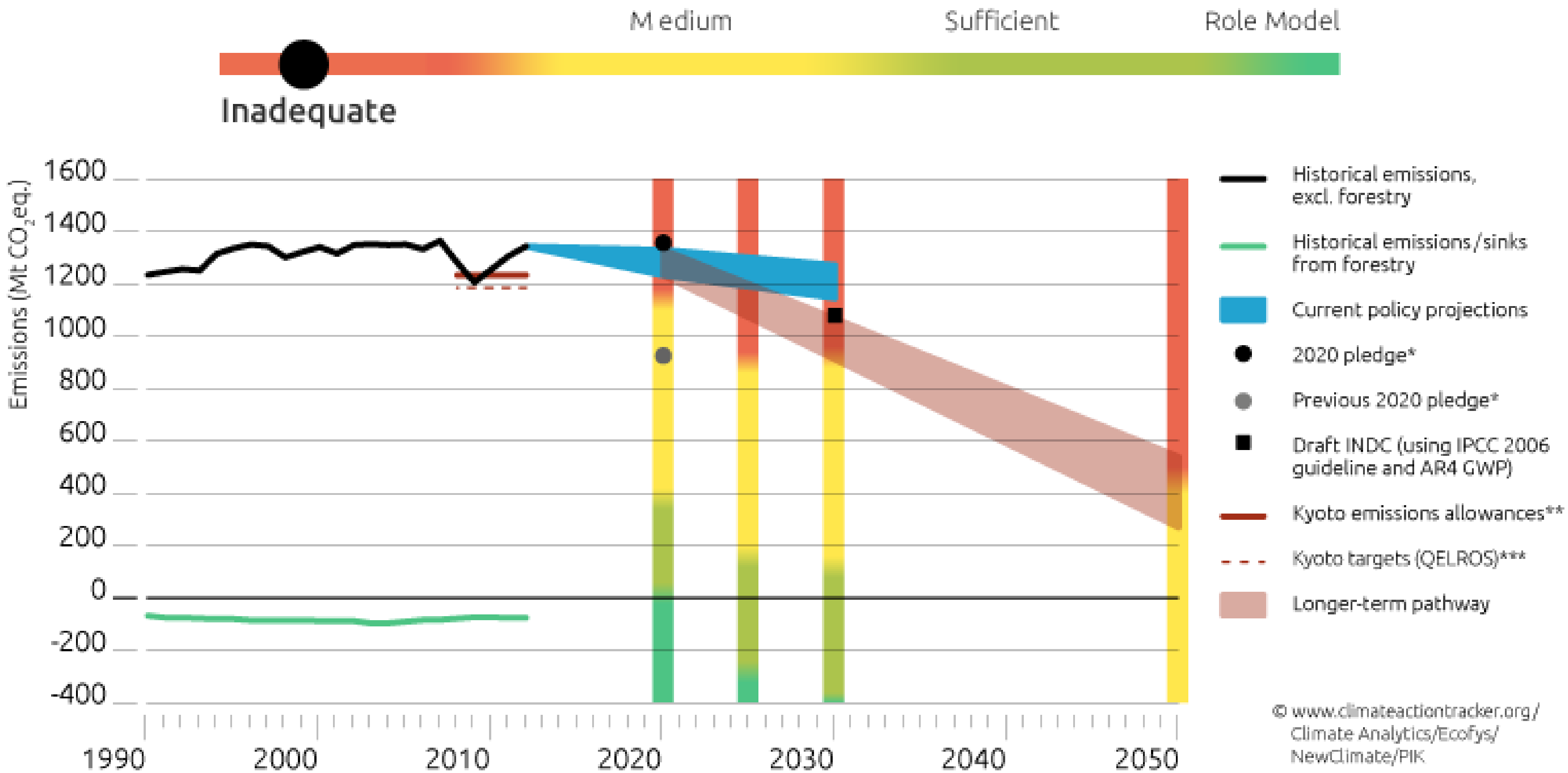
CIGS キヤノングローバル戦略研究所 The Canon Institute for Global Studies

CIGS地球温暖化シンポジウム2015
7月23日　東京

Towards and Beyond Paris
日本のビジョンと温暖化抑制への真の貢献

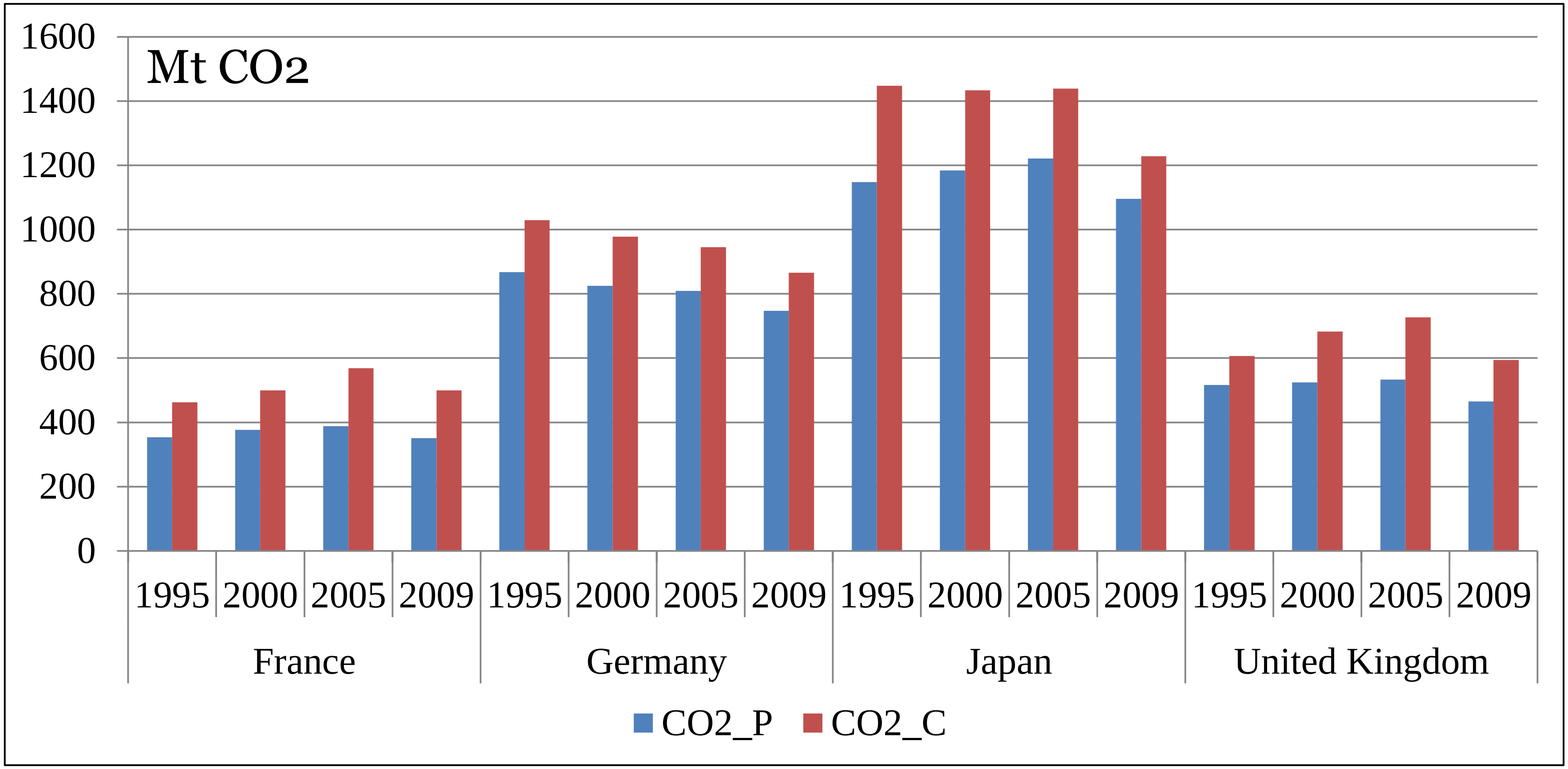
キヤノングローバル戦略研究所
段　烽軍

日本のINDCの評価例



(Climate Action Tracker)

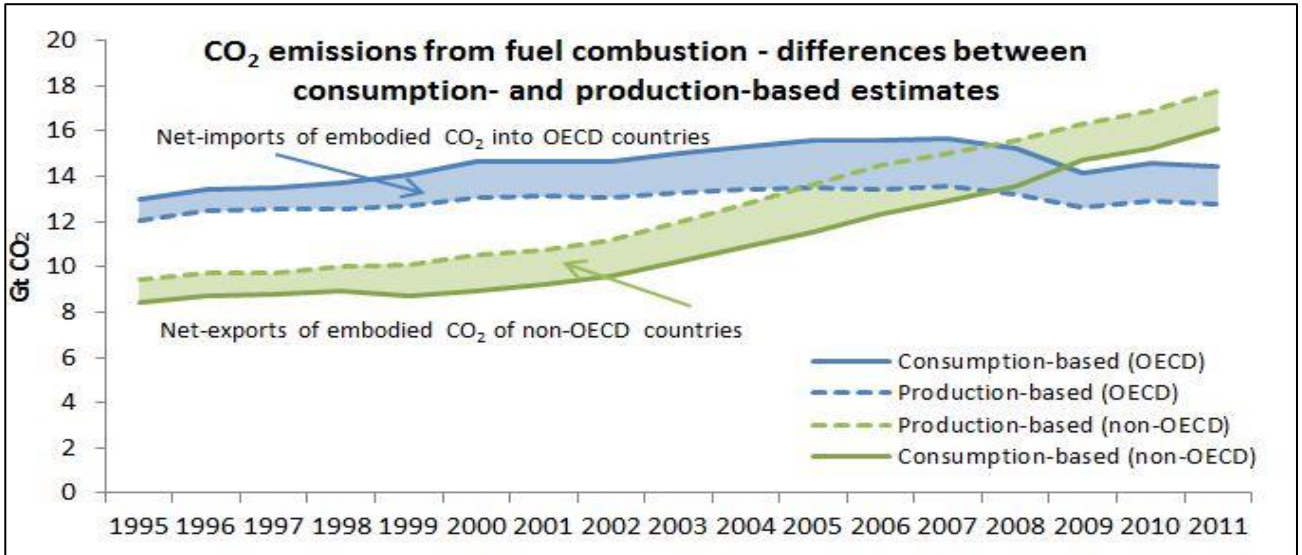
高い数値目標は成功したのか？

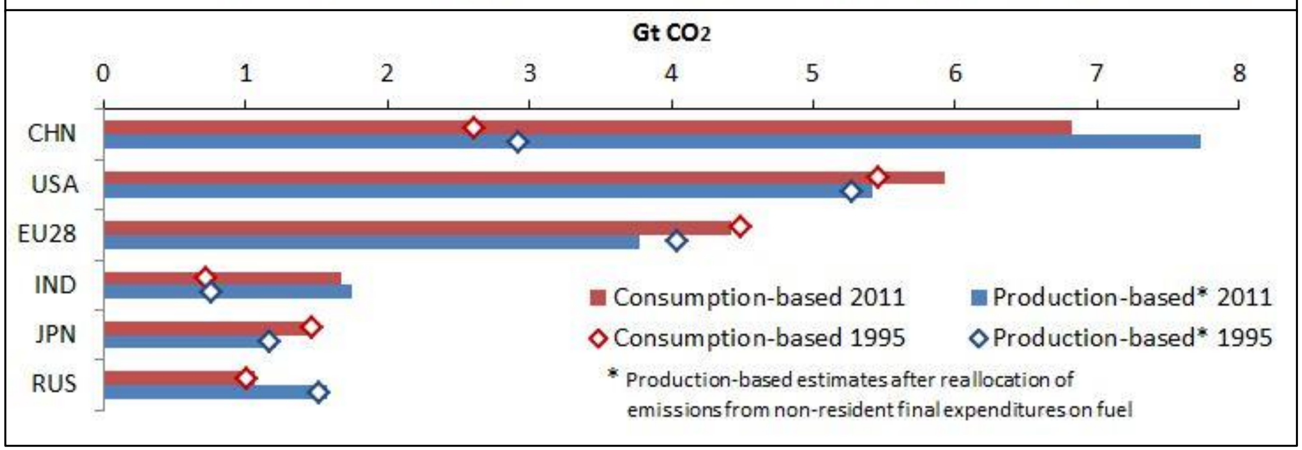


(Data Source: OECD)

EU中心諸国は、ドイツを除いて生産ベースで減っても、消費ベースで増えた。日本は生産ベースで増えても、消費ベースで横ばい

問題の本質は？



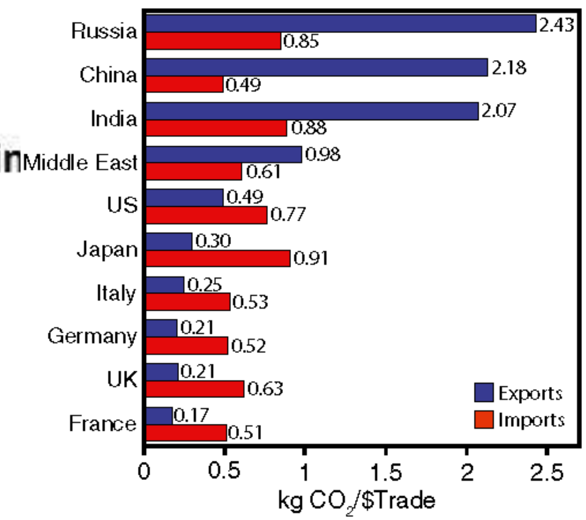


(OECD)

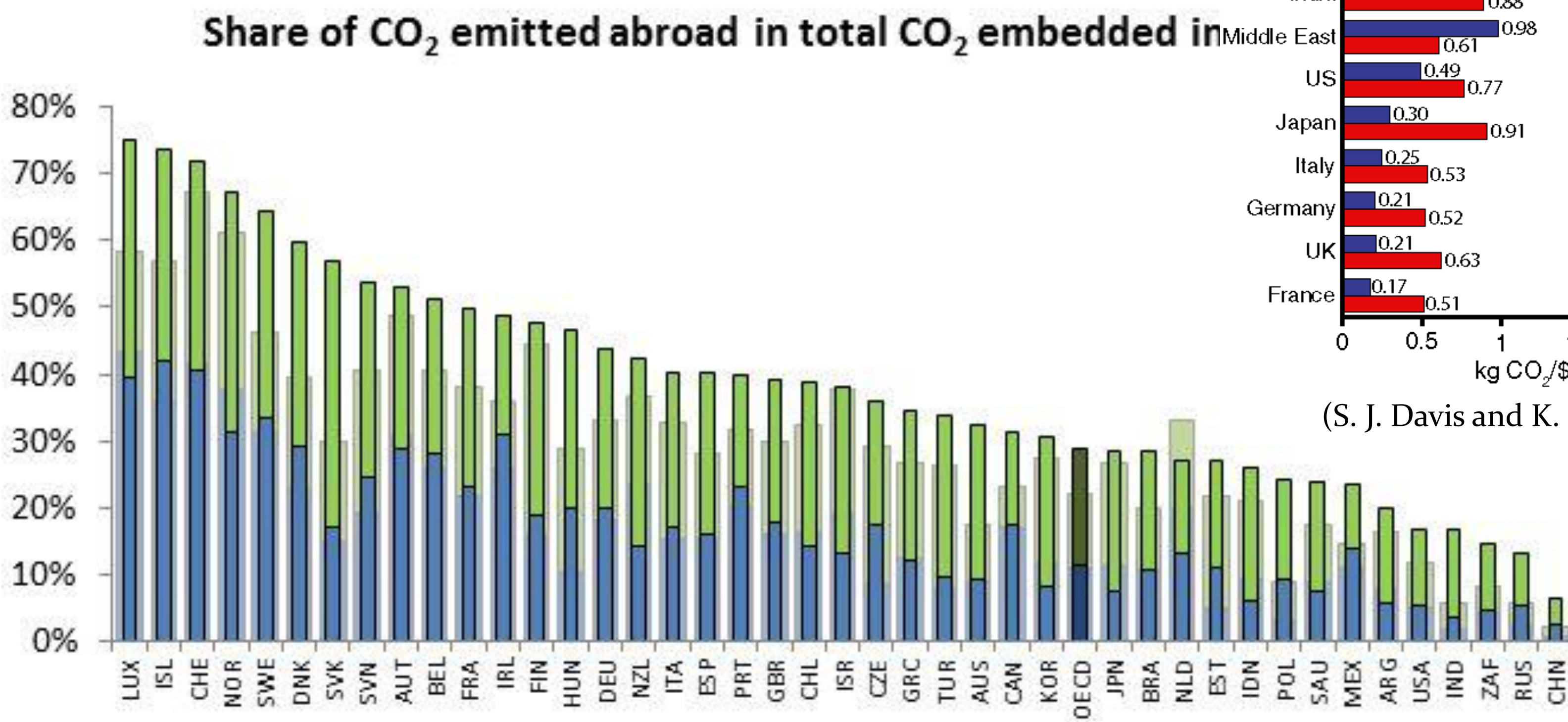
国内排出を海外移転してしまった

さらに

移転先の途上国は、排出原単位が高い



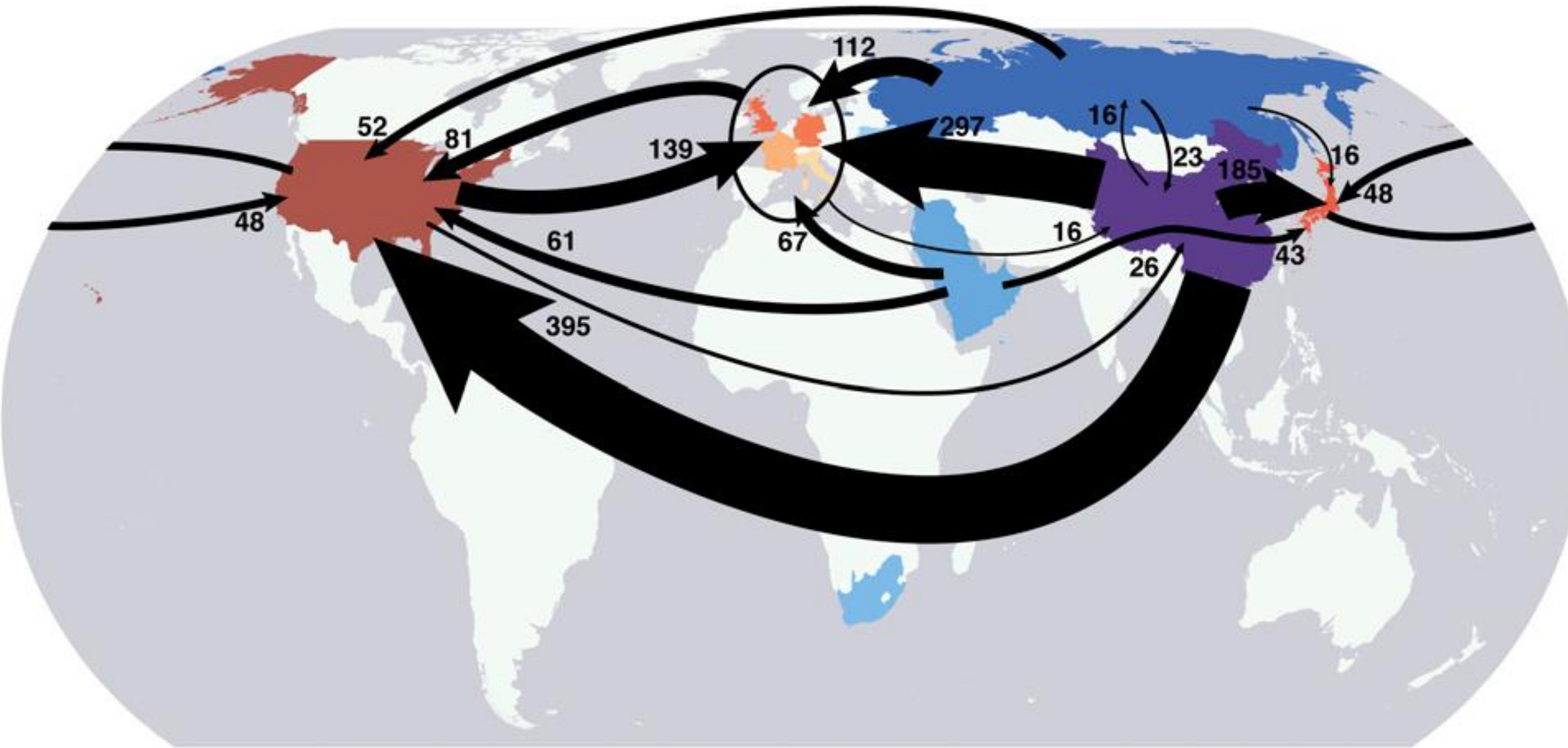
(S. J. Davis and K. Calderira, 2010)



(OECD, 2015)

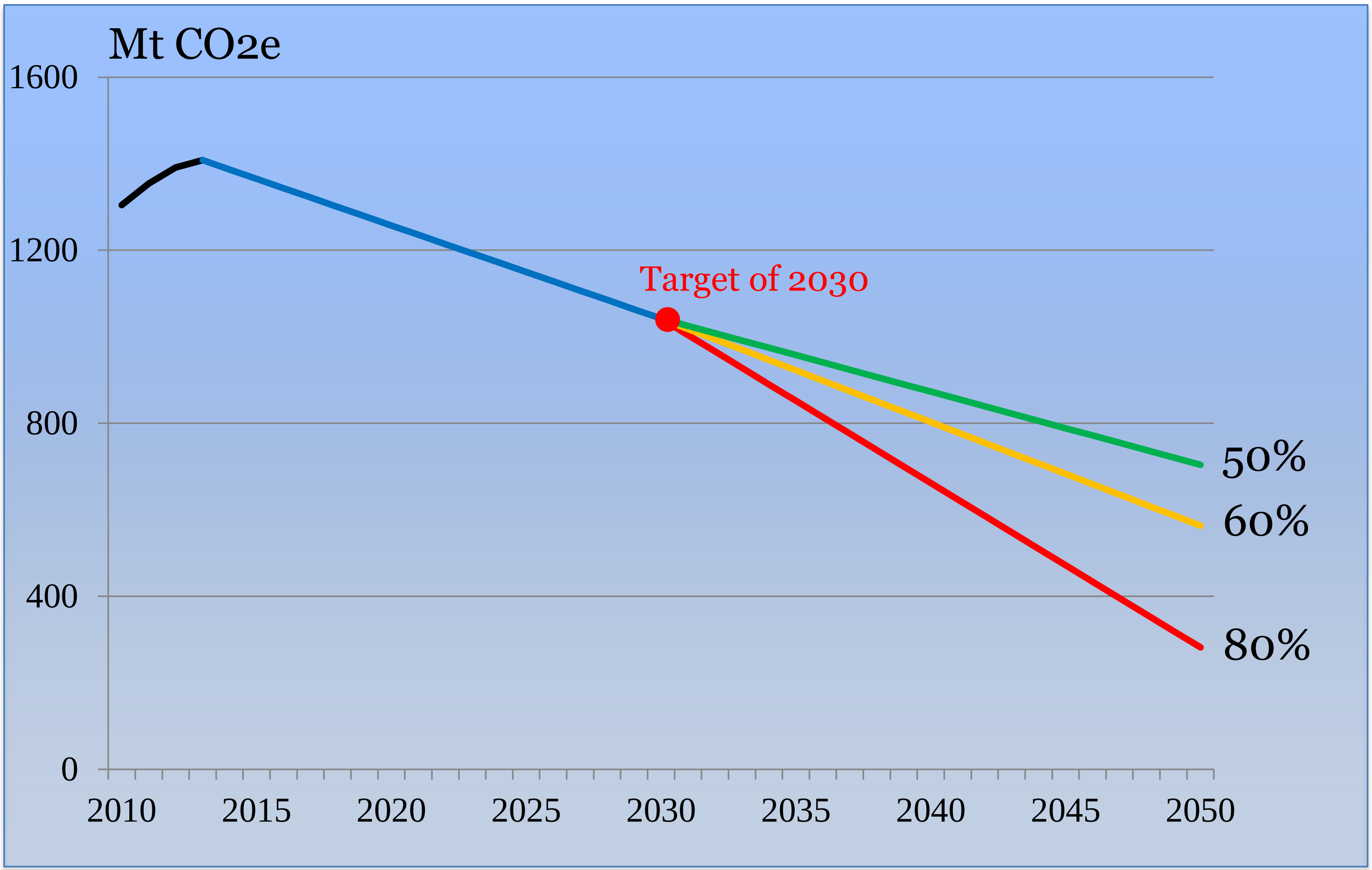
解決するには

世界全体、特に製造業を中心とした途上国における低炭素化を促進しなければならない。即ち、自国ビジョンを世界の長期ビジョンに繋げる



Virtual CO_2 (2004) (S. J. Davis and K. Calderira, 2010)

Way from 2030 to 2050



世界ビジョンは

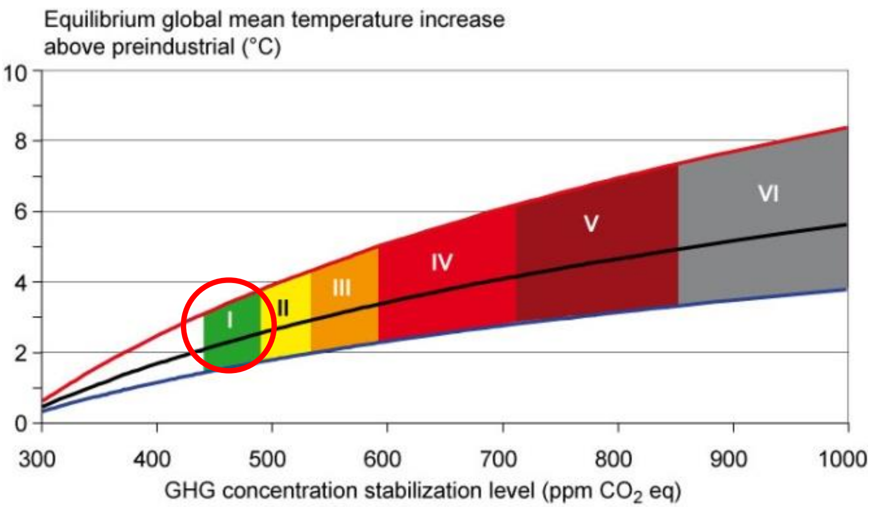
Climate Science

Concentration stabilization to Cumulative emissions

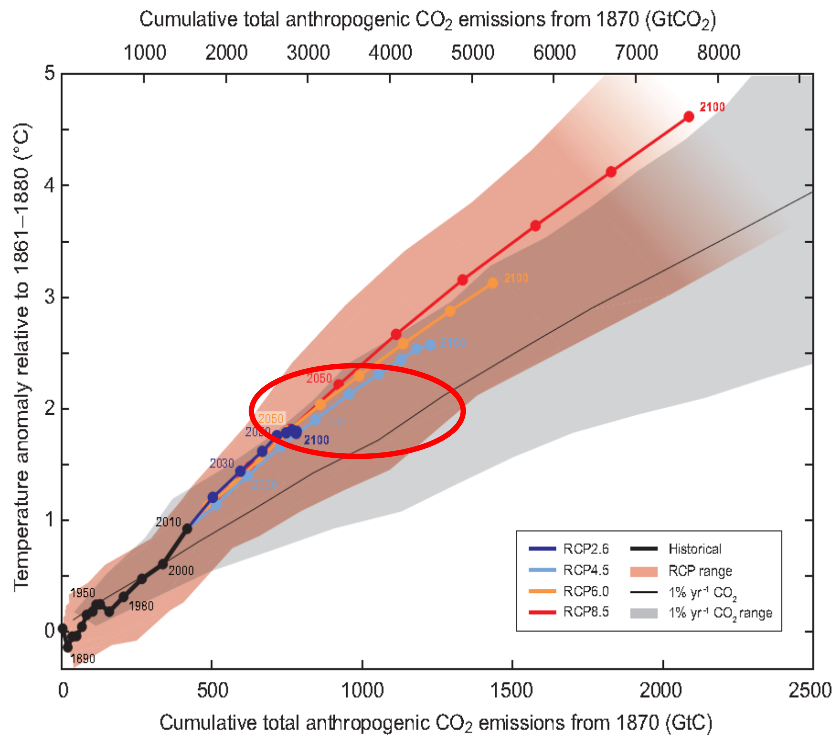
→ flexible pathway

ESC to TCR

→ more possible pathway



IPCC AR4



IPCC AR5

不確実性の中に複数のパスウェー

Scientific base

IPCC AR4

Category	Radiative forcing (W/m²)	CO_2 concentration[c)] (ppm)	CO_2-eq concentration[c)] (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[b), c)] (°C)	Peaking year for CO_2 emissions[d)]	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[d)]	No. of assessed scenarios
I	2.5-3.0	350-400	445-490	2.0-2.4	2000-2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2.4-2.8	2000-2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2.8-3.2	2010-2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	3.2-4.0	2020-2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	4.0-4.9	2050-2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	4.9-6.1	2060-2090	+90 to +140	5
						Total	177

IPCC AR5

CO_2eq Concentrations in 2100 (CO_2eq) Category label (concentration range)[9]	Subcategories	Relative position of the RCPs[5]	Cumulative CO_2 emissions[3] ($GtCO_2$)		Change in CO_2eq emissions compared to 2010 in (%)[4]		Temperature change (relative to 1850–1900)[5,6]				
			2011–2050	2011–2100	2050	2100	2100 Temperature change (°C)[7]	Likelihood of staying below temperature level over the 21st century[8]			
								1.5 °C	2.0 °C	3.0 °C	4.0 °C
< 430	Only a limited number of individual model studies have explored levels below 430 ppm CO_2eq										
450 (430–480)	Total range[1,10]	RCP2.6	550–1300	630–1180	−72 to −41	−118 to −78	1.5–1.7 (1.0–2.8)	More unlikely than likely	Likely	Likely	Likely
500 (480–530)	No overshoot of 530 ppm CO_2eq		860–1180	960–1430	−57 to −42	−107 to −73	1.7–1.9 (1.2–2.9)	Unlikely	More likely than not		
	Overshoot of 530 ppm CO_2eq		1130–1530	990–1550	−55 to −25	−114 to −90	1.8–2.0 (1.2–3.3)		About as likely as not		
550 (530–580)	No overshoot of 580 ppm CO_2eq		1070–1460	1240–2240	−47 to −19	−81 to −59	2.0–2.2 (1.4–3.6)		More unlikely than likely[12]		
	Overshoot of 580 ppm CO_2eq		1420–1750	1170–2100	−16 to 7	−183 to −86	2.1–2.3 (1.4–3.6)				
(580–650)	Total range	RCP4.5	1260–1640	1870–2440	−38 to 24	−134 to −50	2.3–2.6 (1.5–4.2)				
(650–720)	Total range		1310–1750	2570–3340	−11 to 17	−54 to −21	2.6–2.9 (1.8–4.5)		Unlikely	More likely than not	
(720–1000)	Total range	RCP6.0	1570–1940	3620–4990	18 to 54	−7 to 72	3.1–3.7 (2.1–5.8)	Unlikely[11]		More unlikely than likely	
>1000	Total range	RCP8.5	1840–2310	5350–7010	52 to 95	74 to 178	4.1–4.8 (2.8–7.8)		Unlikely[26]	Unlikely	More unlikely than likely

CIGSの提案

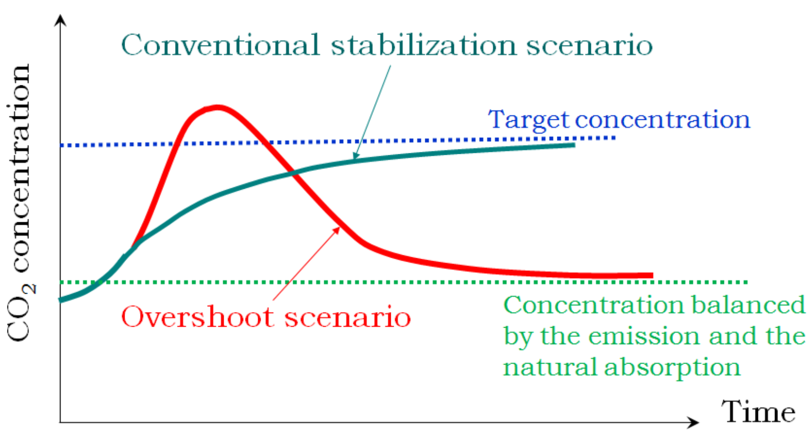
Scientific analysis based on

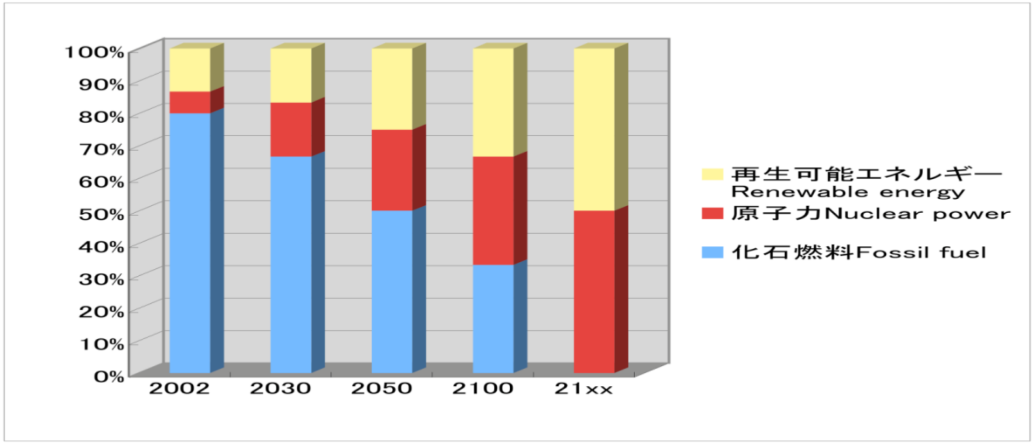
--- target of global mean temperature rise

to limit the global surface temperature rise to approximate 2℃ compared to pre-industrial levels

--- overshoot scenario with zero emission

to decrease the CO2 concentration by zero emission after a peak over the target concentration





CIGSの提案

Z650 Scenario

--- 650GtC

to be the amount of cumulative CO_2 emissions during 21st century

--- Zero emission

to be achieved at the middle of 22nd century (2160)

--- Pathway

to peak at 2020 (11GtC) according to the trend of recent years

with approximate two percent of annual reduction till 2100

with increasing reduction rates in 22nd century till zero emission

Source: Matsuno et al., "Stabilization of the CO2 concentration via zero-emission in the next century", presented at the CIGS Symposium on Oct. 27, 2009

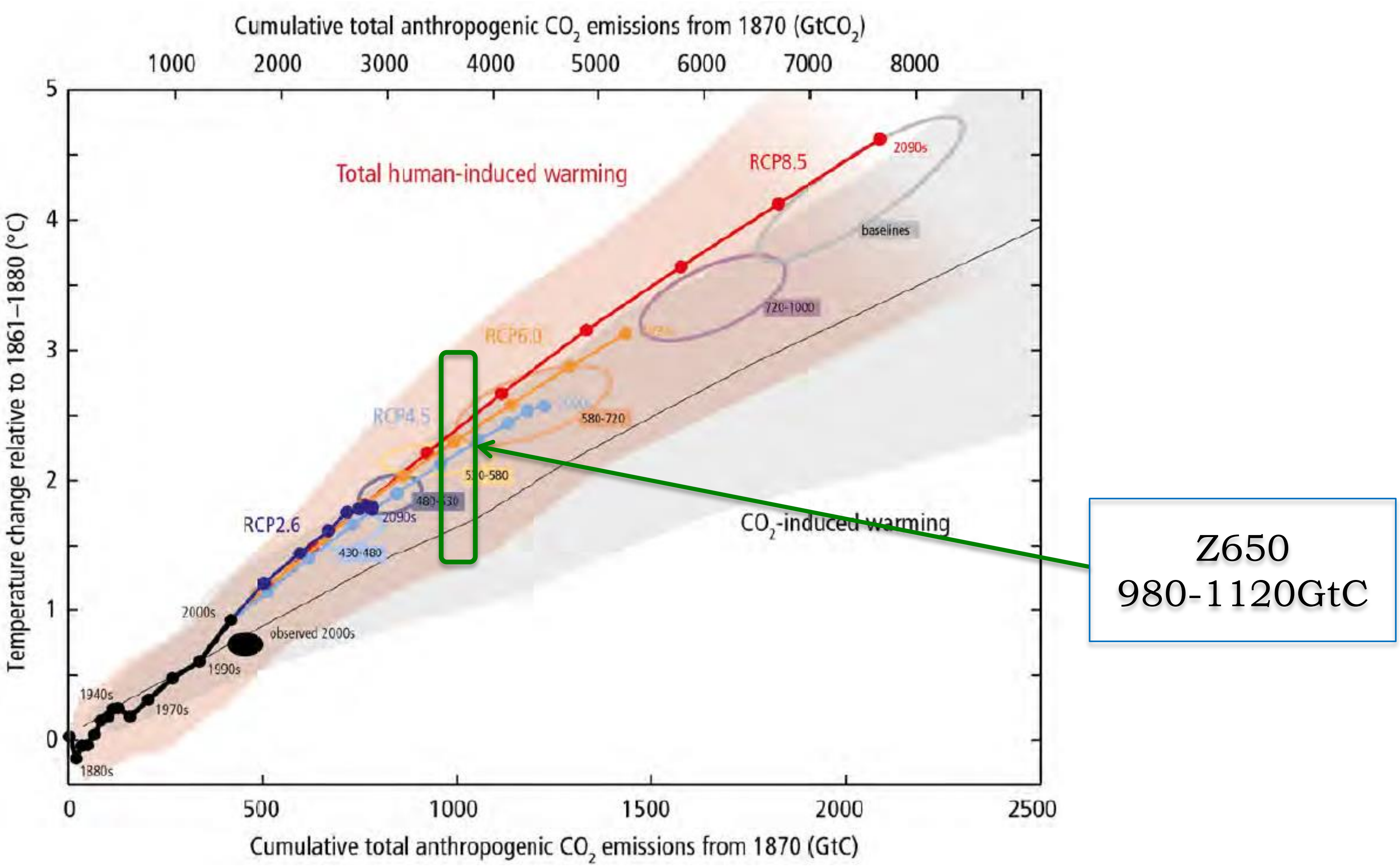
AR5との整合性

Table 3.1 [TABLE SUBJECT TO FINAL COPYEDIT]

CO_2eq Concentrations in 2100 (CO_2eq)[6] Category label (conc. range)	Subcategories	Relative position of the RCPs[4]	Change in CO_2eq emissions compared to 2010 (in %)[3]		Likelihood of staying below a specific temperature level over the 21st century (relative to 1850-1900)[4,5]			
			2050	2100	1.5°C	2°C	3°C	4°C
< 430	*Only a limited number of individual model studies have explored levels below 430 ppm CO_2eq*[10]							
450 (430 – 480)	Total range[1,7]	*RCP2.6*	-72 to -41	-118 to -78	*More unlikely than likely*	*Likely*		
500 (480 – 530)	No overshoot of 530 ppm CO_2eq		-57 to -42	-107 to -73		*More likely than not*		
	Overshoot of 530 ppm CO_2eq		-55 to -25	-114 to -90		*About as likely as not*	*Likely*	
550 (530 – 580)	No overshoot of 580 ppm CO_2eq		-47 to -19	-81 to -59	*Unlikely*	*More unlikely than likely*[9]		*Likely*
	Overshoot of 580 ppm CO_2eq		-16 to 7	-183 to -86				
(580 – 650)	Total range	*RCP4.5*	-38 to 24	-134 to -50				
(650 – 720)	Total range		-11 to 17	-54 to -21		*Unlikely*	*More likely than not*	
(720 – 1000)[2]	Total range	*RCP6.0*	18 to 54	-7 to 72	*Unlikely*[8]		*More unlikely than likely*	
>1000[2]	Total range	*RCP8.5*	52 to 95	74 to 178		*Unlikely*[8]	*Unlikely*	*More unlikely than likely*

AR5との整合性

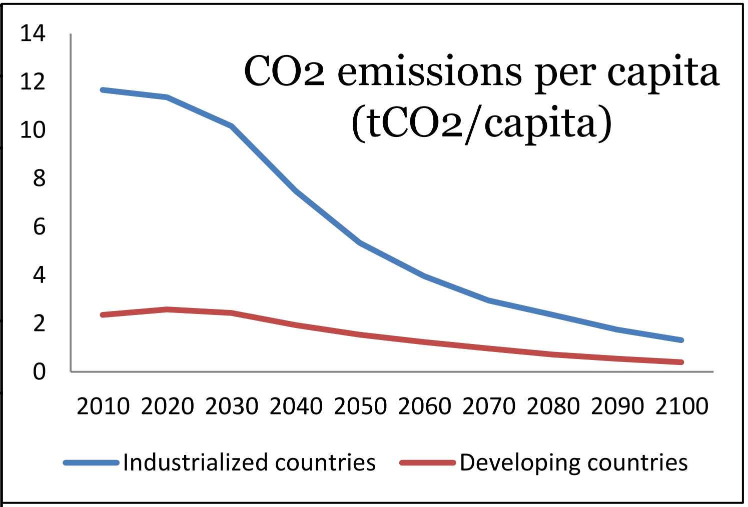
Figure 2.3 [FIGURE SUBJECT TO FINAL COPYEDIT AND QUALITY CONTROL]

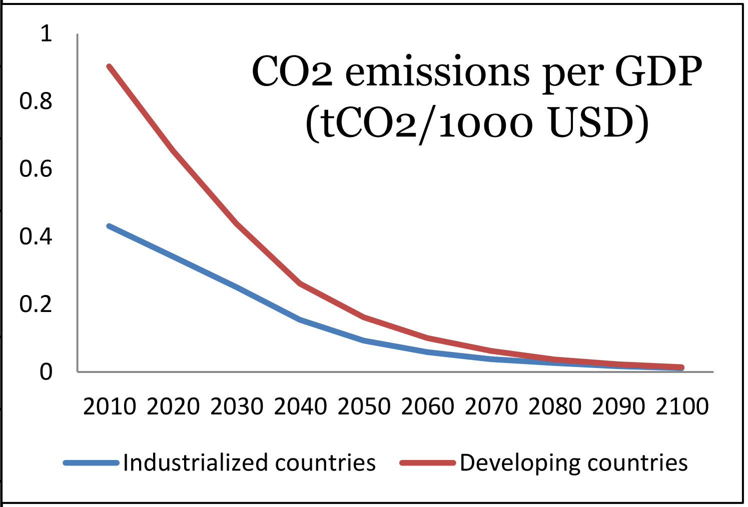


世界全体最適化結果

Output from global energy system optimization model

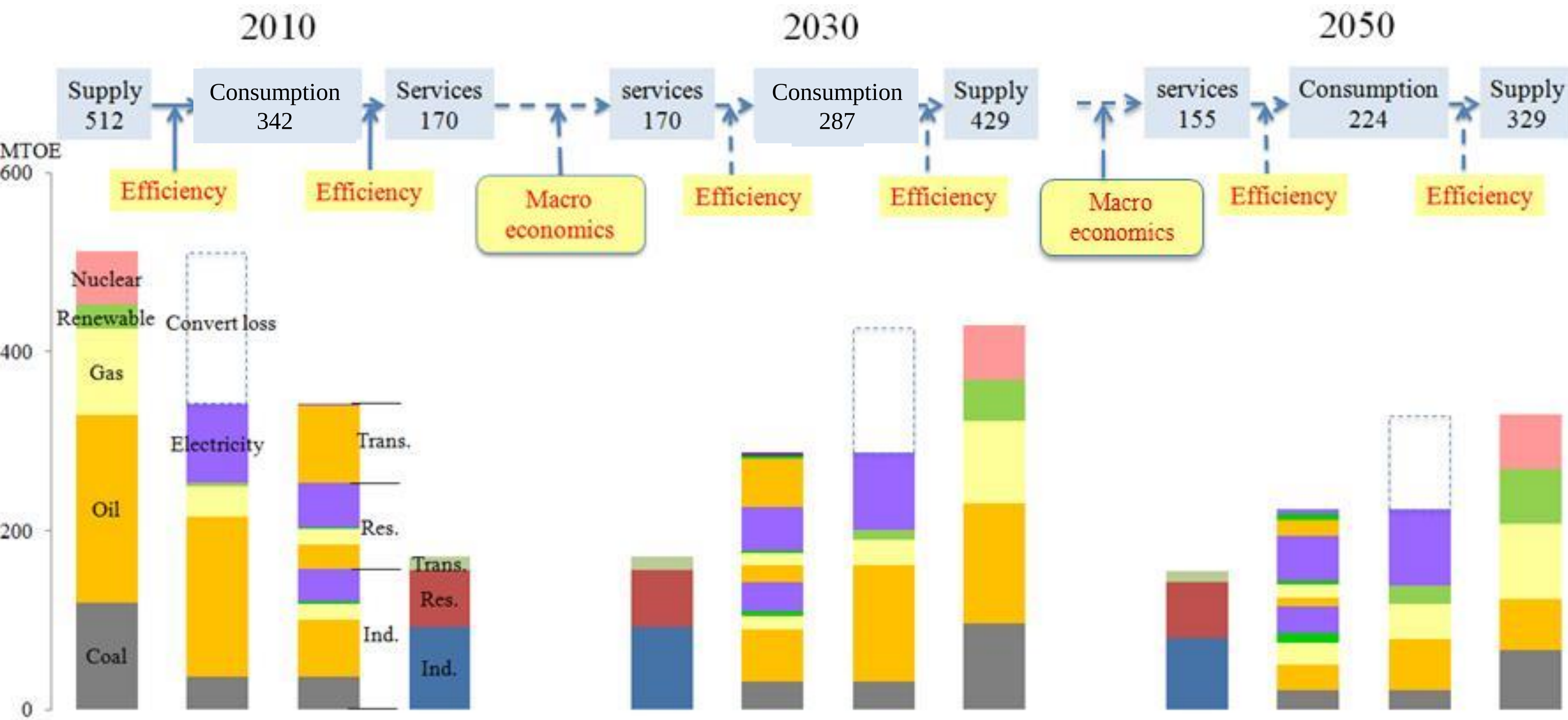
Region	CO2 Emissions			
	2030		2050	
	Ratio to 1990 levels	Ratio to 2005 levels	Ratio to 1990 levels	Ratio to 2005 levels
World	1.60	1.2	1.00	0.75
Industrialized countries	1.05	0.95	0.53	0.48
USA	1.16	0.96	0.57	0.47
EU15	0.89	0.86	0.46	0.45
Japan	0.93	0.79	0.55	0.47
Developing countries	2.82	1.54	2.05	1.12
China	2.77	1.48	1.53	0.82
India	3.42	1.91	2.83	1.57
ASEAN	3.74	1.64	3.41	1.50





(GRAPE試算による)

エネルギーバランス


2010
2030
2050
Supply 512
Consumption 342
Services 170
services 170
Consumption 287
Supply 429
services 155
Consumption 224
Supply 329
Efficiency
Efficiency
Macro economics
Efficiency
Efficiency
Macro economics
Efficiency
Efficiency
MTOE
600
400
200
0
Nuclear
Renewable
Gas
Oil
Coal
Convert loss
Electricity
Trans.
Res.
Ind.
Trans.
Res.
Ind.

Energy Balance Sheet of Japan in 2030 and 2050 MTOE

		Coal	Oil	Gas	RE	Nuclear	Elec.	Total	Service	Loss	Eff.
TPE	**2010**	**120**	**210**	**96**	**26**	**60**		**512**	**170**		**33%**
	2030	**96**	**134**	**92**	**47**	**60**		**429**	**170**		**40%**
	2050	**66**	**57**	**84**	**62**	**60**		**329**	**155**		**47%**
Conv.	**2010**	**-83**	**-32**	**-61**	**-23**	**-60**	**89**	**-170**			
	2030	**-65**	**-3**	**-64**	**-36**	**-60**	**86**	**-142**			
	2050	**-44**		**-45**	**-42**	**-60**	**86**	**-105**			
Cons.	**2010**	**37**	**178**	**35**	**3**		**89**	**342**	**170**	**172**	**50%**
	2030	**31**	**131**	**28**	**11**		**86**	**287**	**170**	**117**	**60%**
	2050	**22**	**57**	**39**	**20**		**86**	**224**	**155**	**69**	**70%**
Industry	**2010**	**37**	**64**	**18**	**2**		**36**	**157**	**93**	**64**	**59%**
	2030	**31**	**59**	**14**	**6**		**33**	**143**	**93**	**50**	**65%**
	2050	**22**	**29**	**24**	**10**		**30**	**115**	**80**	**35**	**70%**
Res.	**2010**		**28**	**17**	**1**		**51**	**97**	**63**	**34**	**65%**
	2030		**18**	**14**	**2**		**50**	**84**	**63**	**21**	**75%**
	2050		**10**	**15**	**4**		**50**	**79**	**63**	**16**	**80%**
Trans.	**2010**		**86**				**2**	**88**	**15**	**73**	**17%**
	2030		**54**		**3**		**3**	**60**	**15**	**45**	**25%**
	2050		**18**		**6**		**6**	**30**	**12**	**18**	**40%**
CO2	**2010**	**456**	**609**	**115**				**1180**			
	2030	**365**	**389**	**193**				**947**			
	2050	**251**	**165**	**176**				**592**			

Energy Mixes of Japan in 2030 and 2050

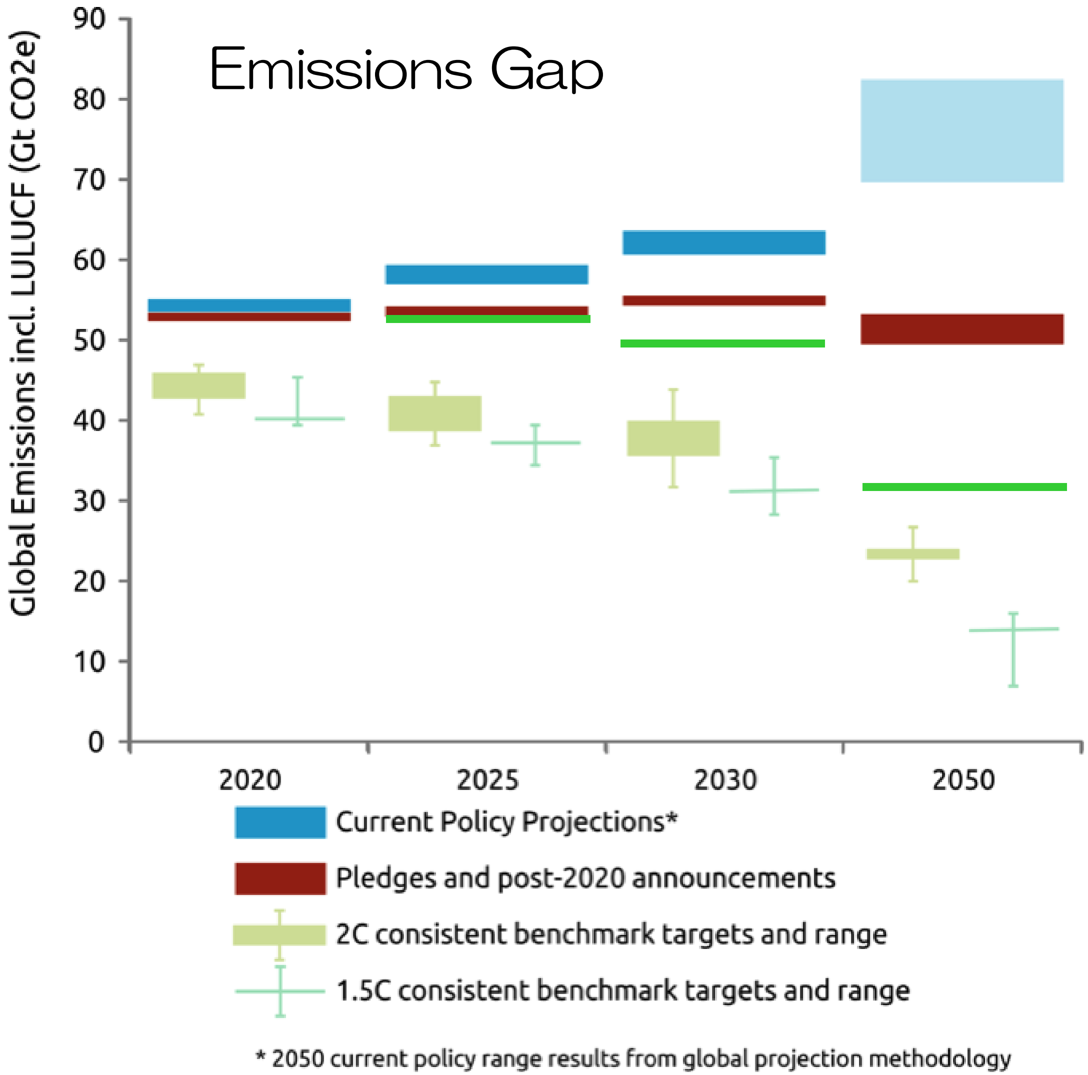
(Power Generation)

	Total (TWh)	Fossil Fuel			Nuclear	Renewable Energy					
		Coal	Oil	Gas		Hydro	Solar	Wind	Ocean	Geothermal	Biomass
2010	1006	252	75	295	292	86	11				
		62%			29%	9%					
2030	1000	235		325	240	91	29	33	15	10	22
		56%			24%	20%					
2050	1000	170		290	240	91	60	60	24	20	45
		46%			24%	30%					

Energy Mixes of Japan in 2030 and 2050
(Total Primary Energy)

MTOE	Coal	Oil	Gas	RE	Nuclear	Total	Eff.	CO_2 (Gt) Reduction
2010	120	210	96	26	60	512	33%	1.2
	83%			5%	12%			
2030	96	134	92	47	60	429	40%	0.95 -21%
	75%			11%	14%			
2050	66	57	84	62	60	329	47%	0.59 -51%
	63%			19%	18%			

COP21に向けて



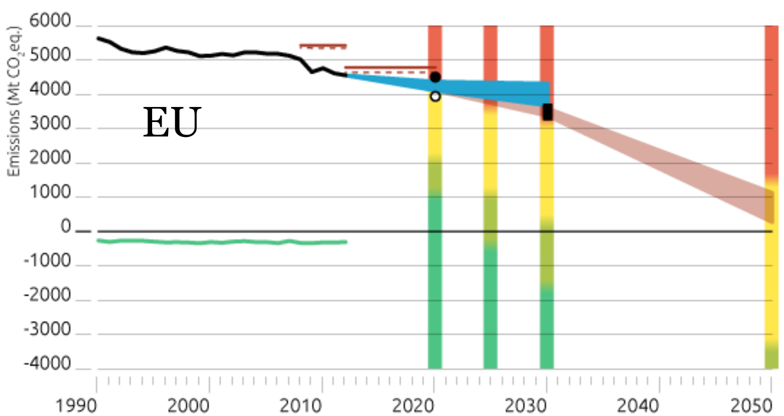
GHG emissions (GtCO2e)

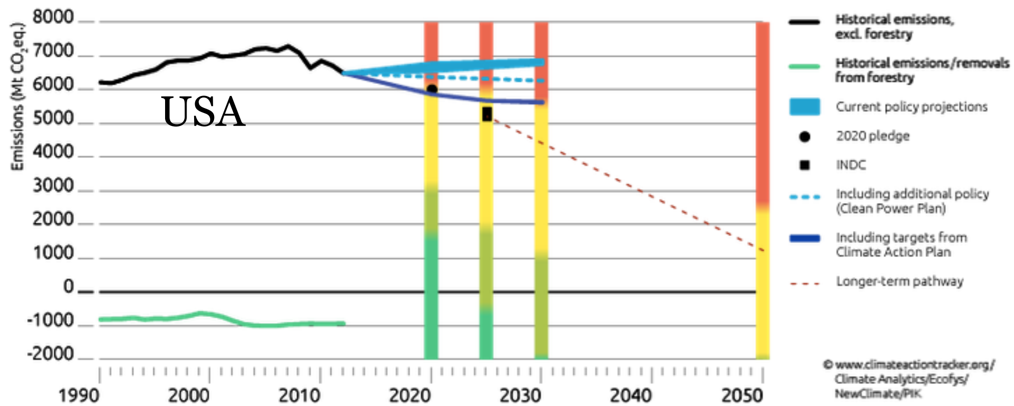
	2025	2030	2050
CP	57-59	61-64	
INDC	53-54	54-56	50-53
450ppm	39-43	36-40	23-24
Z650	52	49	31

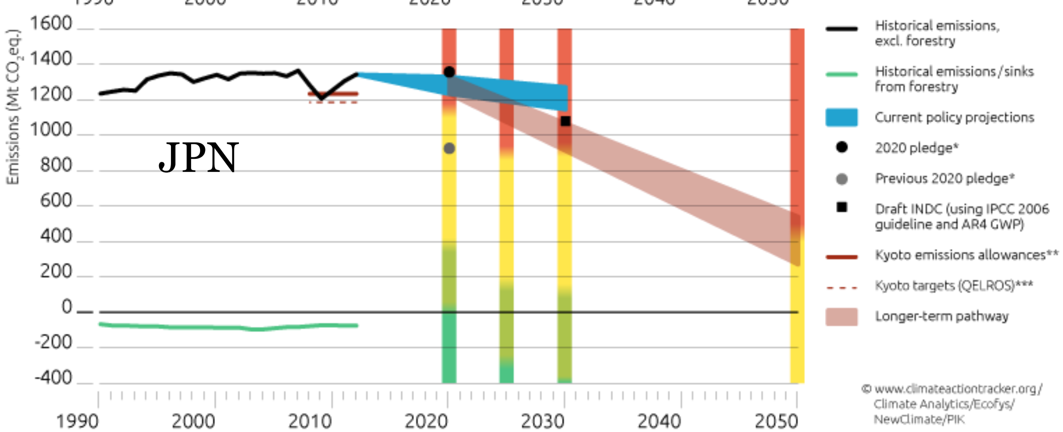
(Climate Action Tracker)

COP21に向けて

Fill in the gap in developed countries?







(Climate Action Tracker)

世界全体最適化の経済性評価

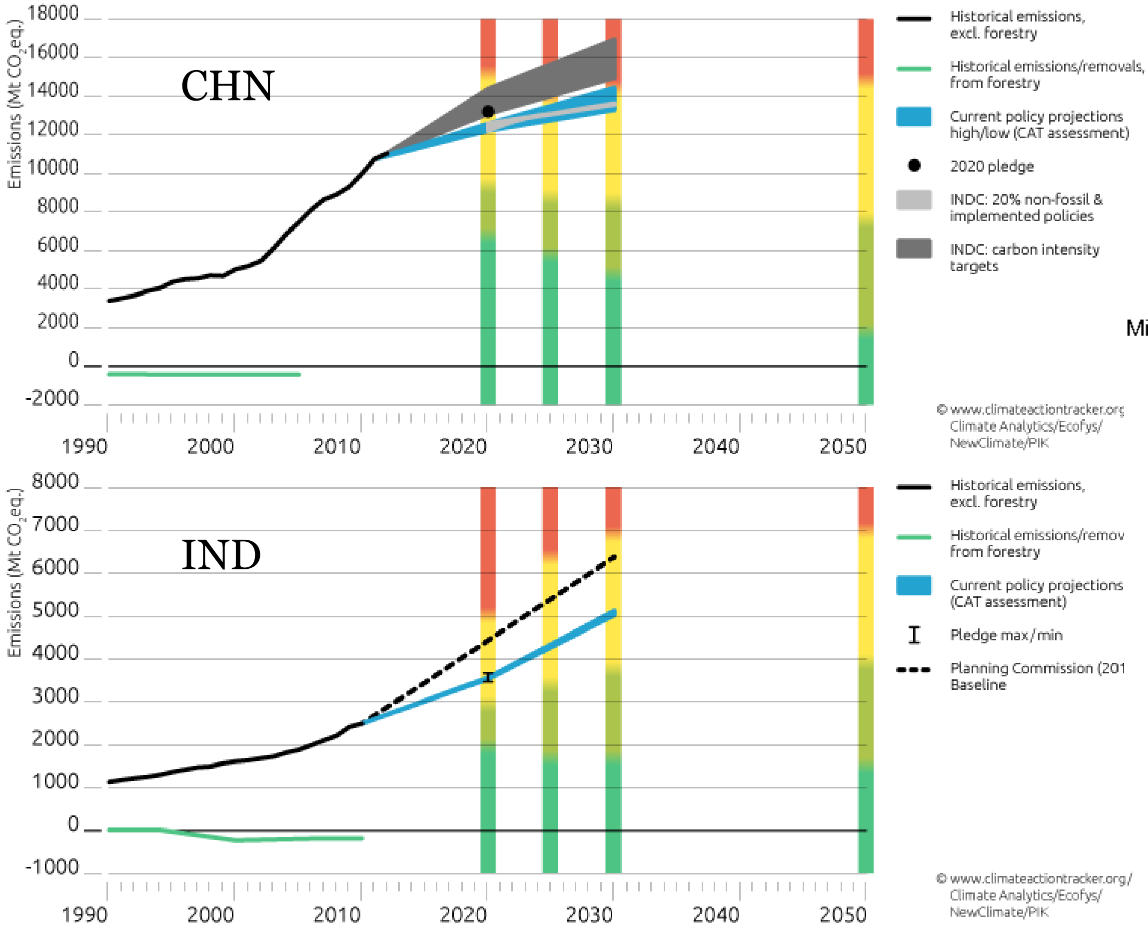
2050年までの累積追加投資と省エネベネフィットの比較（兆ドル）

Z650の実現ルート		追加投資	省エネ	合計利益
世界全体最適化	世界	11	14	3
	先進国	4	5	1
	途上国	7	9	2
先進国80%減	世界	42	10	−32
	先進国	37	10	−27
	途上国	5	0	−5

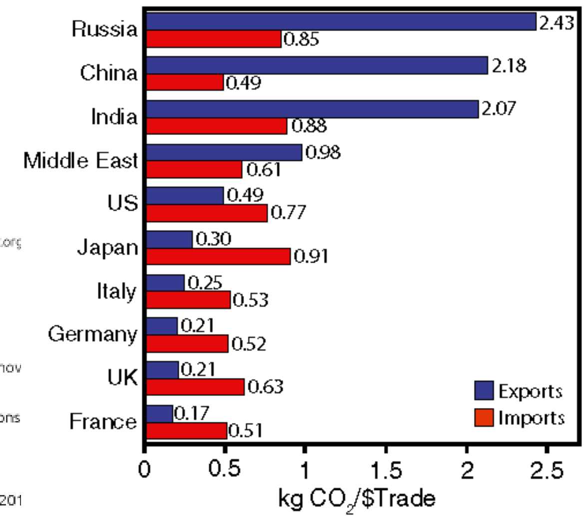
GRAPEモデルによる評価

COP21に向けて

Fill in the gap through international cooperation and cleaning the global industry up

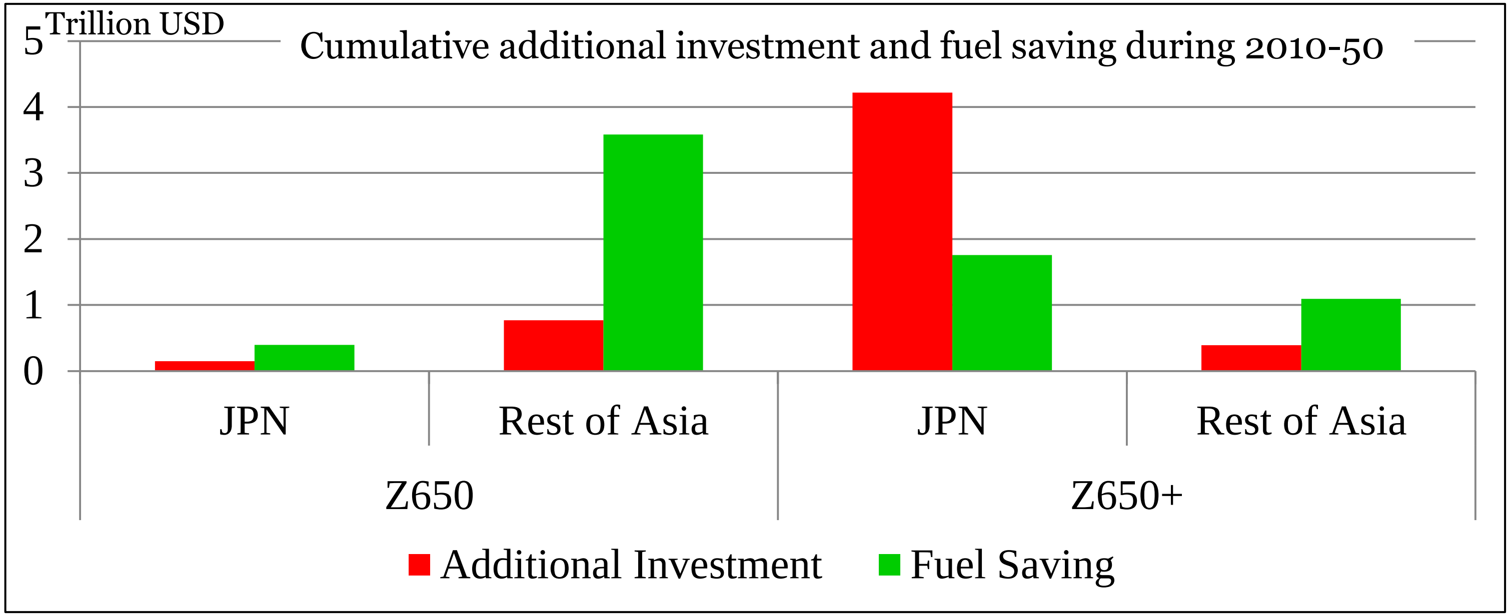


(Climate Action Tracker)



(S. J. Davis and K. Calderira, 2010)

世界全体最適化の優位性



しかし、問題もある

	追加投資のGDP比 （2010-50累積）	削減によるGDP損失 （2050年）
日本	0.05%	0.883
アセアン	0.29%	1.461
	エネルギー工学モデル	経済モデル

(GRAPE試算による)

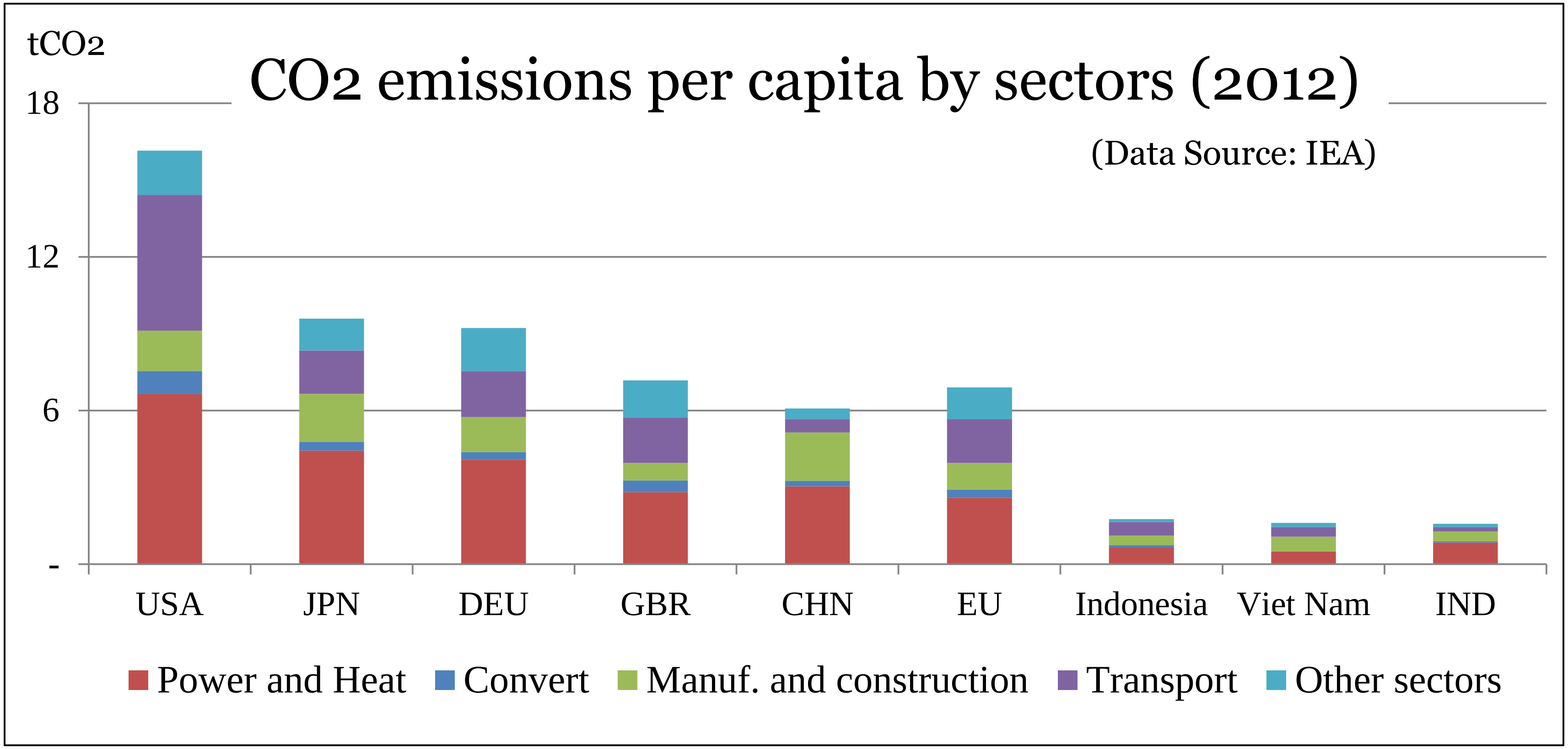
世界全体最適化の優位性

シナリオ	2050年50%減（2005年比）	2050年80%減（2005年比）	
		国内実現	国内50%＋アセアン協力
累積削減量（億トン）	55	155	55＋100
累積追加投資（兆ドル）	0.15	4.22	0.15＋0.19
累積省エネメリット（兆ドル）	0.40	1.76	0.40+0.91
メリット - 投資	0.25	-2.46	0.25+0.72

（GRAPE試算による）

ウェンウェンと同時に、途上国の低炭素化を推進する

もうひとつ重要な役割

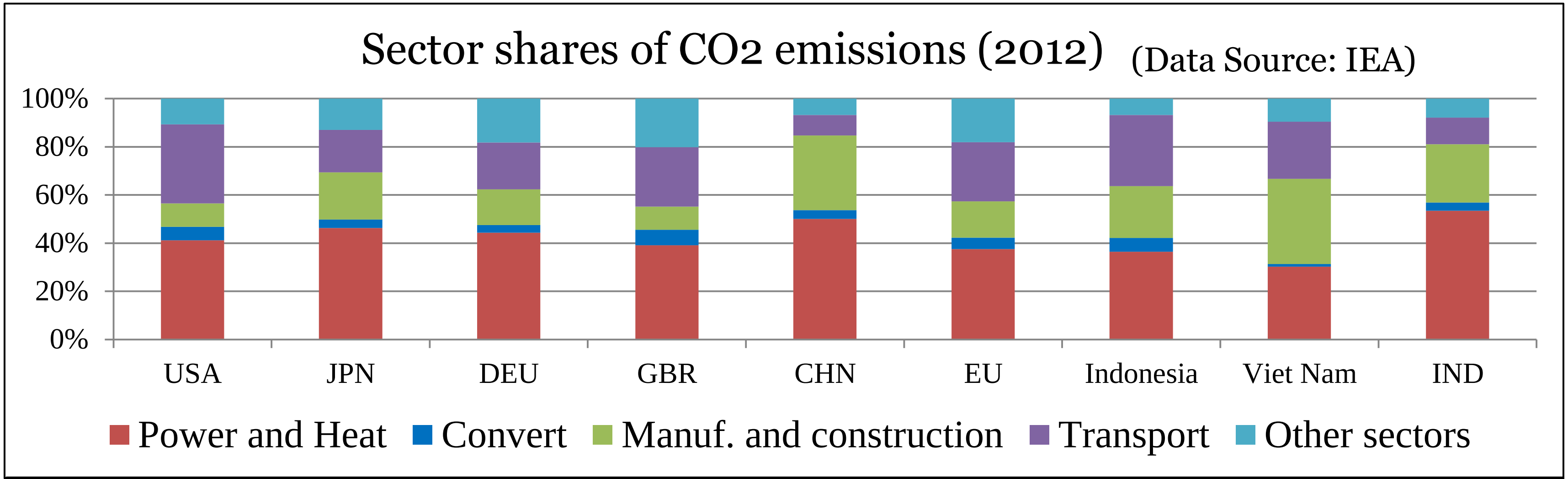


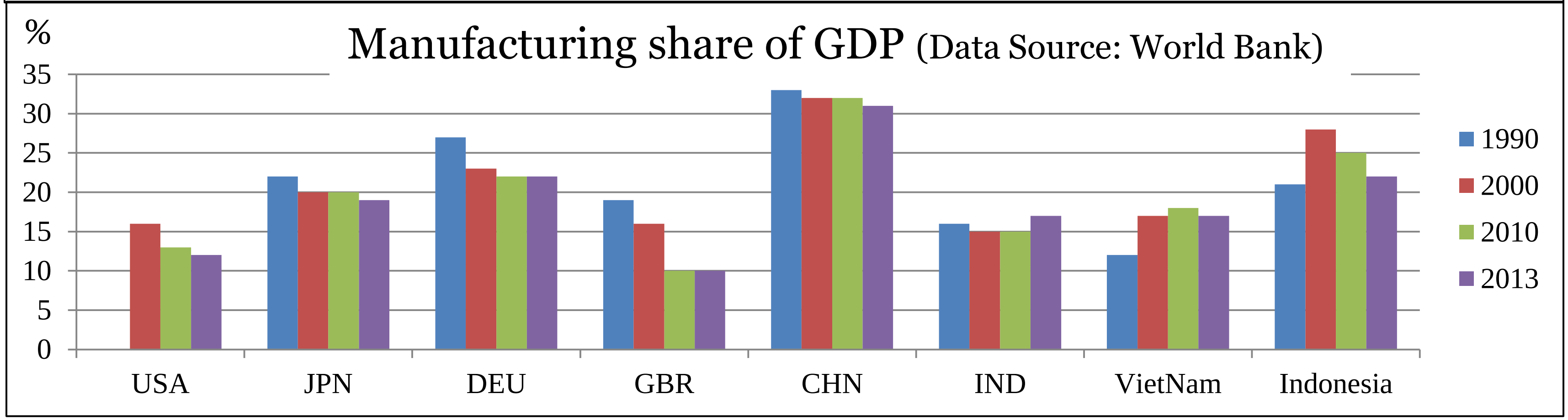
主要先進国の中に、日本の製造業排出量のウェートが最も高い。

2014年日本の鉄鋼生産と輸出とも、世界第二位。

日本の産業社会は、途上国のお手本になり得る。

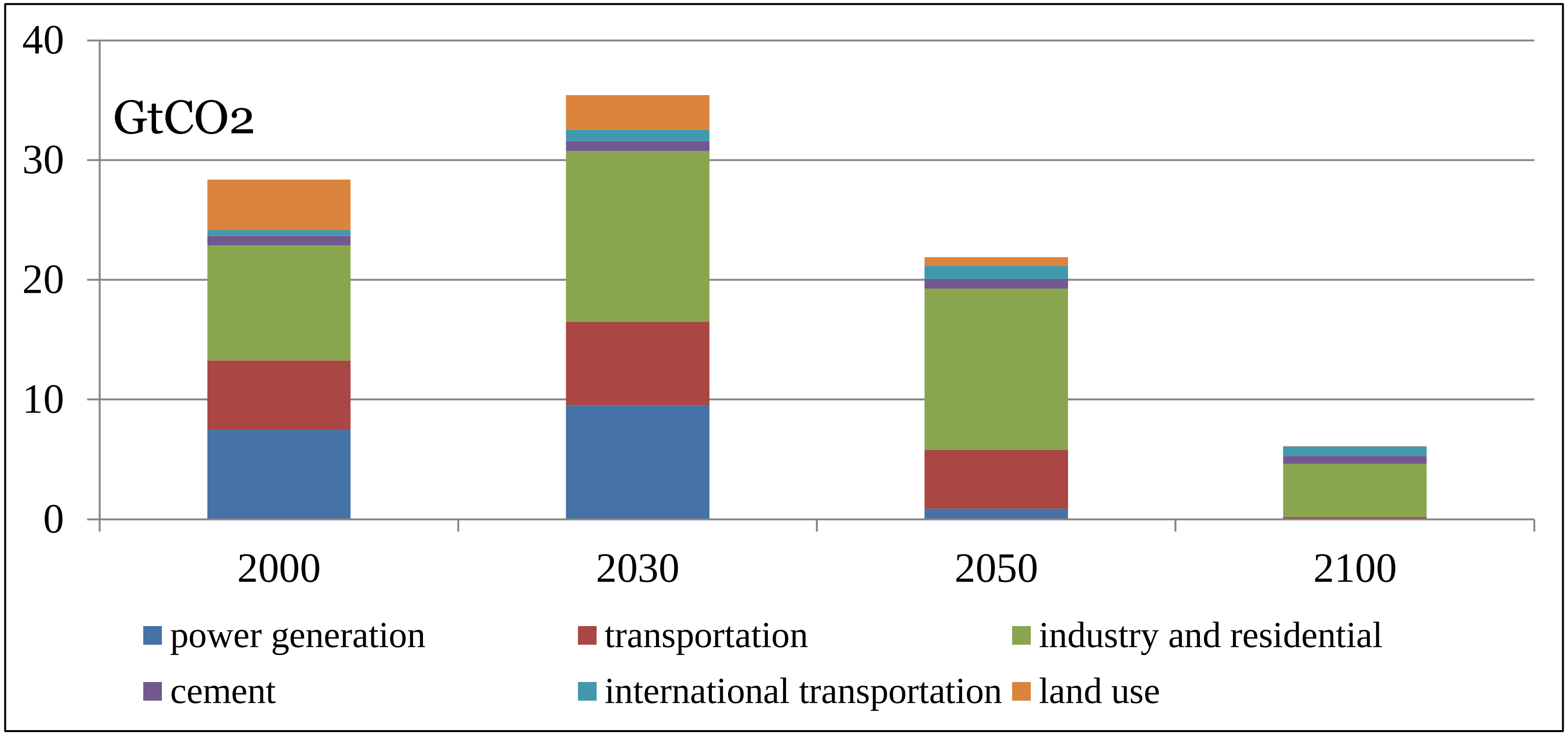
もうひとつ重要な役割





途上国に普及できる高度発達した産業社会のモデルの構築

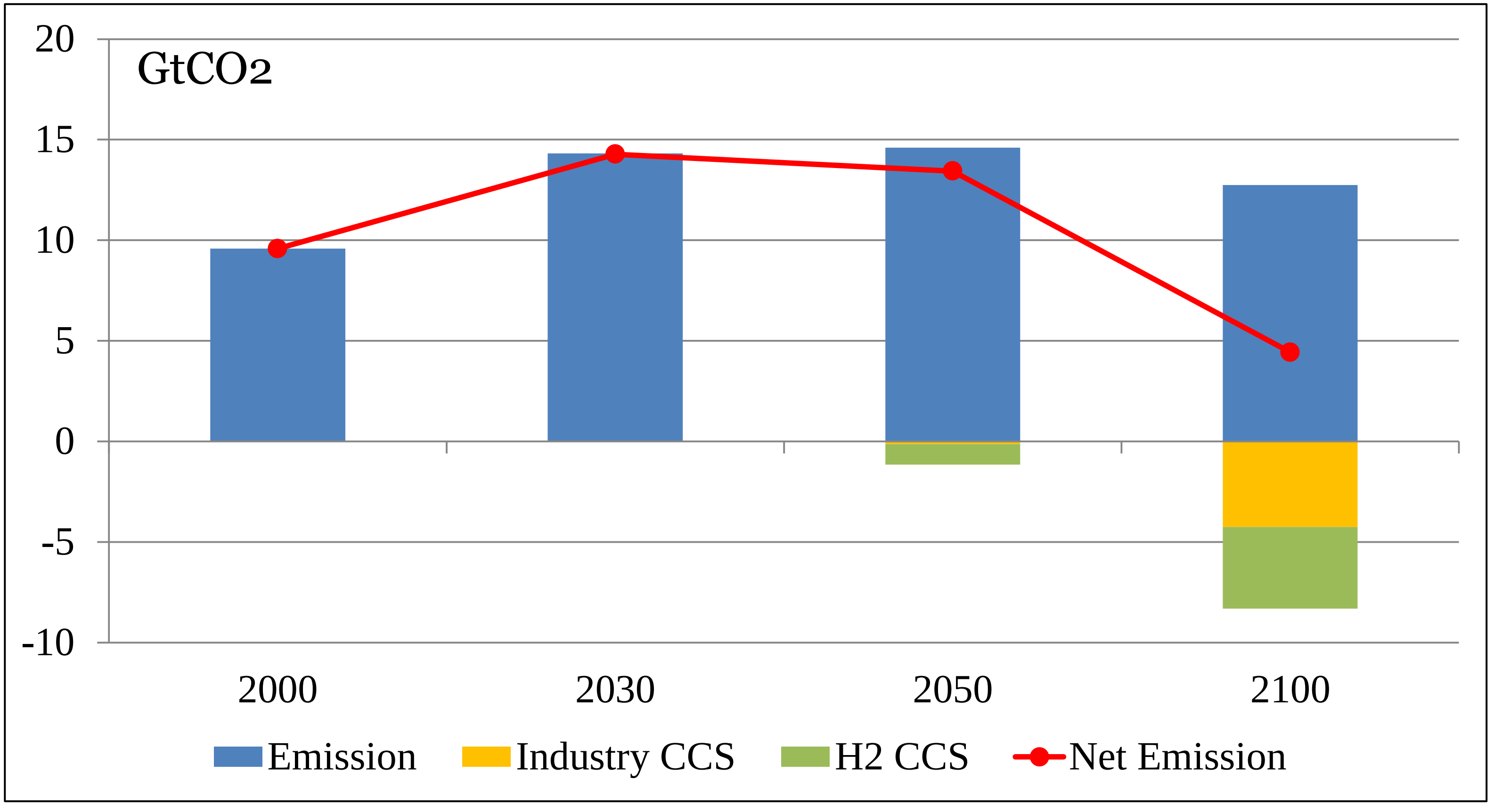
世界の低炭素化のために



Analysis results through energy engineering model (GRAPE)

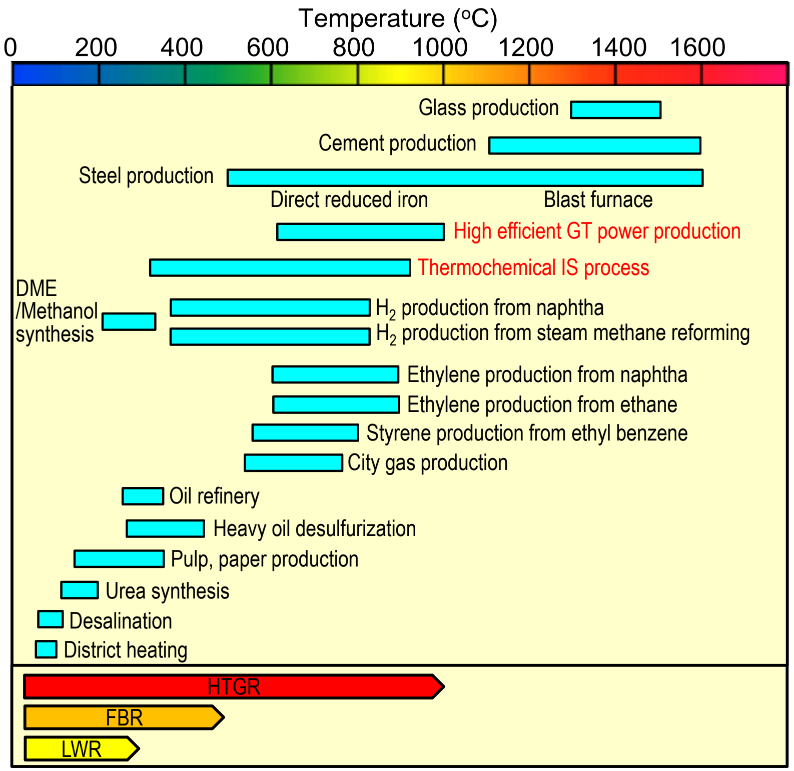
- emissions from industry and residential sectors decrease slowly (share in total emissions: 33%→73%)

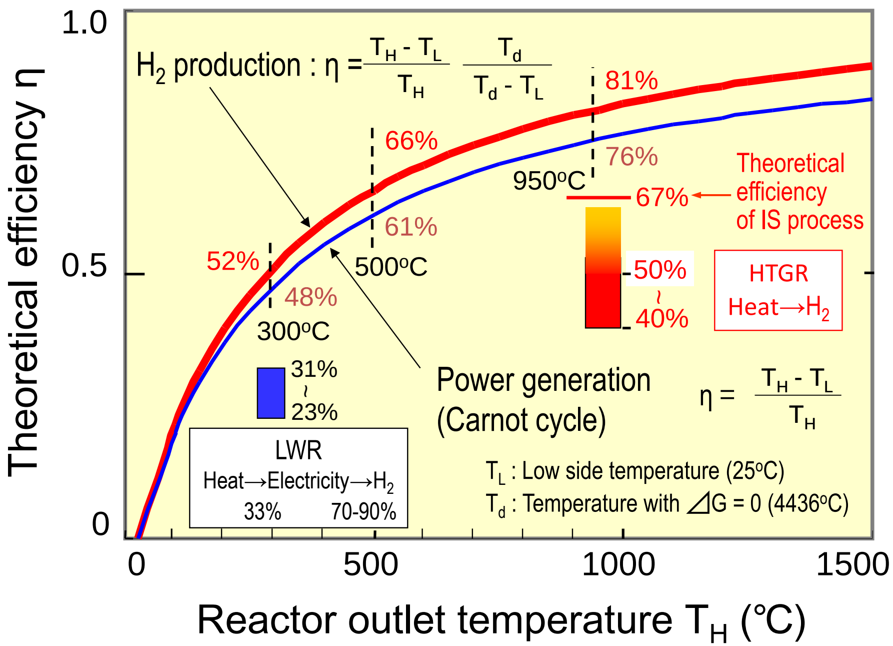
世界の低炭素化のために



(GRAPEによる試算)

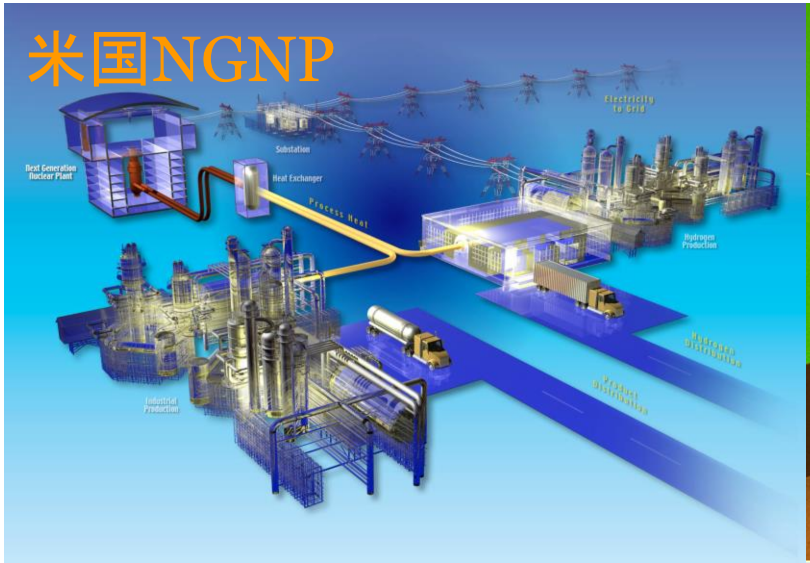
固有の安全性を持つ高温ガス炉技術

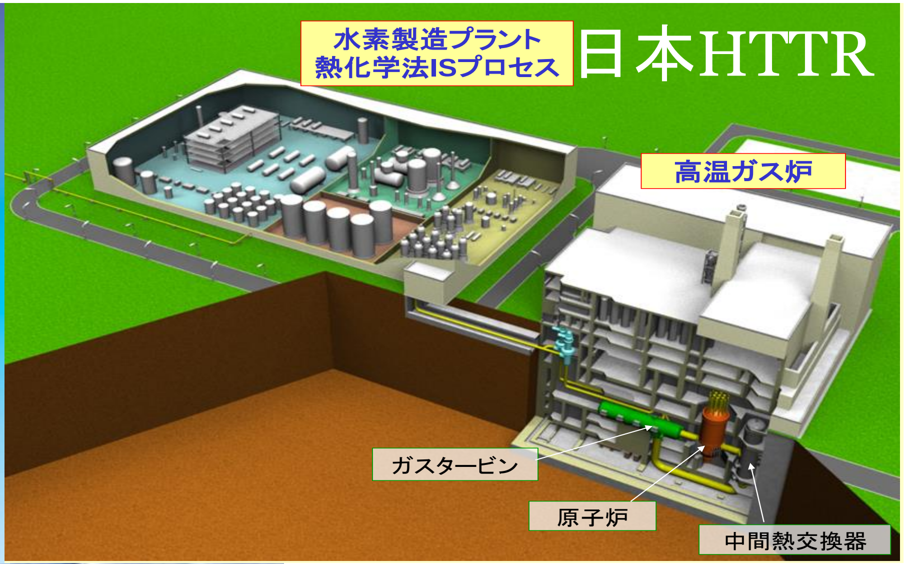




Masuro OGAWA, CIGS 3rd international symposium on global warming

日米中補完的協力による開発推進



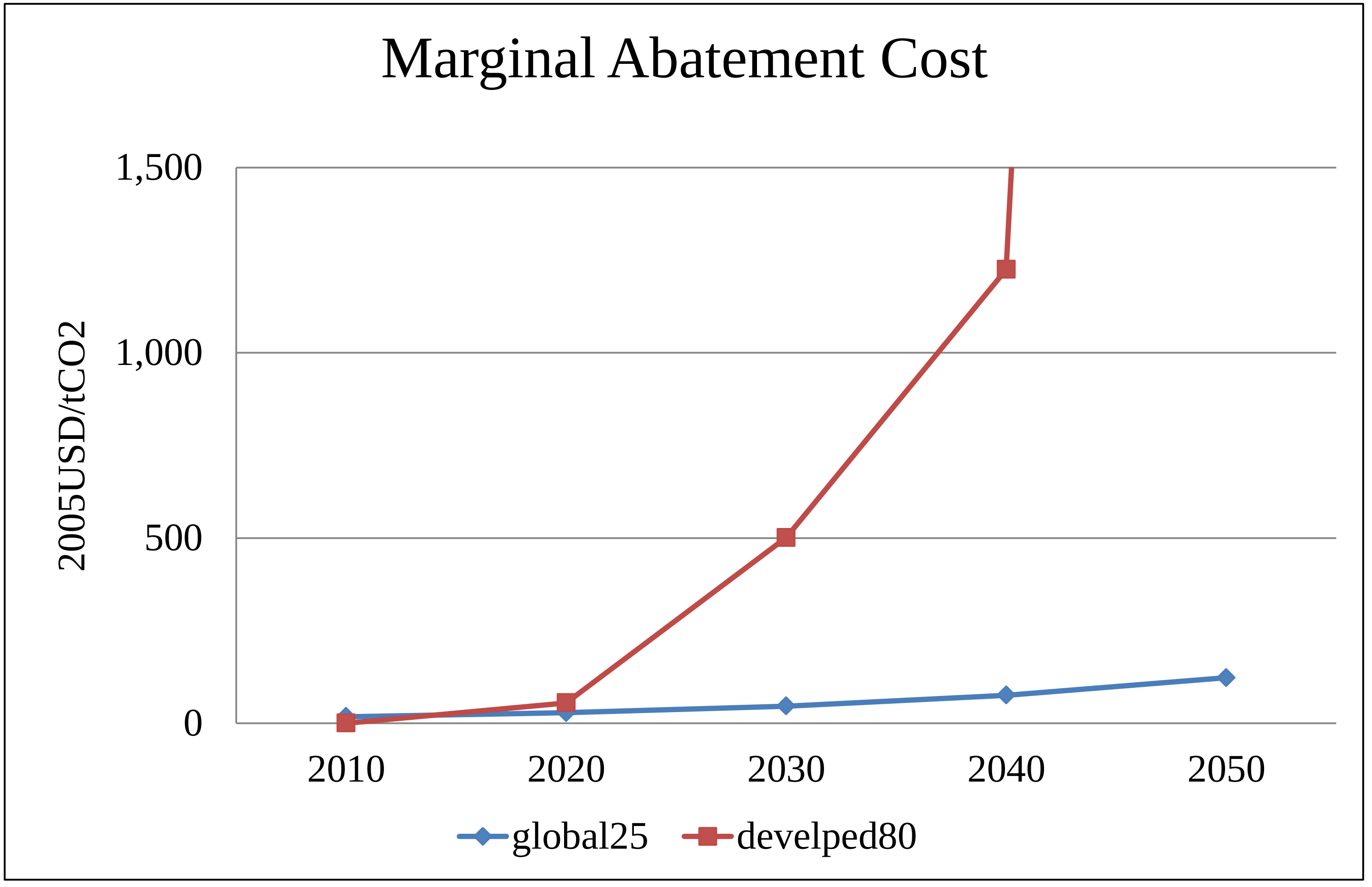


Potential Sample - HTGR
China: Demonstration plant (HTR-PM)
US: Process heat (NGNP)
Japan: Hydrogen production (HTTR)

まとめ

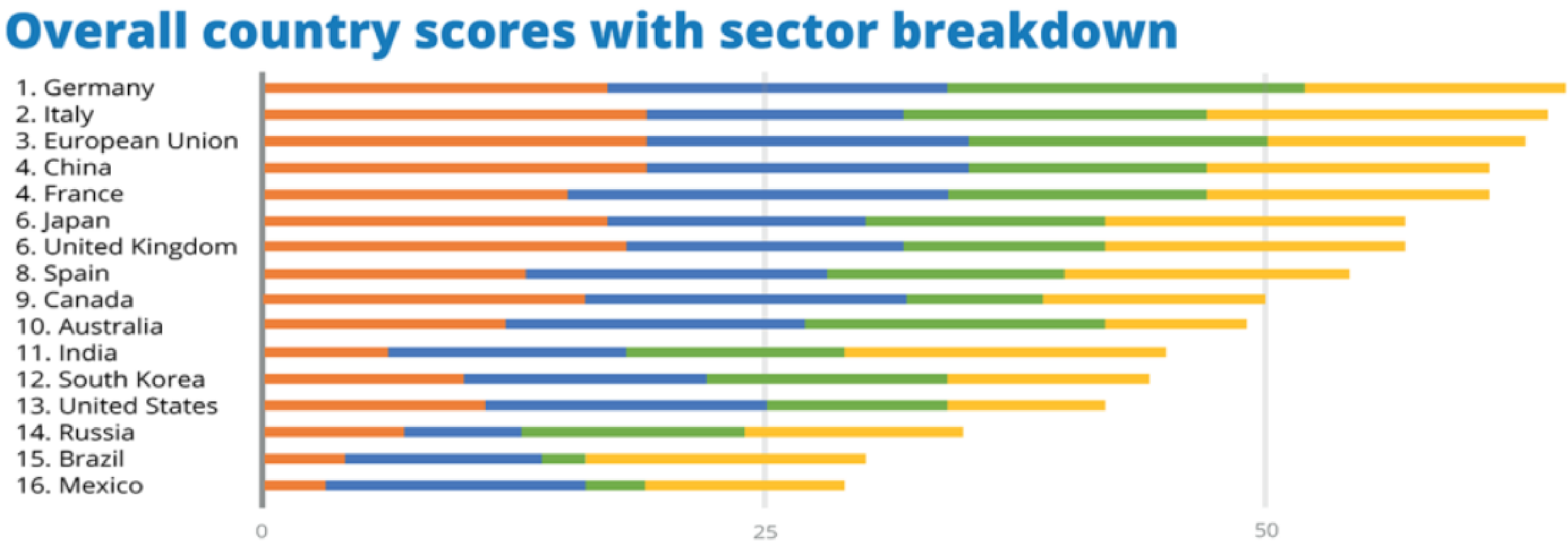
- 高い数値目標は、必ずしも高い貢献度にならない
- 世界全体の低炭素化こそ、温暖化抑制に繋がる
- 世界の長期ビジョンと整合性をとりながら、自国目標を検討すべき。
- 日本の真の貢献は、途上国の低炭素成長に協力すると同時に、高度発達した産業社会モデルの構築である。
- 次世代低炭素技術を、国際協力の下で推進する。

限界削減費用の比較

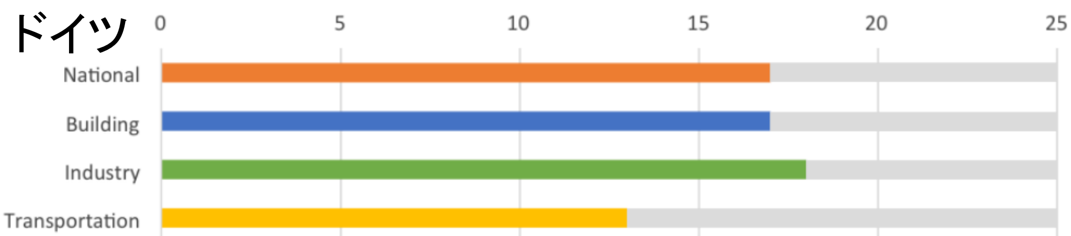


(GRAPEによる試算)

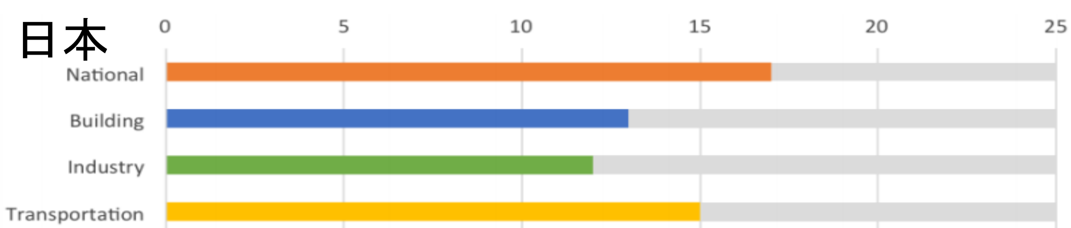
エネルギー効率の総合評価



ドイツ



日本



トップランナーのドイツと比べて、日本はBuildingとIndustryの得点は低い。産業に関して、CHPの少なさとエネルギー消費原単位の高さは指摘された。

ACEEE, The International Energy Efficiency Scorecard, 2014