Special Report on Renewable Energy Sources and Climate Change Mitigation

Presenter Info
Event Info

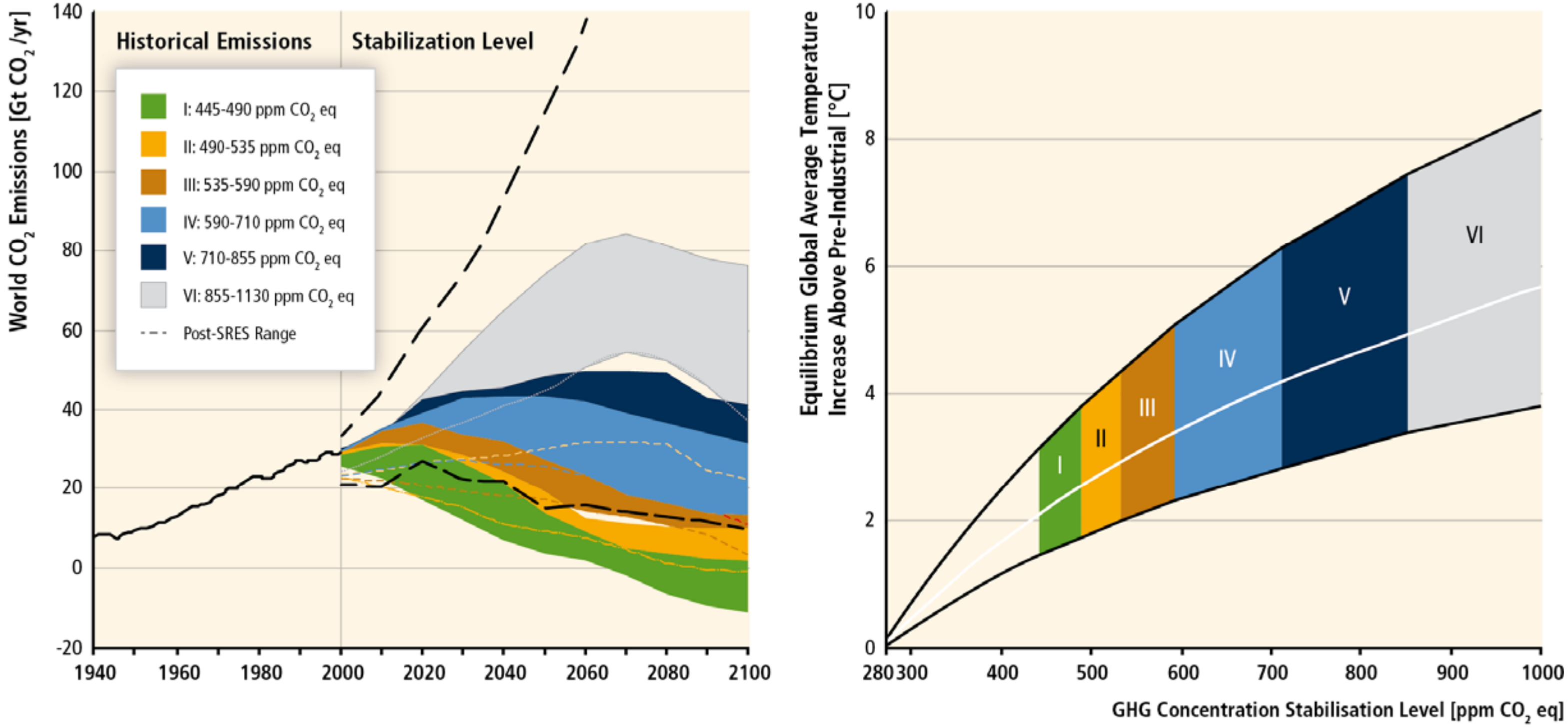
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

WMO UNEP

Special Report on Renewable Energy Sources and Climate Change Mitigation

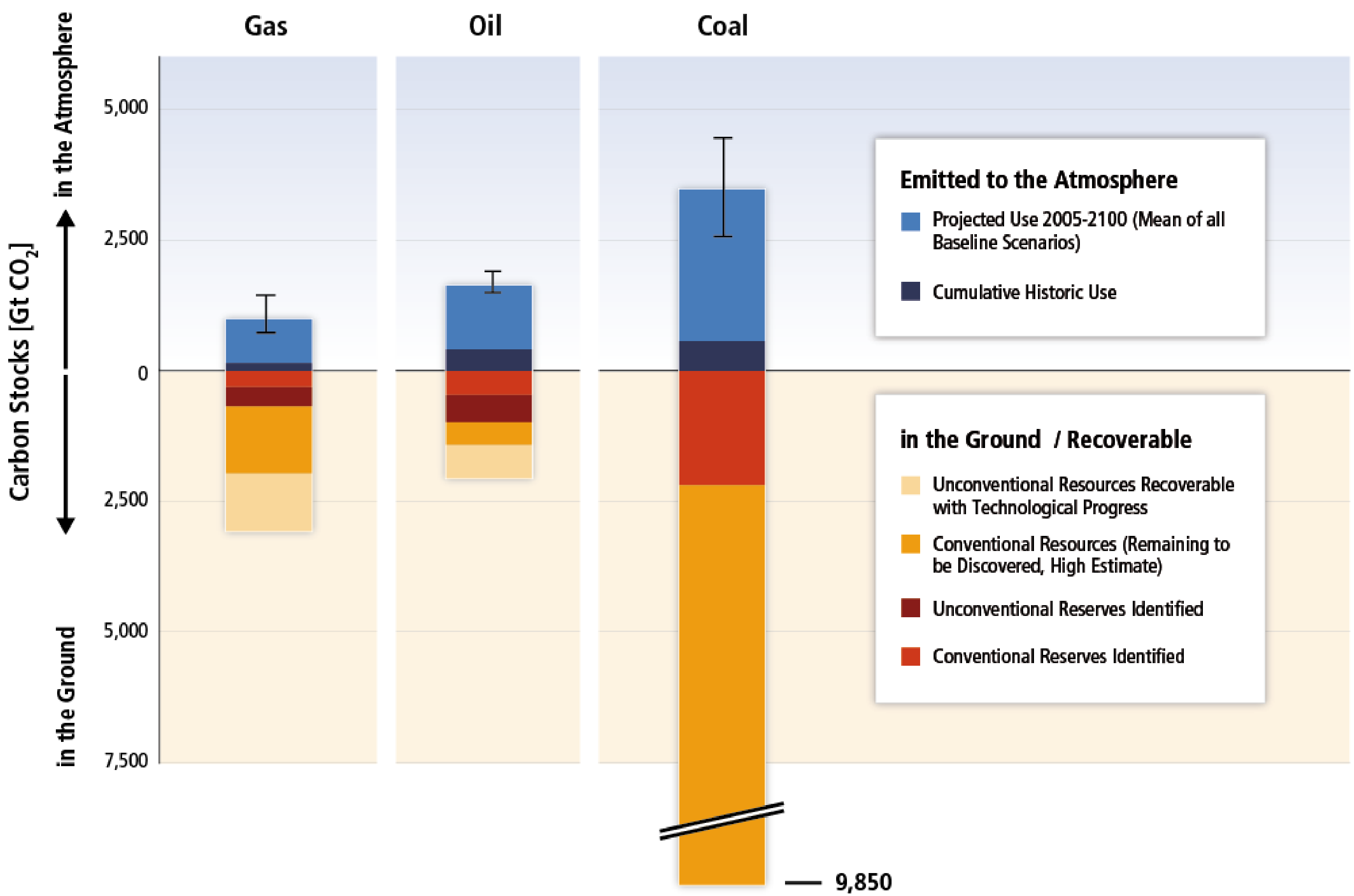
1. Renewable Energy and Climate Change	Introductory Chapter
2. Bioenergy	Technology Chapters
3. Direct Solar Energy	
4. Geothermal Energy	
5. Hydropower	
6. Ocean Energy	
7. Wind Energy	
8. Integration of Renewable Energy into Present and Future Energy Systems	Integrative Chapters
9. Renewable Energy in the Context of Sustainable Development	
10. Mitigation Potential and Costs	
11. Policy, Financing and Implementation	

Demand for energy services is increasing.

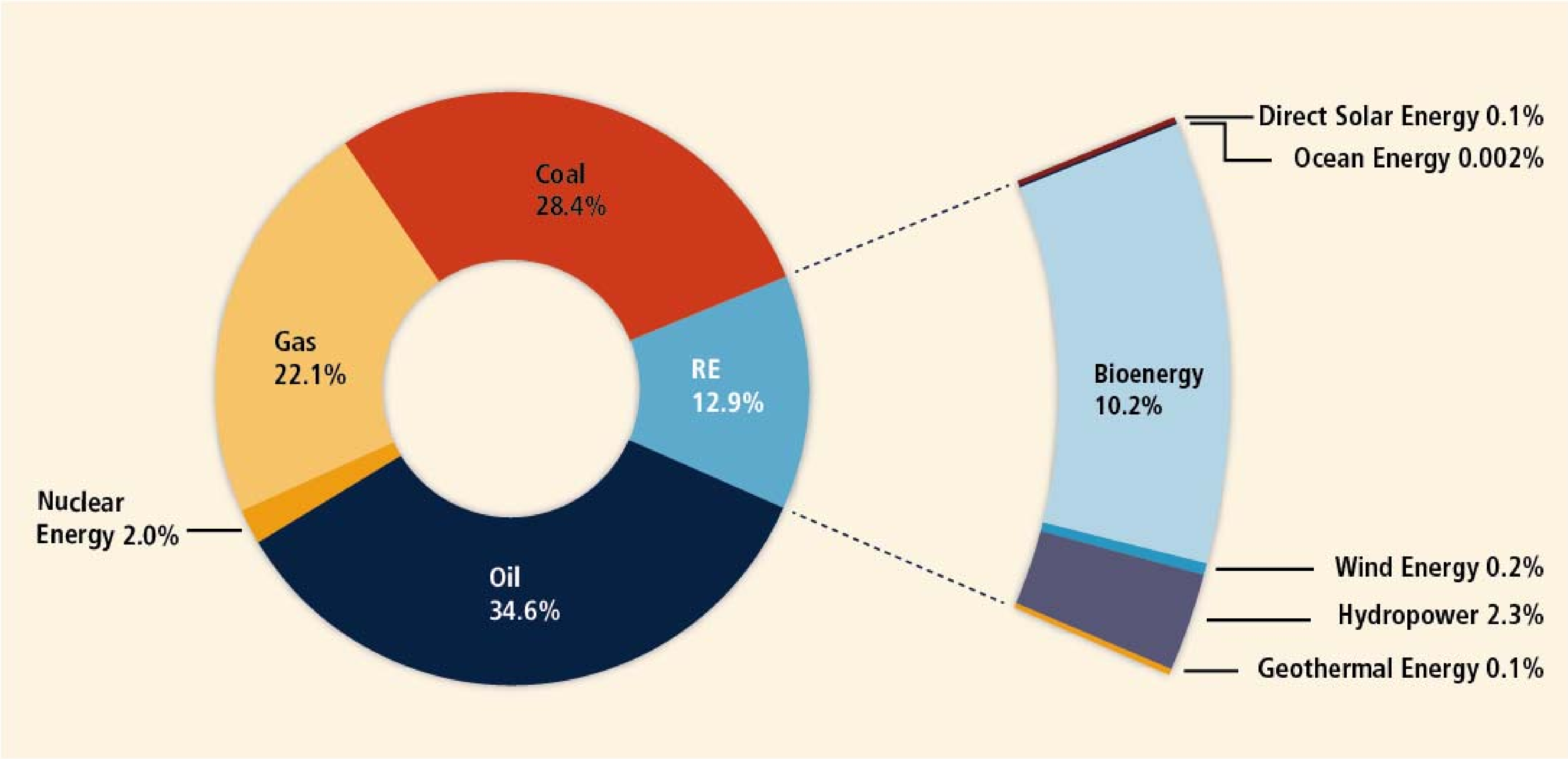


GHG emissions resulting from the provision of energy services contribute significantly to the increase in atmospheric GHG concentrations.

Potential emissions from remaining fossil resources could result in GHG concentration levels far above 600ppm.

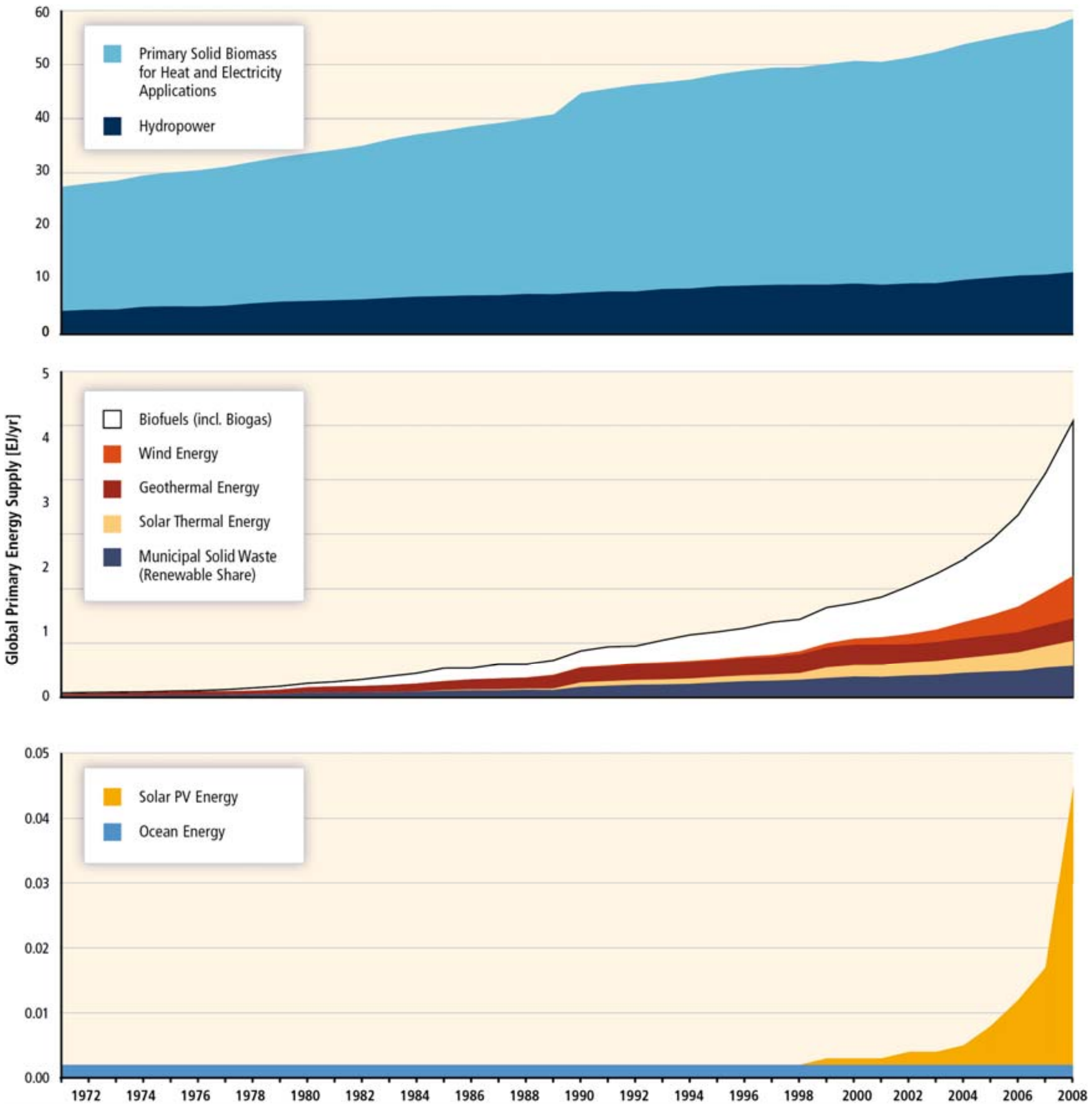


The current global energy system is dominated by fossil fuels.



Shares of energy sources in total global primary energy supply in 2008

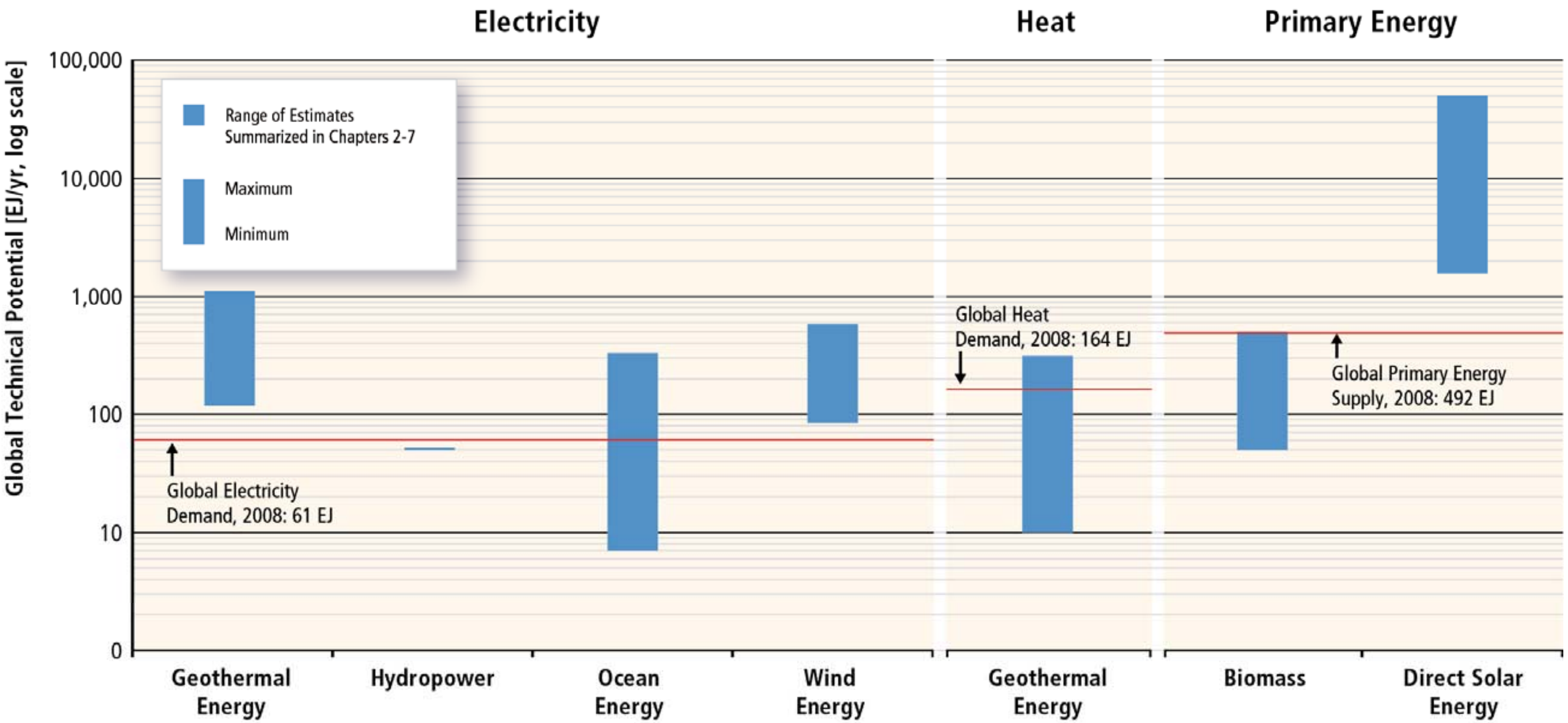
RE capacity has been increasing rapidly in recent years.



140 GW of new RE power plant capacity was built in 2008-2009.

This equals 47% of all power plants built during that period.

The technical potential of renewable energy technologies to supply energy services exceeds current demands.

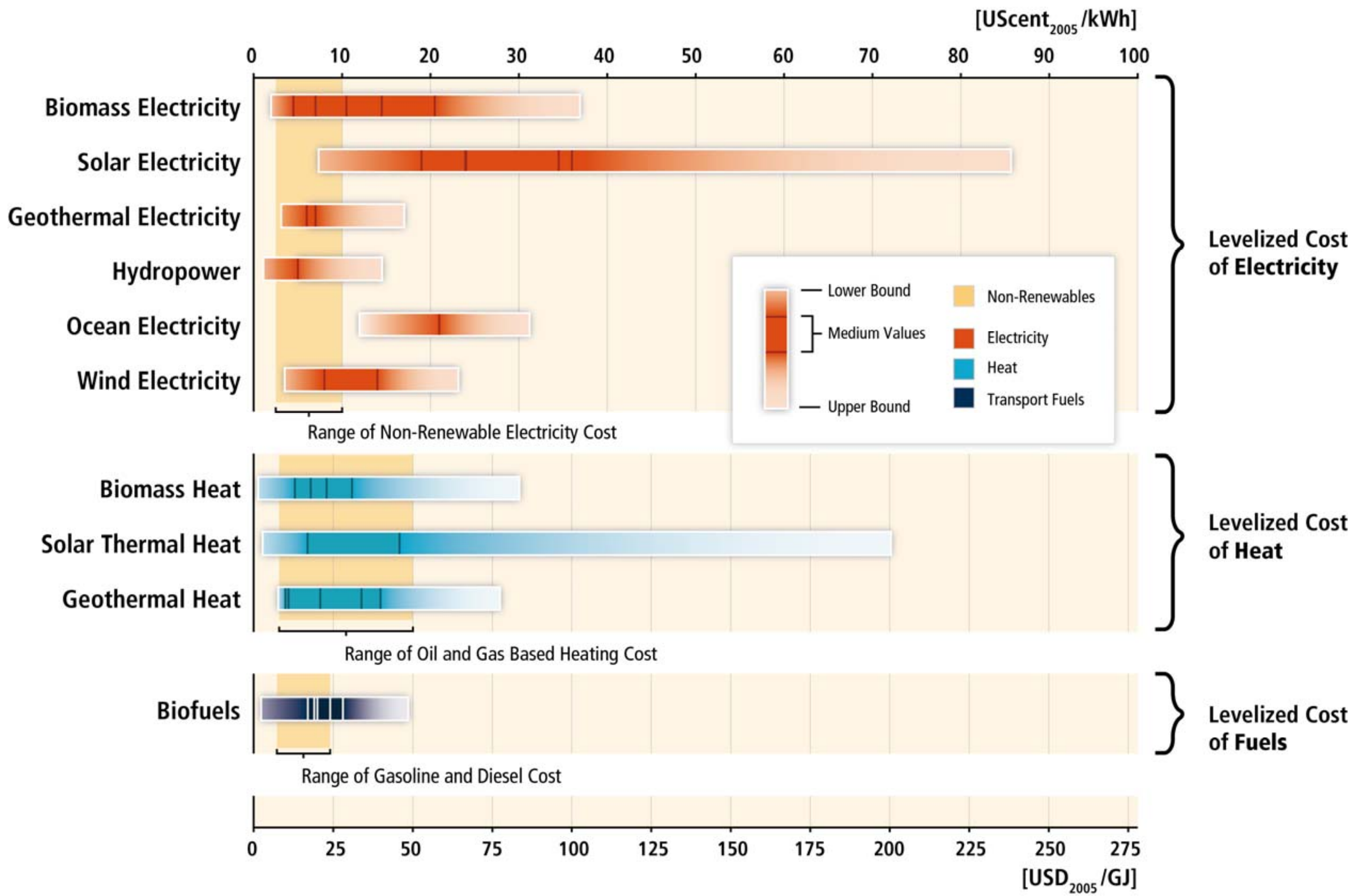


Range of Estimates of Global Technical Potentials

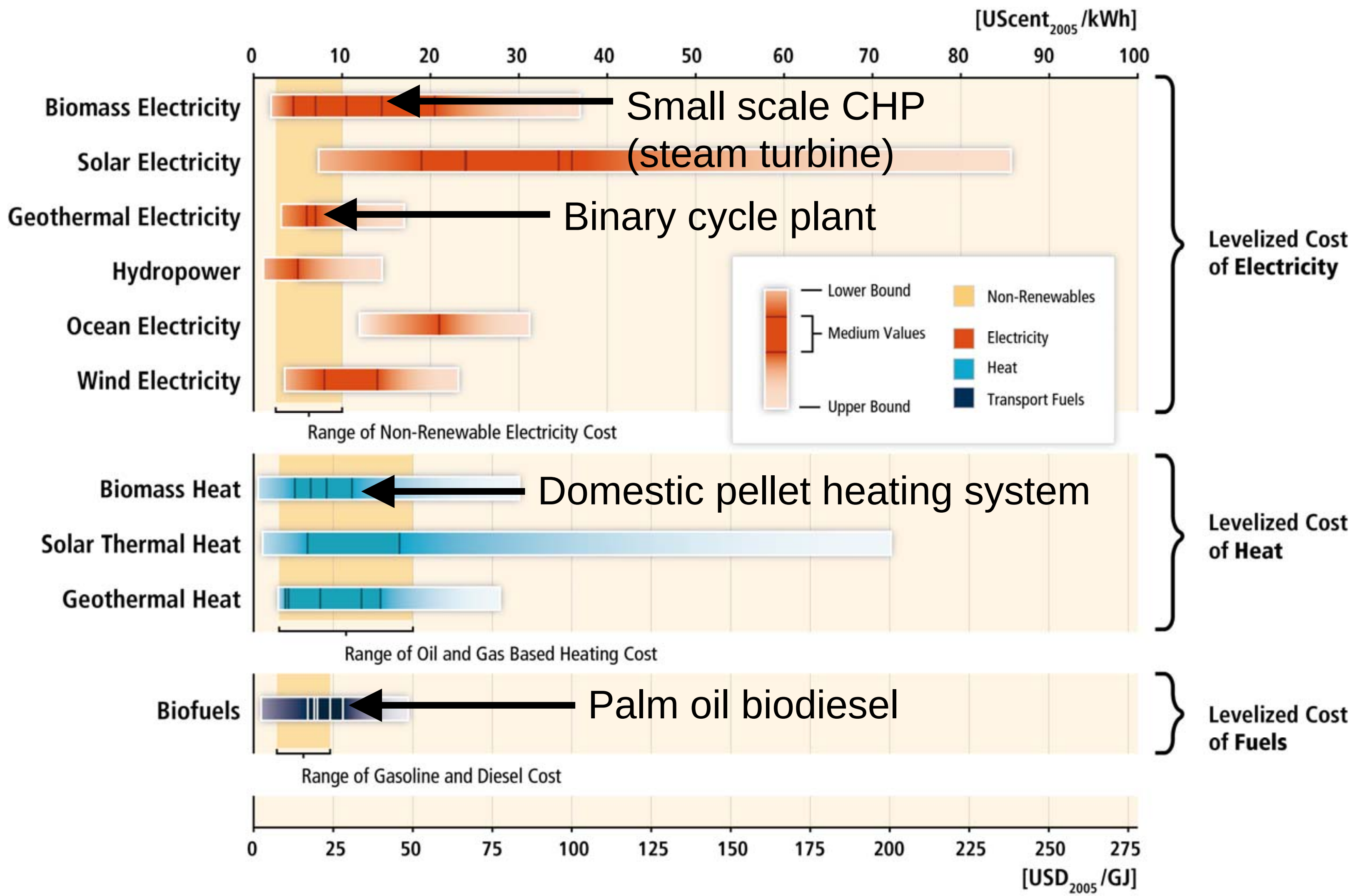
	Geothermal Energy	Hydropower	Ocean Energy	Wind Energy	Geothermal Energy	Biomass	Direct Solar Energy
Max (in EJ/yr)	1109	52	331	580	312	500	49837
Min (in EJ/yr)	118	50	7	85	10	50	1575

INTERGOVERNMENTAL PANEL ON climate change

RE costs are still higher than existing energy prices, but in various settings RE is already competitive.



RE costs are still higher than existing energy prices, but in various settings RE is already competitive.



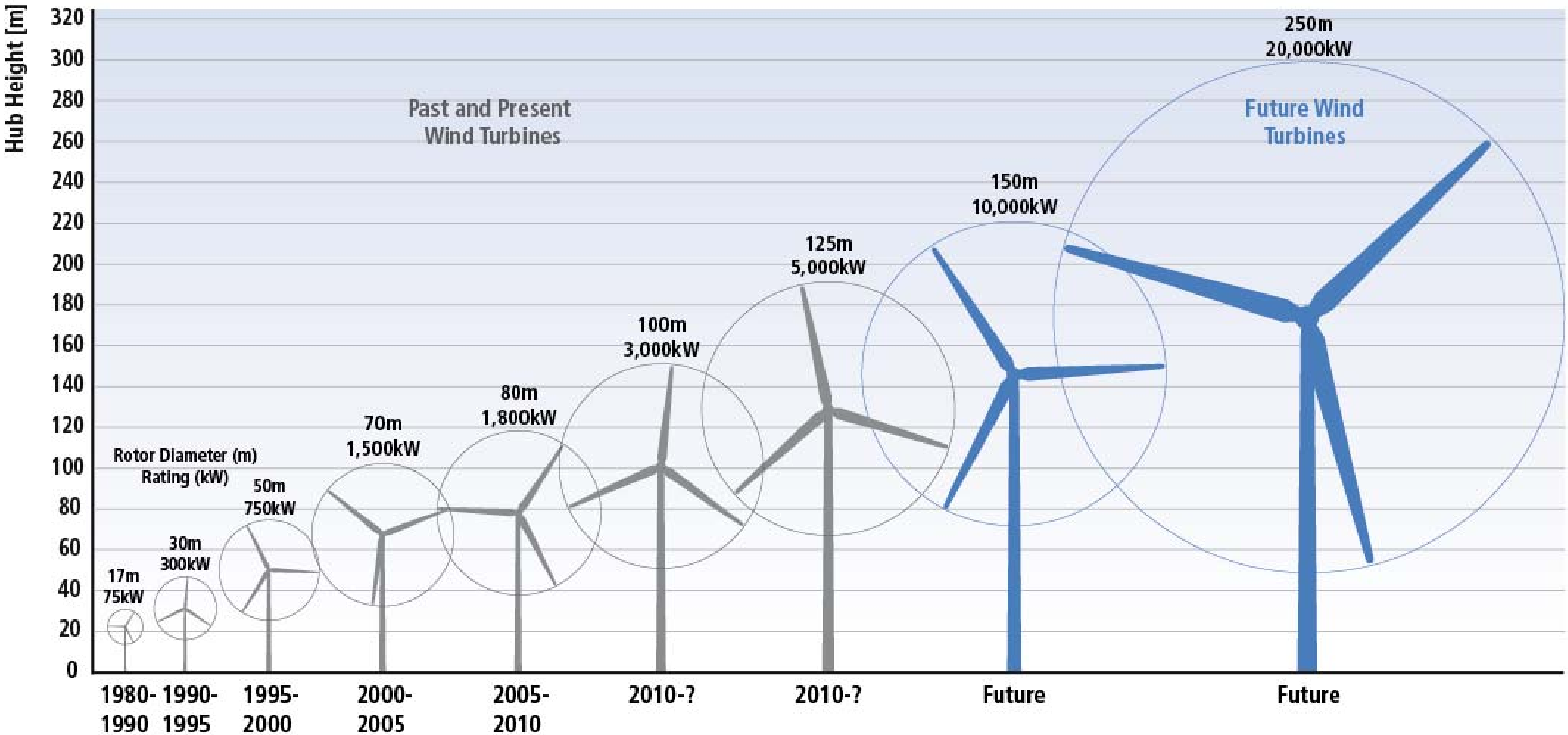
RE costs are still higher than existing energy prices, but in various settings RE is already competitive.

Notes: Medium values are shown for the following subcategories, sorted in the order as they appear in the respective ranges (from left to right):

Electricity	Heat	Transport Fuels
Biomass: 1. Cofiring 2. Small scale combined heat and power, CHP (Gasification internal combustion engine) 3. Direct dedicated stoker & CHP 4. Small scale CHP (steam turbine) 5. Small scale CHP (organic Rankine cycle) **Solar Electricity:** 1. Concentrating solar power 2. Utility-scale PV (1-axis and fixed tilt) 3. Commercial rooftop PV 4. Residential rooftop PV **Geothermal Electricity:** 1. Condensing flash plant 2. Binary cycle plant **Hydropower:** 1. All types **Ocean Electricity:** 1. Tidal barrage **Wind Electricity:** 1. Onshore 2. Offshore	**Biomass Heat:** 1. Municipal solid waste based CHP 2. Anaerobic digestion based CHP 3. Steam turbine CHP 4. Domestic pellet heating system **Solar Thermal Heat:** 1. Domestic hot water systems in China 2. Water and space heating **Geothermal Heat:** 1. Greenhouses 2. Uncovered aquaculture ponds 3. District heating 4. Geothermal heat pumps 5. Geothermal building heating	**Biofuels:** 1. Corn ethanol 2. Soy biodiesel 3. Wheat ethanol 4. Sugarcane ethanol 5. Palm oil biodiesel

The lower range of the levelized cost of energy for each RE technology is based on a combination of the most favourable input-values, whereas the upper range is based on a combination of the least favourable input values. Reference ranges in the figure background for non-renewable electricity options are indicative of the levelized cost of centralized non-renewable electricity generation. Reference ranges for heat are indicative of recent costs for oil and gas based heat supply options. Reference ranges for transport fuels are based on recent crude oil spot prices of USD 40 to 130/barrel and corresponding diesel and gasoline costs, excluding taxes.

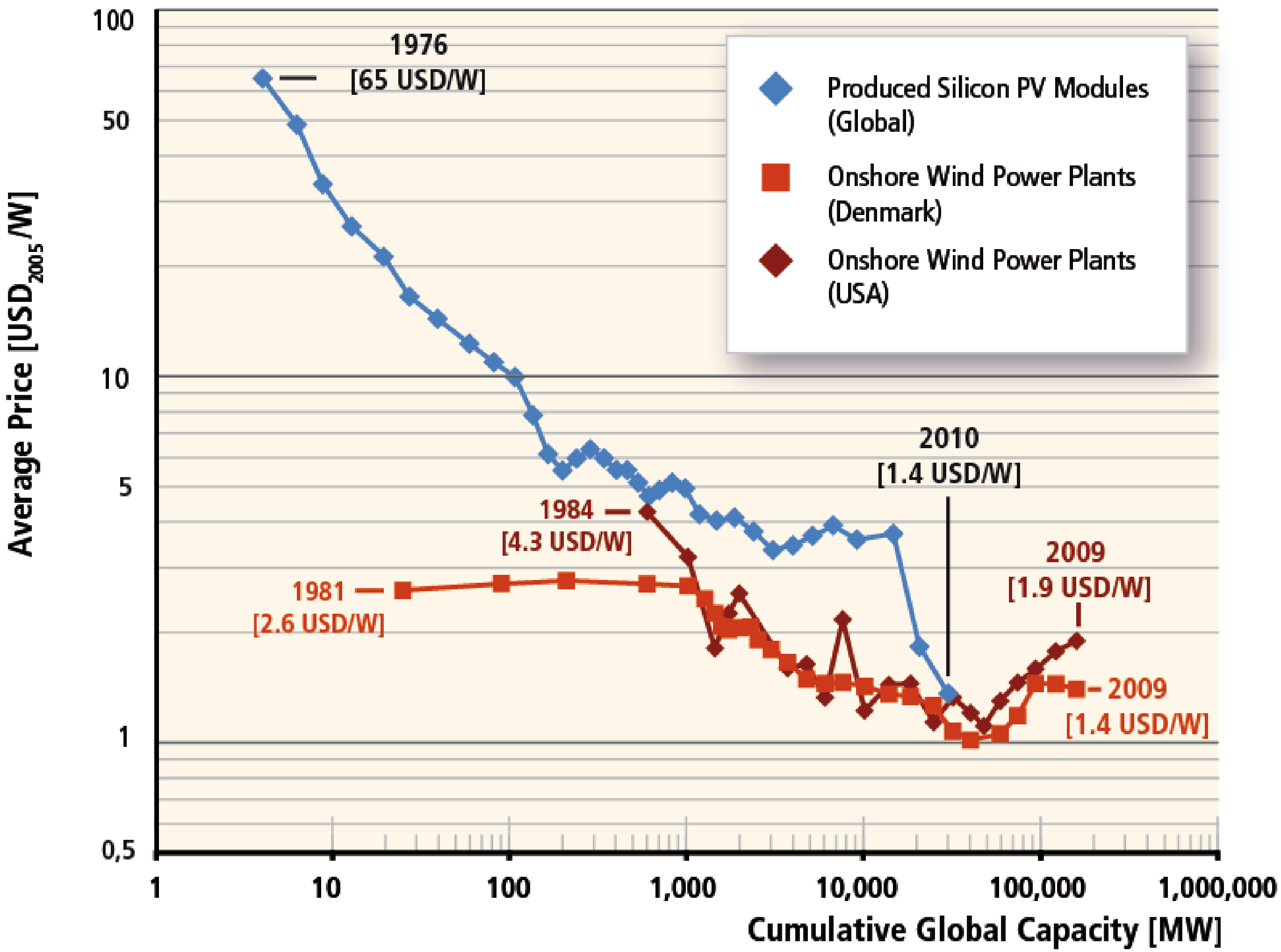
Technical Advancements: For instance growth in size of typical commercial wind turbines.



ipcc INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

RE costs have declined in the past and further declines can be expected in the future.



Integration characteristics for a selection of RE electricity generation technologies

Technology		Plant size range	Variability: Characteristic time scales for power system operation	Dispatchability	Geographical diversity potential	Predictability	Capacity factor range	Capacity credit range	Active power, frequency control	Voltage, reactive power control
		(MW)	Time scale	See legend	See legend	See legend	%	%	See legend	See legend
Bioenergy		0.1–100	Seasons (depending on biomass availability)	+++	+	++	50–90	Similar to thermal and CHP	++	++
Direct solar energy	PV	0.004–100 modular	Minutes to years	+	++	+	12–27	<25–75	+	+
	CSP with thermal storage*	50–250	Hours to years	++	+**	++	35–42	90	++	++
Geothermal energy		2–100	Years	+++	N/A	++	60–90	Similar to thermal	++	++
Hydropower	Run of river	0.1–1,500	Hours to years	++	+	++	20–95	0–90	++	++
	Reservoir	1–20,000	Days to years	+++	+	++	30–60	Similar to thermal	++	++
Ocean energy	Tidal range	0.1–300	Hours to days	+	+	++	22.5–28.5	<10	++	++
	Tidal current	1–200	Hours to days	+	+	++	19–60	10–20	+	++
	Wave	1–200	Minutes to years	+	++	+	22–31	16	+	+
Wind energy		5–300	Minutes to years	+	++	+	20–40 onshore, 30–45 offshore	5–40	+	++

* Assuming CSP system with 6 hours of thermal storage in US Southwest.
** In areas with Direct Normal Irradiation (DNI) > 2,000 kWh/m2/yr (7,200 MJ/m2/yr)

Capacity credit is an indicator for the reliability of a generation type to be available during peak demand hours.

Technology		[…]	Capacity credit range
		[…]	%
Bioenergy		[…]	Similar to thermal and CHP
Direct solar energy	PV	[…]	<25–75
	CSP with thermal storage*	[…]	90
Geothermal energy		[…]	Similar to thermal
Hydropower	Run of river	[…]	0–90
	Reservoir	[…]	Similar to thermal
Ocean energy	Tidal range	[…]	<10
	Tidal current	[…]	10–20
	Wave	[…]	16
Wind energy		[…]	5–40

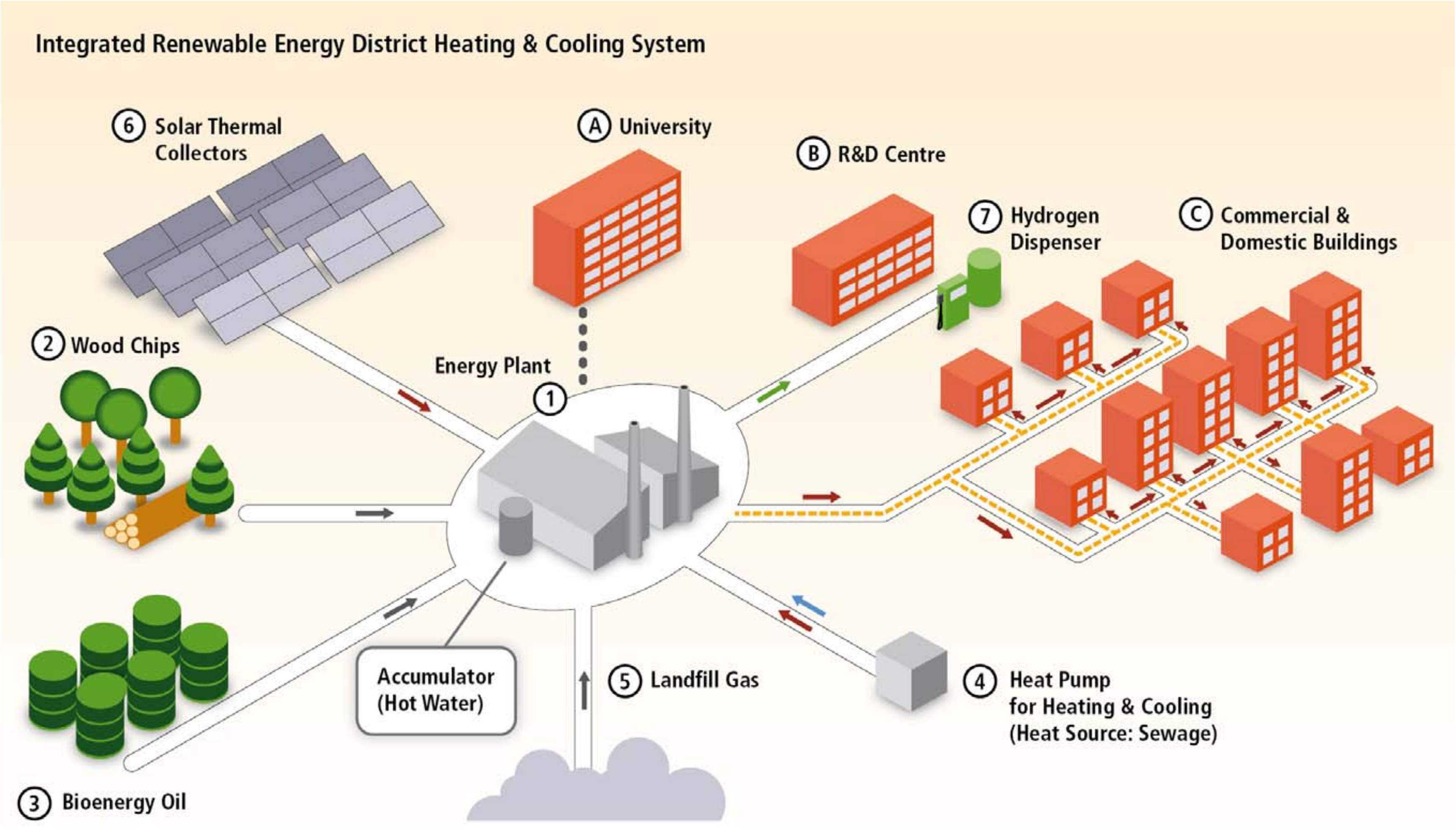
If a type of generation has a low capacity credit,
the available output tends to be low during high demand periods.

INTERGOVERNMENTAL PANEL ON climate change

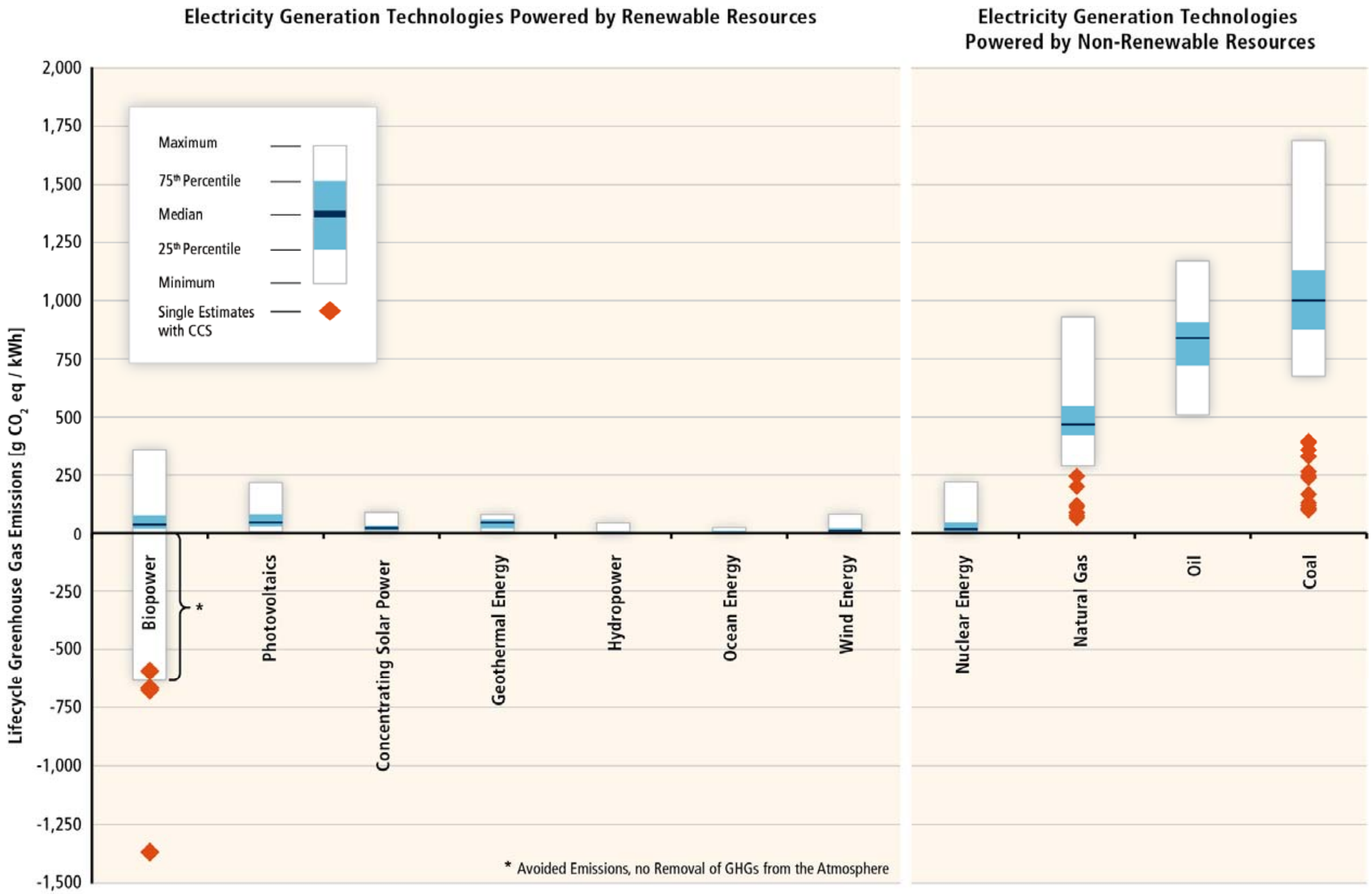
Few, if any, fundamental technical limits exist to the integration of a majority share of RE, but advancements in several areas are needed.

- Transmission and distribution infrastructure
- Generation flexibility
- Energy storage technologies
- Demand side management
- Improved forecasting and operational planning methods

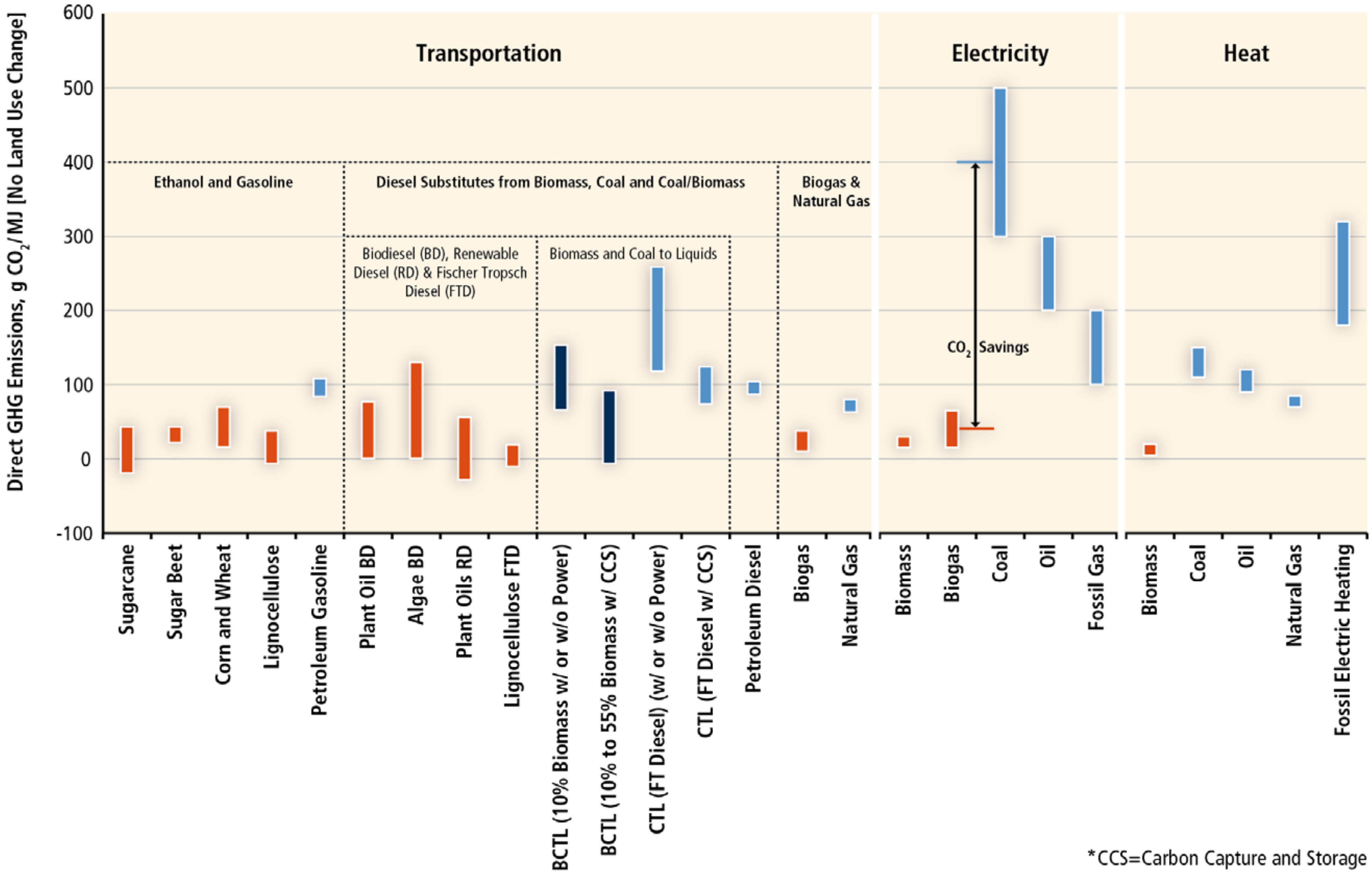
An integrated RE-based energy plant in Lillestrøm, Norway, supplying commercial and domestic buildings



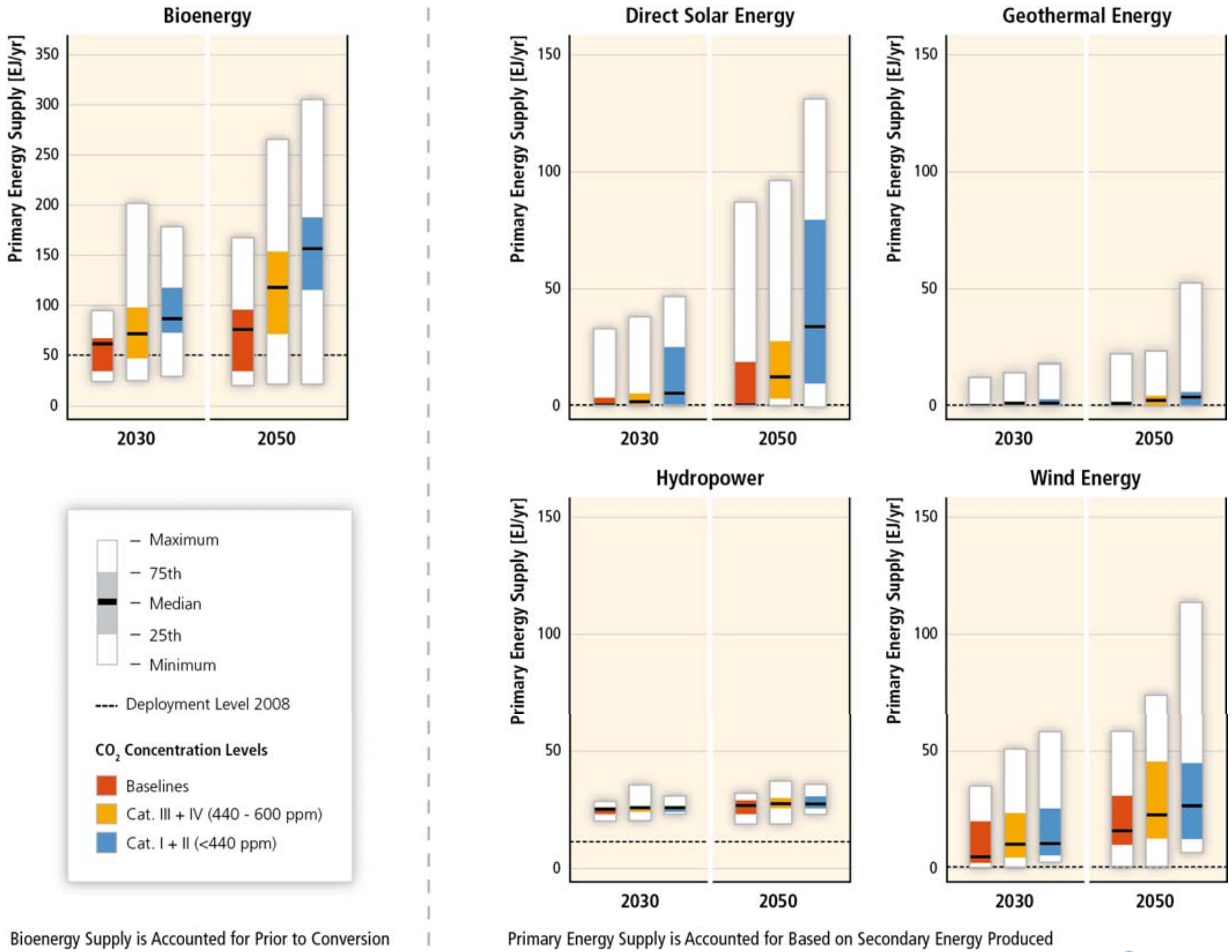
Lifecycle GHG emissions of RE technologies are, in general, considerably lower than those of fossil fuel options.



GHG emissions from modern bioenergy chains compared to fossil fuel energy systems, excluding land-use change effects.

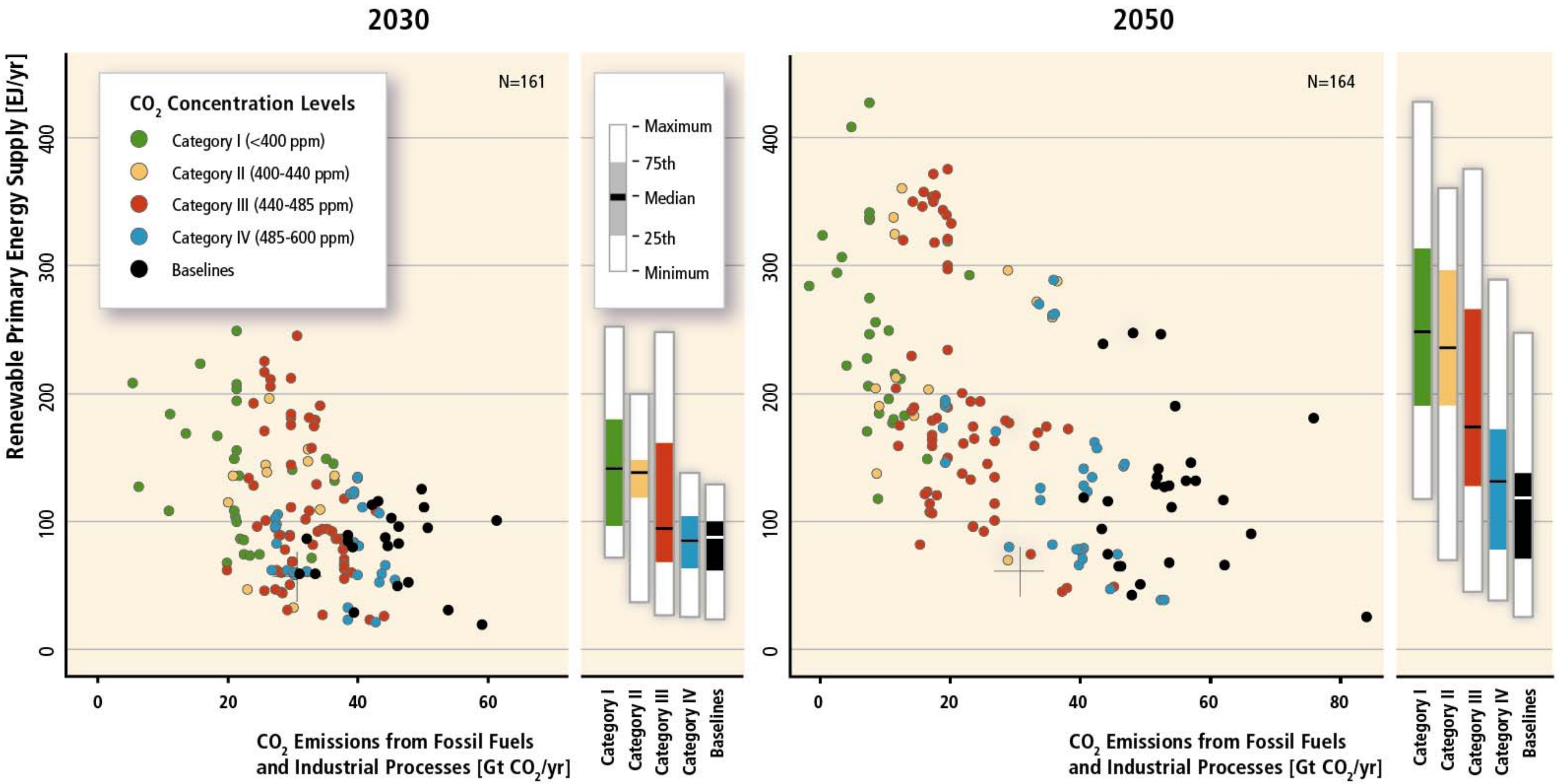


RE deployment increases in scenarios with lower greenhouse gas concentration stabilization levels.



INTERGOVERNMENTAL PANEL ON climate change

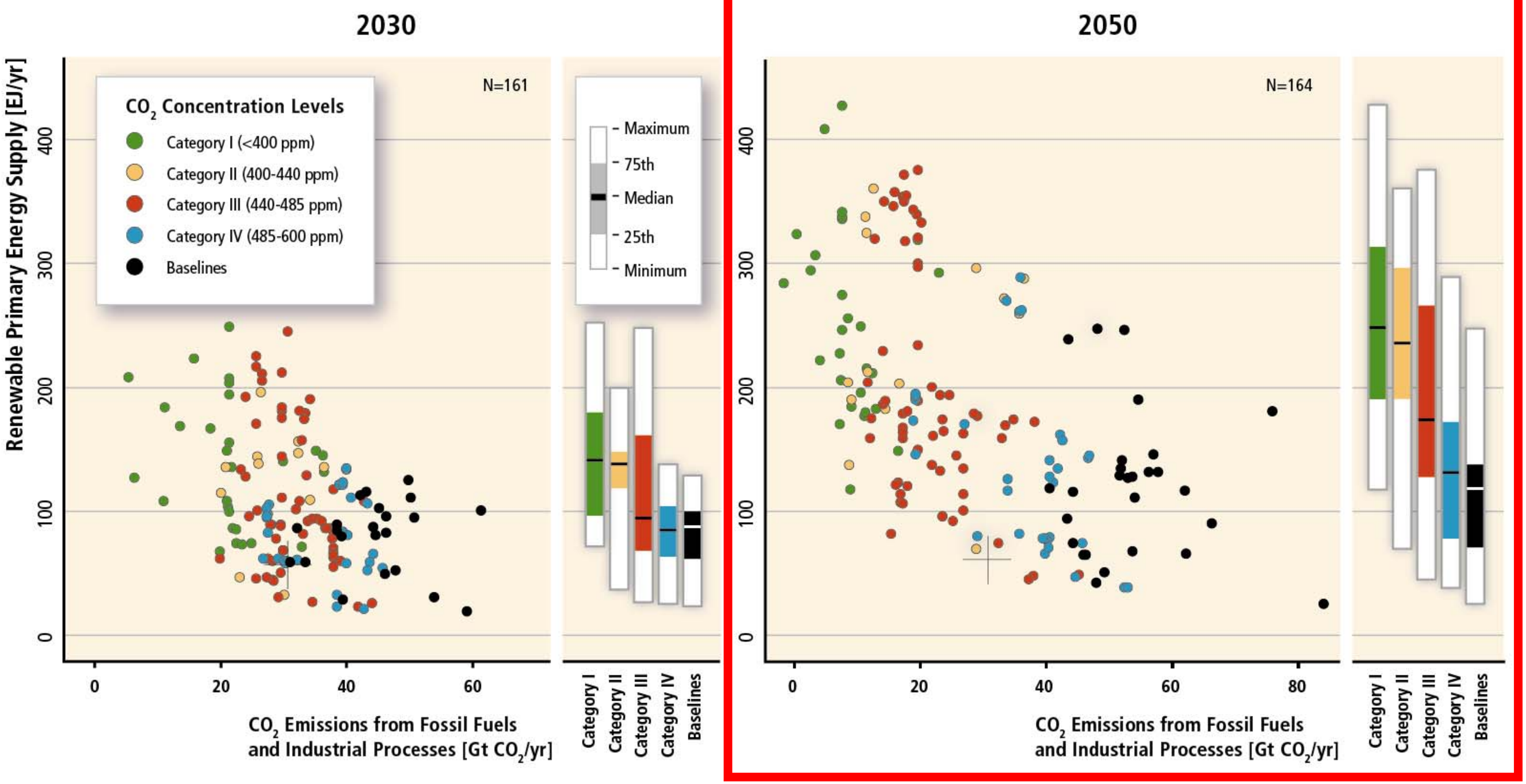
Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.



INTERGOVERNMENTAL PANEL ON climate change

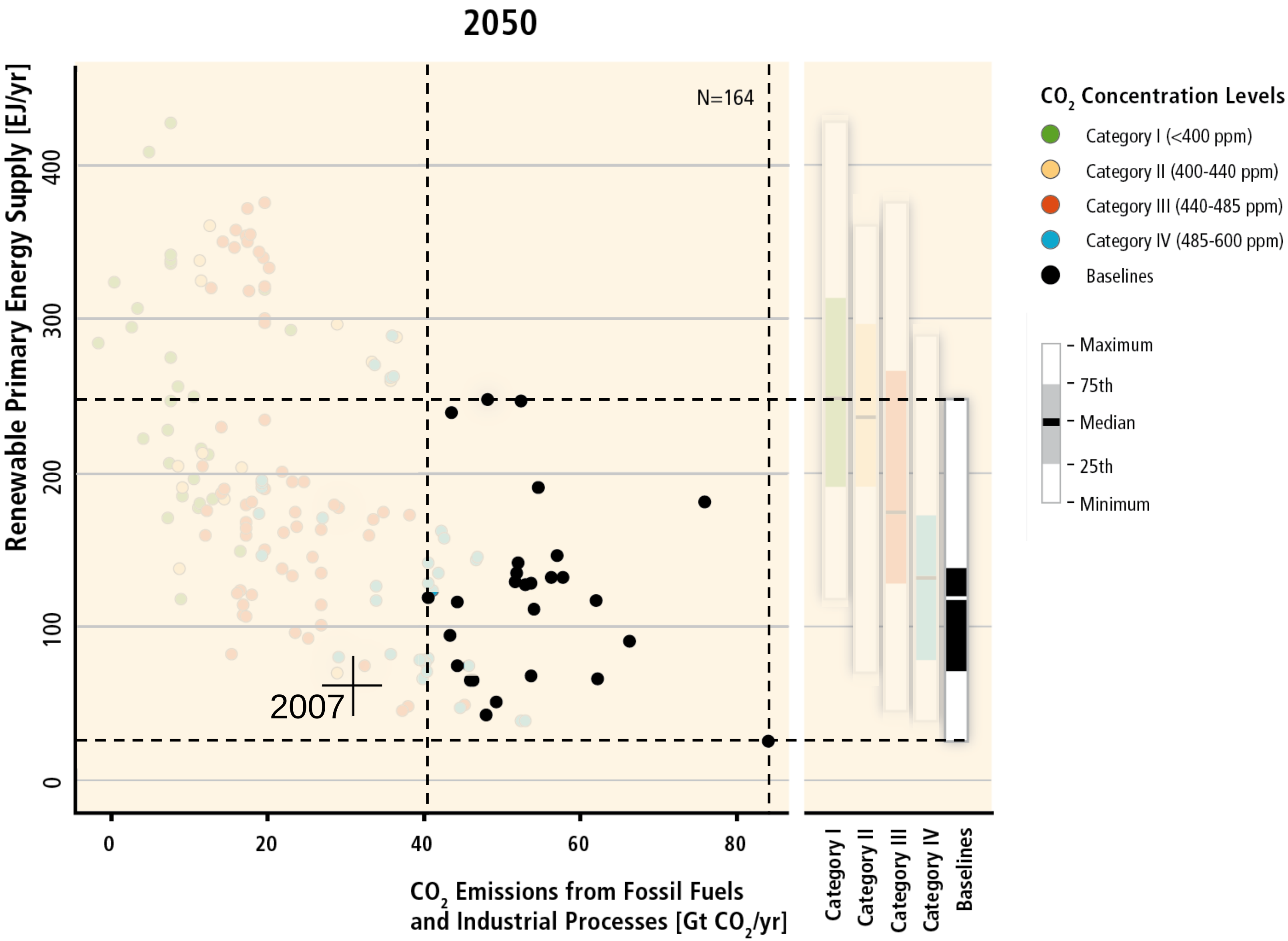
WMO UNEP

Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.

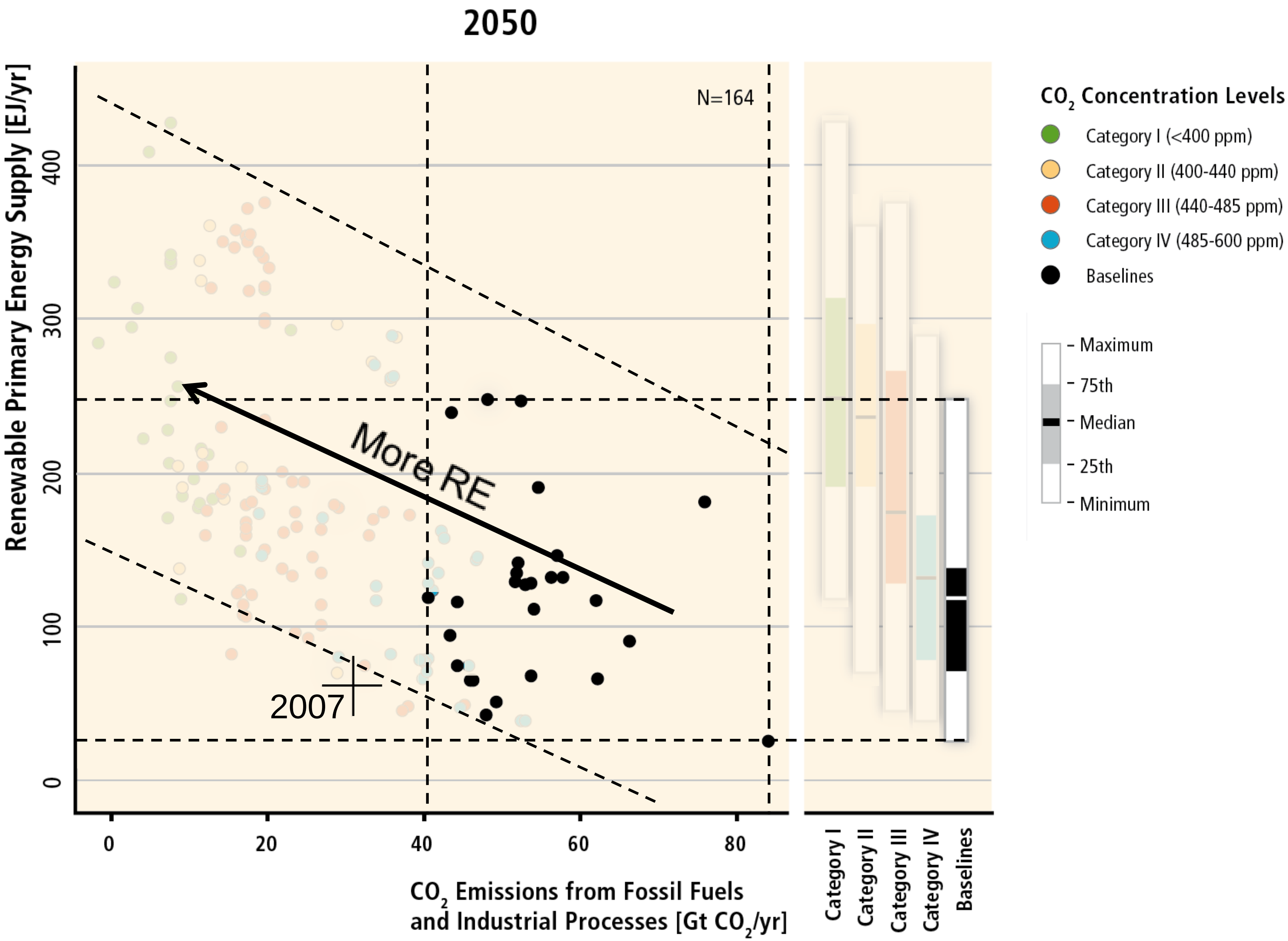


ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

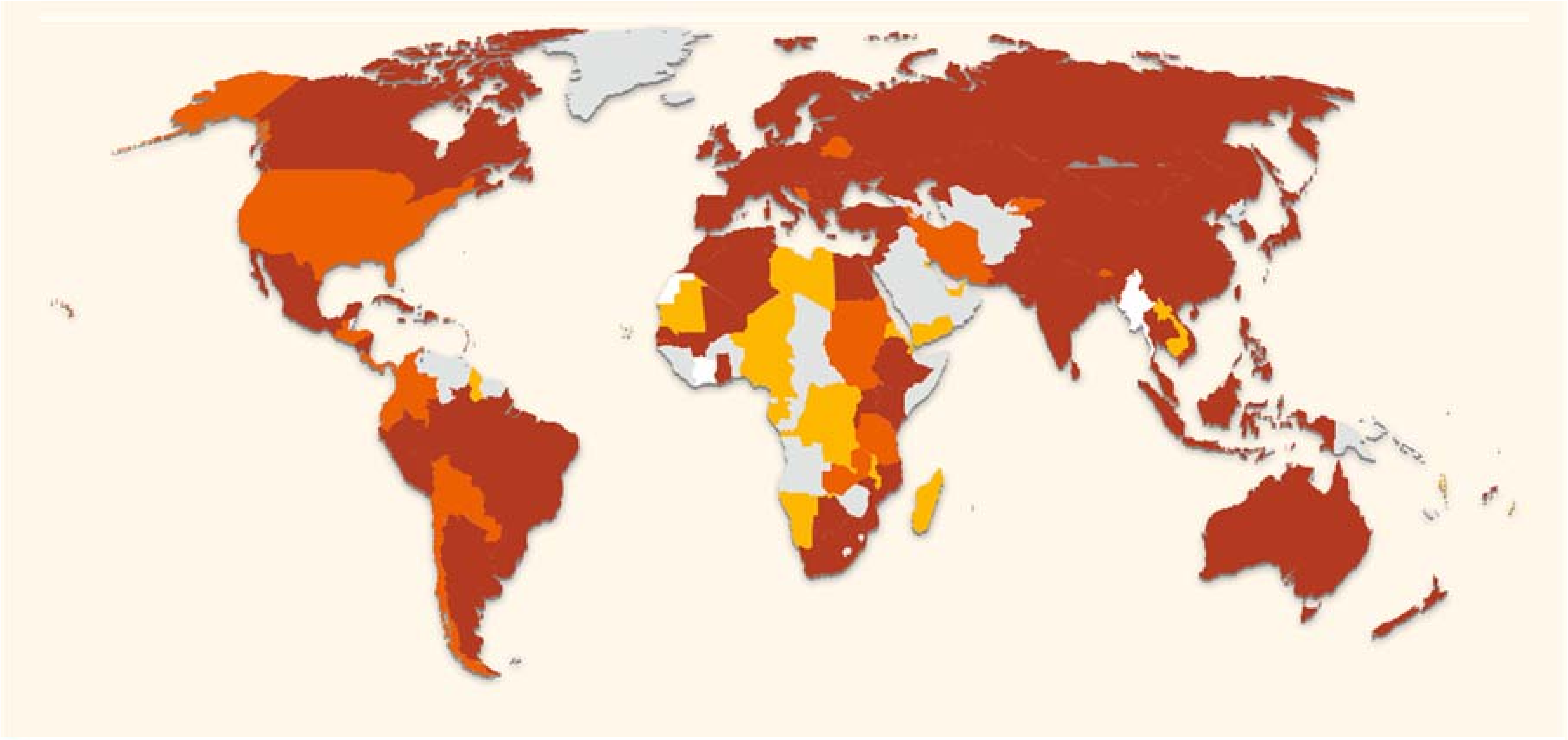
Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.



Global RE primary energy supply from 164 long-term scenarios versus fossil and industrial CO_2 emissions.

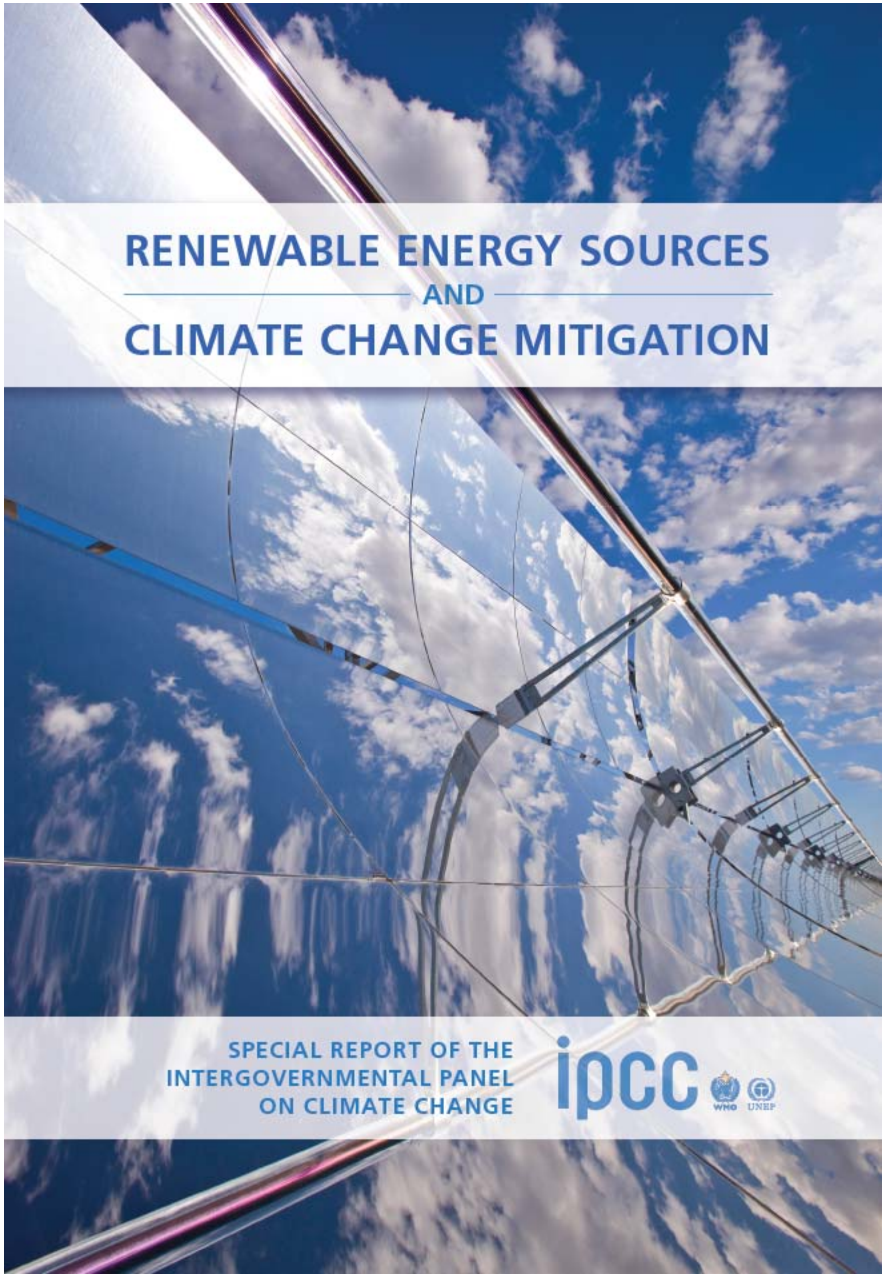


RE-specific policies and RE targets 2011



Countries with AT LEAST ONE National RE Policy and ONE RE Target
Countries with AT LEAST ONE National RE Policy
Countries with AT LEAST ONE National RE Target
Countries without RE Policy Mechanisms and RE Targets
No Data

INTERGOVERNMENTAL PANEL ON climate change



www.srren.org

Thank you for your attention!

Presenter Info
Event Info
Place, Date

INTERGOVERNMENTAL PANEL ON climate change