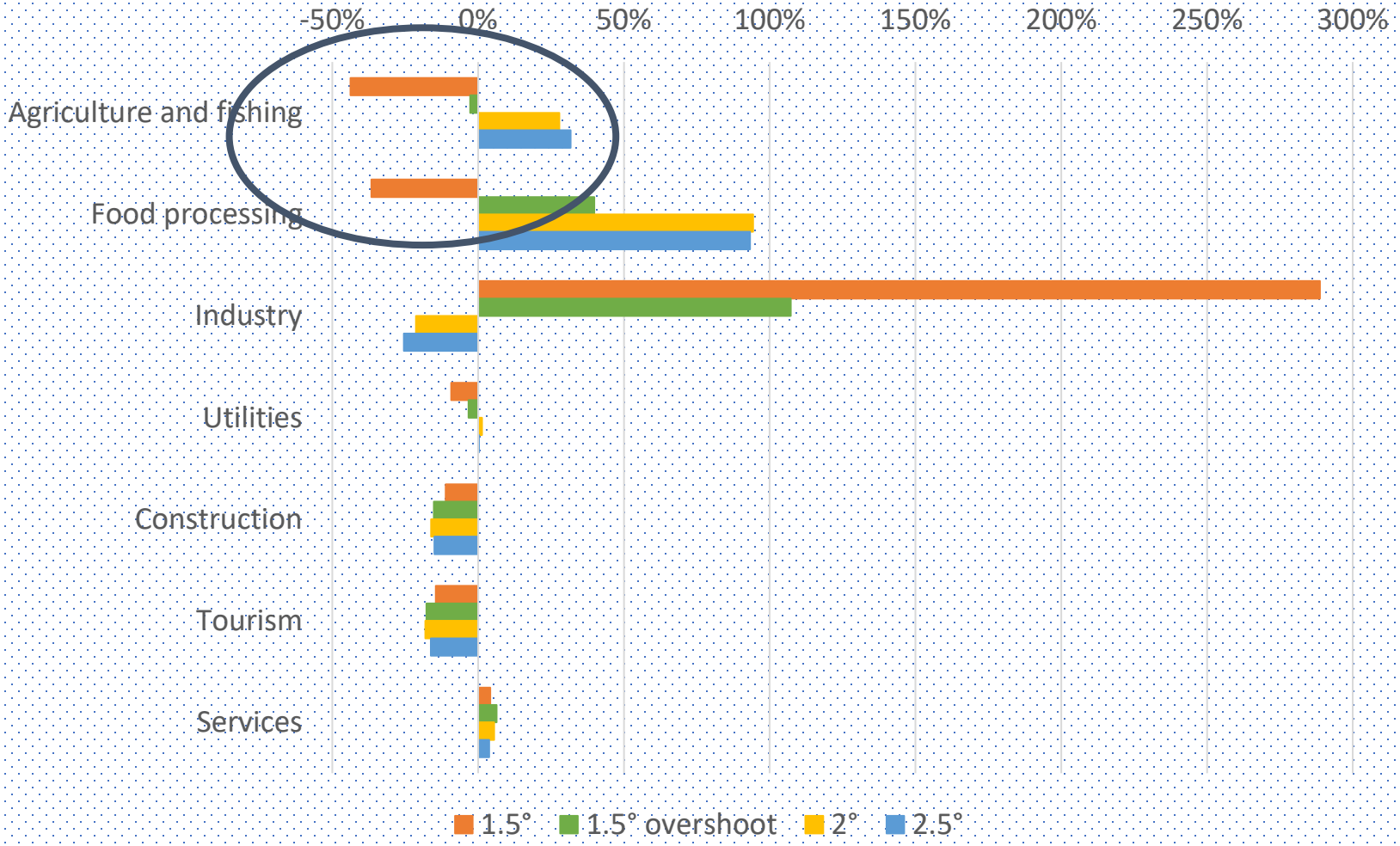



- With imports > exports → lower GDP compared to the reference scenario
- Higher welfare (absorption) due to cheap imports allowing higher consumption
- More import dependent




- With cheaper oil imports, significant growth in production
- Especially fisheries and agri products (processing fish)

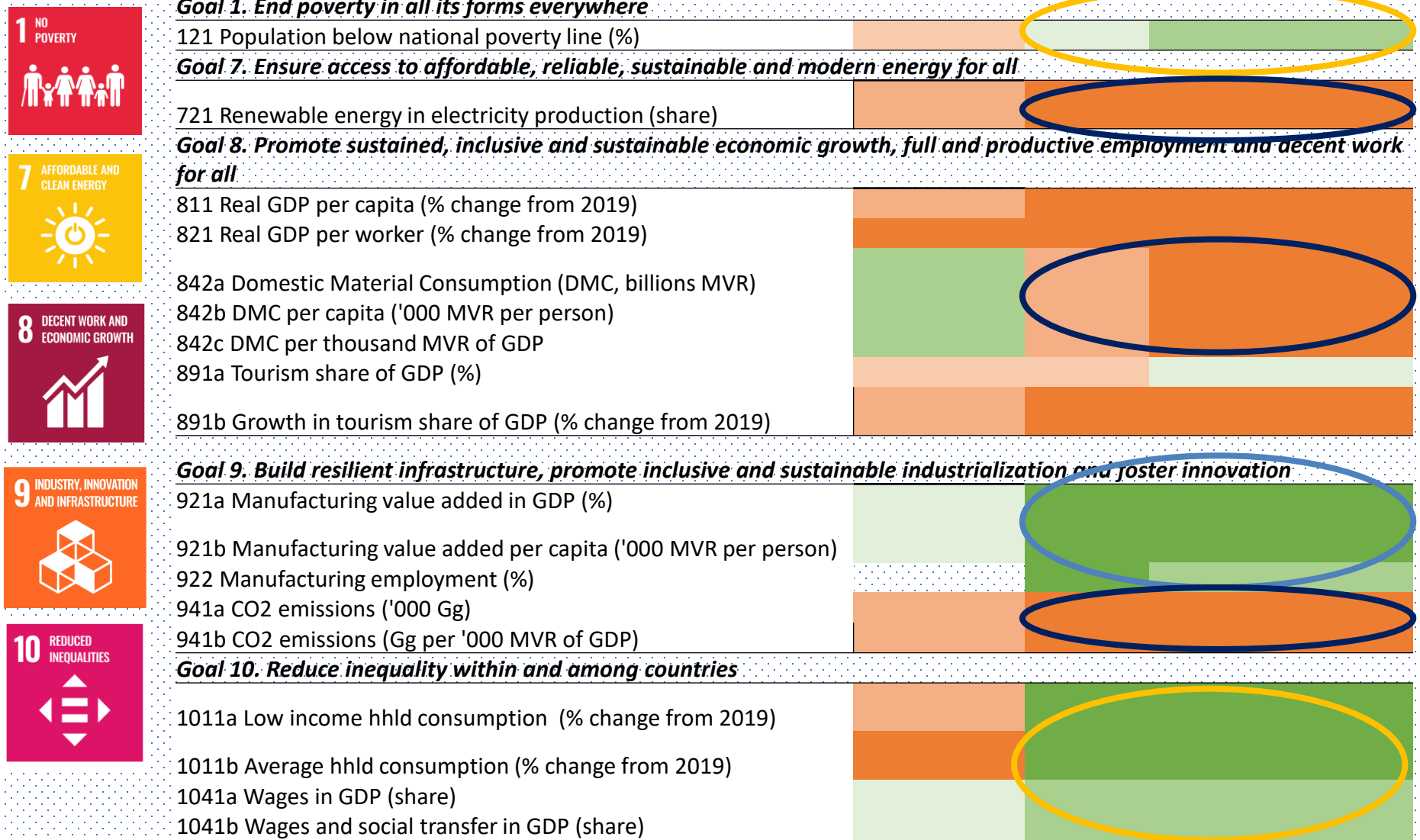
# JOBS (% change from reference scenario, 2045)




- Job shift towards fishing and fish processing
- Switch of infrastructure, technology?
- Job loss and just transition?

# Impact on progress towards the SDGs
## (% change from REFERENCE SCENARIO IN 2045)

**Social + Economic + Environmental -**




Regression away from the goal

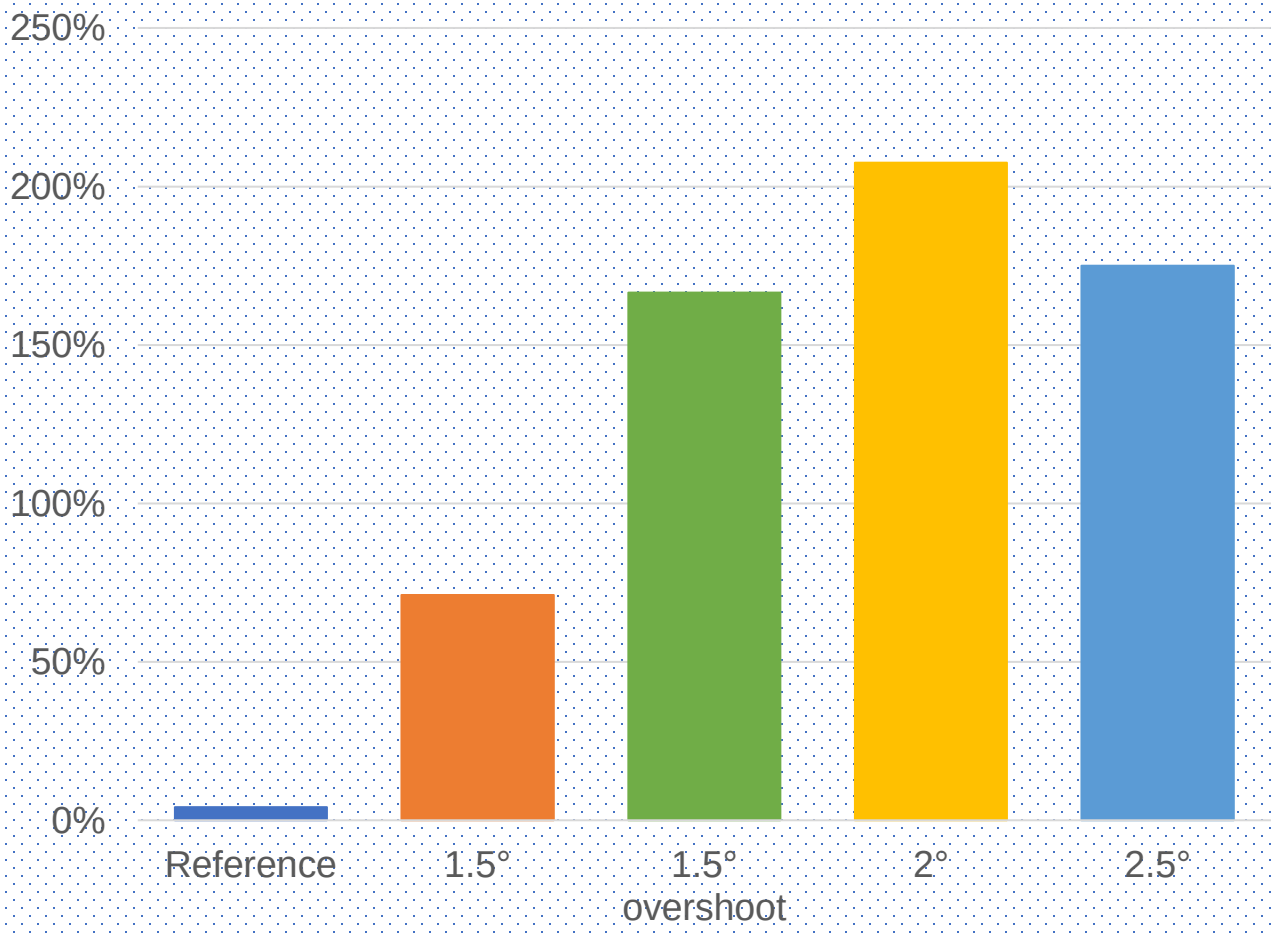
| < -50% | -10 to -50% | 0 to -10% |
|---|---|---|

Progress towards the goal

| 0 to 10% | 10 to 50% | >50% |
|---|---|---|

**Higher emissions**

# Emissions (CO2 equivalent, % change 2019-2045)

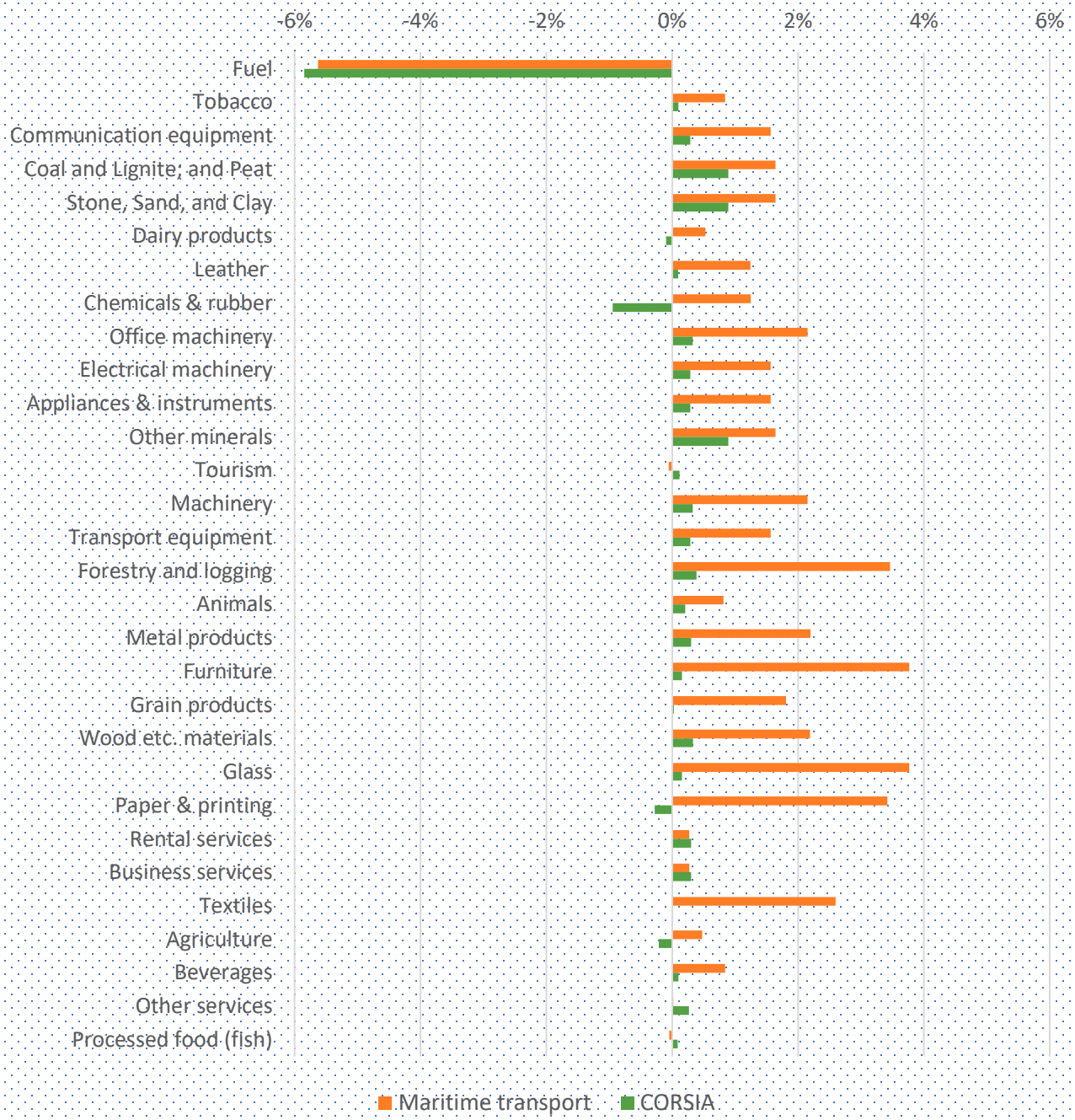



- Large production with cheap oil import
- Emissions increase
- Higher welfare (absorption) due to cheap imports allowing higher consumption
- More import dependent

# Global response measures impact

- Global response measures lead to an externality effect
- Implementation of the carbon tax reduces the global demand and price for fossil fuels.
- Maldives who do not implement the carbon tax can import more oil at lower prices
- An indirect, unintended consequence – in which increases in emissions and reduced incentives to invest in renewables Emissions increase

# CROSS-BORDER IMPACTS
# REDUCTION IN AVIATION & MARITIME EMISSIONS: MALDIVES IMPACTS




# World import prices faced by Maldives (% change 2019-2045)

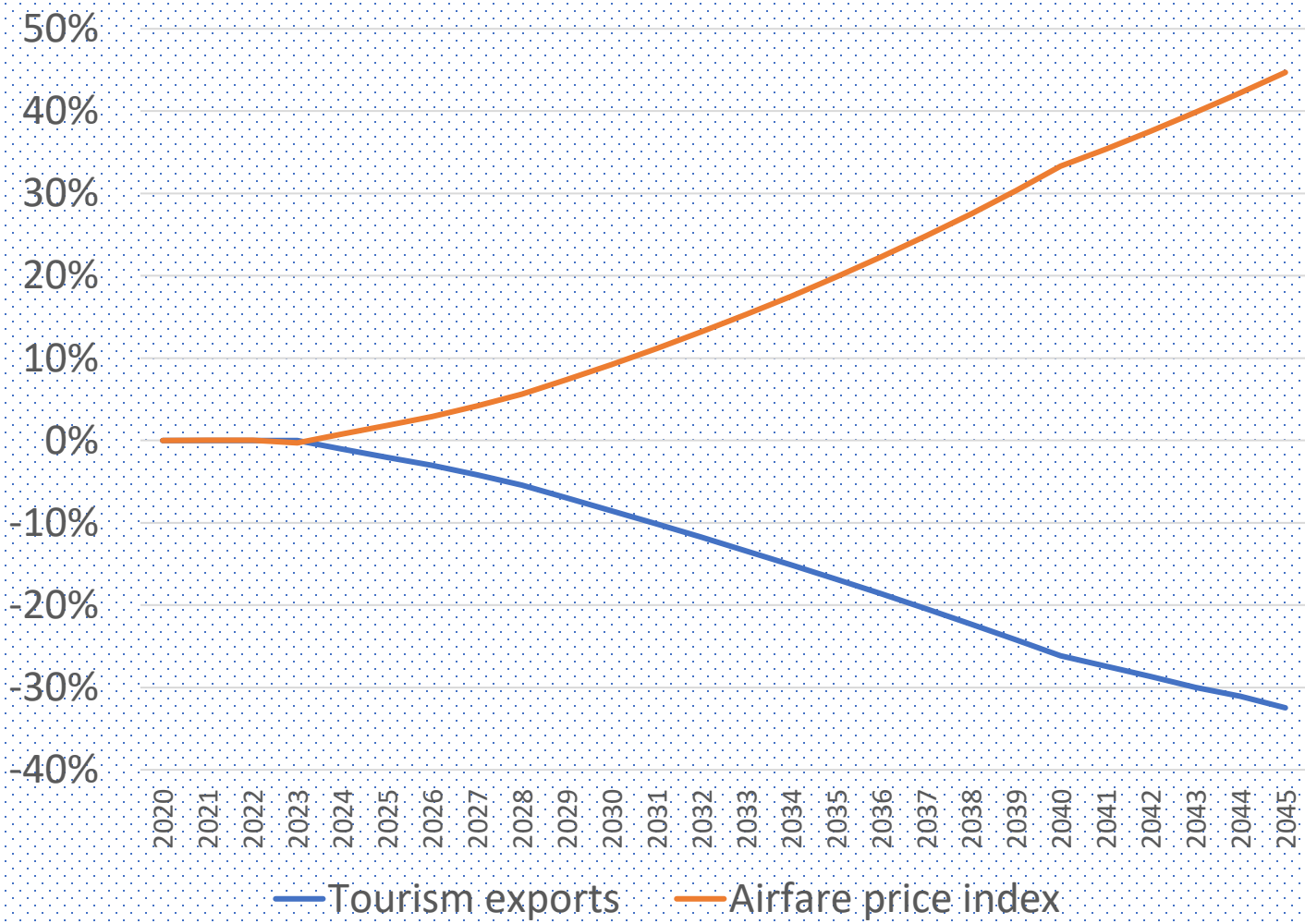
- Import prices are generally higher under the transport
- Larger effects under the maritime
- Fuel prices go down

# Tourism demand

- Export price of Maldives' accommodation/food/beverages unaffected
- Long-haul destination: 41% from Europe, 21% NE Asia (2019)

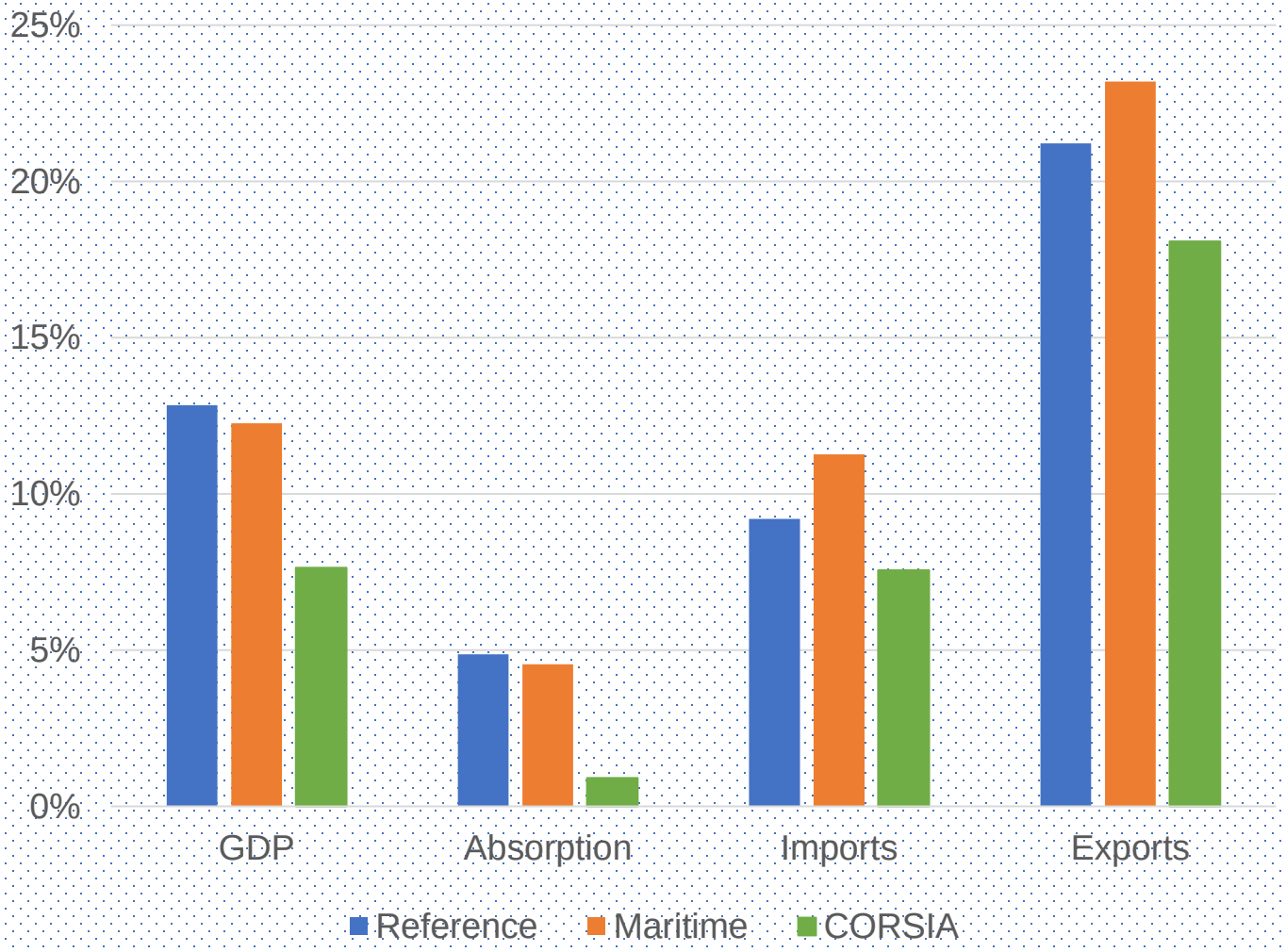
*'All of the studies reviewed, spanning a period of over 25 years, found that there was a* ***significant demand response*** *to changes in air fares, such that* ***increases in air fares led to lower passenger traffic demand****. The consistency of this result strongly indicates that any policy action that results in higher fares, e.g., taxes, increased landing fees, will result in a decline in demand.' IATA (2007)*

# Tourism demand



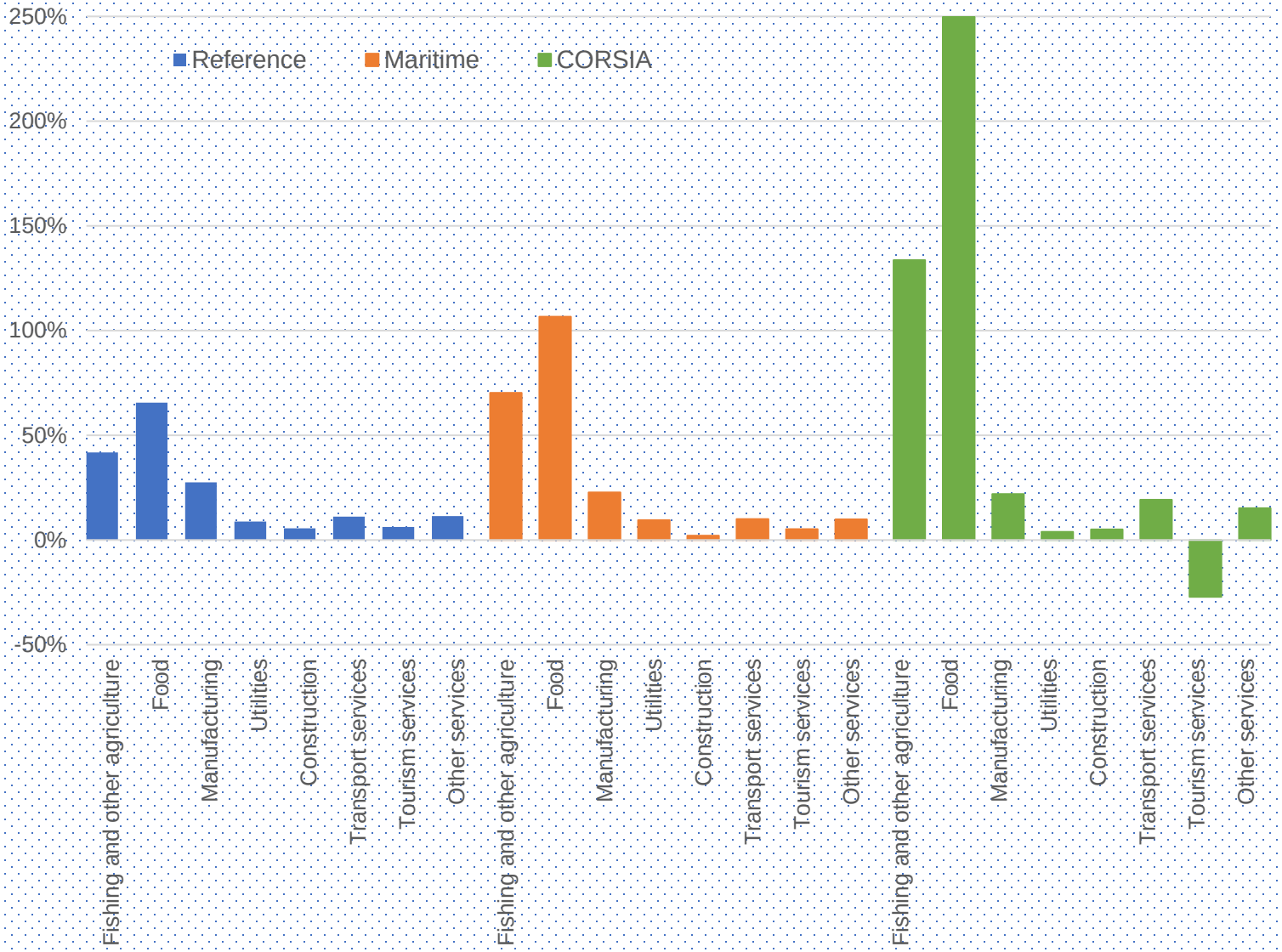

- By 2045, airfares 45% higher than reference scenario, tourism exports 32% lower

# Macroeconomic impacts (nominal, % change 2019-2045)



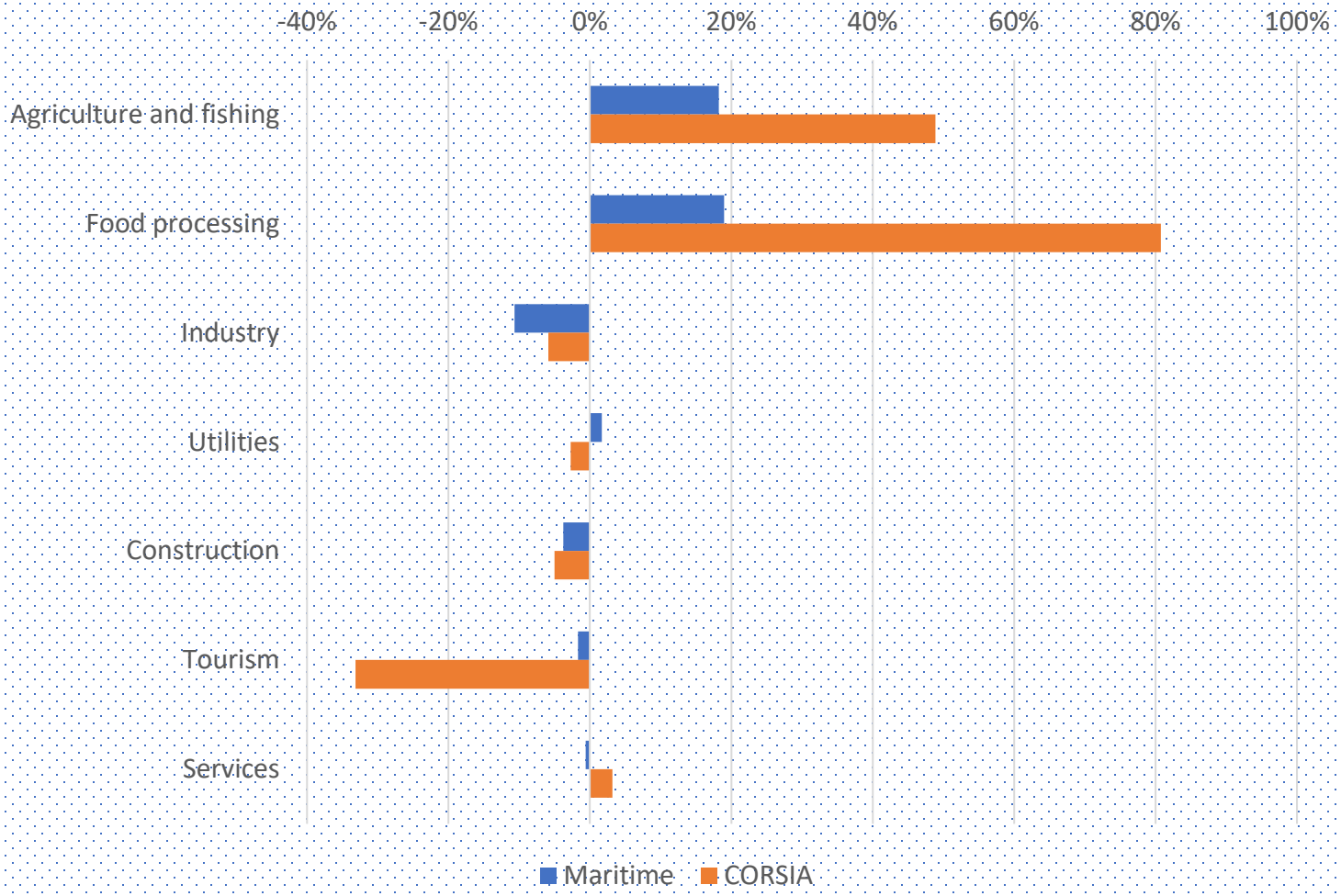

- Changes in world import and export prices -> Lower GDP under both scenarios
- Under CORSIA its more due to reduced tourism demand on higher airfare

# Production (real, % change 2019-2045)




- Decline of tourism under CORSIA led to expansion in other export sector
- Transport and other serviced pick due to cheap fuel price
- Economic diversification opportunities
- Just transition of jobs

# JOBS (% change from reference scenario)




- Decrease in tourism, fall of fuel price for other export
- Restructure of job market
- Other opportunities for technology transfer
- Just transition

# Summary: GLOBAL CARBON TAX IMPACTS

- **Findings**
  - Cross-border impacts for Maldives as a non-participating country
  - Strong effects driven by cheaper oil imports → ↑ emissions
  - Conflicting goals: higher welfare vs. emissions
  - Harder to achieve NDC commitments
- **Policy options**
  - Tax reform to ‘choke off’ cheaper oil imports
  - Participate in carbon tax, reintroduce fuel import duty
  - Limit emissions growth

# Summary: REDUCTION IN GLOBAL AVIATION & MARITIME EMISSIONS

- **Findings**
  - Strong effects even with inelastic demand response in aviation
  - Expansion of non-tourism export sectors
  - Dual impacts: cheaper oil and lower tourism
  - Harder to meet NDC commitments
- **Policy options**
  - Reduce total holiday cost via Tourism GST (will have national revenue implications)
  - Focus on markets serviceable by Maldivian airline. Scalable?
  - Higher value, lower volume tourism – less price sensitive

# Challenges

- **Data availability**
  - Data for SAM no update or not available from statistics department
  - Data from other sector, import, export, energy use, transport
  - Proxy data from other sources might not be the most recent

- **Human resources**
  - Understanding of the issue (response measures and this assessment)
  - The right mix of technical people, economists, accounts, policies makers difficult to obtain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