Impact of Renewable Energy on Emission Reductions

Trends, Benefits and Policy Recommendations

Presented by:

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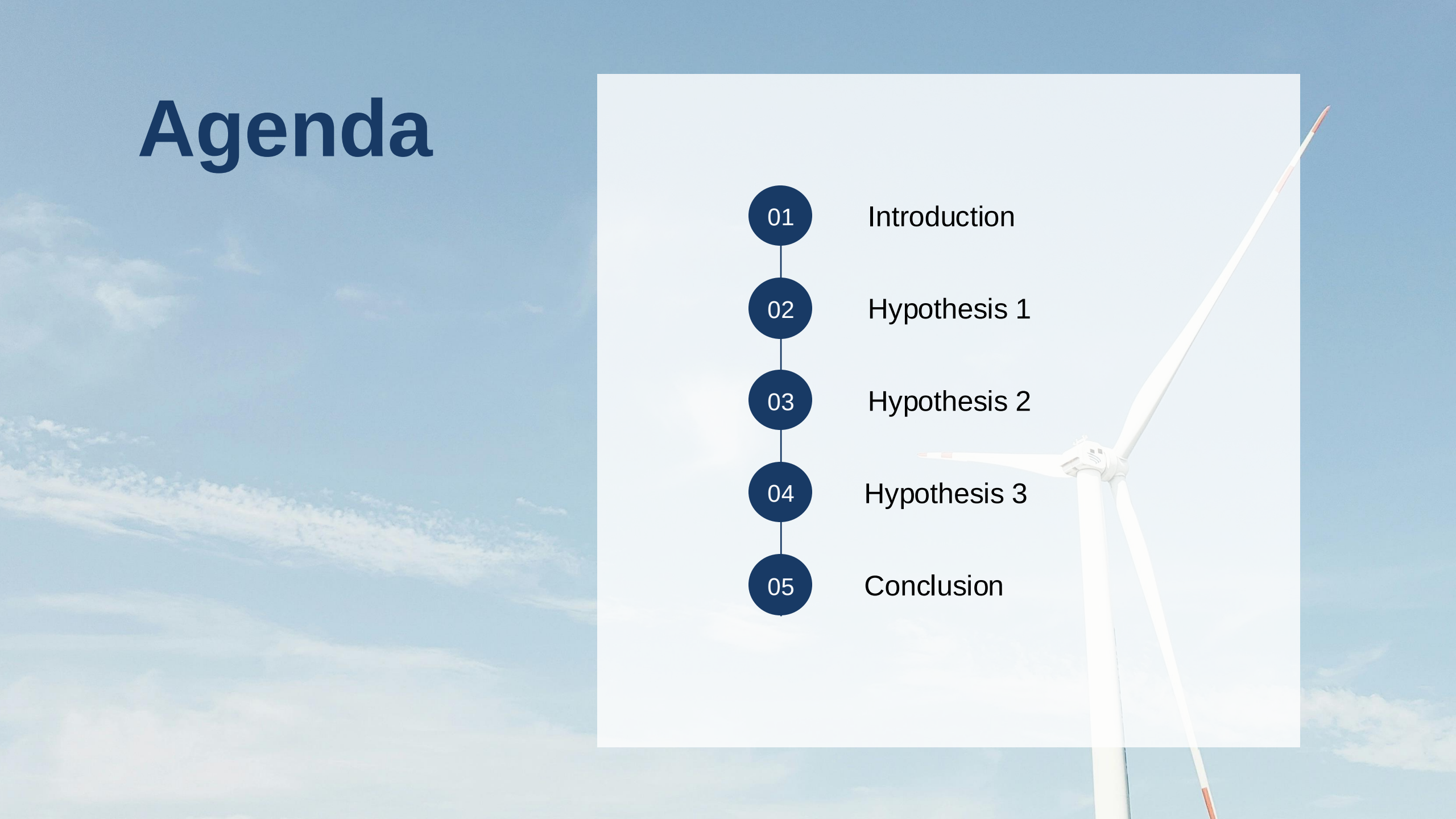
June 21, 2024

Agenda



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Introduction

Reduction of CO2 emissions in developed countries

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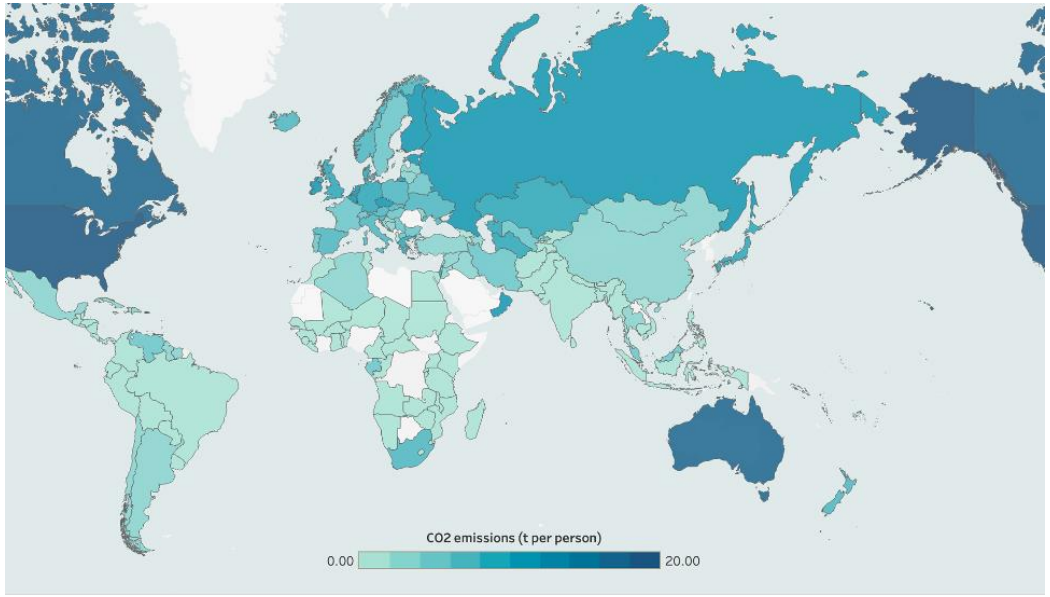

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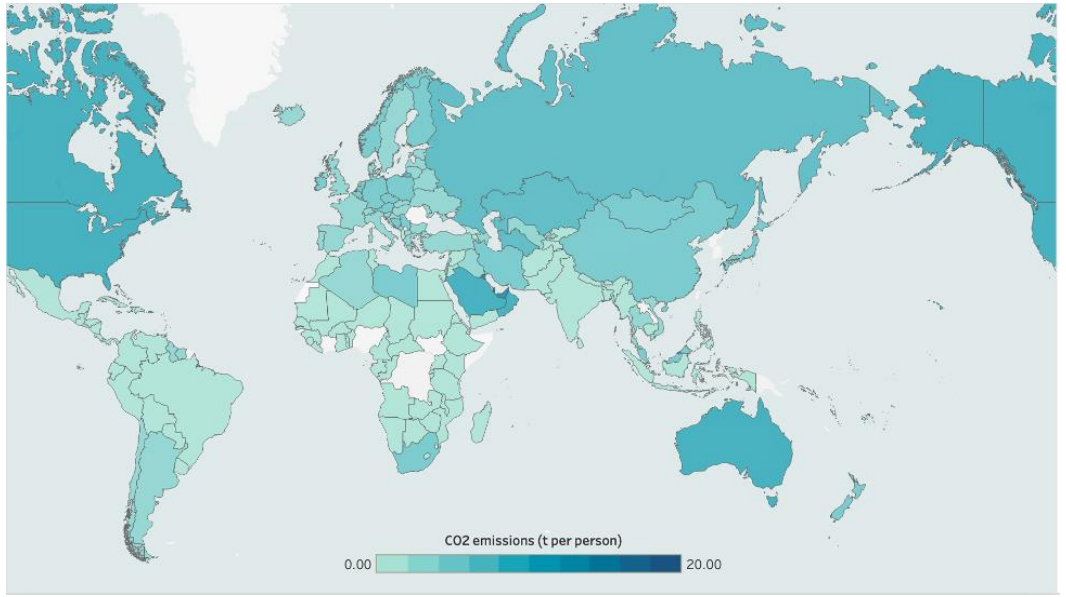

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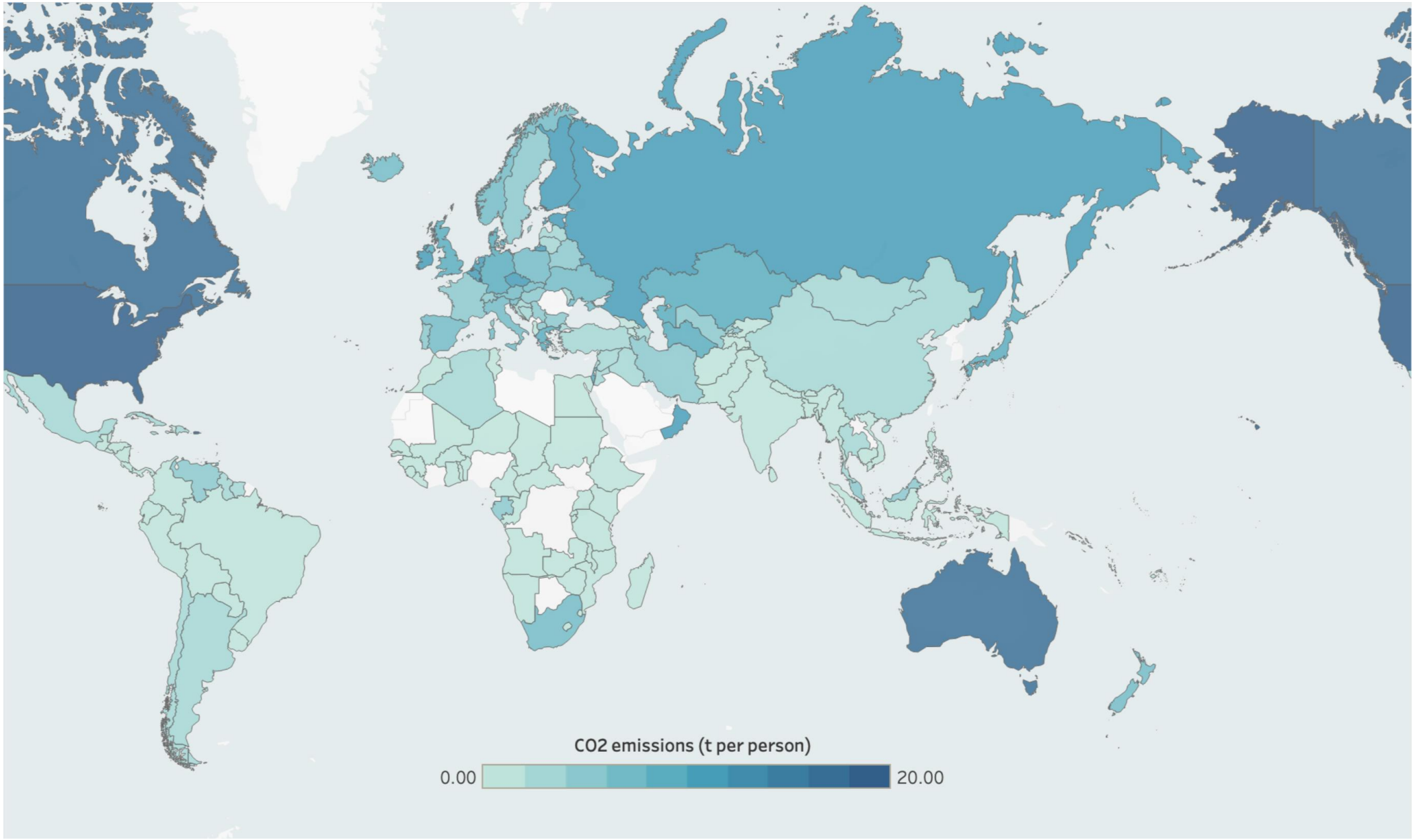

Reduction of CO2 emissions in developed countries

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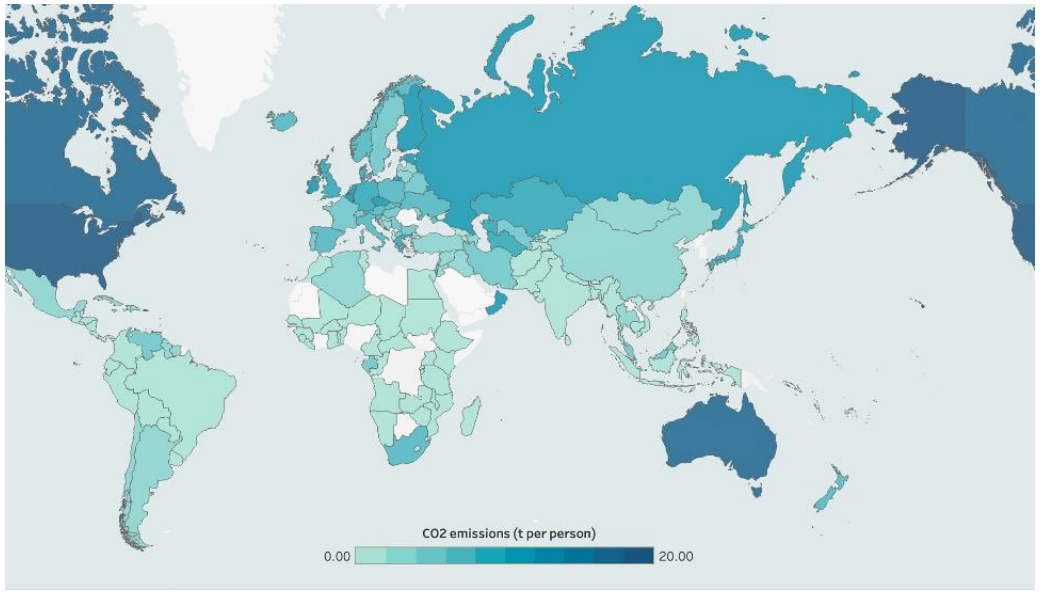

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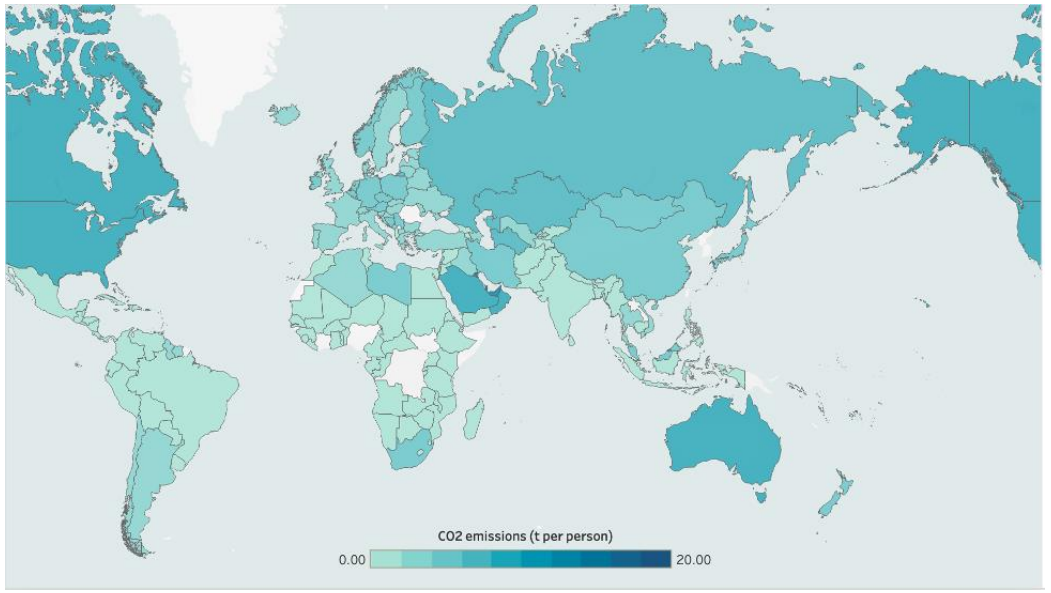

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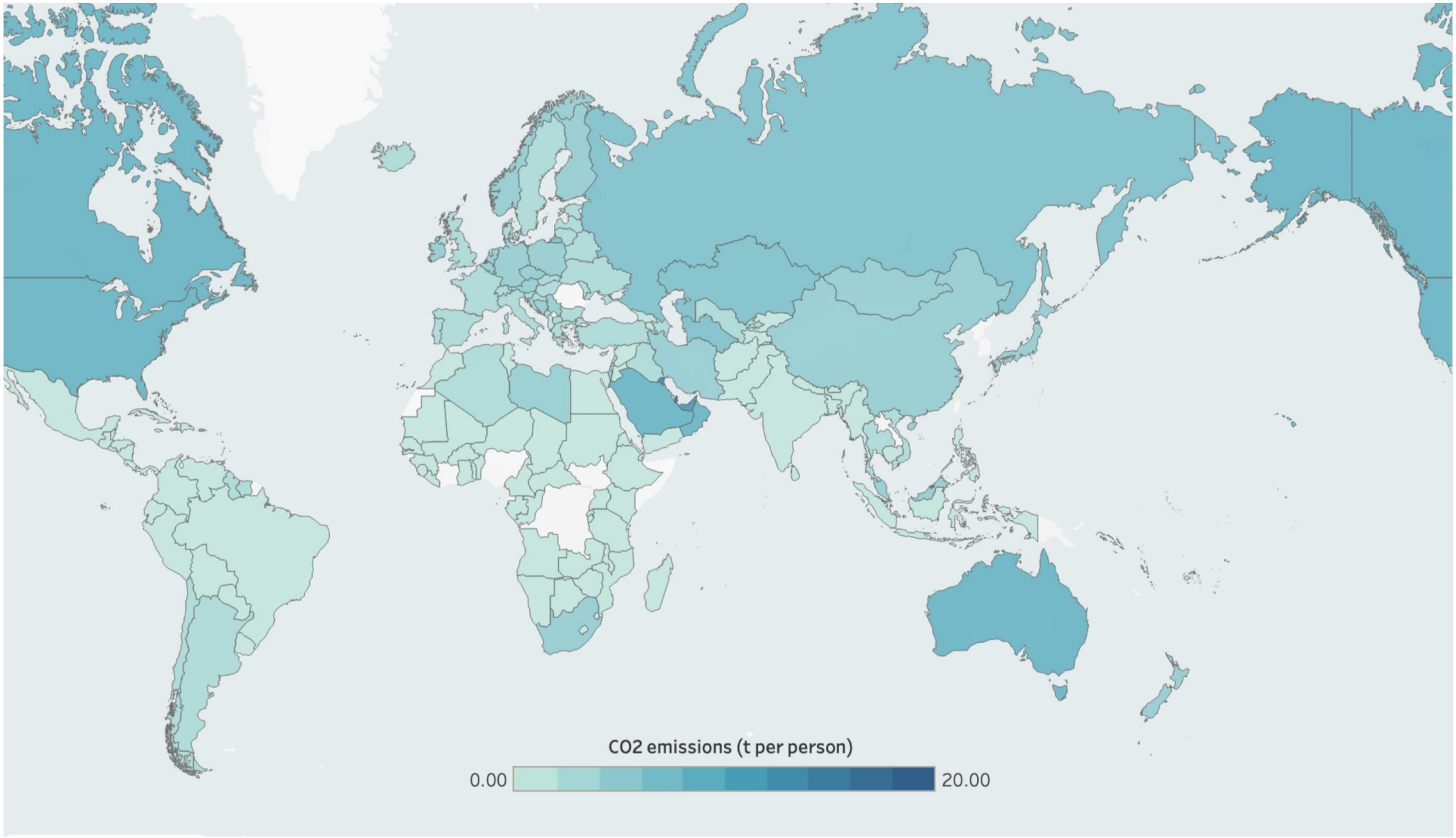

Energy as the main driver of CO2 emissions

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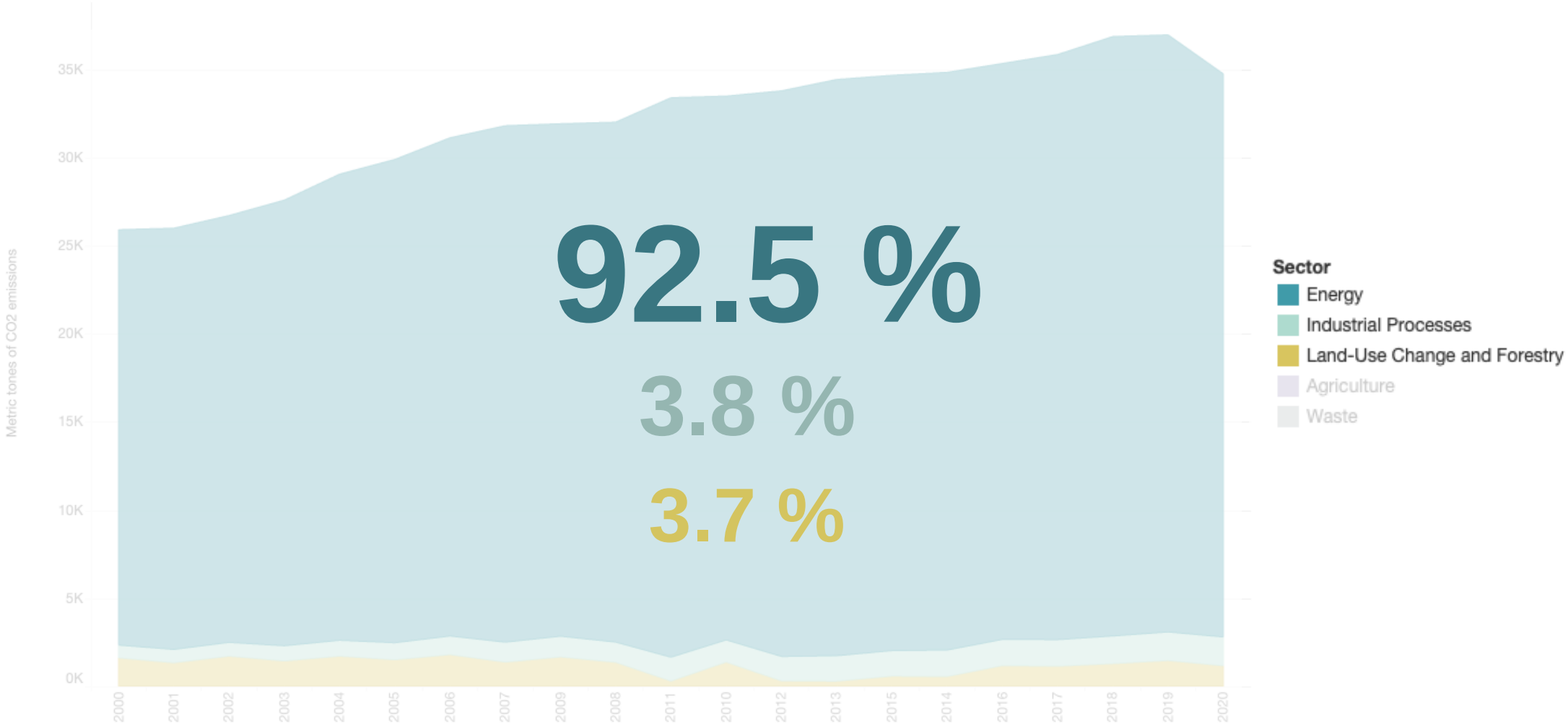

Research Question

What are the **trends** in renewable energy and how does it contribute to the **reduction** of emissions?

Solar and wind energy are the **fastest-growing** types of renewable energy

Hypothesis 1

Generation intensity

$$\frac{Electricity\ generated\ with\ R.E.\ (KWh)}{Electricity\ Installed\ Capacity\ from\ R.E.(MW)}\ \%$$

Year-on-year growth rate

$$\frac{Electricity\ generated\ Y1 - Electricity\ generated\ Y0}{Electricity\ generated\ Y0}\ \%$$

Rapid acceleration of solar and wind energy generation

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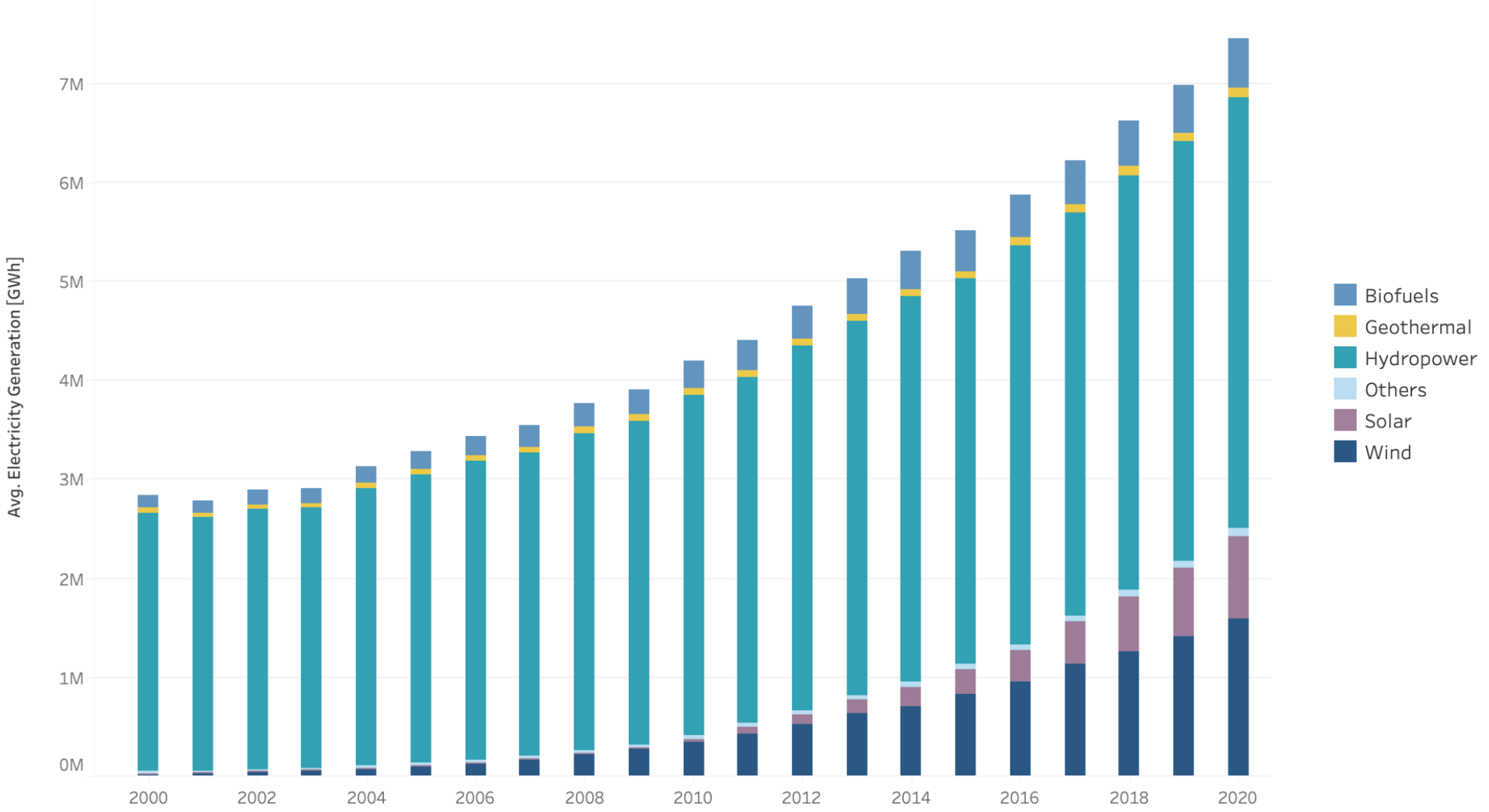

Rapid acceleration of solar and wind energy generation

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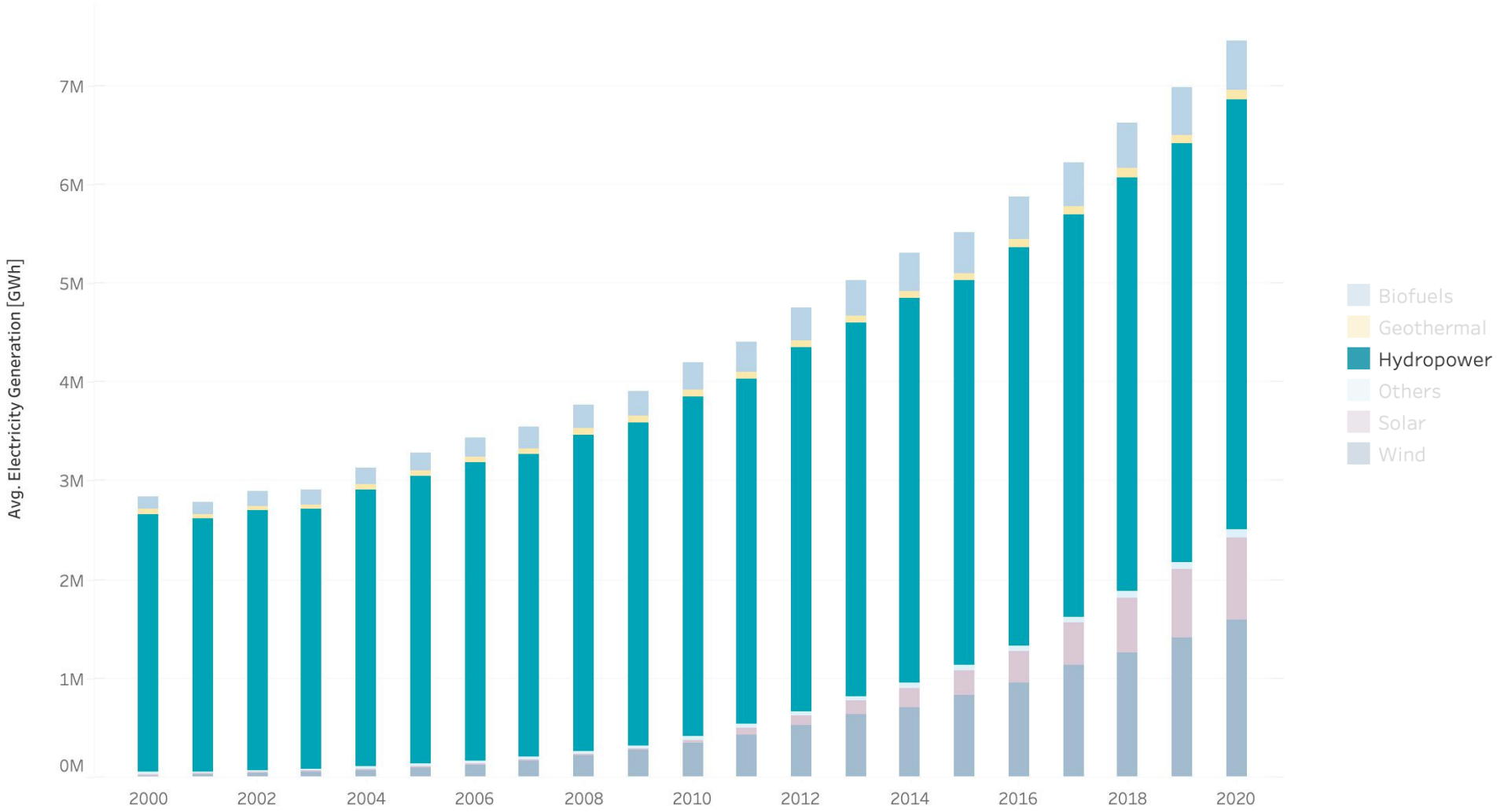

Rapid acceleration of solar and wind energy generation

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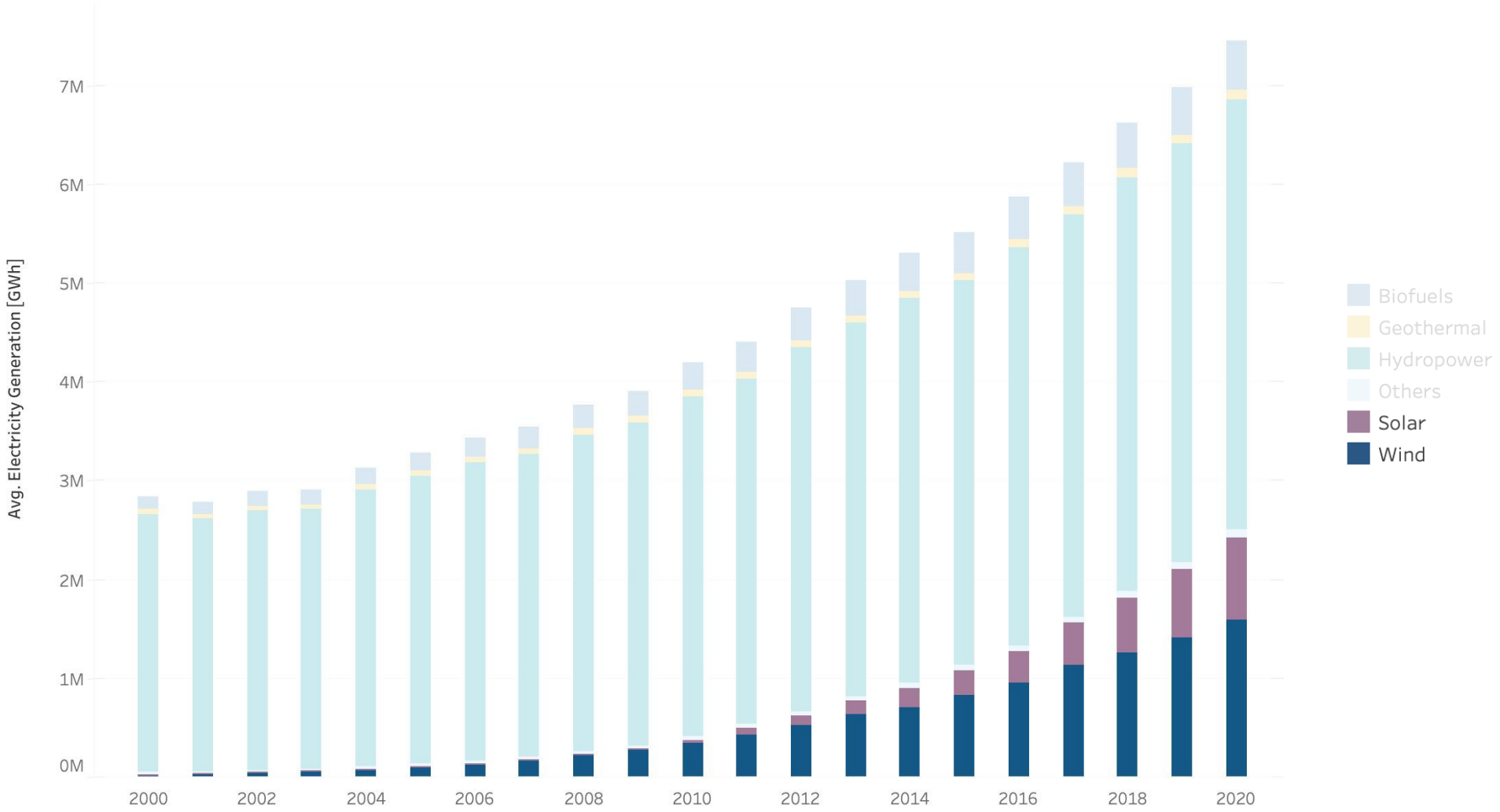

Growth rates of renewable energy generation

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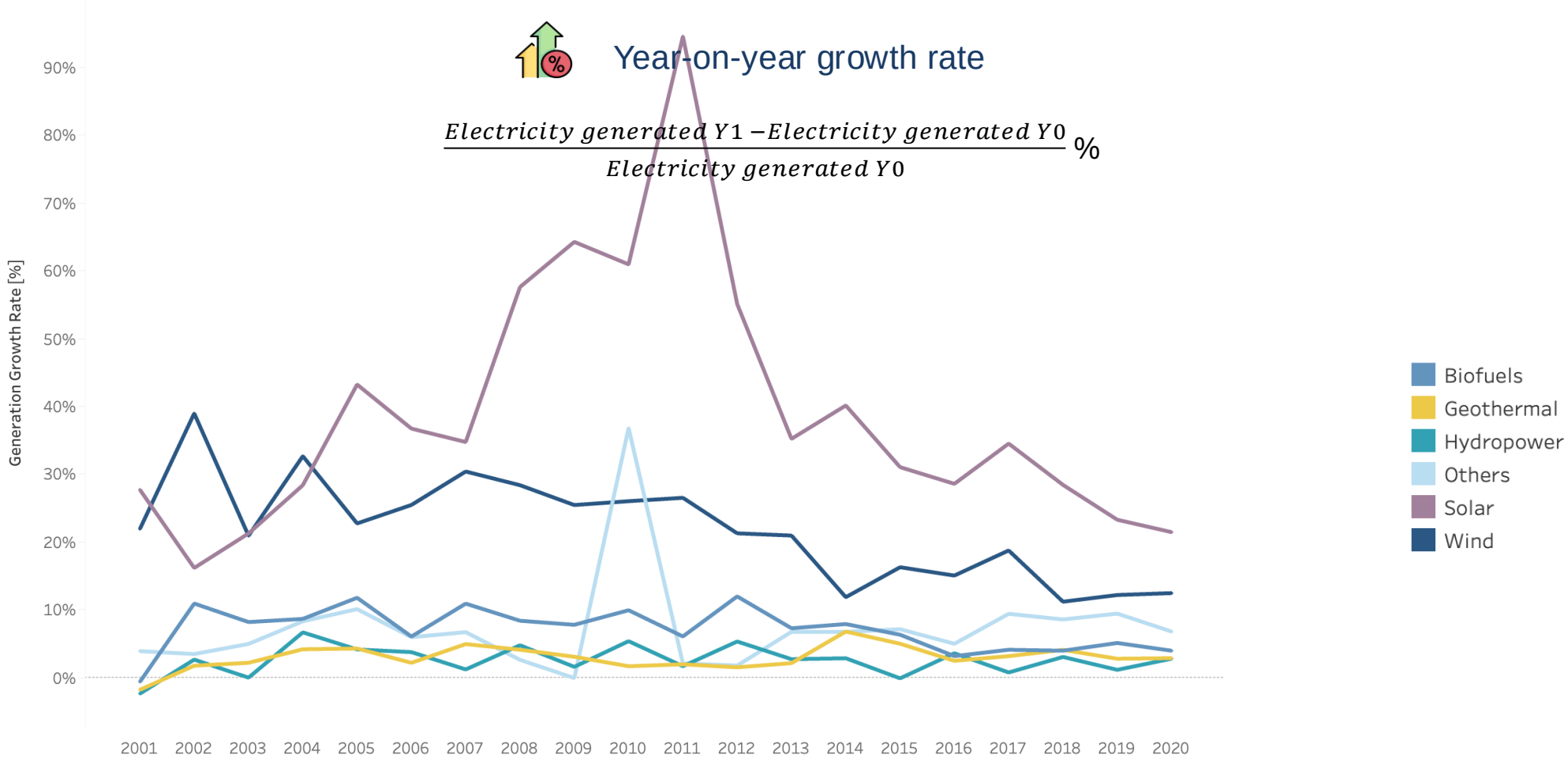

Growth rates of renewable energy generation

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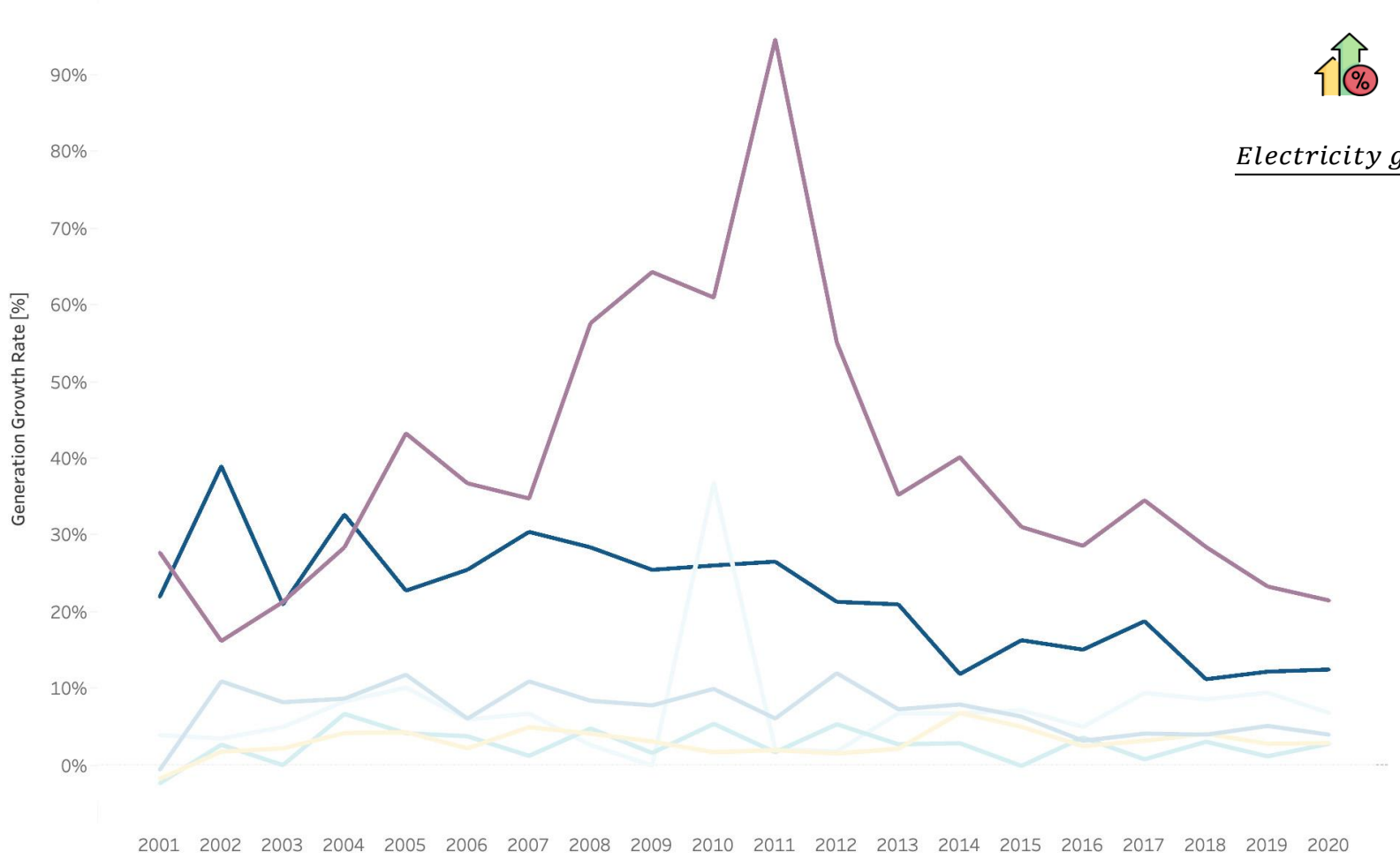

Year-on-year growth rate

$$\frac{Electricity\ generated\ Y1 - Electricity\ generated\ Y0}{Electricity\ generated\ Y0}\ \%$$

Biofuels
Geothermal
Hydropower
Others
Solar
Wind

Comparison of generation intensity

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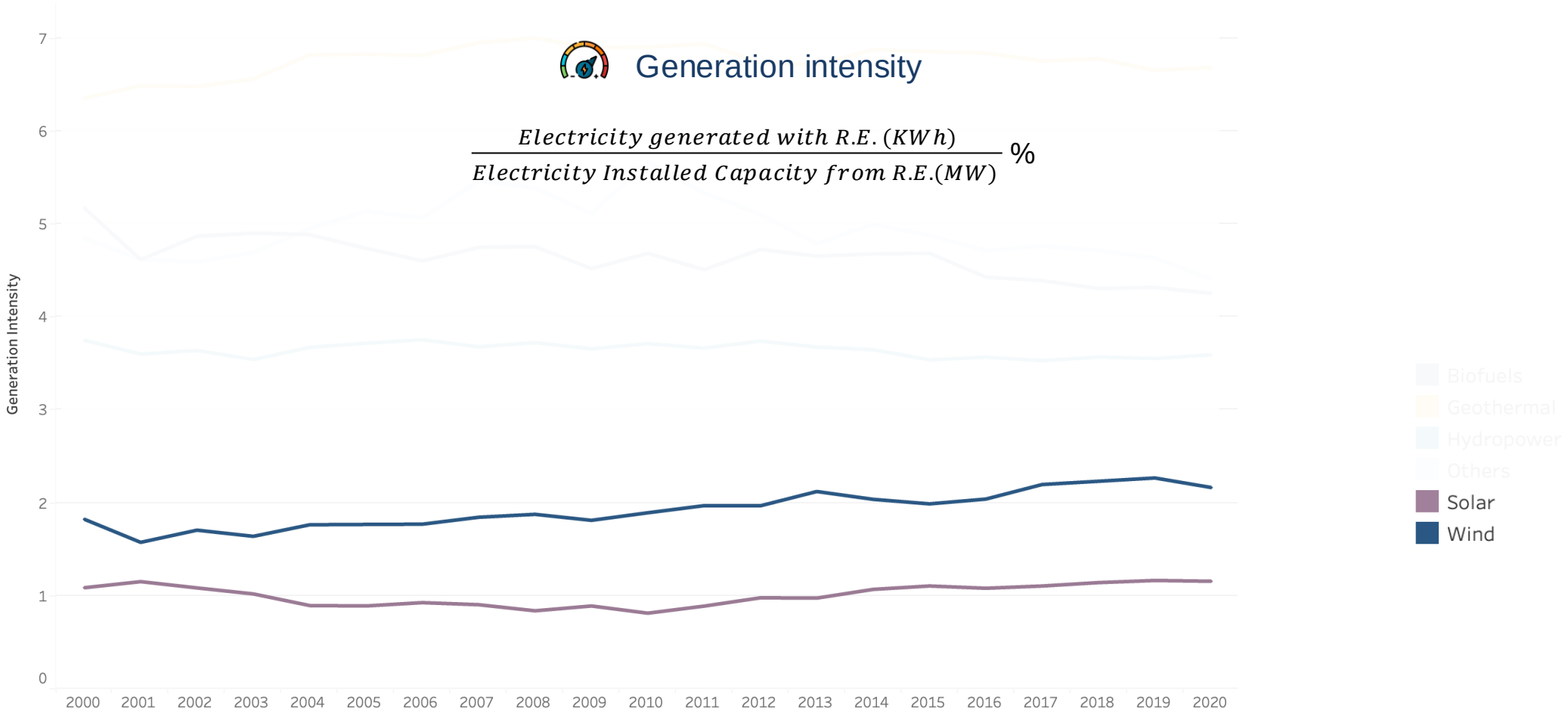
Generation intensity

$$\frac{Electricity\ generated\ with\ R.E.\ (KWh)}{Electricity\ Installed\ Capacity\ from\ R.E.(MW)}\ \%$$



Advantages over other renewables

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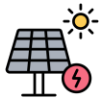

Solar energy

- ✓ Abundant and versatile
- ✓ Low operational costs
- ✓ Environmental benefits
- ✓ Technological advancements

Wind energy

- ✓ High energy efficiency
- ✓ Low operational costs
- ✓ Environmental benefits
- ✓ Technological advancements

Solar and wind energy are the **fastest-growing** types of renewable energy ✅

Policy Implications

- Countries with favorable weather conditions for **solar and wind energy** should focus on them as their **top choices**
- For other countries, it is advisable to choose **other types of renewable energy sources** as these have a **higher generation intensity**

Higher share of **renewable energy generation** is associated with **lower carbon intensity** levels, indicating a cleaner energy production

Hypothesis 2

Carbon intensity

$$\frac{Carbon\ dioxide\ emissions\ (gCO2)}{Unit\ of\ electricity\ generated\ (kwh)}$$

Share of electricity generated with renewable energy

$$\frac{Electricity\ generated\ with\ R.E.}{Total\ Electricity\ Generated}\ \%$$

Global carbon intensity and renewable energy generation share

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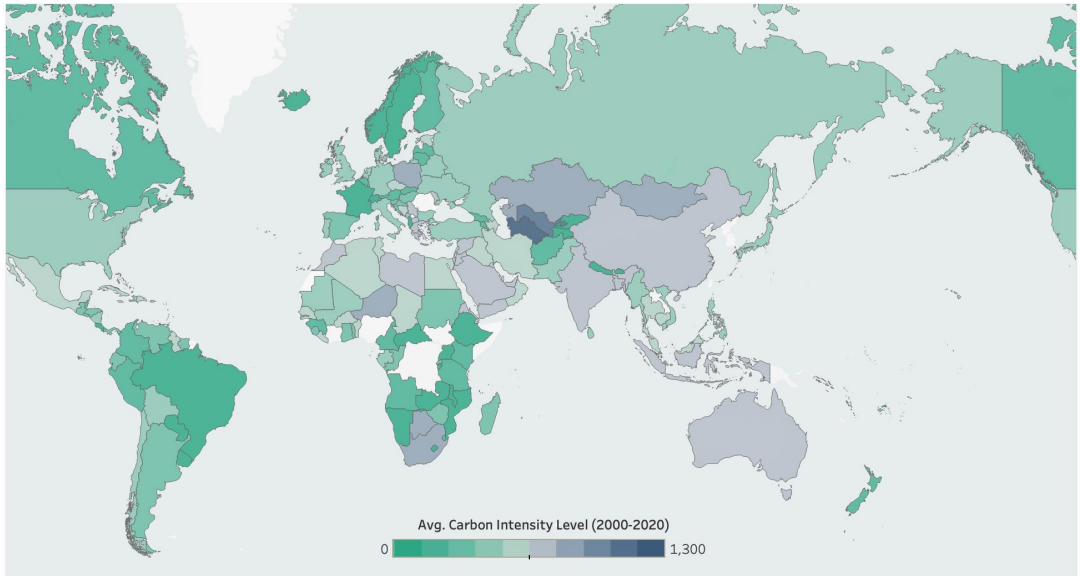
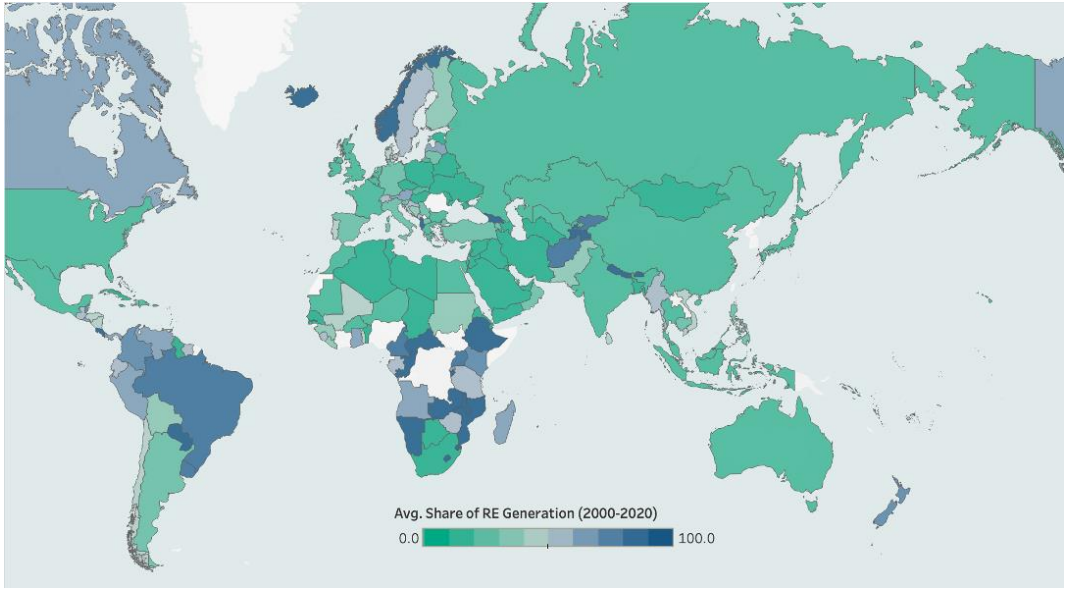


Carbon Intensity



Share of renewable energy generation

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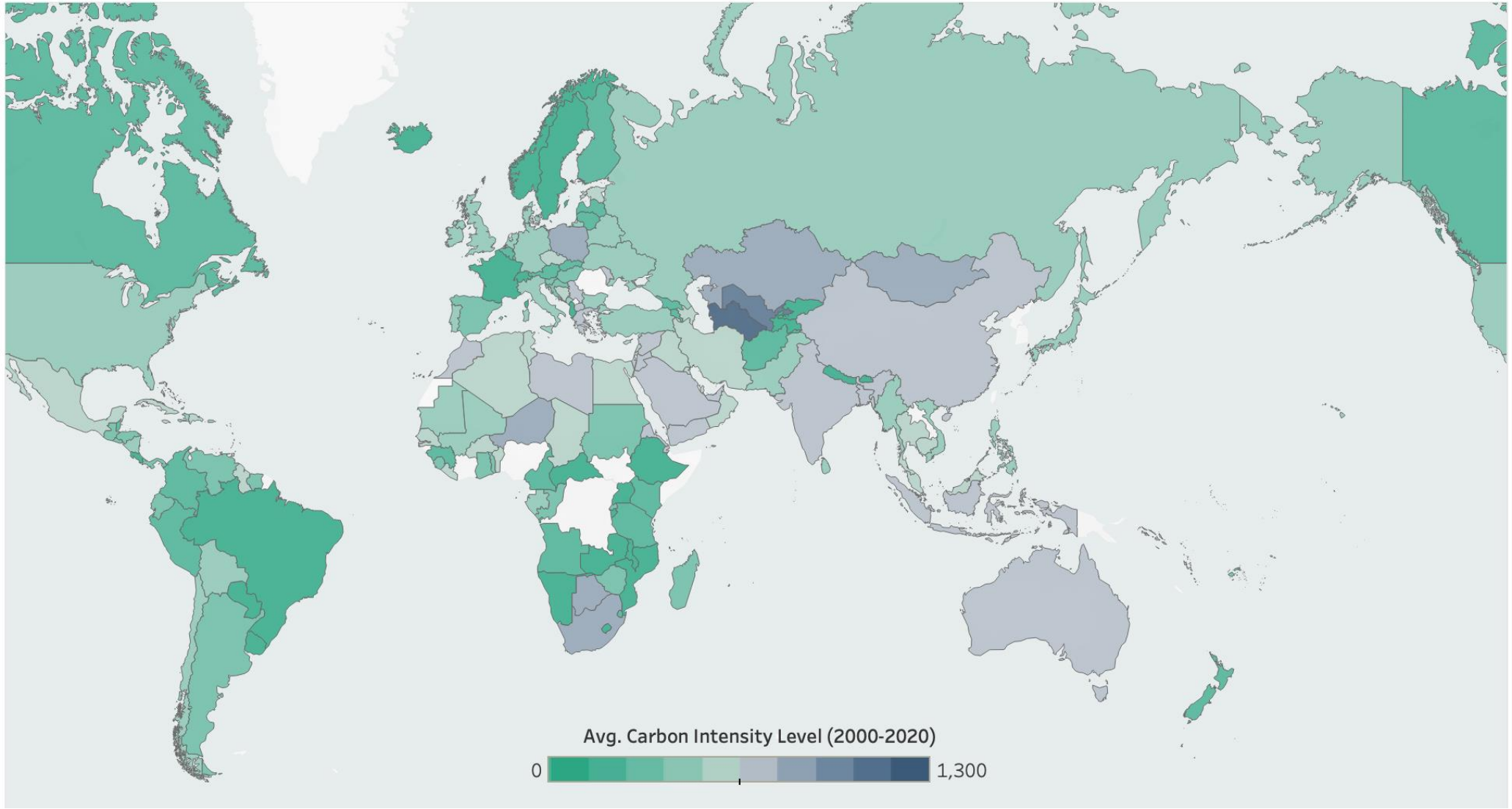

Carbon Intensity

Global carbon intensity and renewable energy generation share

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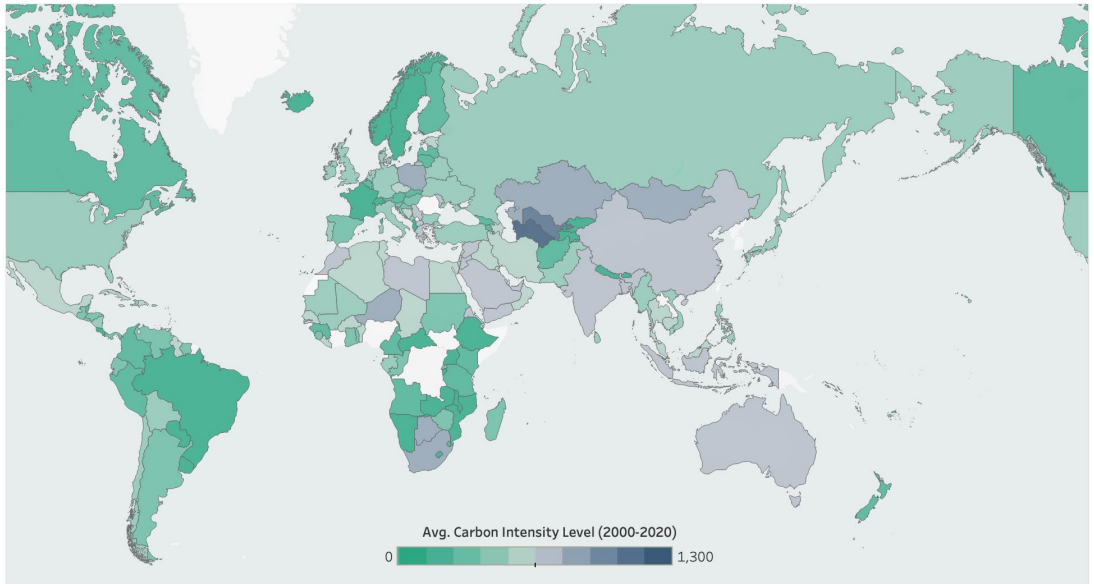
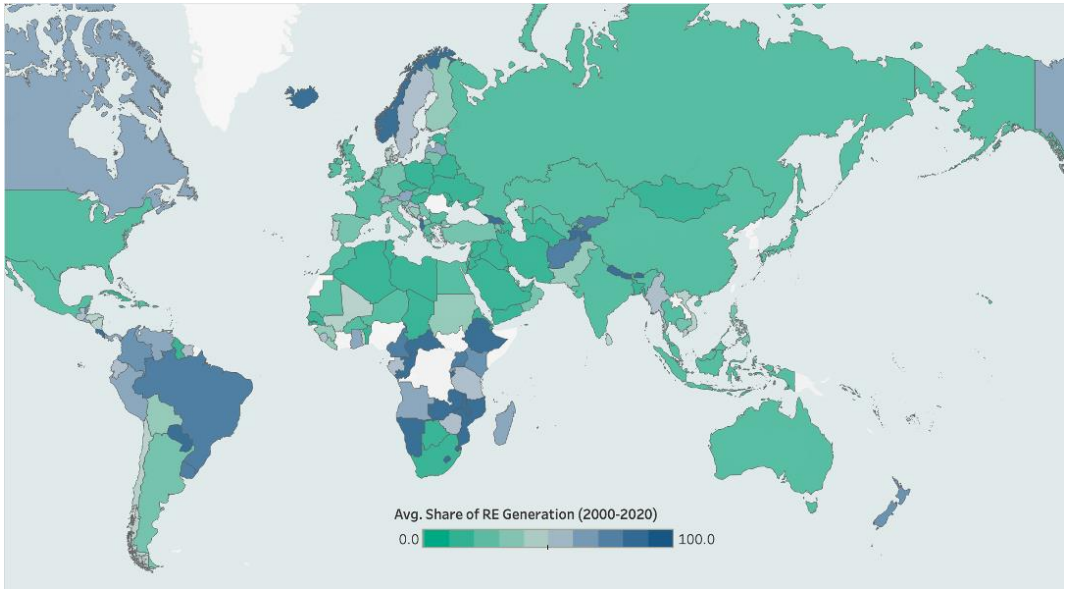
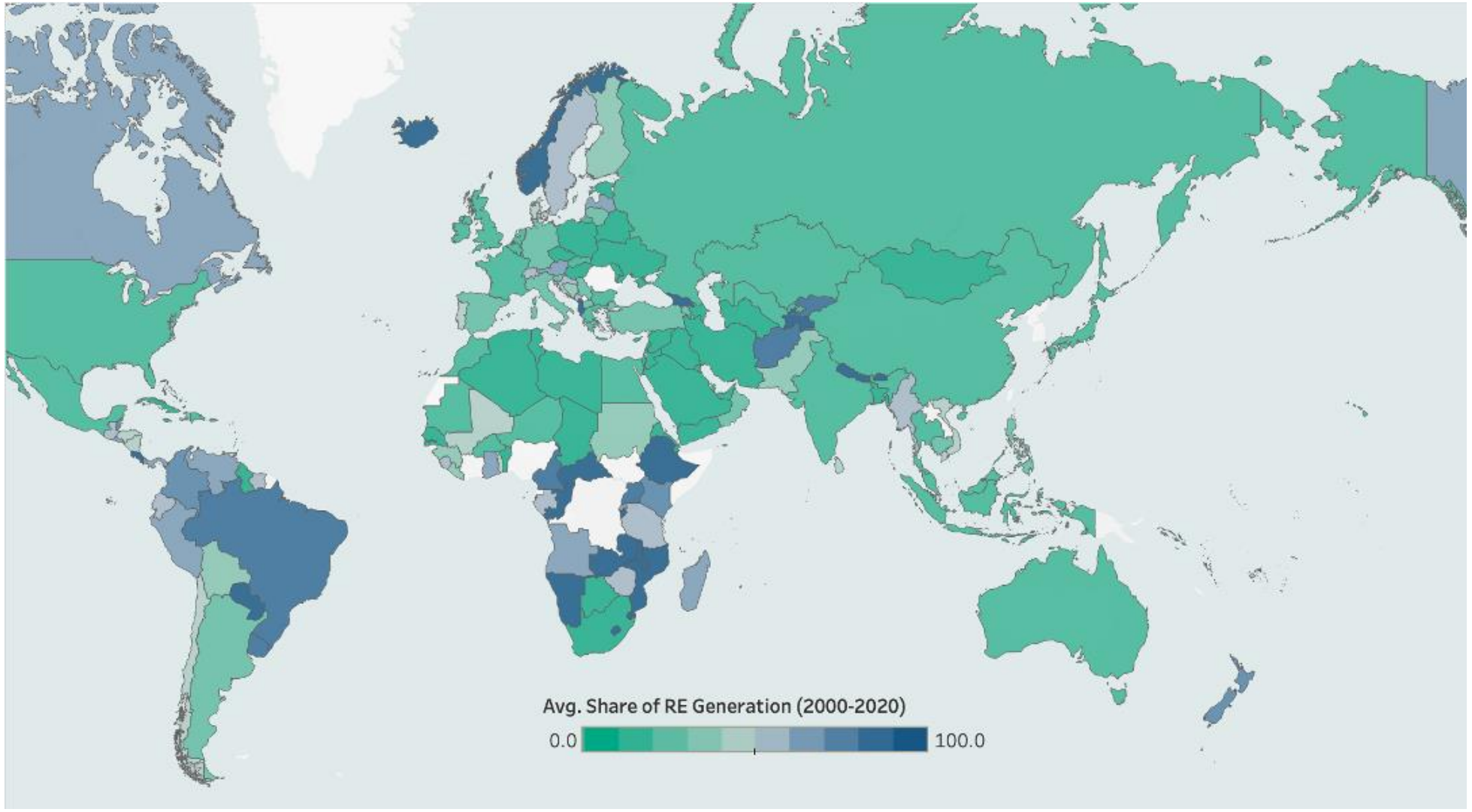


Carbon Intensity

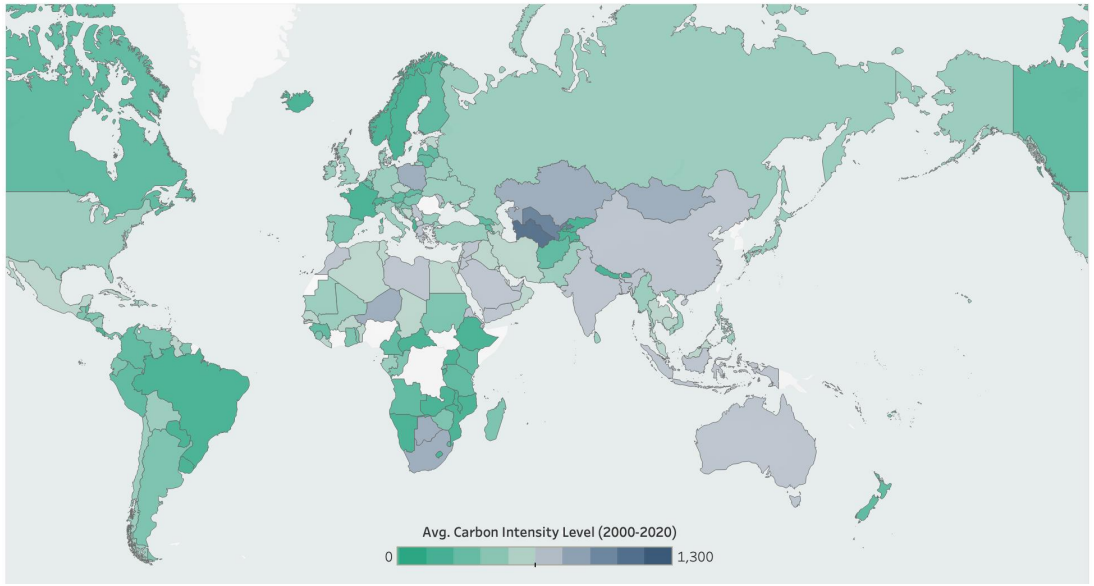


Share of renewable energy generation

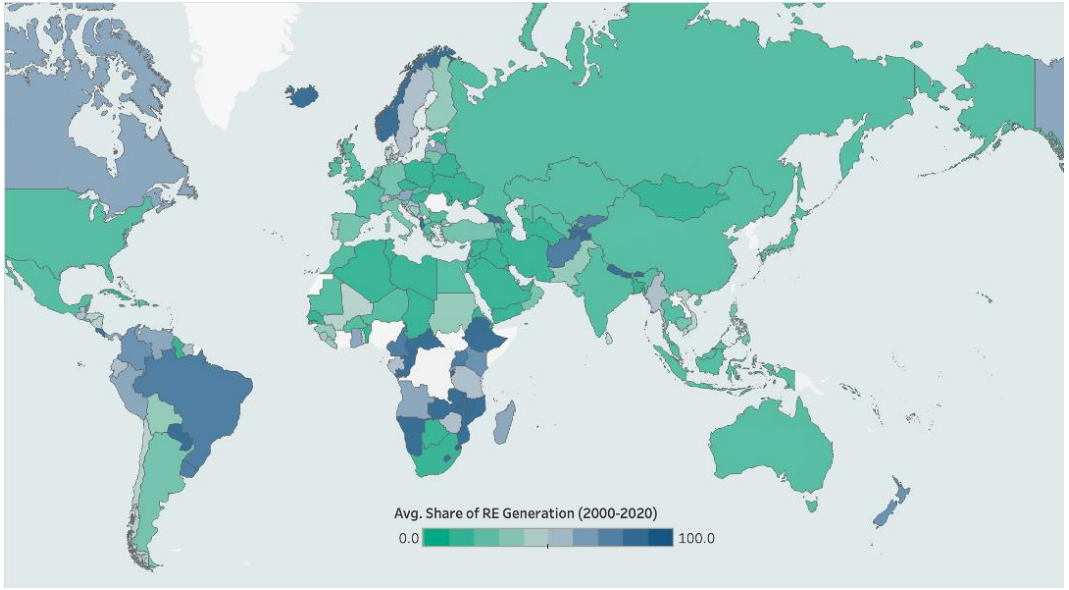


Share of renewable energy generation

Global carbon intensity and renewable energy generation share



Carbon Intensity



Share of renewable energy generation

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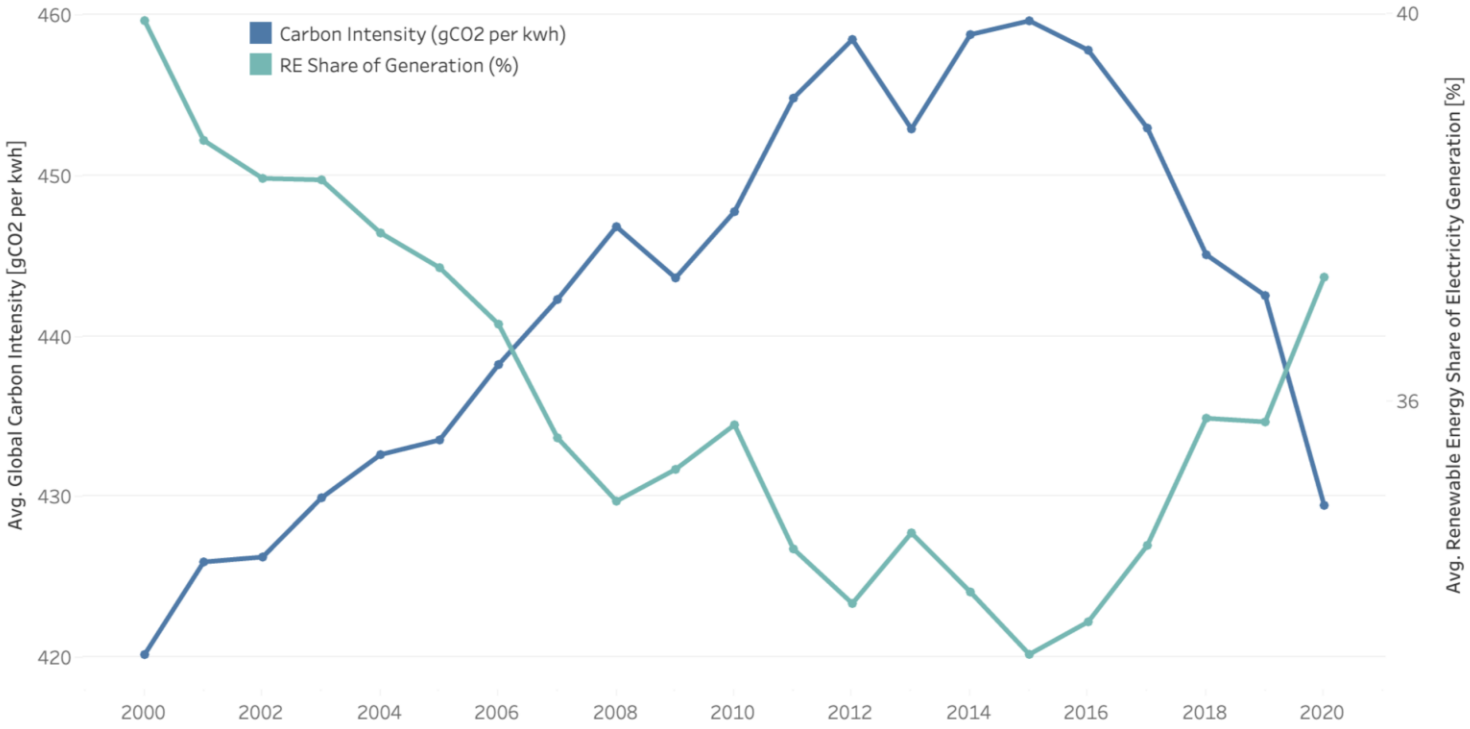
Global carbon intensity and renewable energy generation share



- Correlation coefficient: **-0.81**
- p-value: **< 0.001**
- Strong **inverse** relationship
- Statistically **significant**

Variance of carbon intensity

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- Dependent variable: Carbon Intensity
- Independent variable: Share of renewable energy generation

Measure	Value	Probability
R-squared	0.66	
F-Statistic	6739	< 0.001

66 % of the variance in **carbon intensity** can be explained by the share of renewable energy generation

✓ The model is **significant** to explain carbon intensity levels

15 countries with the **lowest** carbon intensity

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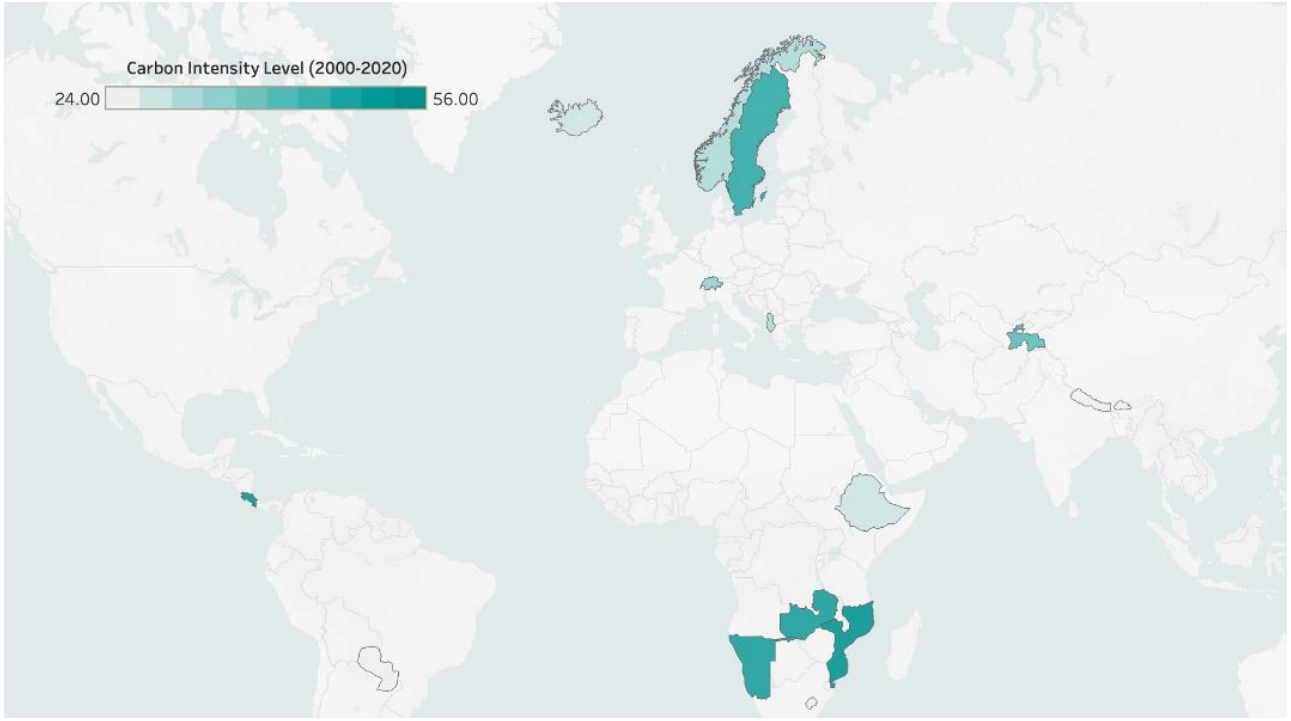

Indicator	Value
Carbon intensity	36.8
% Electricity generation from R.E.	92.4
Share of hydropower (%)	94.5
Share of solar (%)	0.5
Share of wind (%)	1.3
Share of biofuels (%)	0.9
Others (%)	0.3

15 countries with the **highest** carbon intensity

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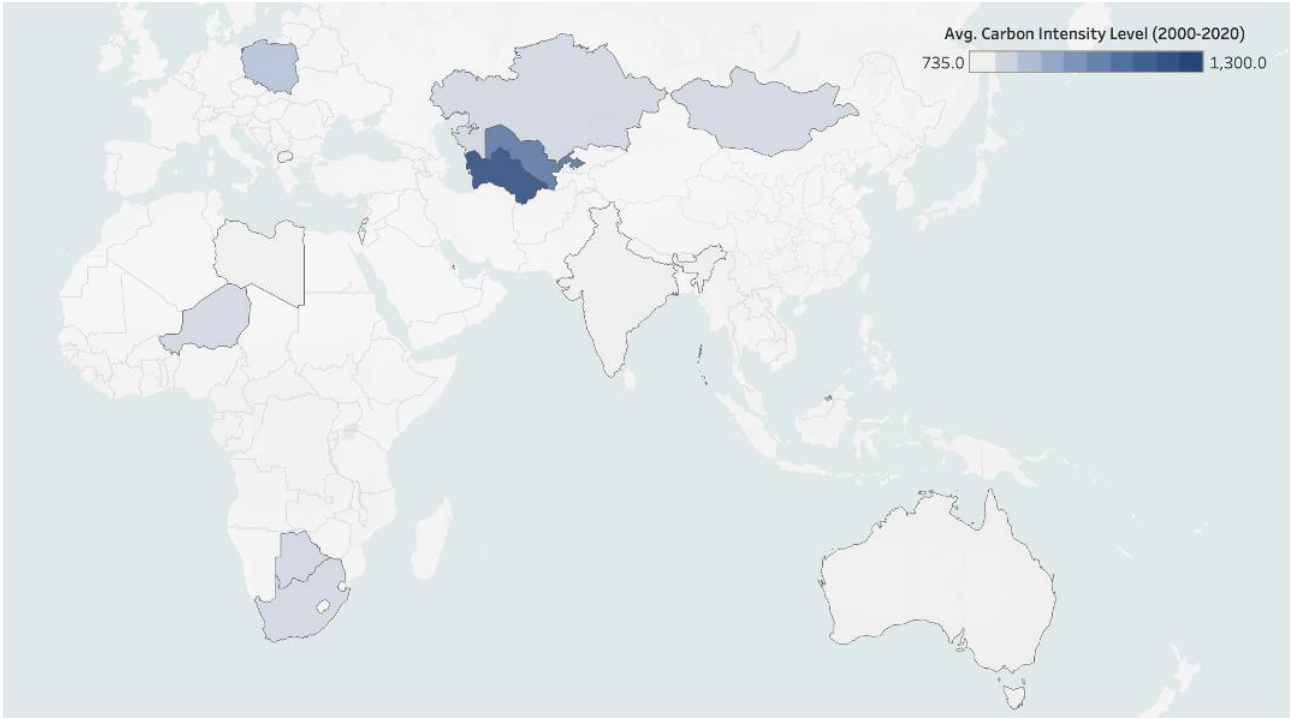

Indicator	Value
Carbon intensity	863.7
% Electricity generation from R.E.	8.3
Share of hydropower (%)	60.0
Share of solar (%)	23.4
Share of wind (%)	9.6
Share of biofuels (%)	6.2
Others (%)	< 0.1

Higher share of **renewable energy generation** is associated with **lower carbon intensity** levels, indicating a cleaner energy production

Policy Implications

- **Promoting renewable energy** sources can effectively **reduce CO2 emission** per energy unit produced
- Countries with **water abundance** should focus on **hydropower** in their renewable energy mix
- For other countries, **diversifying** their energy portfolio is a good strategy to **prevent over-reliance** on weather-dependent sources

Carbon footprint is determined by the level of **economic development** and the share of **renewable energy consumption**

Hypothesis 3

Carbon footprint

$$\frac{Carbon\ dioxide\ emissions\ (gCO2)}{Population}$$

Share of electricity consumed from renewable energy

$$\frac{Electricity\ consumed\ from\ R.E.}{Total\ Electricity\ Consumed}\ \%$$

Carbon footprint and GDP per capita

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- Correlation coefficient: **0.69**
- p-value: **< 0.001**

- Strong **positive** relationship
- Statistically **significant**

Carbon footprint and renewable energy consumption

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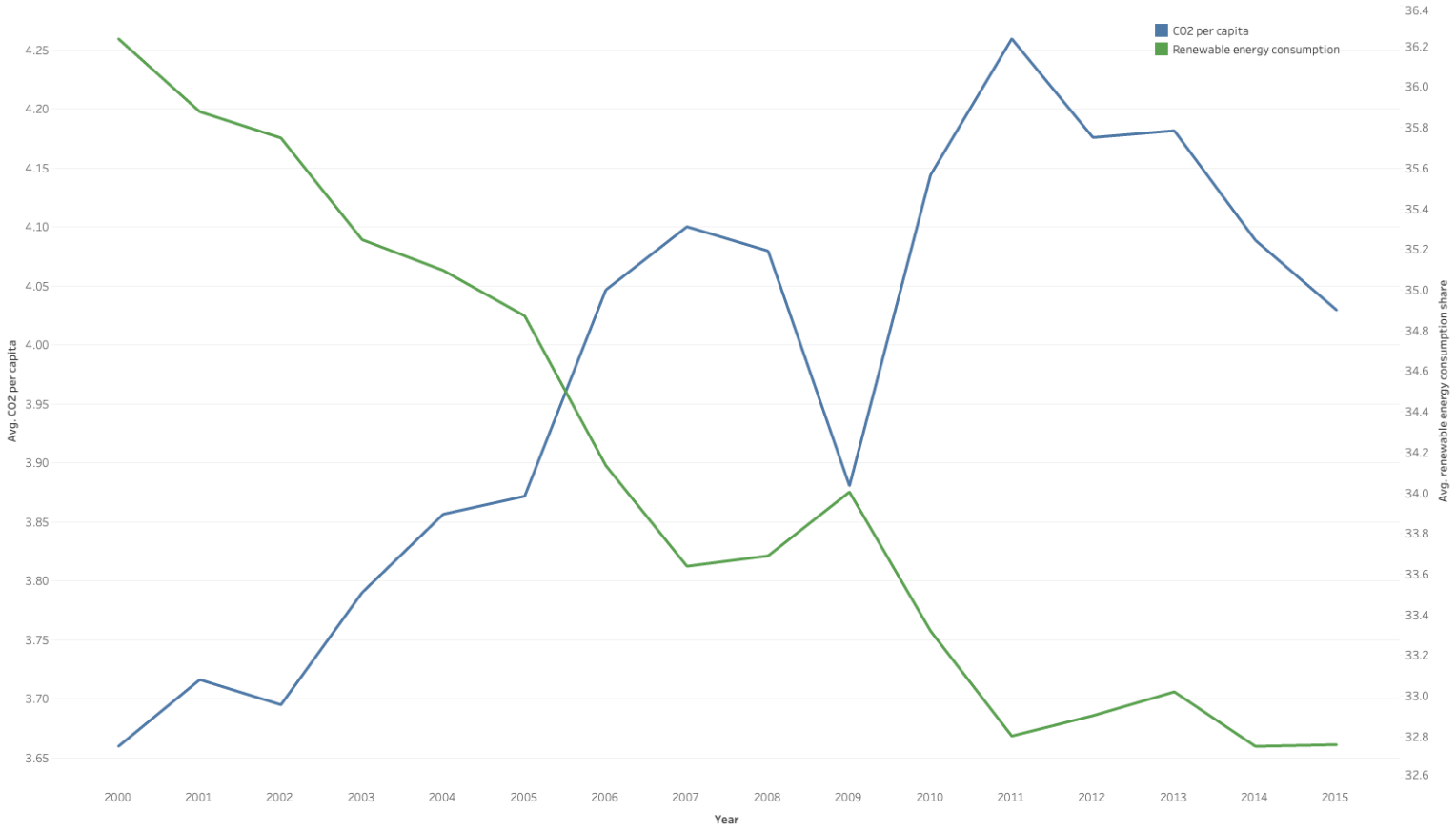

- Correlation coefficient: **-0.58**
- p-value: **< 0.001**

- Moderate **inverse** relationship
- Statistically **significant**

Variance of carbon footprint

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C

- Dependent variable: Carbon footprint
- Independent variable: Share of renewable energy consumption & GDP per capita

Measure	Value	Probability
R-squared	0.609	
F-Statistic	2283	< 0.001

61 % of the variance in CO2 emissions per capita can be explained by the independent variables

✓ The model is **significant** to explain carbon footprint levels

Include industry share and energy intensity

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Carbon footprint and industry share

- Correlation coefficient: **0.33**
- p-value: **< 0.001**

- Slight **positive** relationship and statistically **significant**

Carbon footprint and energy intensity

- correlation coefficient: **-0.003**
- p-value: **0.86**

- **No relationship** and statistically **not significant**

- It is correlated with other variables

Variance of carbon footprint

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H1

H2

H3

C

- Dependent variable: Carbon footprint
- Independent variable: Share of renewable energy consumption, GDP per capita, **industry share and energy intensity**

Measure	Value	Probability
R-squared	0.711	
F-Statistic	2283	< 0.001

71 % of the variance in CO2 emissions per capita can be explained by the independent variables

✓ The model is **significant** to explain carbon footprint levels

Carbon footprint is determined by the level of **economic development** and the share of **renewable energy consumption** 

Policy Implications

- **Financial incentives** to promote renewable energy consumption
- Incentivize **industrial sector** to adopt **energy-efficient** technologies and practices
- Support **diversification** of the economy to reduce reliance on high-carbon industries

Key takeaways

- **Prioritize solar** and **wind energy** if weather conditions are favorable
- **Water-abundant** countries should **focus on hydropower**, while others should **diversify** their **energy portfolios**
- **Incentivize renewable energy** sources and adopt measures to **improve energy efficiency** and **diversify economies** with a high industrial share

Thank you