Energy Technology Perspectives 2012

Pathways to a Clean Energy System

Brasilia launch presentation

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IEA Deputy Executive Director

9 July 2012

International Energy Agency

ETP 2012 – Choice of 3 Futures

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2DS

a vision of a **sustainable** energy system of reduced Greenhouse Gas (GHG) and CO_2 emissions

The 2° C Scenario

4DS

reflecting pledges by countries to cut emissions and boost energy efficiency

The 4° C Scenario

6DS

where the world is now heading with potentially **devastating** results

The 6° C Scenario

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Sustainable future still in reach

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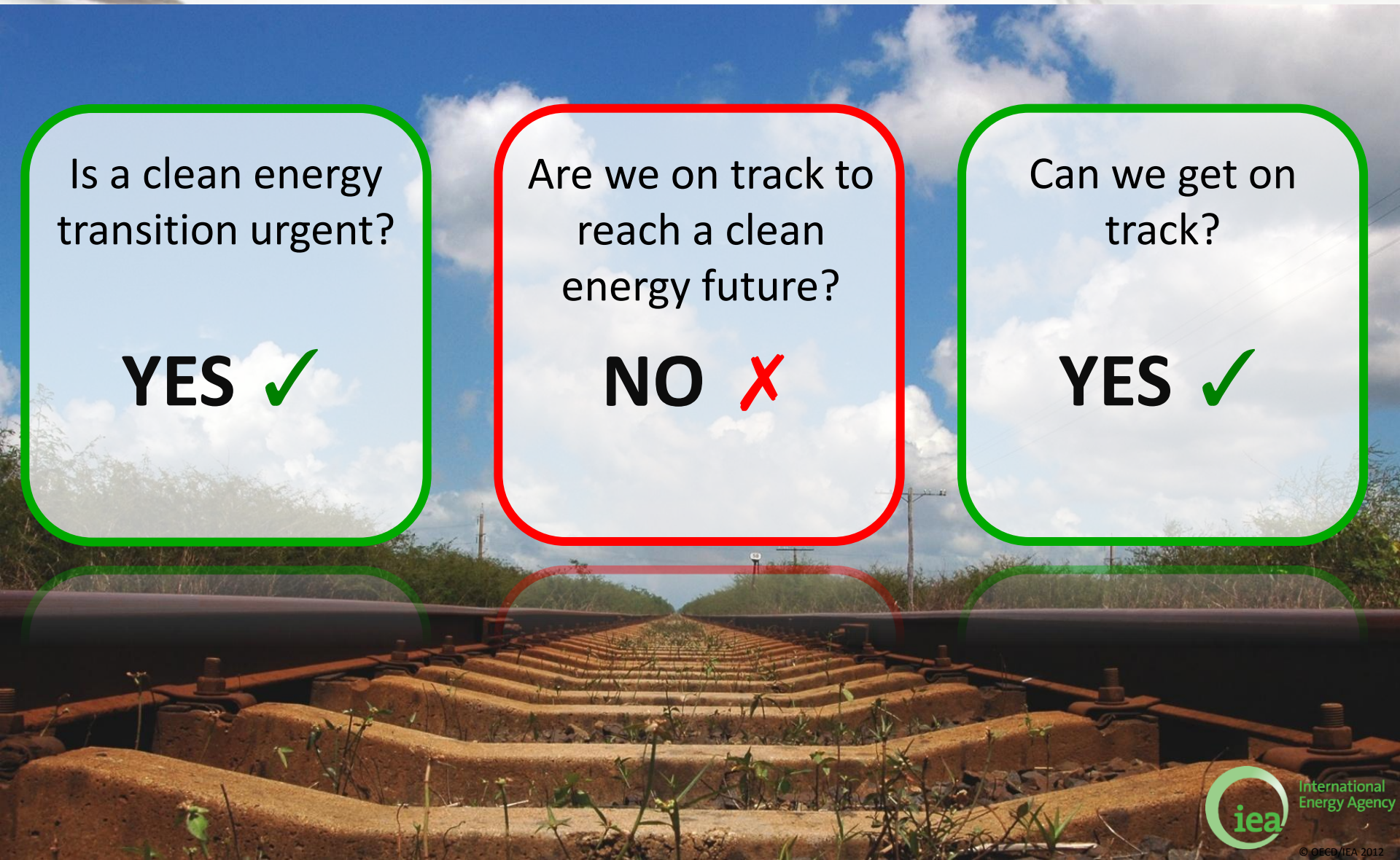

Is a clean energy transition urgent?

YES ✓

Are we on track to reach a clean energy future?

NO ✗

Can we get on track?

YES ✓

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Clean energy: slow lane to fast track

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Cleaner coal power

Nuclear power

Renewable power

CCS in power

CCS in industry

Industry

Buildings

Fuel economy

Electric vehicles

Biofuels for transport

Progress is too slow in almost all technology areas

Significant action is required to get back on track

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Non-hydro sources spread out widely

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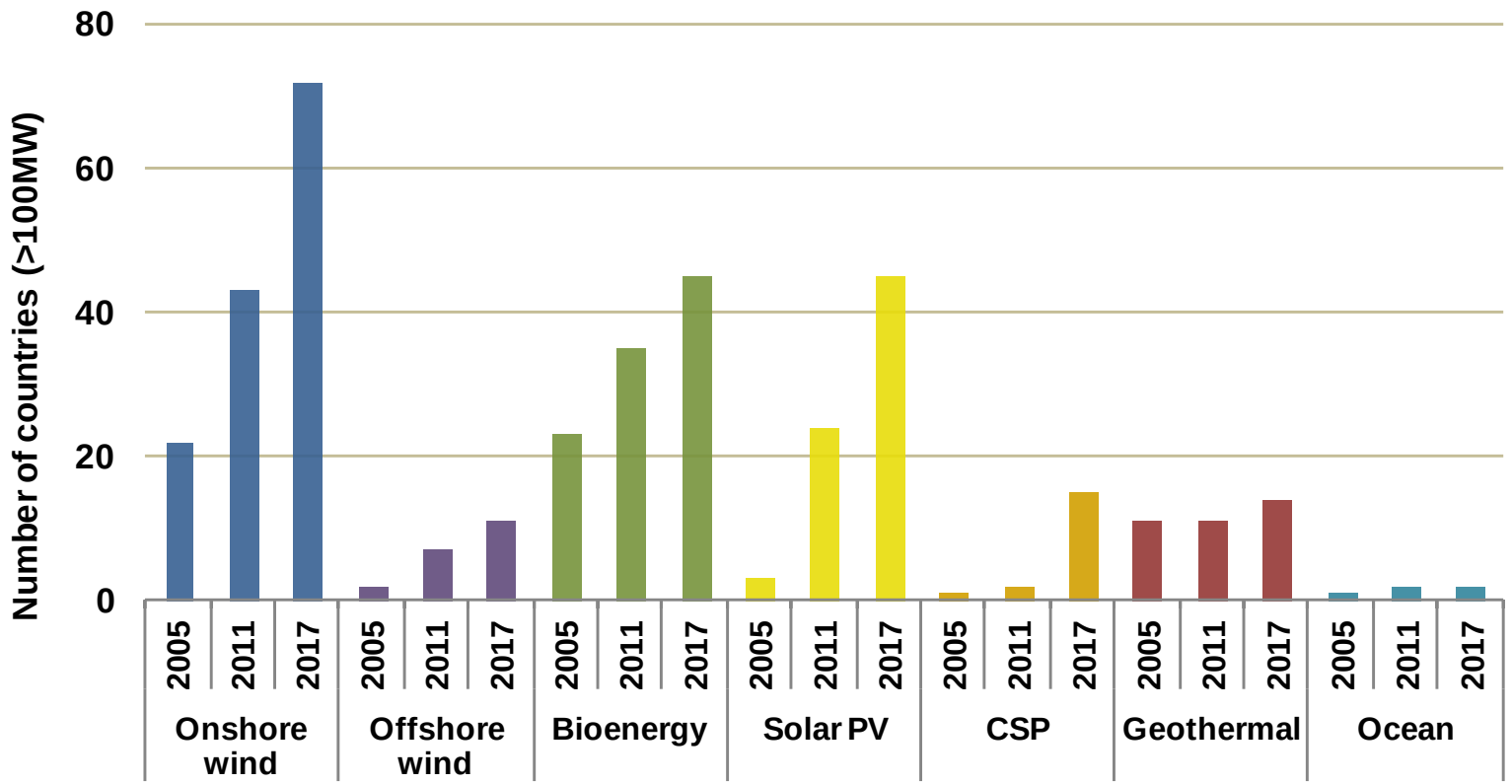

IEA MRMR 2012

Growth is expected to shift beyond traditional support markets (OECD) to all regions

Number of countries with installations >100MW increases significantly

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Recommendations to Governments

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1. Create an investment climate of confidence in clean energy

2. Unlock the incredible potential of energy efficiency – “the hidden” fuel of the future

3. Accelerate innovation and public research, development and demonstration (RD&D)

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A smart, sustainable energy system

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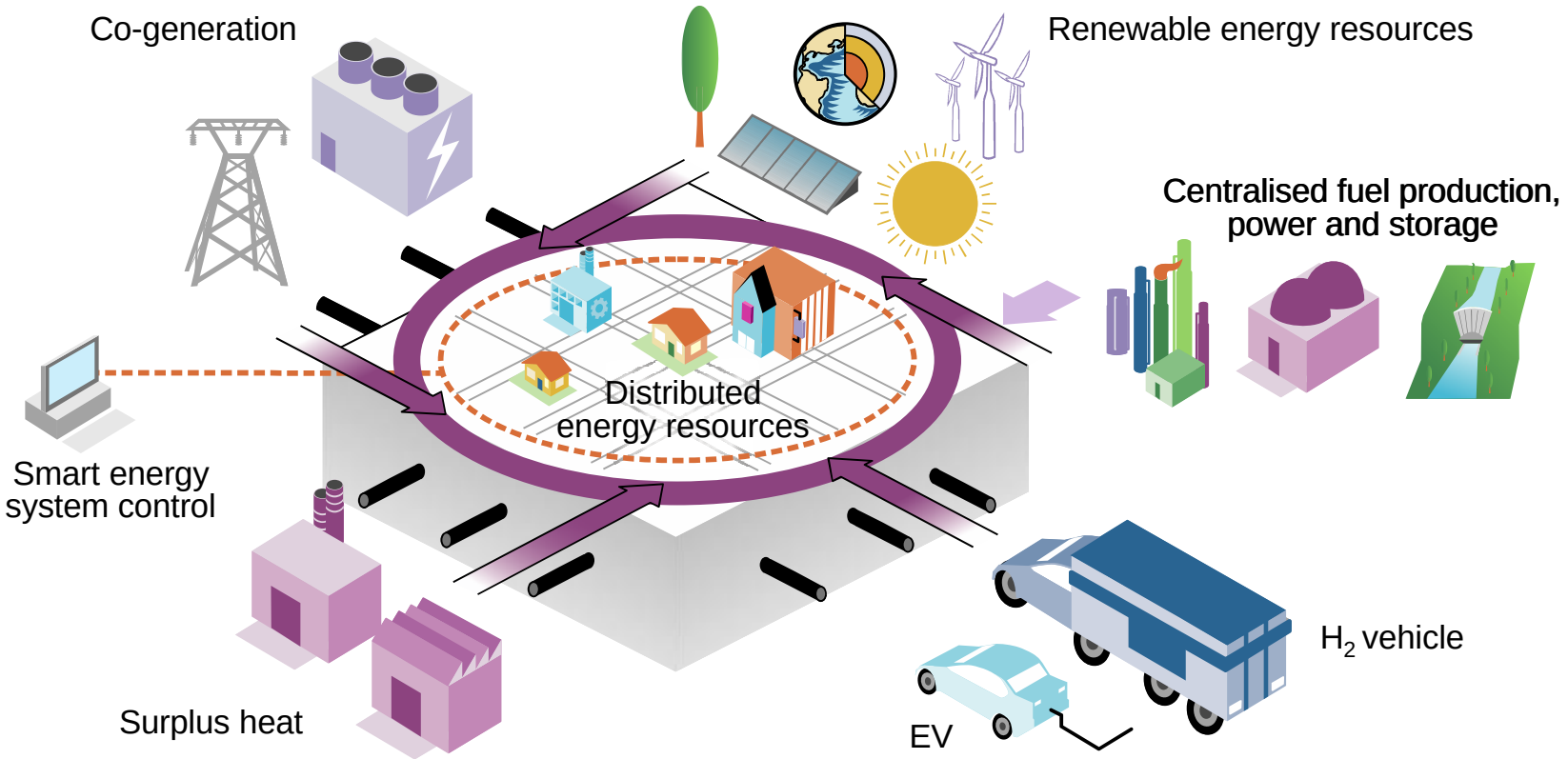

A sustainable energy system is a smarter, more unified and integrated energy system

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Low-carbon electricity: a clean core

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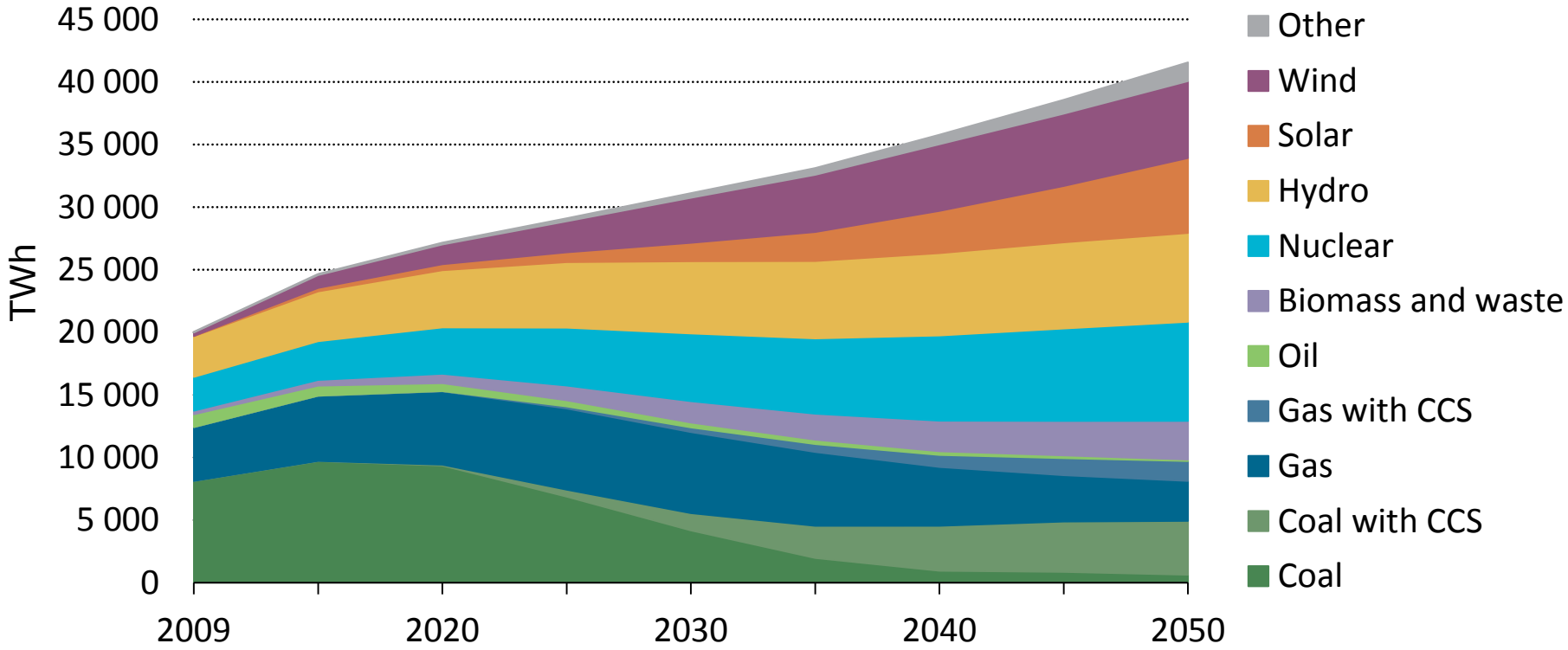

Renewables will generate more than half the world's electricity in the 2DS

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Hydropower is a giant

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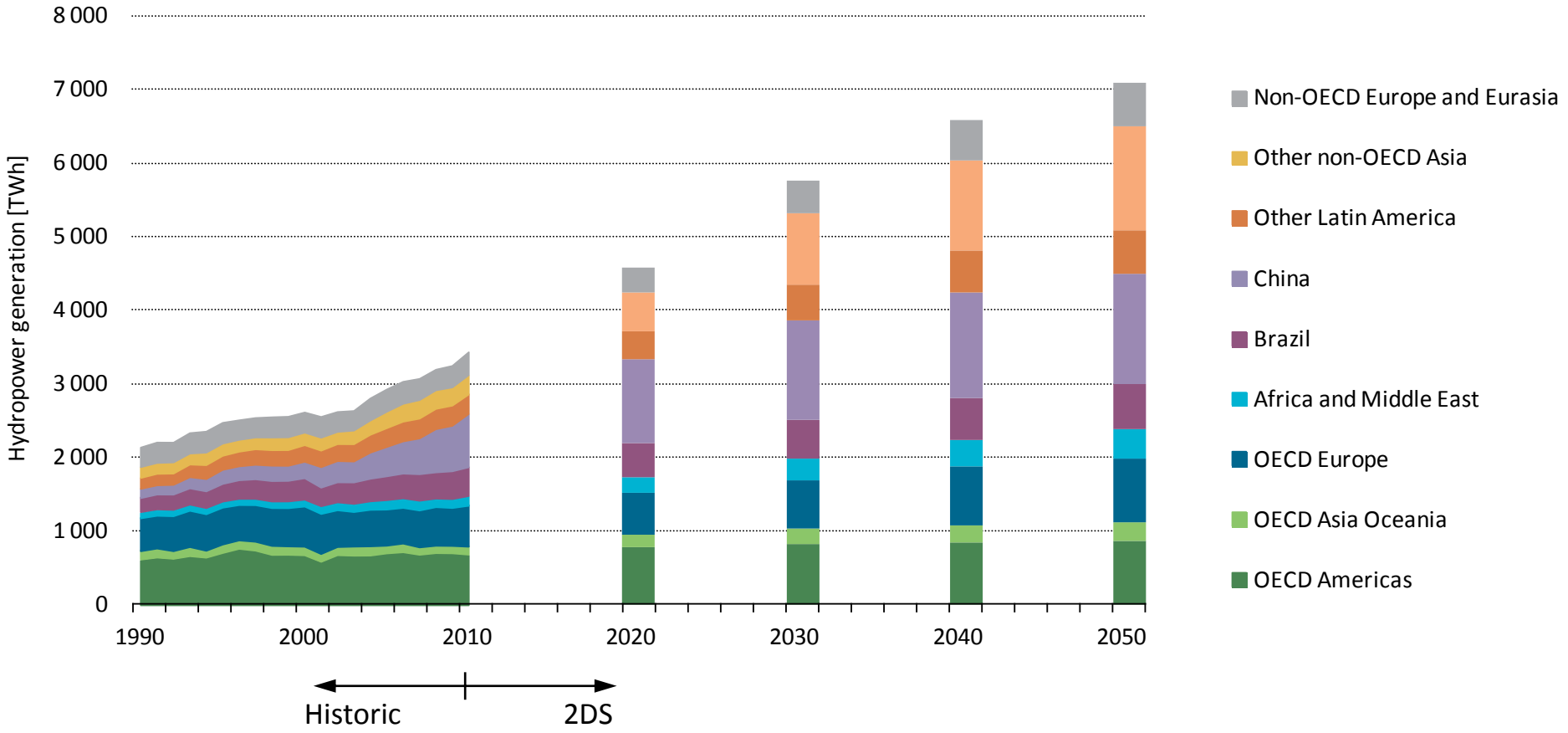

Hydropower will continue to play a major role in power generation: hydropower generation more than doubles in the 2DS compared to today.

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Natural Gas: a transitional fuel

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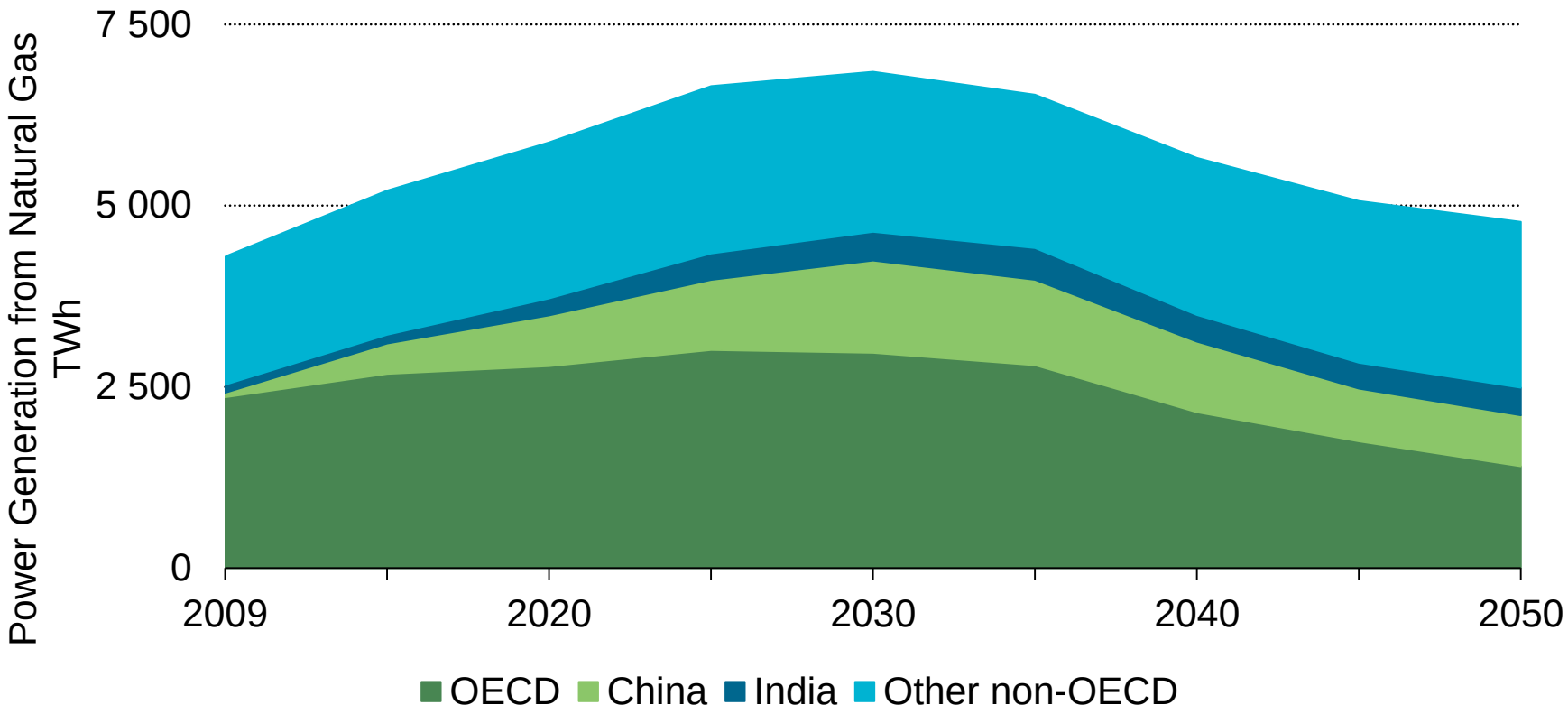

Around 2030, natural gas becomes 'high carbon'

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The CCS infant must grow quickly

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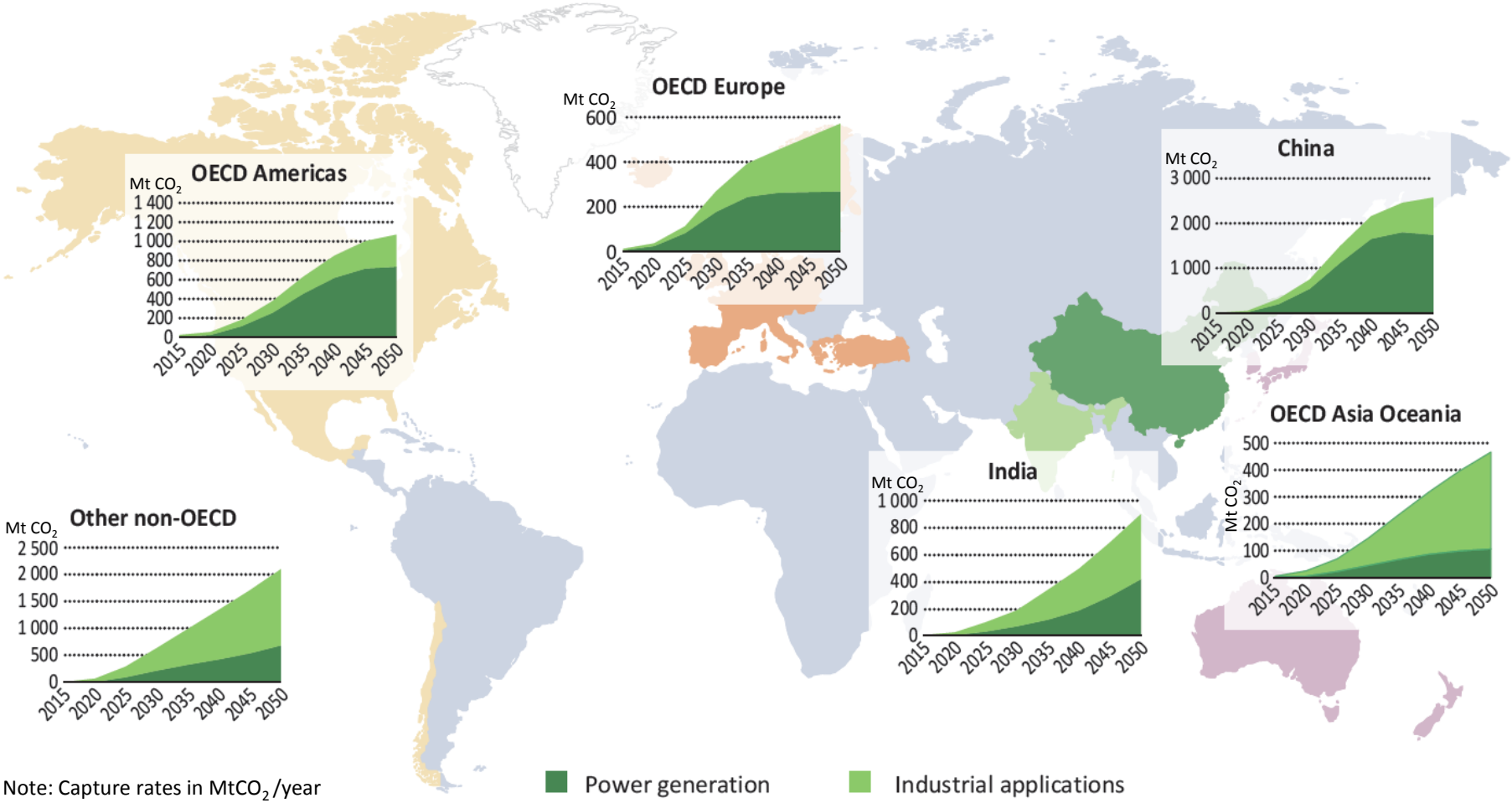

Note: Capture rates in $MtCO_2$/year

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Translating targets into action

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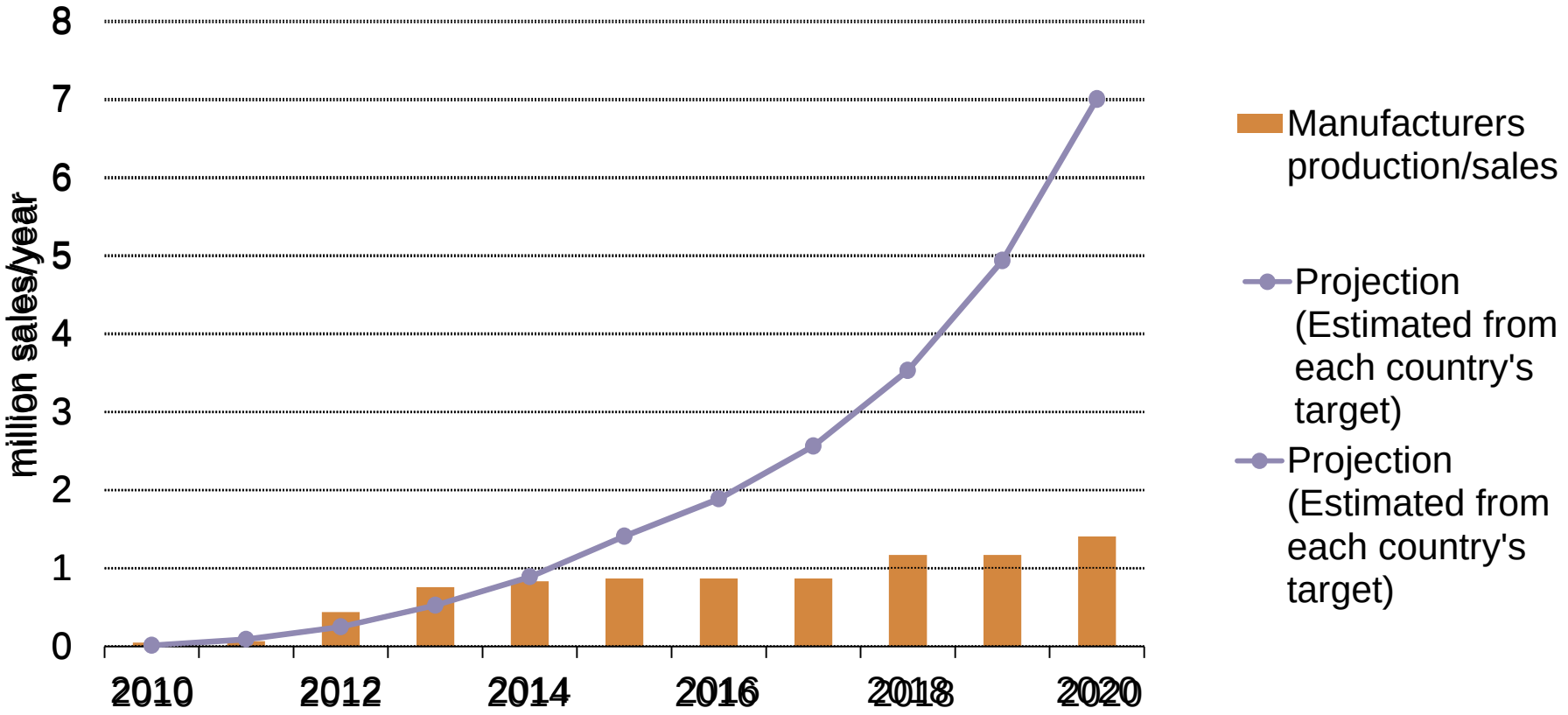

Government targets need to be backed by policy action. Electric vehicles provide a good example.

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Building sector challenges differ

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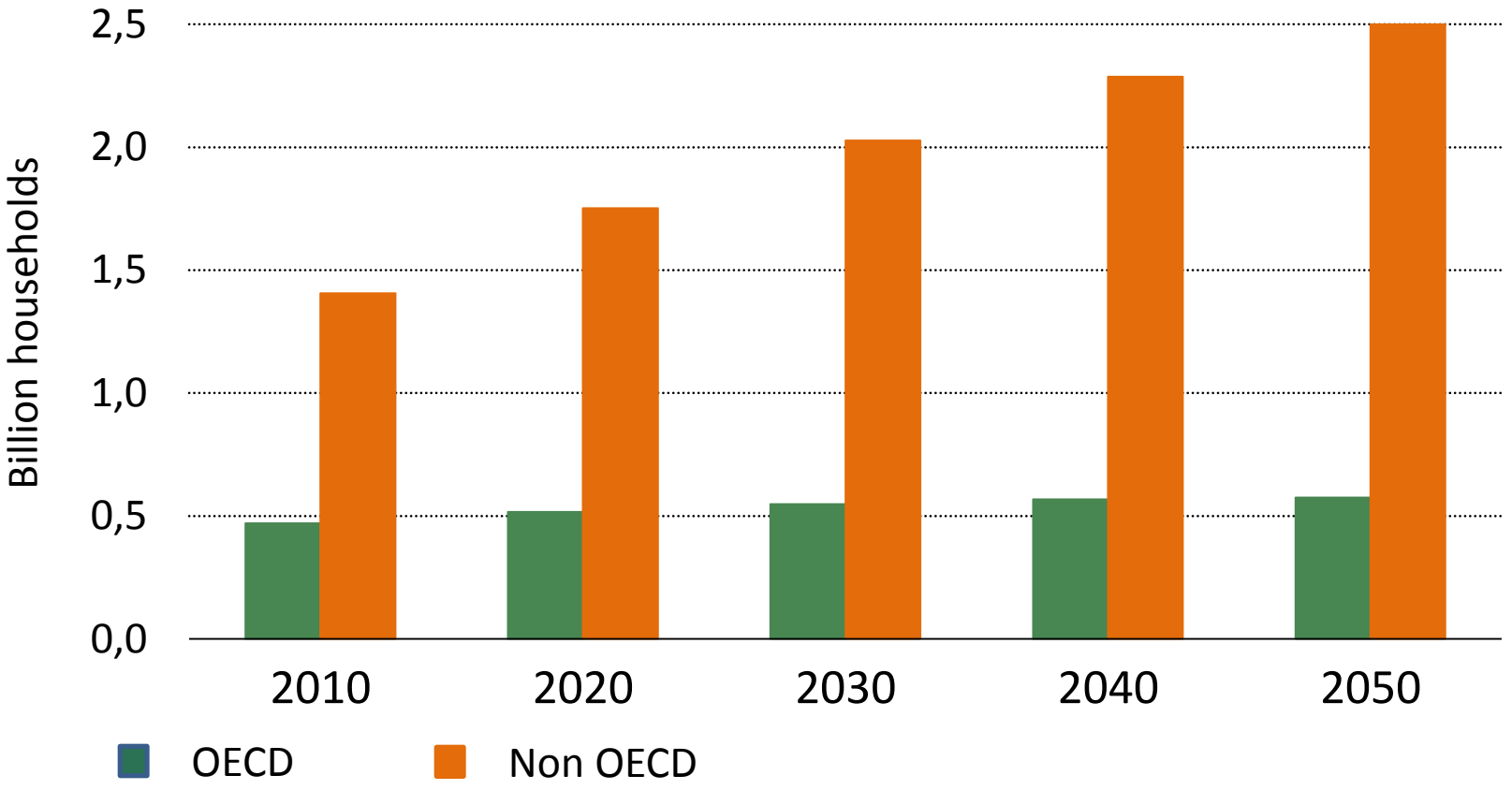

75% of current buildings in OECD will still be standing in 2050

Heating & Cooling: huge potential

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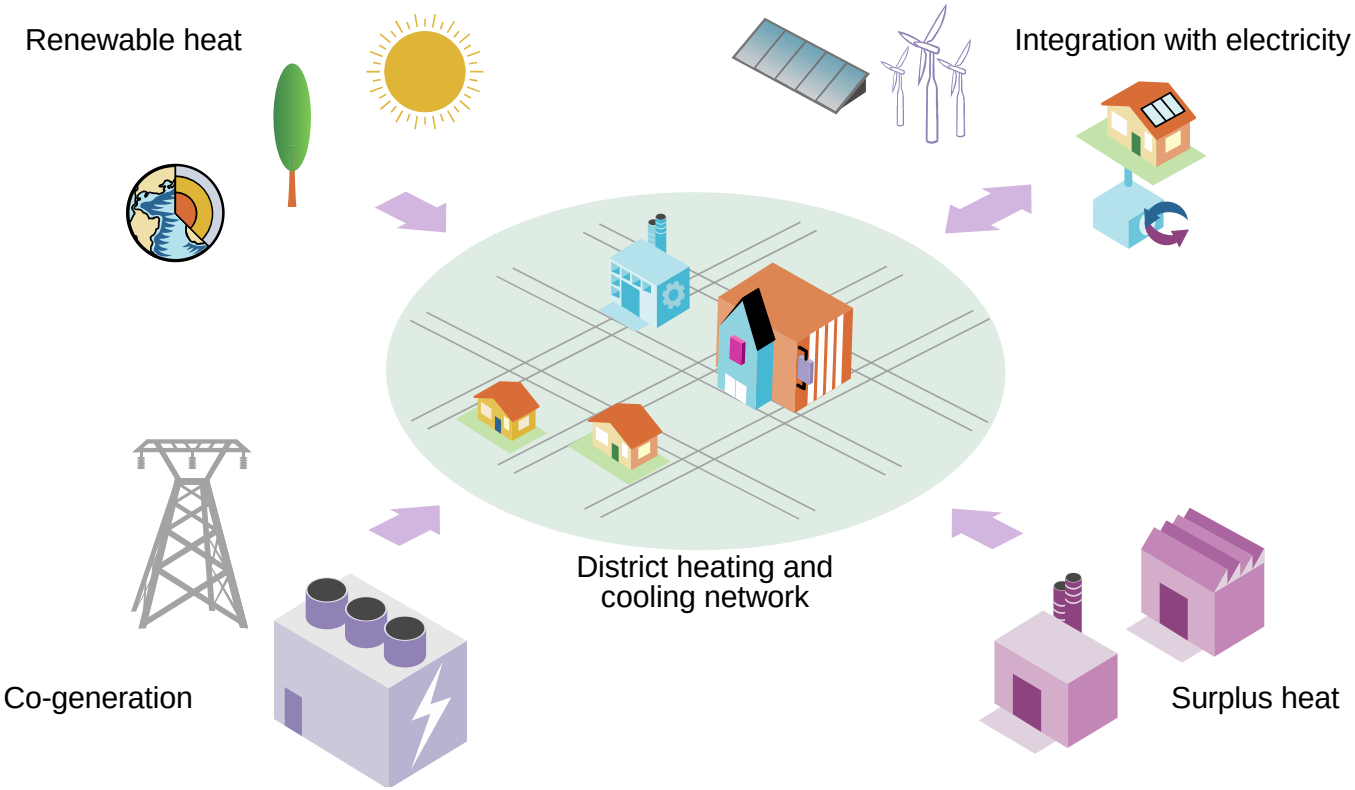

Heating and cooling account for 46% of global energy use.
Their huge potential for cutting CO2 emissions is often neglected.

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Clean energy investment pays off

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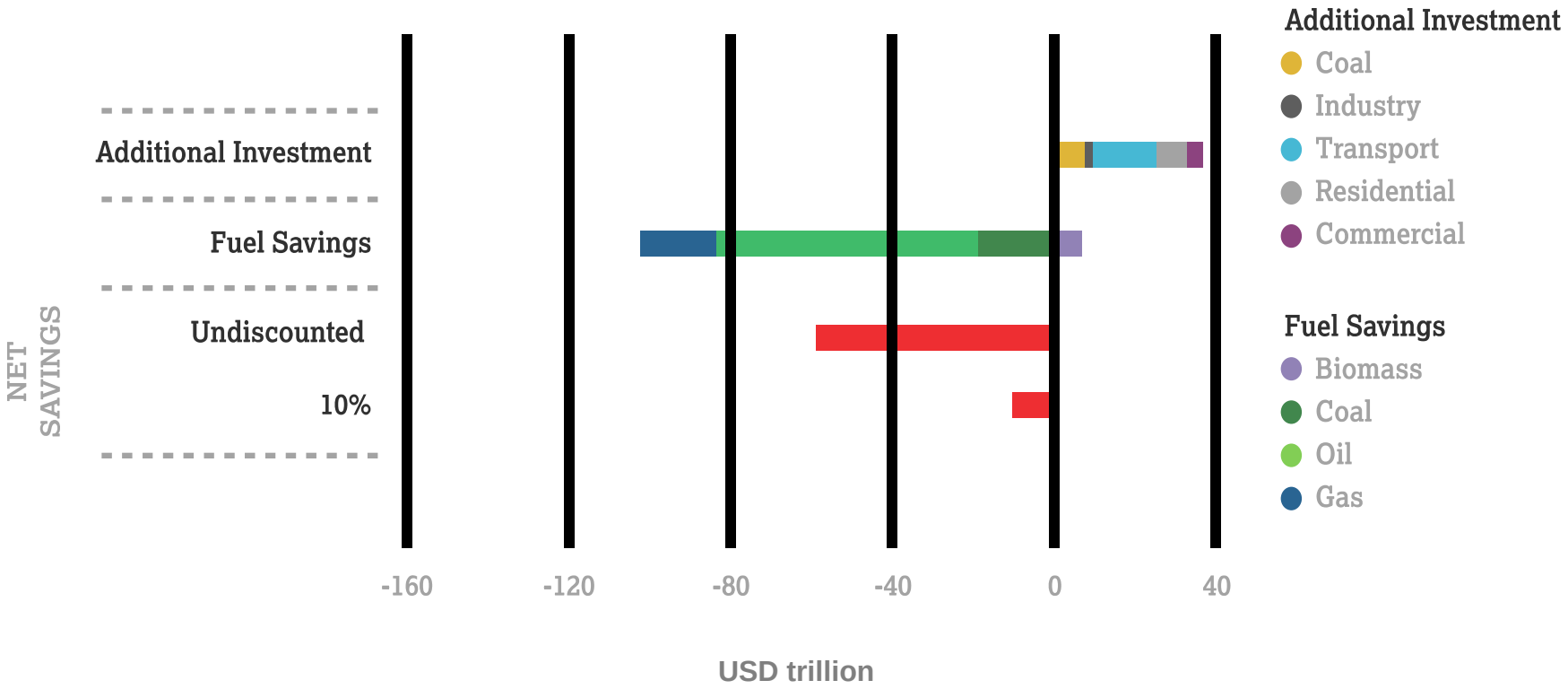

Every additional dollar invested in clean energy can generate 3 dollars in return.

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Brazil's CO_2 emissions need to be almost halved

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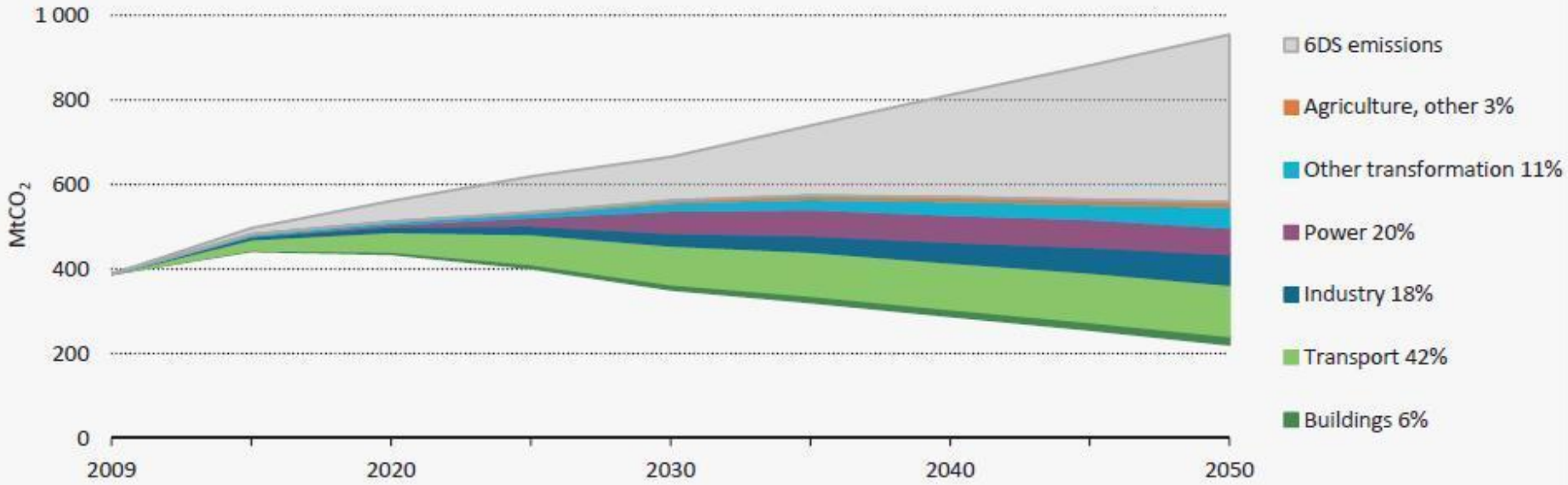

Transport sector decarbonisation as main source of CO2 reduction

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Increased gas use in Brazil's electricity leads to higher emissions in the 4 degree scenario

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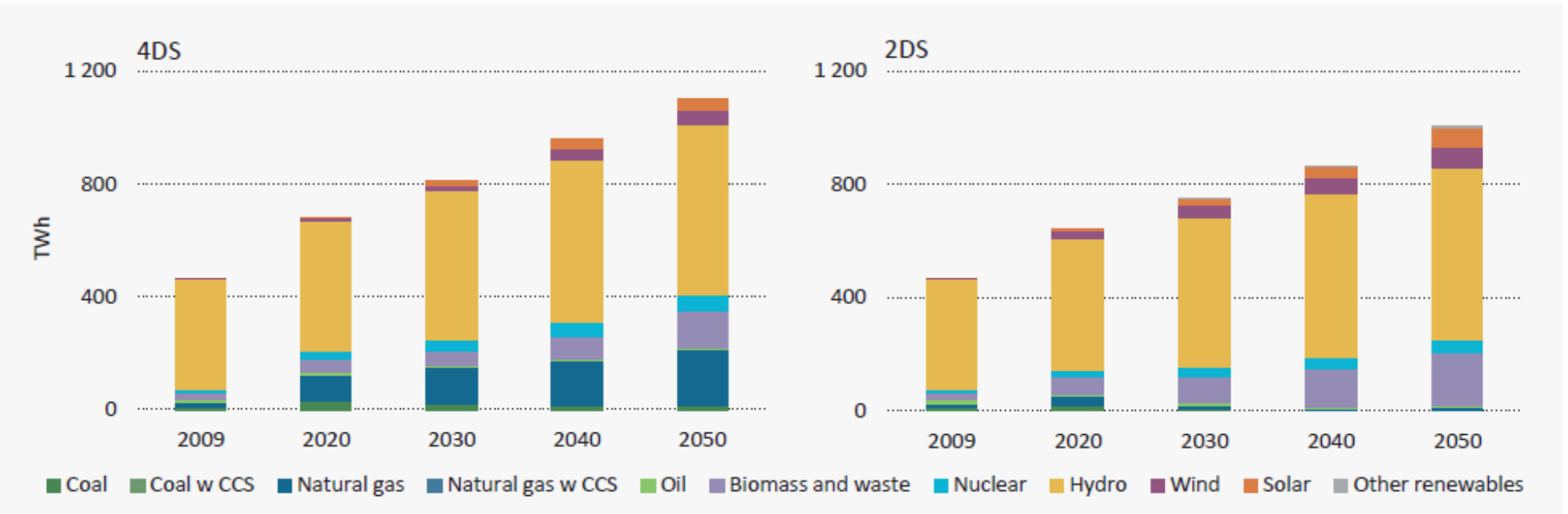

In the 2 degree scenario, renewables - notably hydro, wind and solar - cover the increase in electricity generation

Brazil's industrial energy use rise in all scenarios

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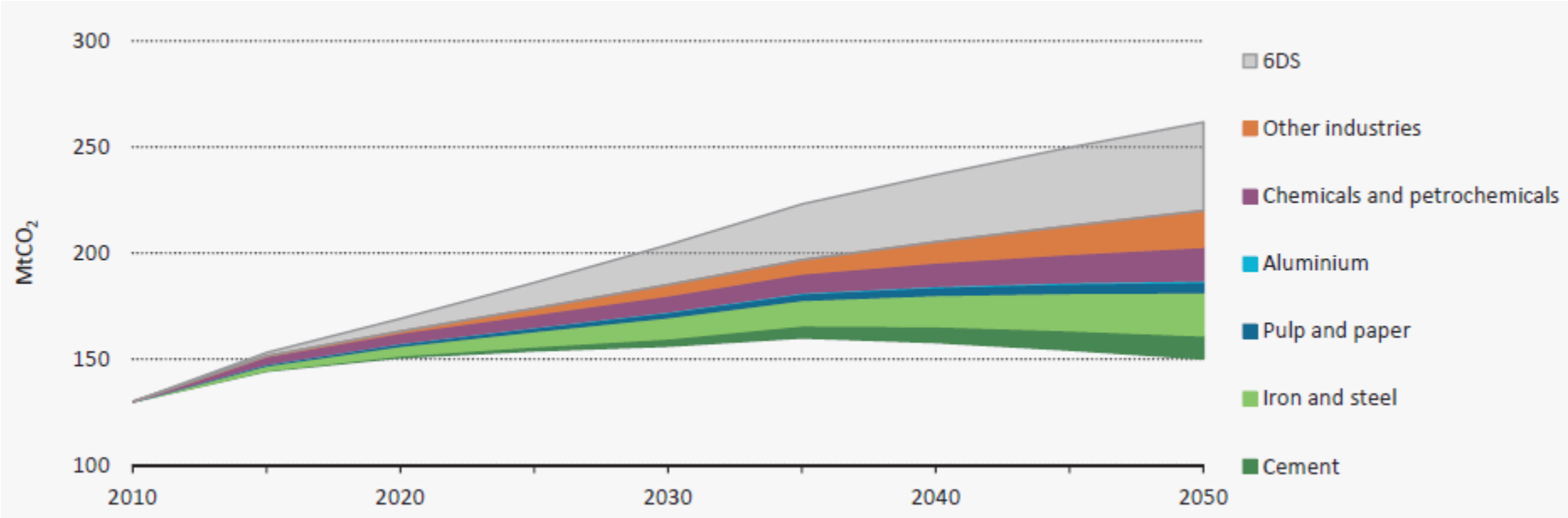

Implementation of the 2DS limits increase of CO2 emissions to 16% from today's level, mainly thanks to energy efficiency measures

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Brazil leads the way on FFVs

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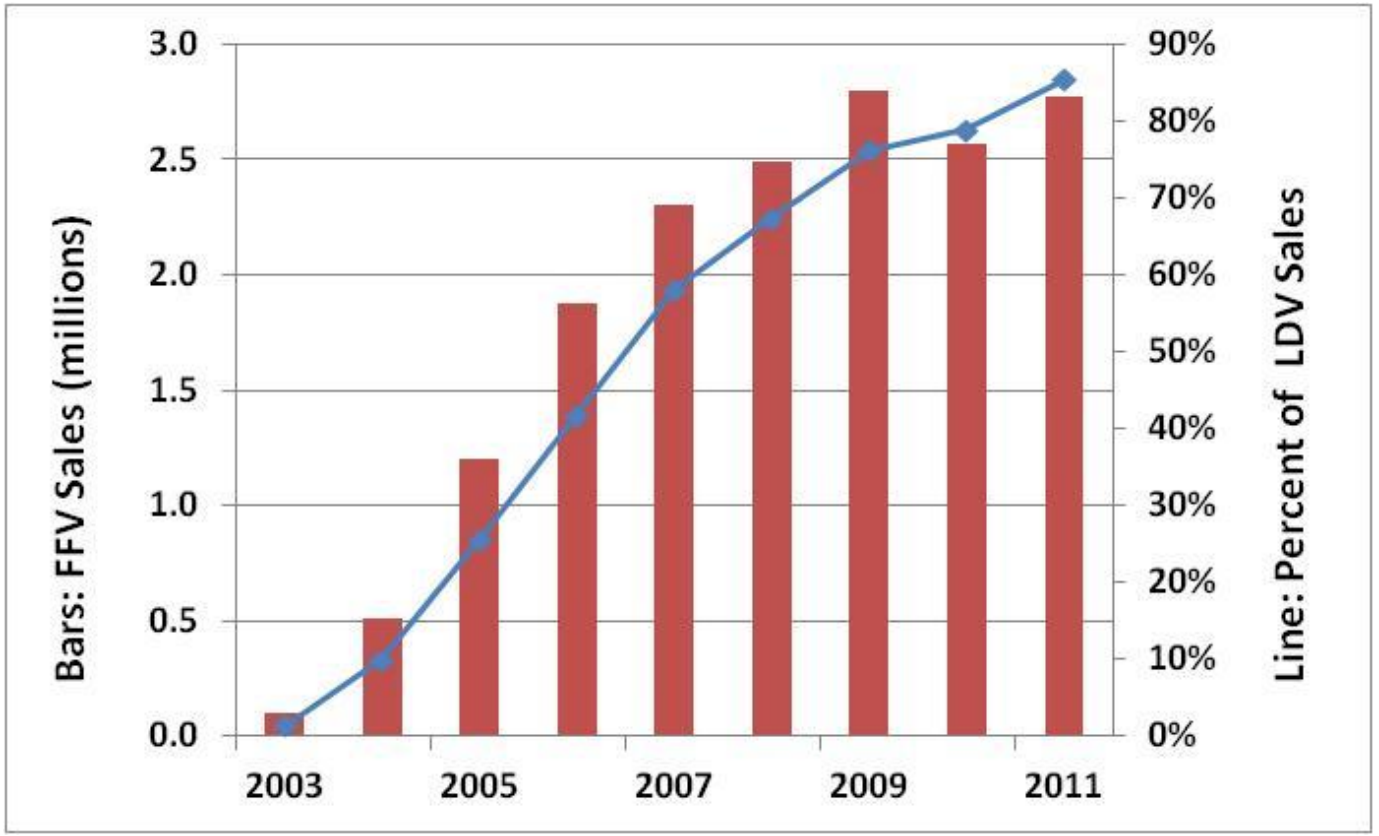

Nearly 90% of new Brazilian light duty vehicles in 2011 are ethanol-gasoline compatible

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Energy efficiency and fuel switching key in the Brazilian buildings sector

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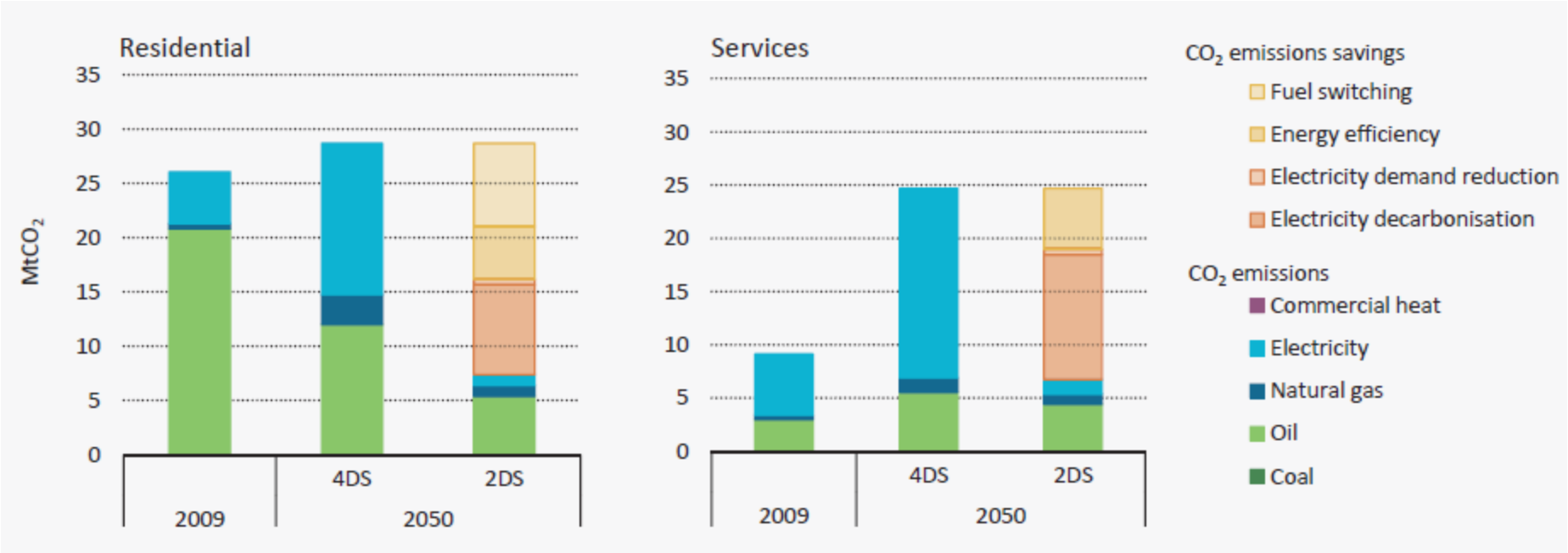

In the 4DS, building energy consumption in 2050 is almost two times higher than at present

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A low-carbon future for Brazil

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- At present, Brazil has one of the highest shares of renewables in its energy mix worldwide
- The maintenance of a clean energy matrix and further mitigation entails opportunities and challenges
- Brazil can maintain a leadership position in the deployment of low-carbon technologies
  - Address difficulties that could potentially hamper growth in power generation from hydropower and wind
  - Further expand the production and use of sustainable biofuels in the transport sector
  - Bring experience and knowledge for international cooperation

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Visualising ETP Data – reductions

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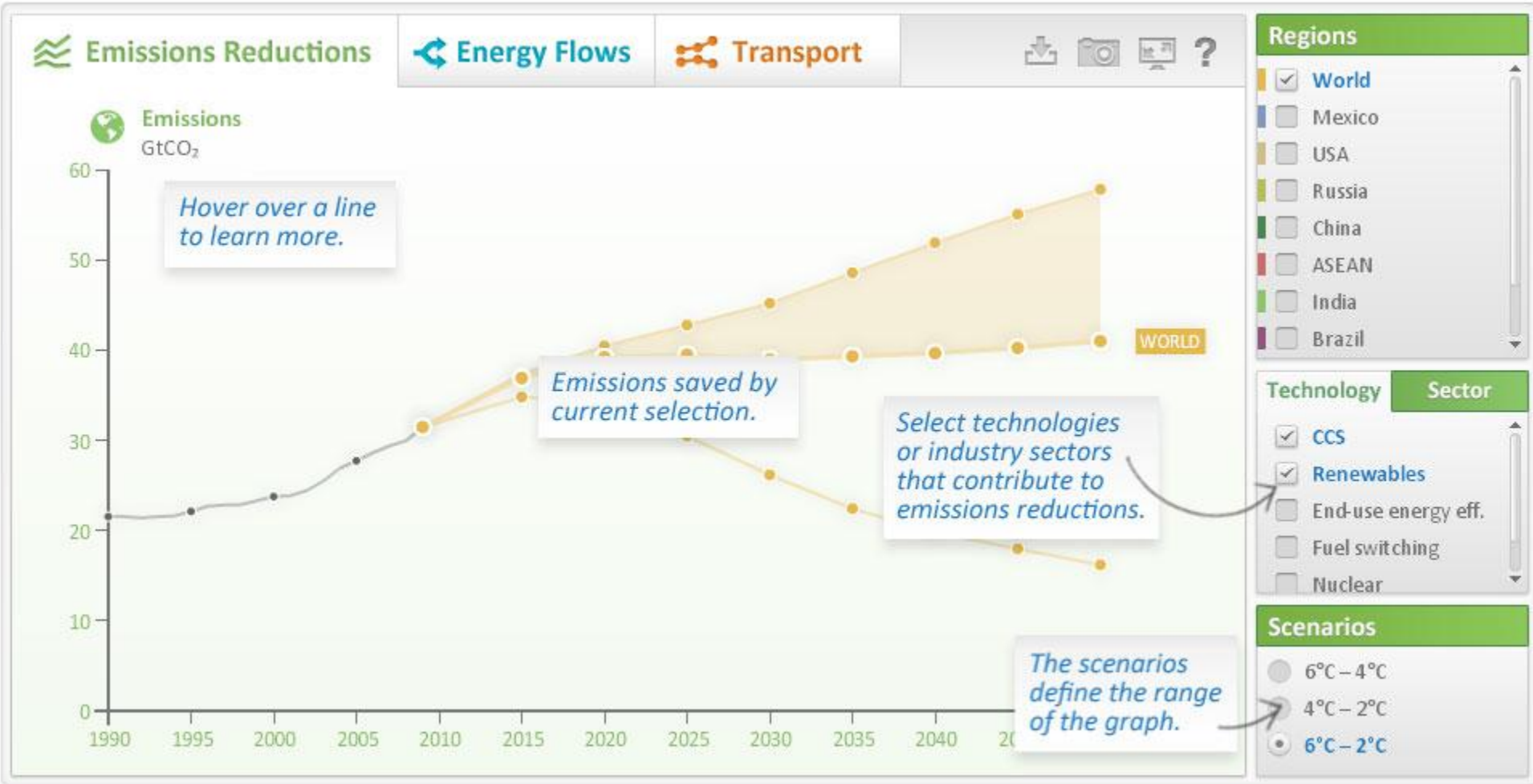

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Visualising ETP Data – energy flows

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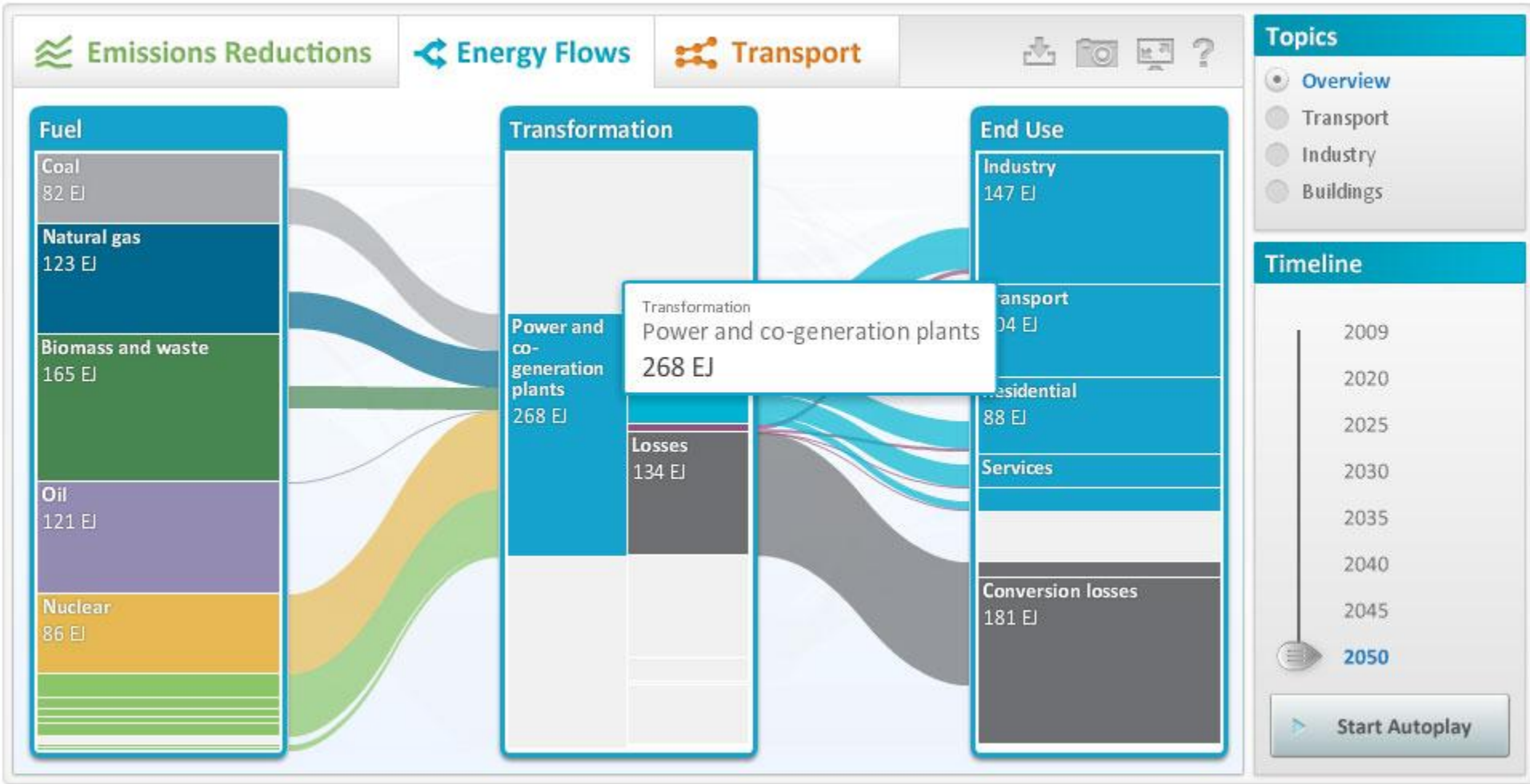

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Visualising ETP Data – fuel flows

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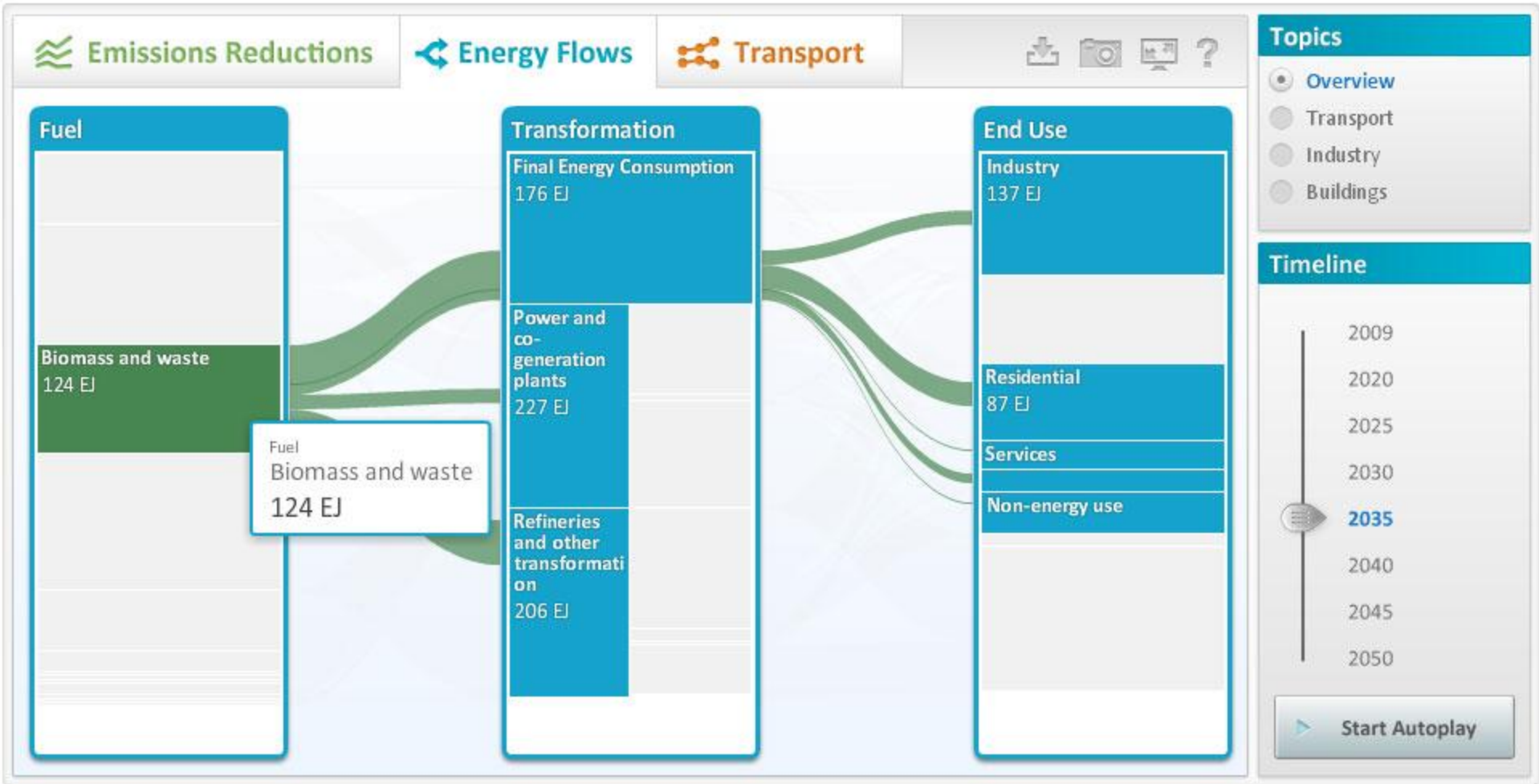

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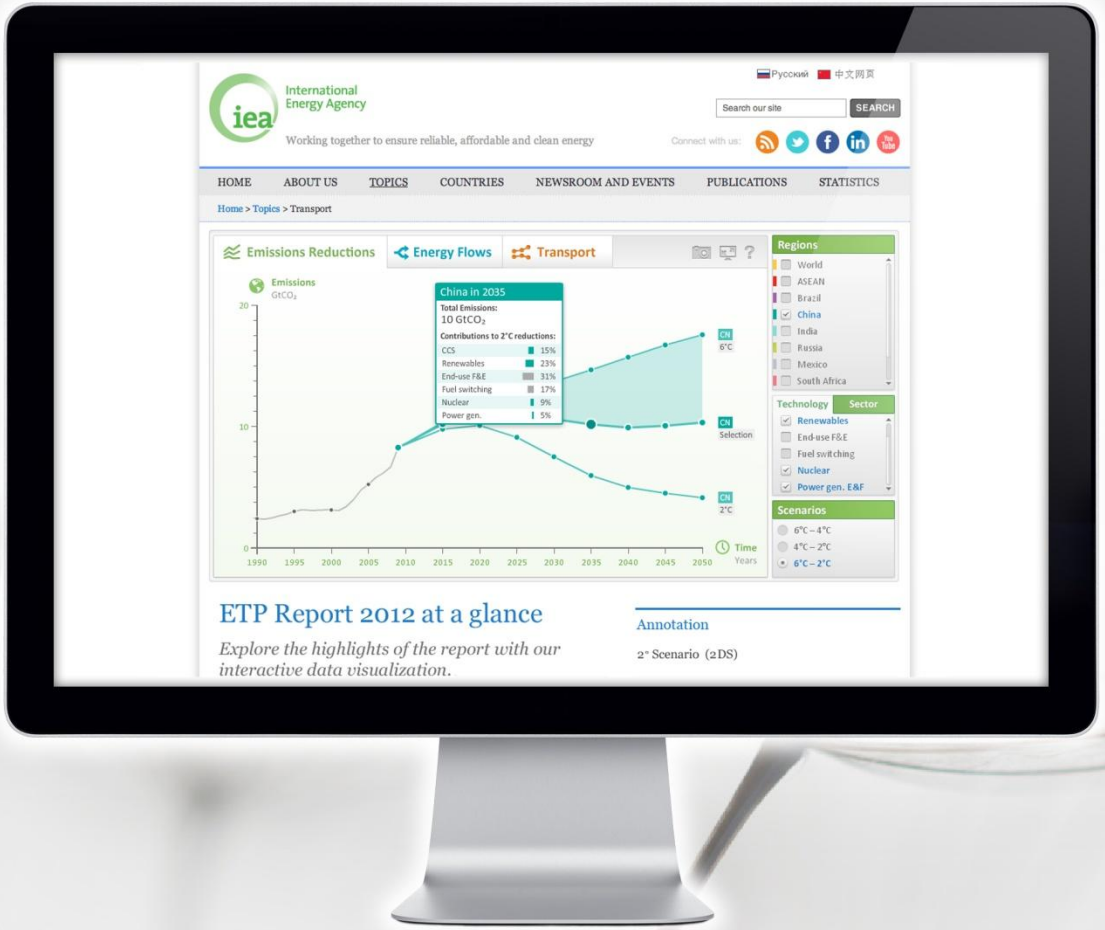
Explore the data behind *ETP*



www.iea.org/etp

Assumptions- GDP and population

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Table A.1 GDP projections in *ETP 2012* (assumed identical across scenarios)

CAAGR (%)	2009-20	2020-30	2030-50	2009-50	2050-75
World	4.2	3.1	2.9	3.3	2.7
OECD	2.4	2.0	1.8	2.0	1.8
Non-OECD	6.1	4.1	3.5	4.3	3.1
ASEAN	5.3	3.5	3.8	4.1	3.9
Brazil	4.3	3.3	3.0	3.4	2.8
China	8.1	4.4	3.2	4.8	2.4
European Union	2.0	1.8	1.7	1.8	1.6
India	7.7	5.9	4.8	5.8	3.9
Mexico	3.7	3.1	2.8	3.1	2.4
Russia	4.1	3.3	2.4	3.1	1.8
South Africa	3.6	2.6	2.9	3.0	3.1
United States	2.6	2.2	2.1	2.3	2.1

Notes: CAAGR = compounded average annual growth rate; ASEAN = Association of Southeast Asian Nations.
Sources: IMF, 2011 and 2011-16; IEA analysis.

Table A.2 Population projections used in *ETP 2012*

Country	2010	2020	2030	2040	2050	2060	2070	2075
World	6 896	7 657	8 321	8 874	9 306	9 615	9 827	9 905
OECD	1 234	1 302	1 353	1 385	1 403	1 408	1 409	1 410
Non-OECD	5 662	6 354	6 969	7 489	7 904	8 207	8 418	8 495
ASEAN	592	654	704	738	756	759	750	743
Brazil	195	210	220	224	223	217	208	203
China	1 341	1 388	1 393	1 361	1 296	1 212	1 126	1 086
European Union	500	511	516	515	512	504	496	494
India	1 225	1 387	1 523	1 627	1 692	1 718	1 708	1 692
Mexico	113	126	135	142	144	143	140	138
Russia	143	141	136	131	126	121	116	115
South Africa	50	53	55	56	57	57	57	57
United States	310	337	362	383	403	421	438	446

Note: Mumbers in millions
Source: UN, 2011

Assumptions- fossil fuel prices

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Table A.3 Fossil fuel prices by scenario

Oil	Scenario	2010	2020	2025	2030	2035	2040	2045	2050
IEA crude oil import price	2DS	78	97	97	97	97	92	89	87
2010 USD/bbl	4DS	78	109	114	117	120	119	119	118
	6DS	78	118	127	134	140	143	146	149
Coal	**Scenario**	**2010**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
OECD steam coal import price	2DS	99	93	83	74	68	64	62	60
2010 USD/tonne	4DS	99	106	108	109	110	109	109	109
	6DS	99	109	113	116	118	121	123	126
Gas	**Scenario**	**2010**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
United States import price	2DS	4	7	8	8	8	7	7	7
2010 USD/Mbtu	4DS	4	7	7	8	9	8	8	8
	6DS	4	7	8	8	9	9	9	10
Europe import price	2DS	7	10	10	10	9	9	9	8
2010 USD/Mbtu	4DS	7	10	11	12	12	12	12	12
	6DS	7	11	12	13	13	13	14	14
Japan import price	2DS	11	12	12	12	12	12	11	11
2010 USD/Mbtu	4DS	11	13	13	14	14	14	14	14
	6DS	11	14	14	15	15	15	16	16

Note: bbl = barrel, Mbtu = million British thermal units

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Carbon prices (model result)

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Table 1.1 Global marginal abatement costs and example marginal abatement options in the 2DS

	2020	2030	2040	2050
Marginal cost (USD/tCO_2)	30-50	80-100	110-130	130-160
Energy conversion	Onshore wind Rooftop PV Coal w CCS	Utility scale PV Offshore wind Solar CSP Natural gas w CCS Enhanced geothermal systems	Same as for 2030, but scaled up deployment in broader markets	Biomass with CCS Ocean energy
Industry	Application of BAT in all sectors Top-gas recycling blast furnace Improve catalytic process performance CCS in ammonia and HVC	Bio-based chemicals and plastics Black liquor gasification	Novel membrane separation technologies Inert anodes and carbothermic reduction CCS in cement	Hydrogen smelting and molten oxide electrolysis in iron and steel New cement types CCS in aluminium
Transport	Diesel ICE HEV PHEV	HEV PHEV BEV Advanced biofuels	Same as for 2030, but wider deployment and to all modes	FCEV New aircraft concepts
Buildings	Solar thermal space and water heating Improved building shells	Stability of organic LED System integration and optimisation with geothermal heat-pumps	Solar thermal space cooling	Novel buildings materials; development of "smart buildings" Fuel cells co-generation

Notes: HVC = high-value chemicals, FCEV = fuel-cell electric vehicle, LED = light emitting diode.

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