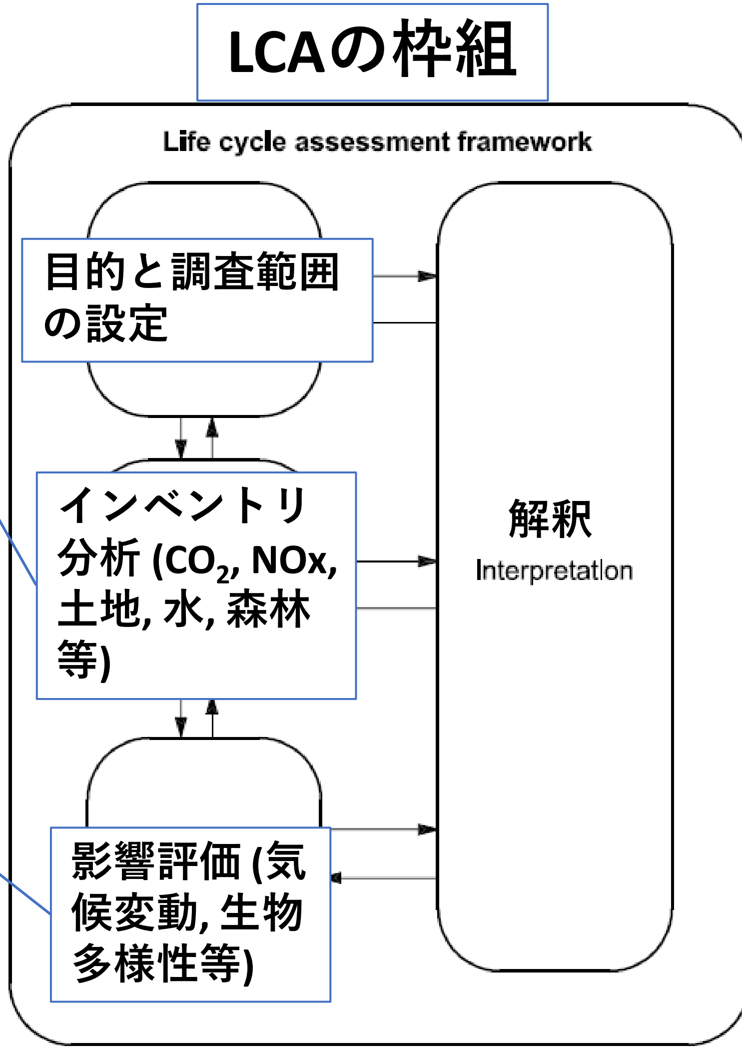
LCA (ISO14040)と主な方法やDB

LCAの枠組



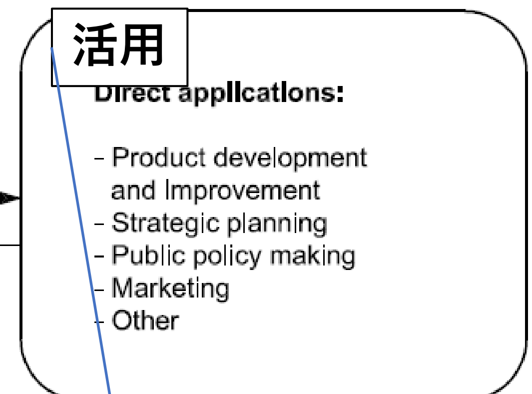
インベントリデータベース

- ➢ Ecoinvent (スイス)
- ➢ ILCD, ELCD (欧州)
- ➢ IDEA (産総研)
- ➢ 3EID, GLIO (環境研)

影響評価手法

- ➢ Recipe2016 (ｵﾗﾝﾀﾞ)
- ➢ EPS2015 (ｽｳｪｰﾃﾞﾝ)
- ➢ LCImpact (欧州)
- ➢ Impact world+ (北欧)
- ➢ LIME3 (日本)

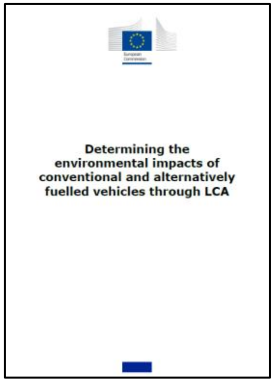
活用

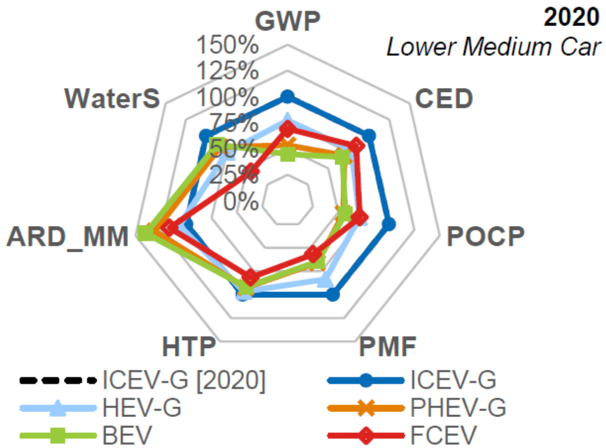


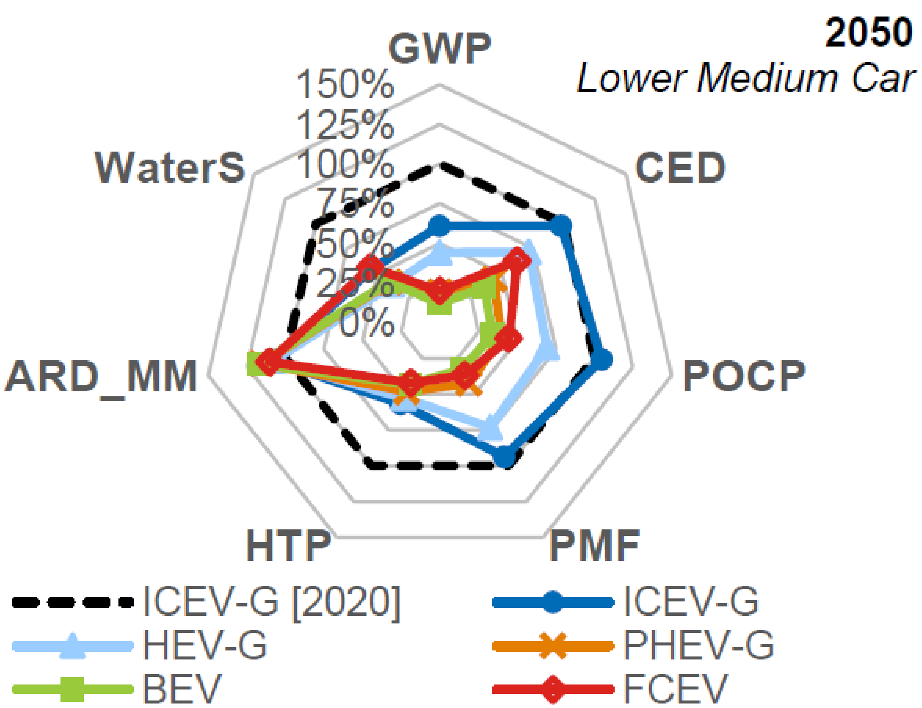
応用手法

- ➢ CFP, WF, 環境フットプリント
- ➢ SCOPE3、組織評価
- ➢ 環境会計、環境効率
- ➢ 経済評価、費用対便益分析

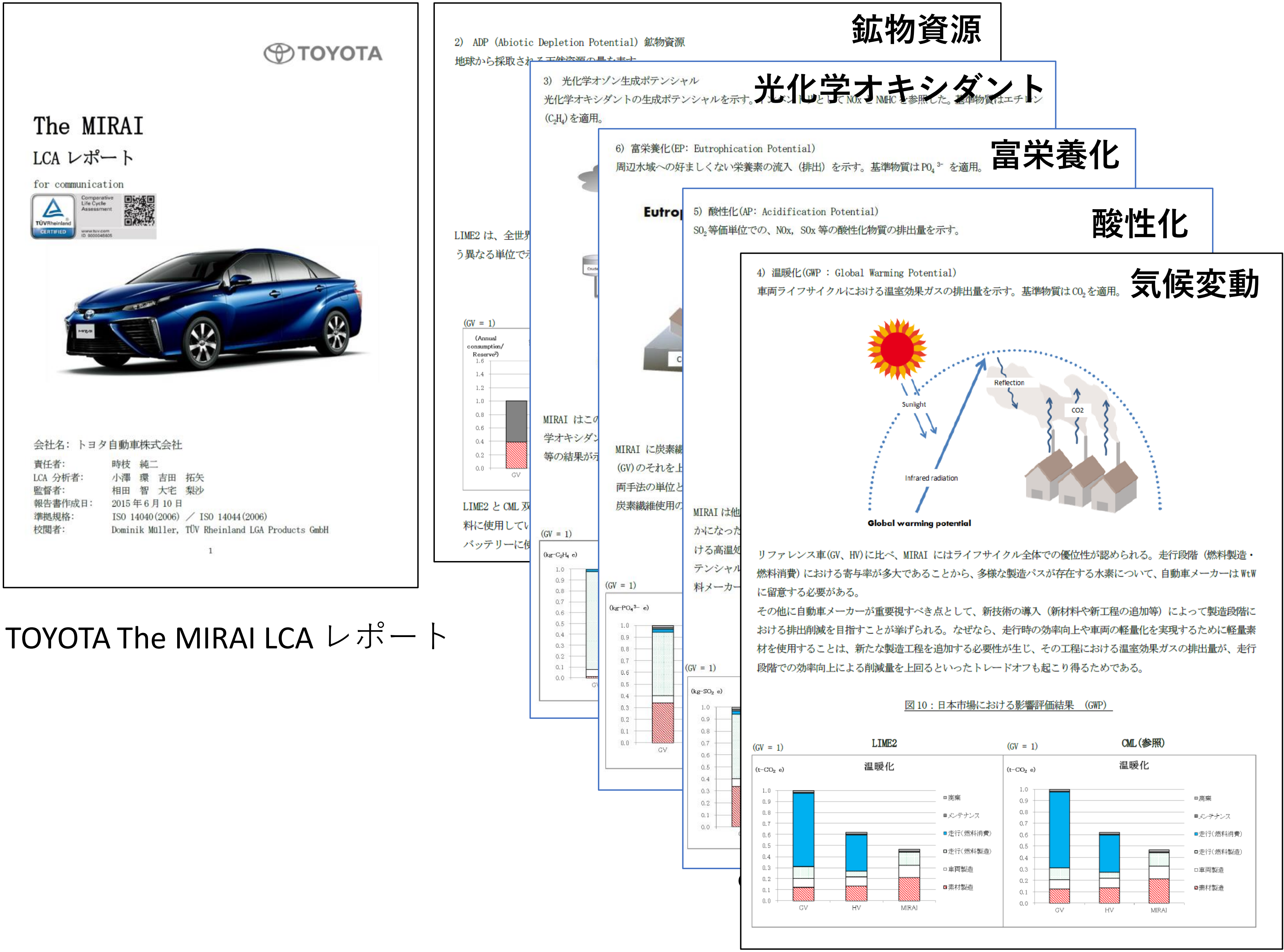
欧州委員会自動車LCA報告書





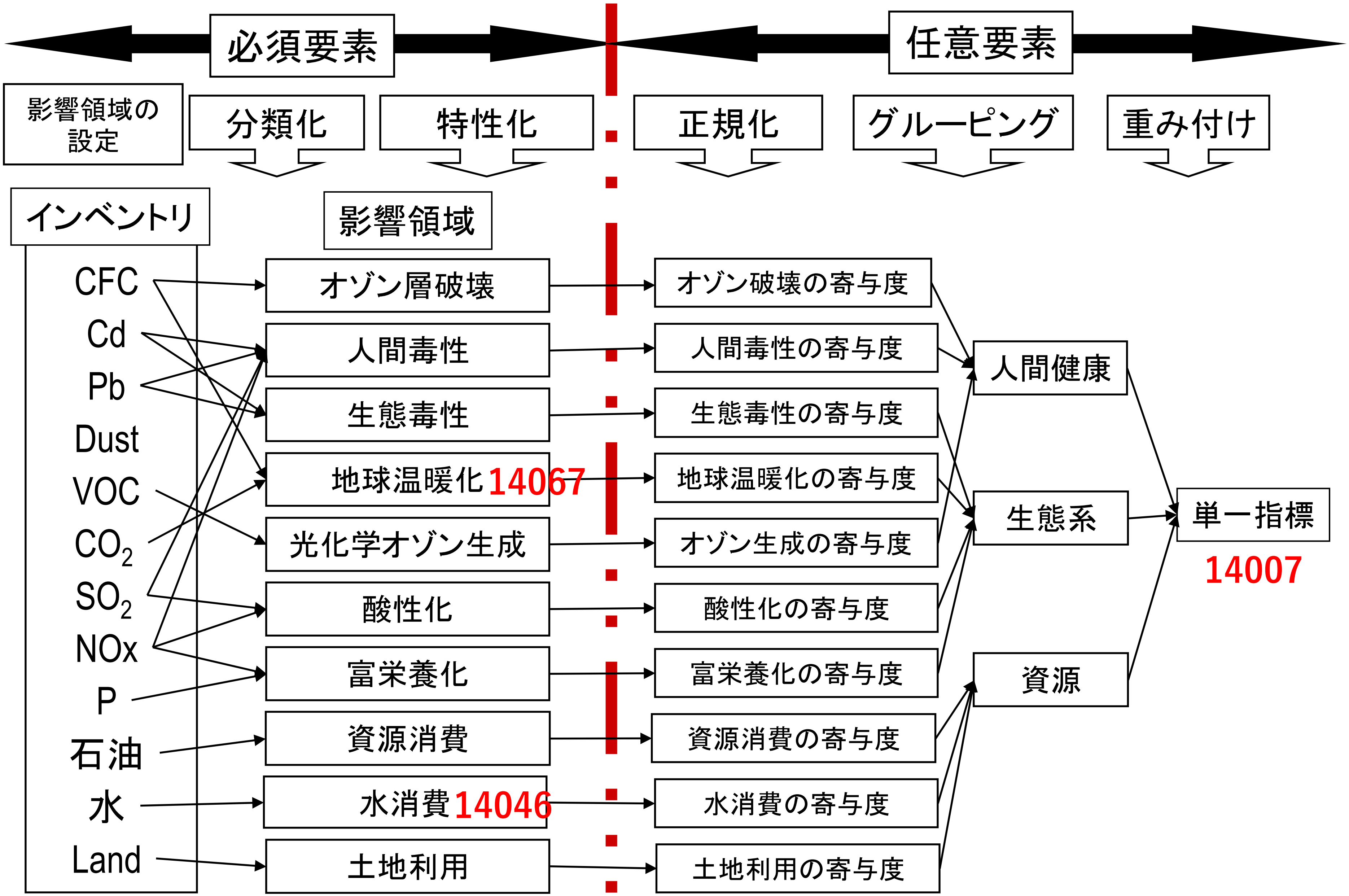


- 欧州委員会主導で自動車LCAを実施した結果を公表
- 2020年7月発行
- 複数の車種を対象
  - ICEV-G, ICEV-D, ICEV-CNG, ICEV-LPG, ICEV-LNG, HEV-G, HEV-D, PHEV-G, PHEV-D, BEV, FCEV
  - Passenger car, Van, Lorry, Bus, Coach,
- 複数の影響領域を網羅
  - 気候変動, エネルギー, 水, 鉱物資源, ヒト毒性, PM, 光化学オゾン
- 2020年時点のほか、30年、50年、1.5℃目標の際の評価について実施
- 欧州における自動車の環境政策に強く影響するものと想定



TOYOTA The MIRAI LCA レポート

ライフサイクル影響評価のフロー(ISO14044より作成)



東洋製缶
飲料容器の評価

【DI缶】
- 一般的なアルミ
- 潤滑剤、缶内面の塗装が必要

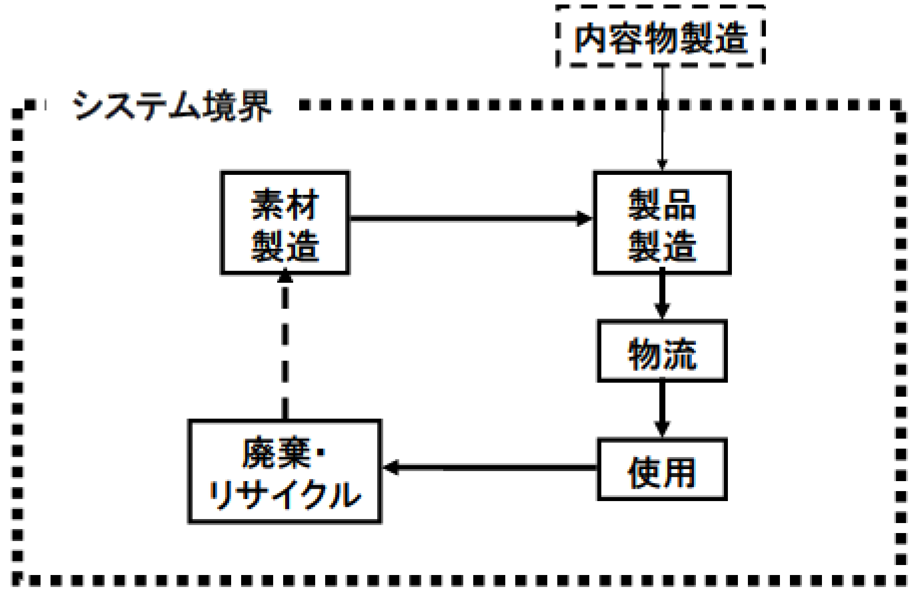
【aTULC】
- Aluminum Toyo Ultimate Can
- 潤滑剤、缶内面の塗装が不要

【PETボトル】
- お茶等が充填できる耐熱ボトル

（炭酸用途がないため耐熱ボトルとした）

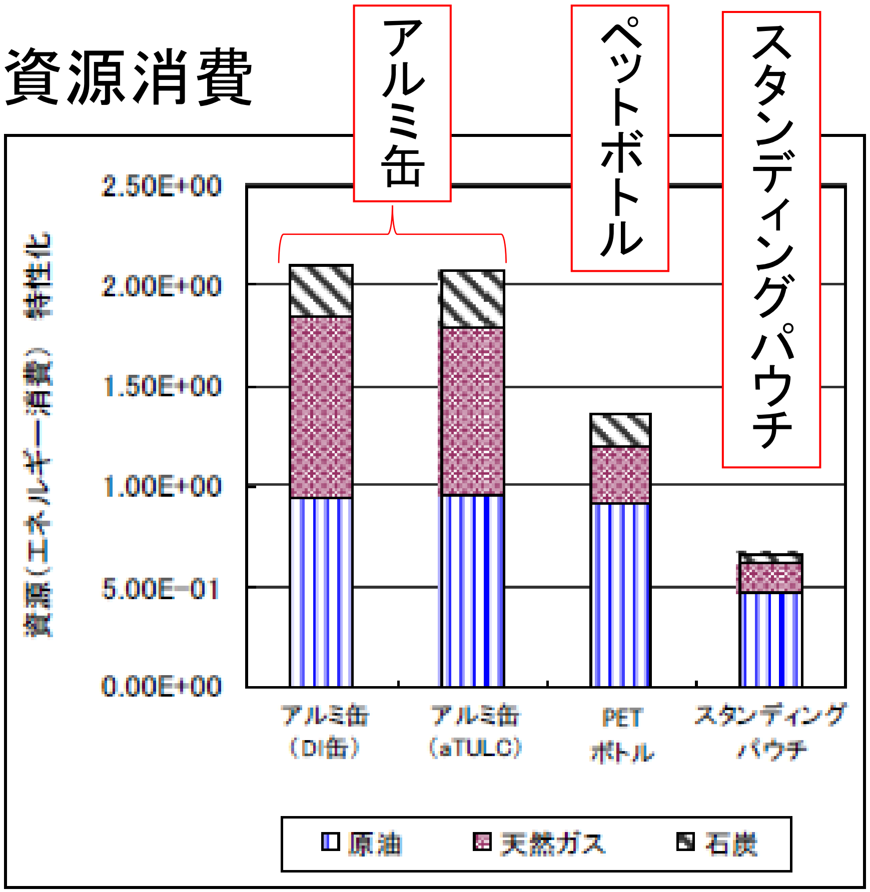
【スタンディングパウチ】
- 洗剤等で用いられる詰め替え用パウチ

（飲料用途がないため洗剤用途とした）

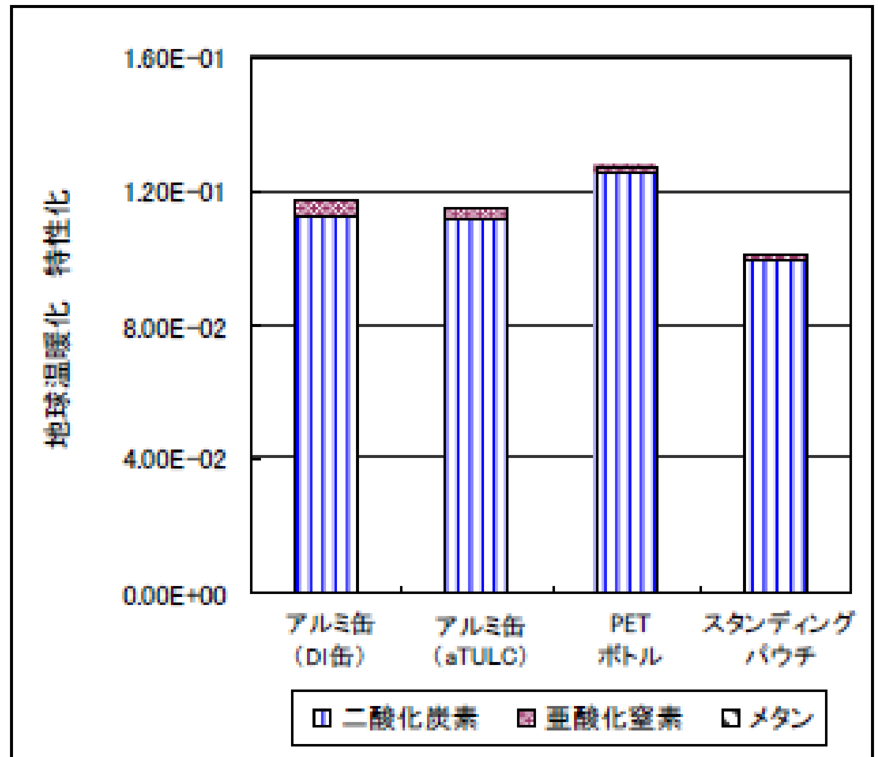


東洋製缶
飲料容器の評価（特性化）

資源消費



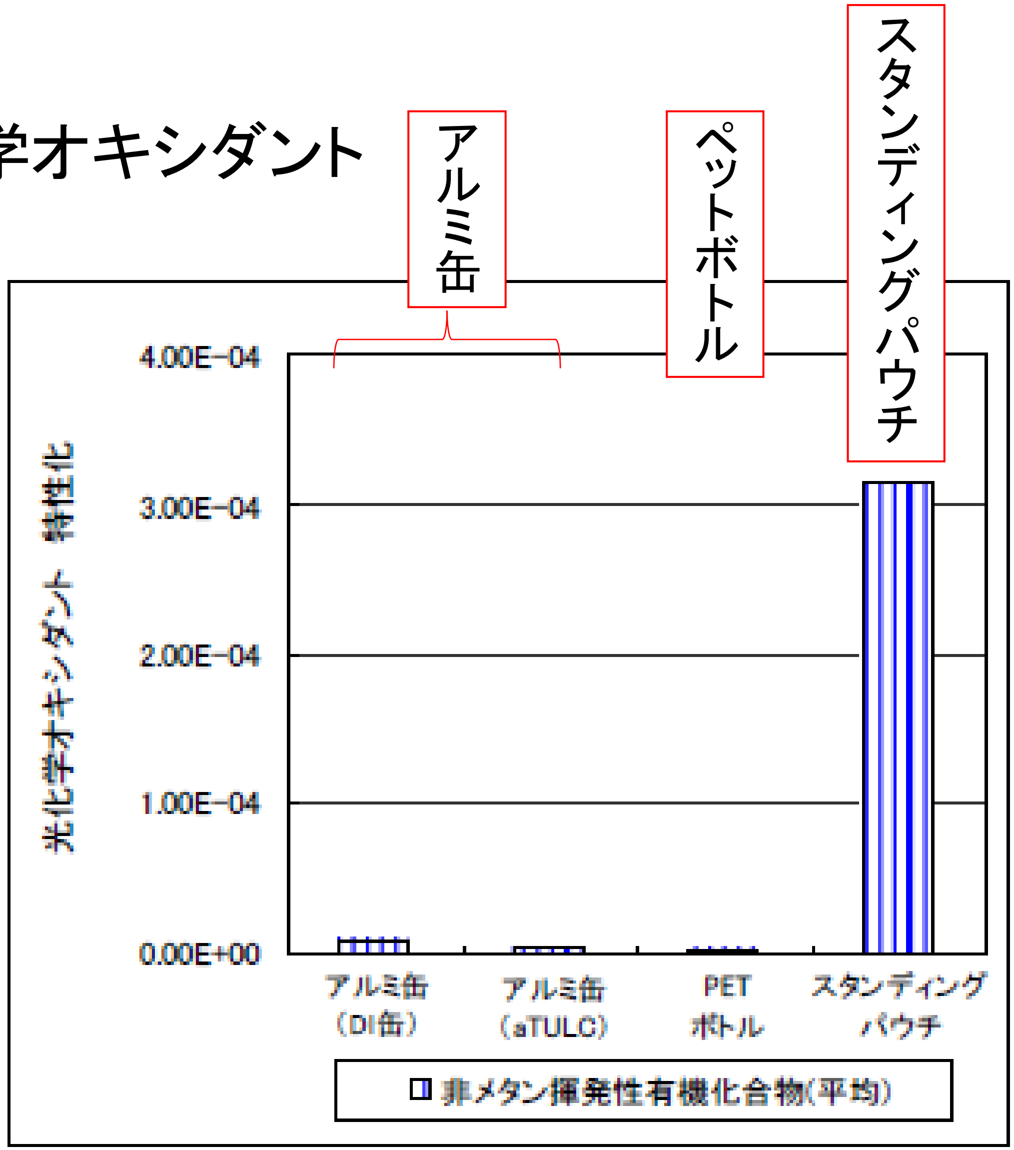
地球温暖化



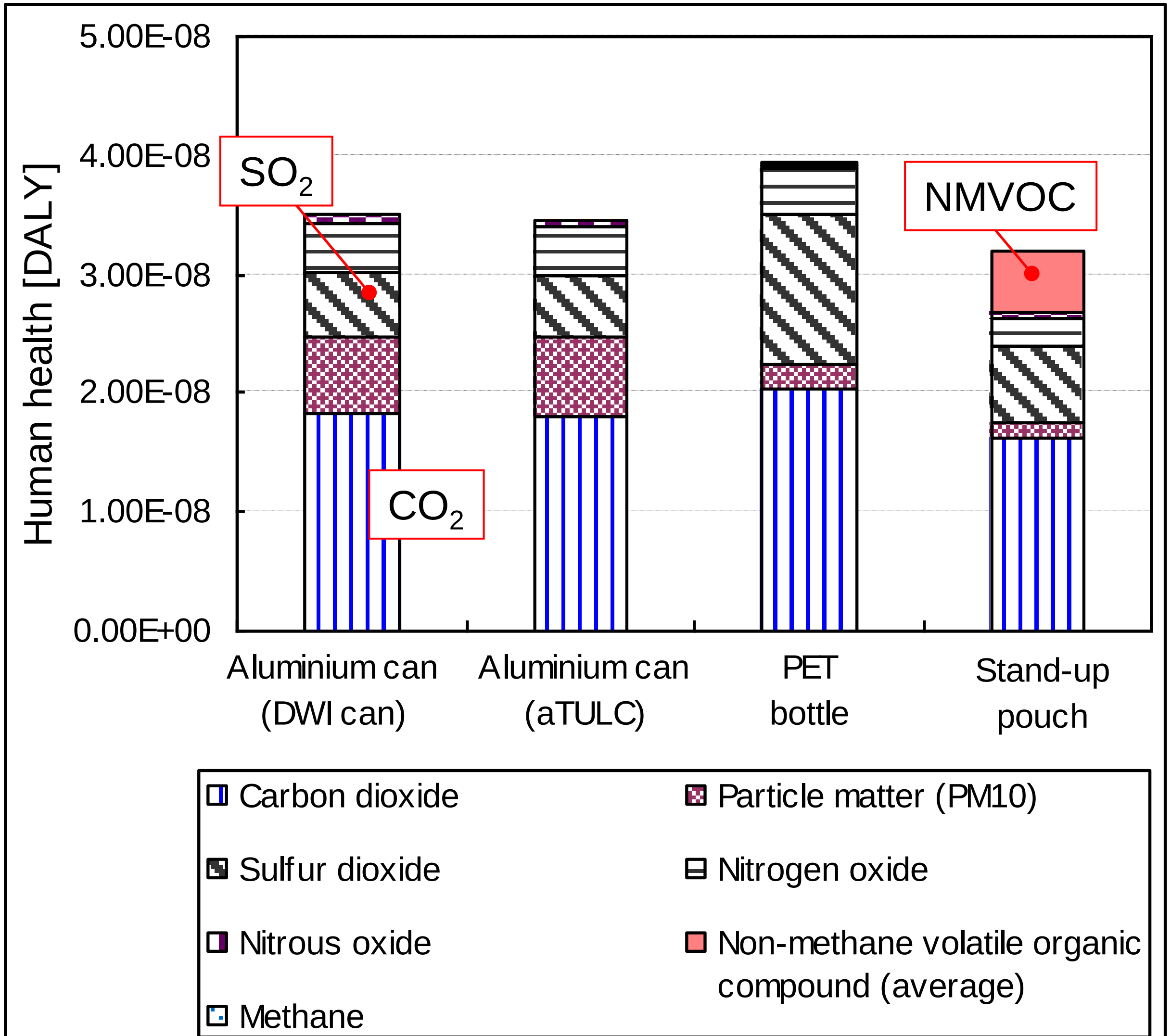
影響領域によっては異なる結果が得られる。

東洋製缶
飲料容器の評価（特性化）

光化学オキシダント

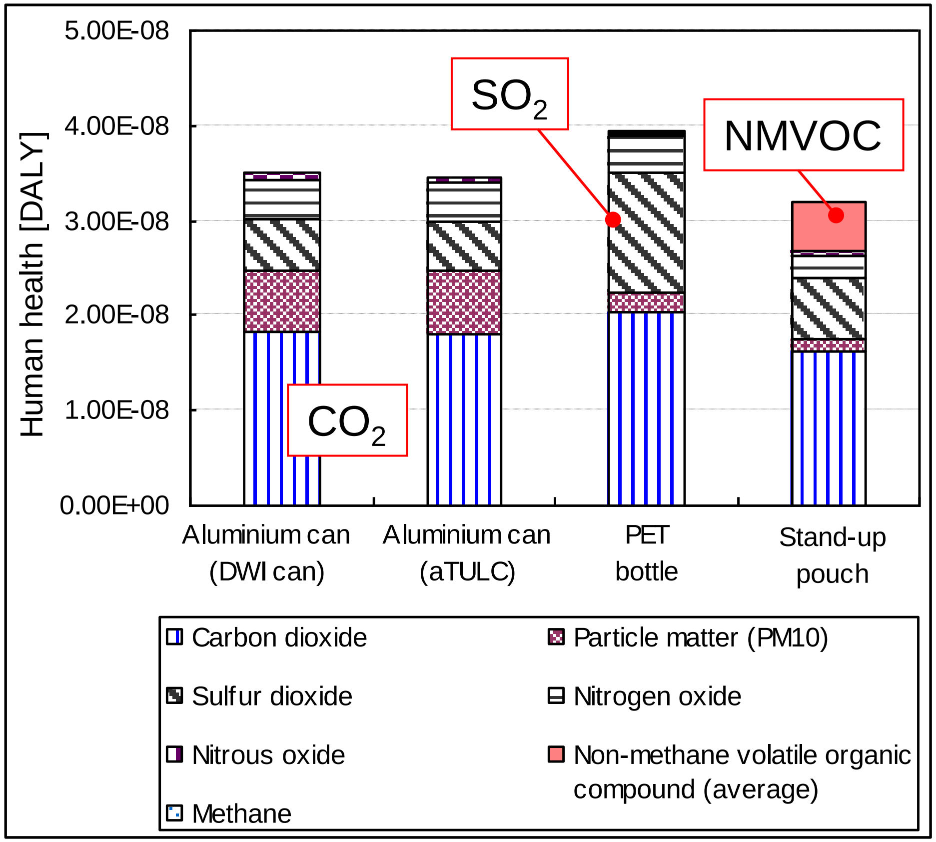


東洋製缶
飲料容器の評価（被害評価:人間健康）

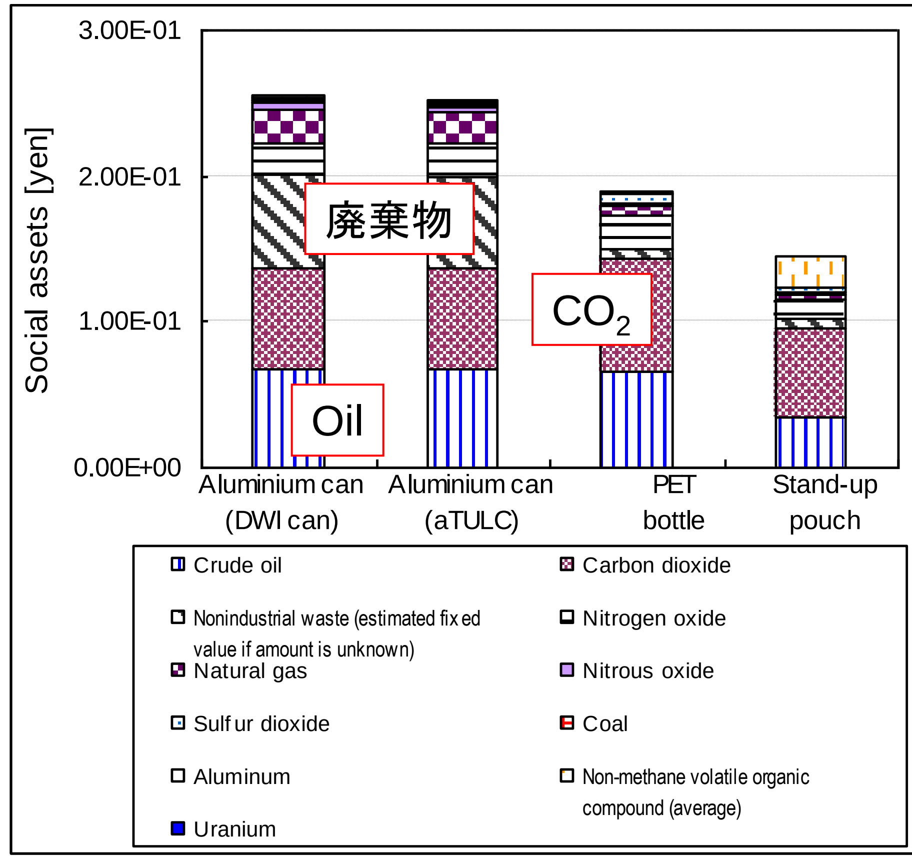


東洋製缶
飲料容器の評価（被害評価）

人間健康

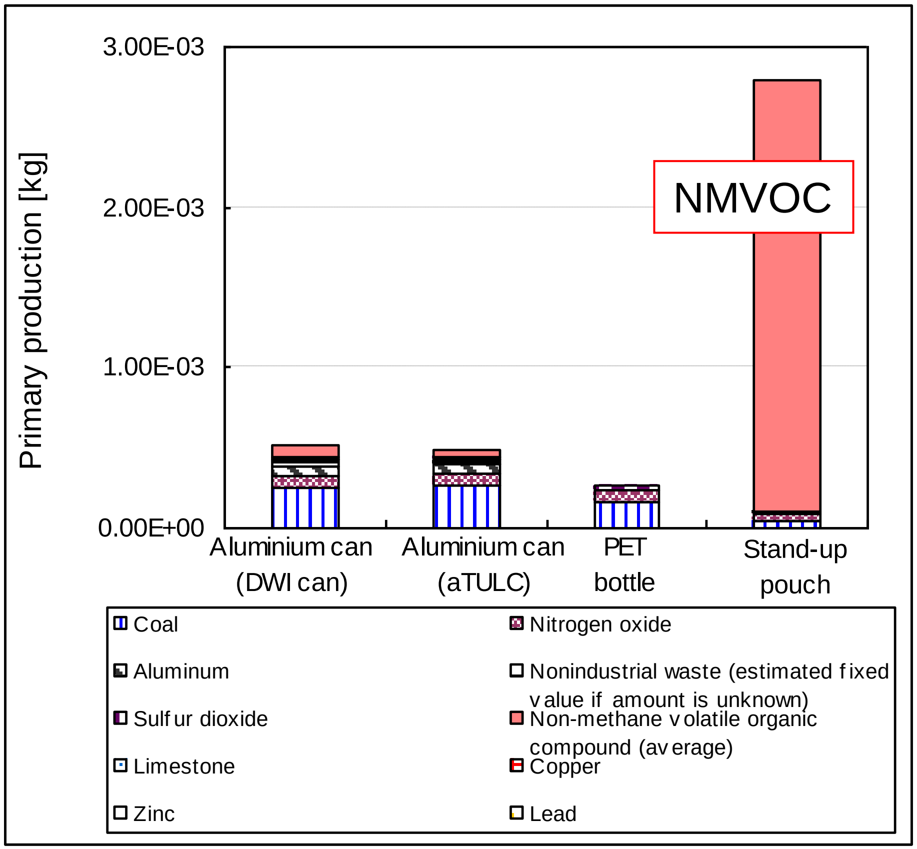


社会資産

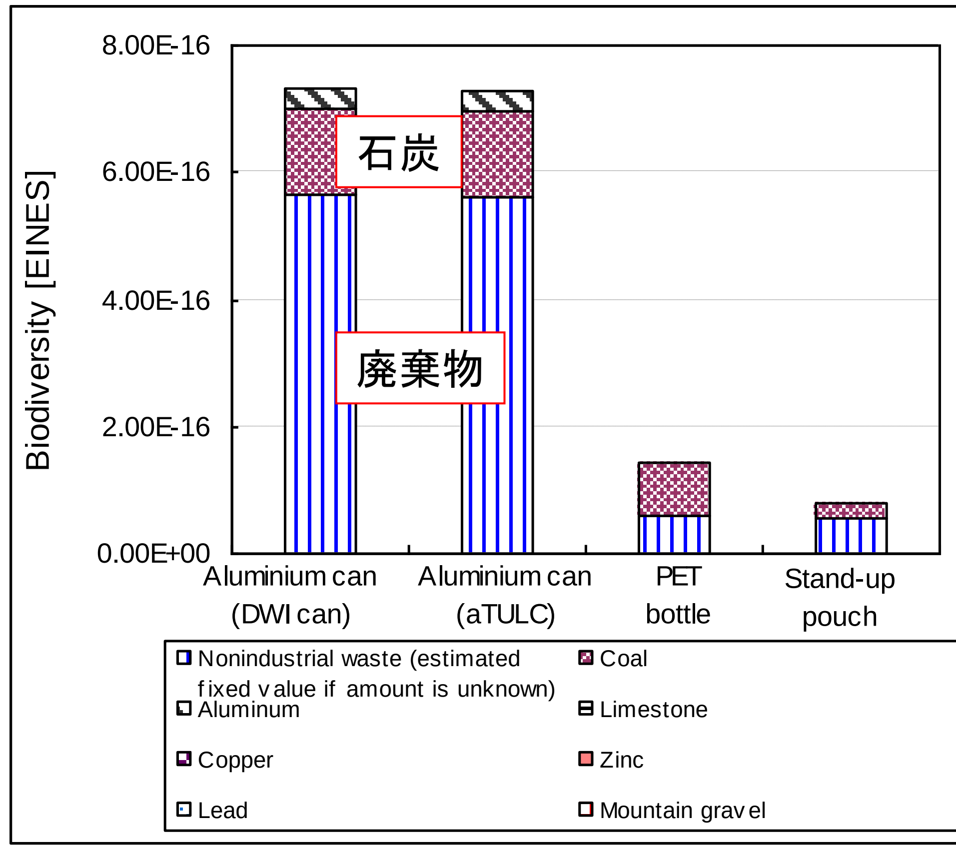


東洋製缶
飲料容器の評価（被害評価）

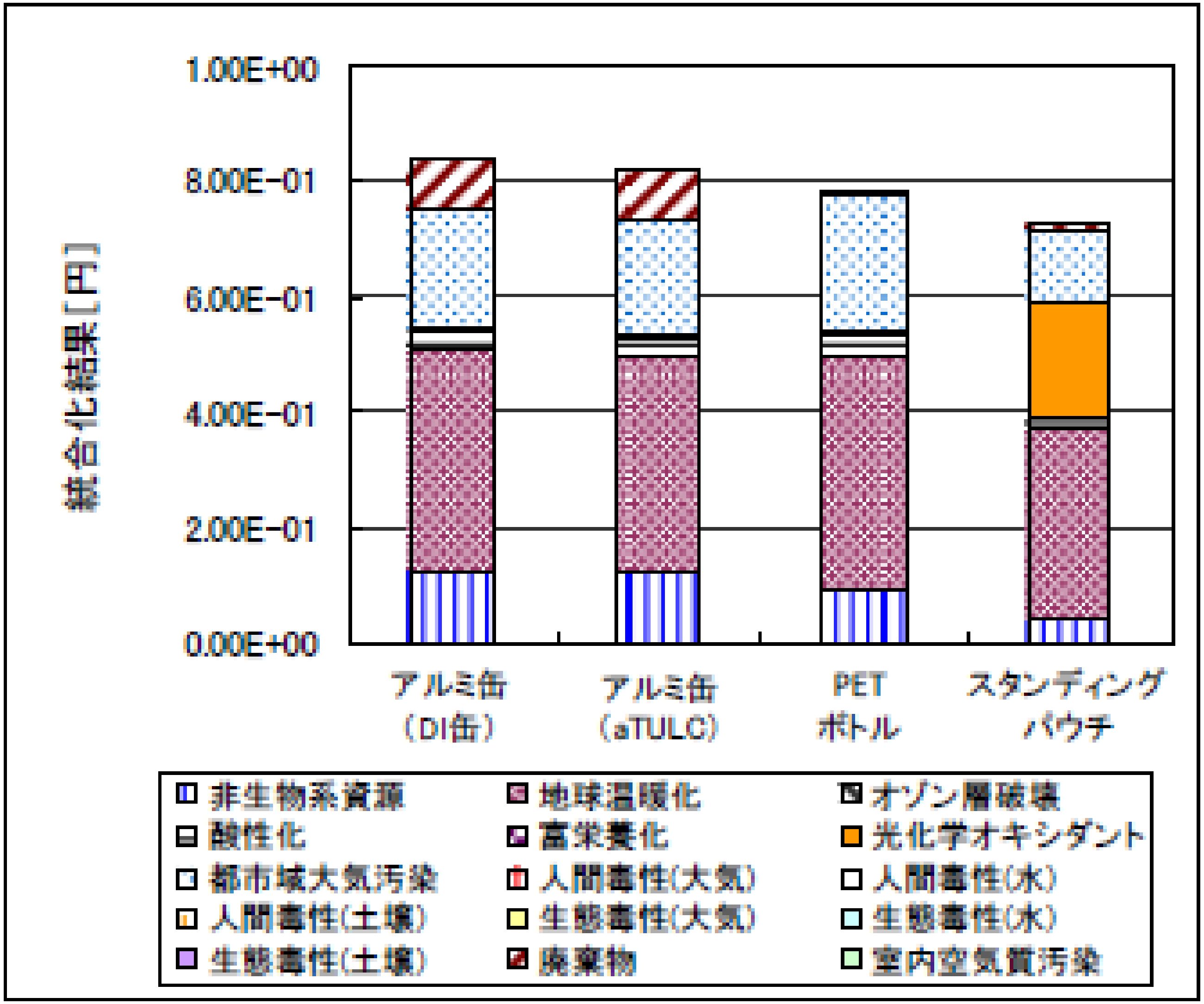
一次生産



生物多様性

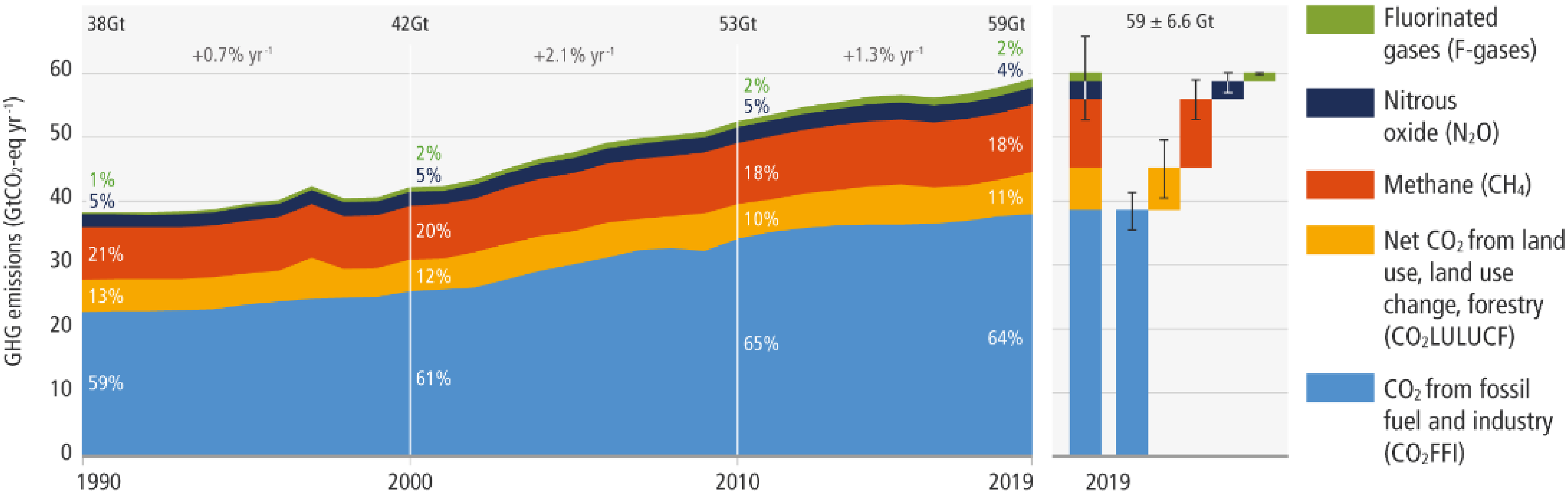


東洋製缶
飲料容器の評価（統合化）

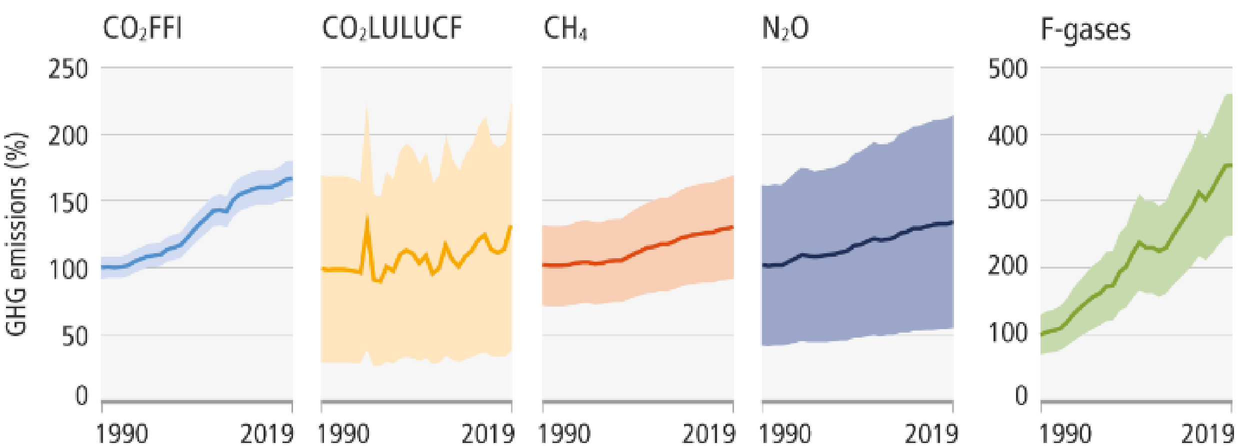


Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.

a. Global net anthropogenic GHG emissions 1990–2019 (5)



b. Global anthropogenic GHG emissions and uncertainties by gas – relative to 1990



	2019 emissions ($GtCO_2$-eq)	1990–2019 increase ($GtCO_2$-eq)	Emissions in 2019, relative to 1990 (%)
CO_2 FFI	38±3	15	167
CO_2 LULUCF	6.6±4.6	1.6	133
CH_4	11±3.2	2.4	129
N_2O	2.7±1.6	0.65	133
F-gases	1.4±0.41	0.97	354
Total	59±6.6	21	154

The solid line indicates central estimate of emissions trends. The shaded area indicates the uncertainty range.

GWP (Global Warming Potential)

$$GWP(x) = \frac{\int_0^{TH} a_x \cdot [x(t)]dt}{\int_0^{TH} a_r \cdot [r(t)]dt}$$

赤外線の吸収強度

大気中寿命

TH: 計算で考慮する排出後の経過時間, ax: 放射強制力 (Wm^{-2}kg^{-1}), x(t):排出後t年経過時の残量, r: 参照ガス (二酸化炭素)

Species	Lifetime (Years)	Radiative Efficiency (W m^{-2} ppb^{-1})	GWP-20	GWP-100	GWP-500
CO_2	Multiple	$1.33 \pm 0.16 \times 10^{-5}$	1.	1.000	1.000
CH_4-fossil	11.8 ± 1.8	$5.7 \pm 1.4 \times 10^{-4}$	82.5 ± 25.8	29.8 ± 11	10.0 ± 3.8
CH_4-non fossil	11.8 ± 1.8	$5.7 \pm 1.4 \times 10^{-4}$	79.7 ± 25.8	27.0 ± 11	7.2 ± 3.8
N_2O	109 ± 10	$2.8 \pm 1.1 \times 10^{-3}$	273 ± 118	273 ± 130	130 ± 64
HFC-32	5.4 ± 1.1	$1.1 \pm 0.2 \times 10^{-1}$	2693 ± 842	771 ± 292	220 ± 87
HFC-134a	14.0 ± 2.8	$1.67 \pm 0.32 \times 10^{-1}$	4144 ± 1160	1526 ± 577	436 ± 173
CFC-11	52.0 ± 10.4	$2.91 \pm 0.65 \times 10^{-1}$	8321 ± 2419	6226 ± 2297	2093 ± 865
PFC-14	50,000	$9.89 \pm 0.19 \times 10^{-2}$	5301 ± 1395	7380 ± 2430	10,587 ± 3692

特性化(地球温暖化)
例：冷蔵庫1台のLCA

データ項目	インベントリ(kg)	GWP_{100}	カテゴリインディケータ
CH_4	0.15	29.8	4.47
CO_2	3,000	1	3.0×10^3
HFC-134a	1.0	1526	1.53×10^3
N_2O	0.2	273	5.46×10^1
合計			4.59×10^3 kg CO_{2eq}

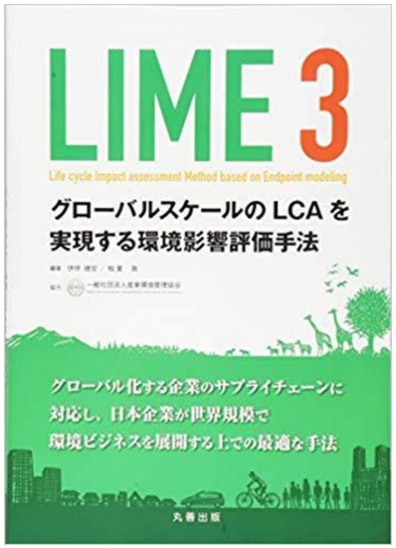
影響領域および特性化係数の一覧

影響領域	特性化係数	備考	影響領域	特性化係数	備考
地球温暖化	GWP_{100}	放射強制力	水生生態毒性	AETP(J)	Conc./PNEC
オゾン層破壊	ODP_{∞}	オゾン破壊能力	鉱物資源	1/R	可採埋蔵量の逆数
酸性化	DAP	酸性降下物の沈着	化石燃料	Total MJ	エネルギー消費
光化学オゾン	OECF(J)	オゾン生成能	土地利用(改変)	Area	改変面積の総和
富栄養化	EP(J)	DO濃度の変化	土地利用(占有)	Area × time	占有面積と占有期間
人間毒性	HTP(J)	Exposure/ADI	廃棄物	Volume	体積
陸生生態毒性	TETP(J)	Conc./PNEC			

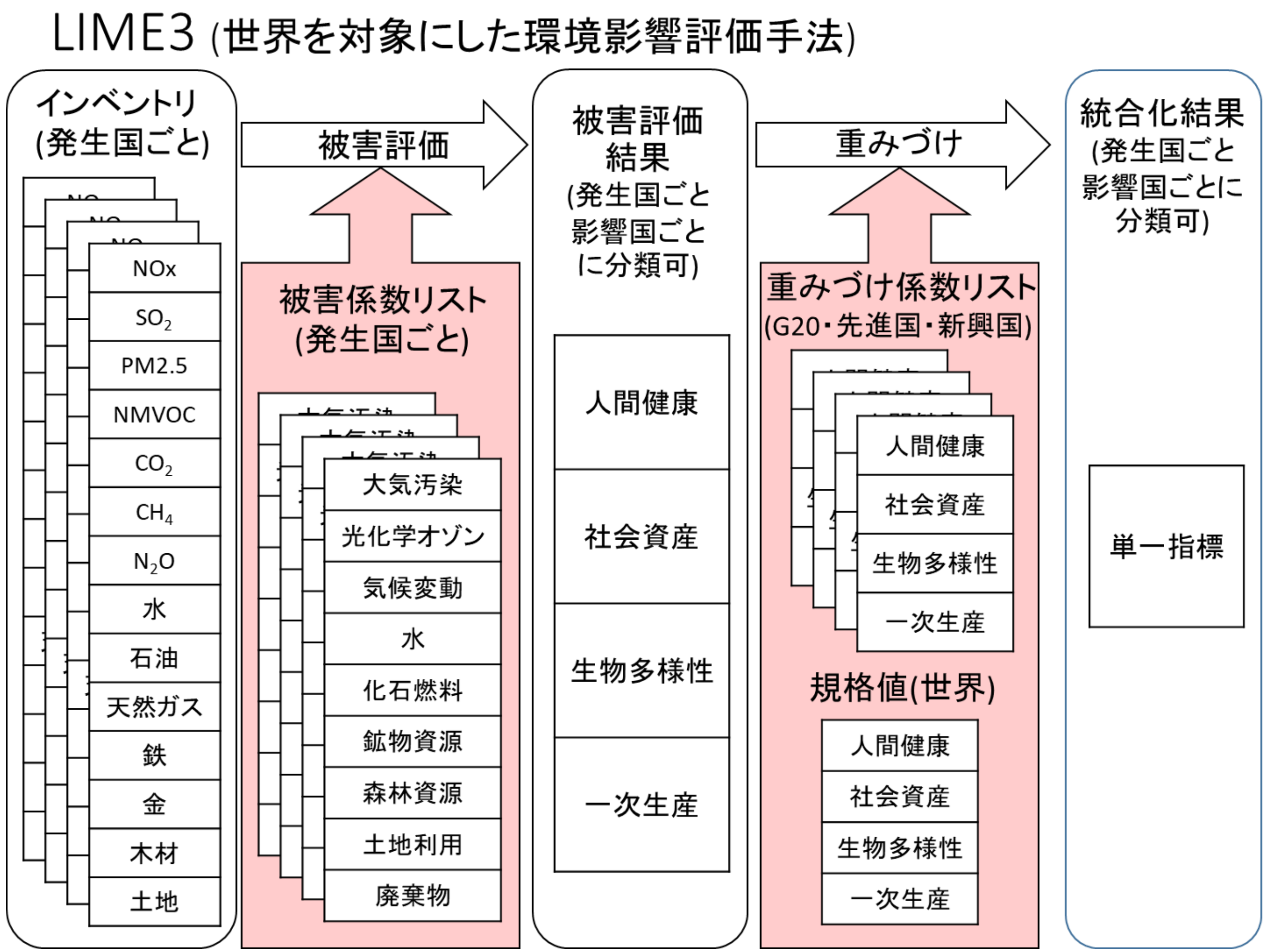
国際的に合意　評価地域の環境条件に依存　合意に至っていない

LIME3

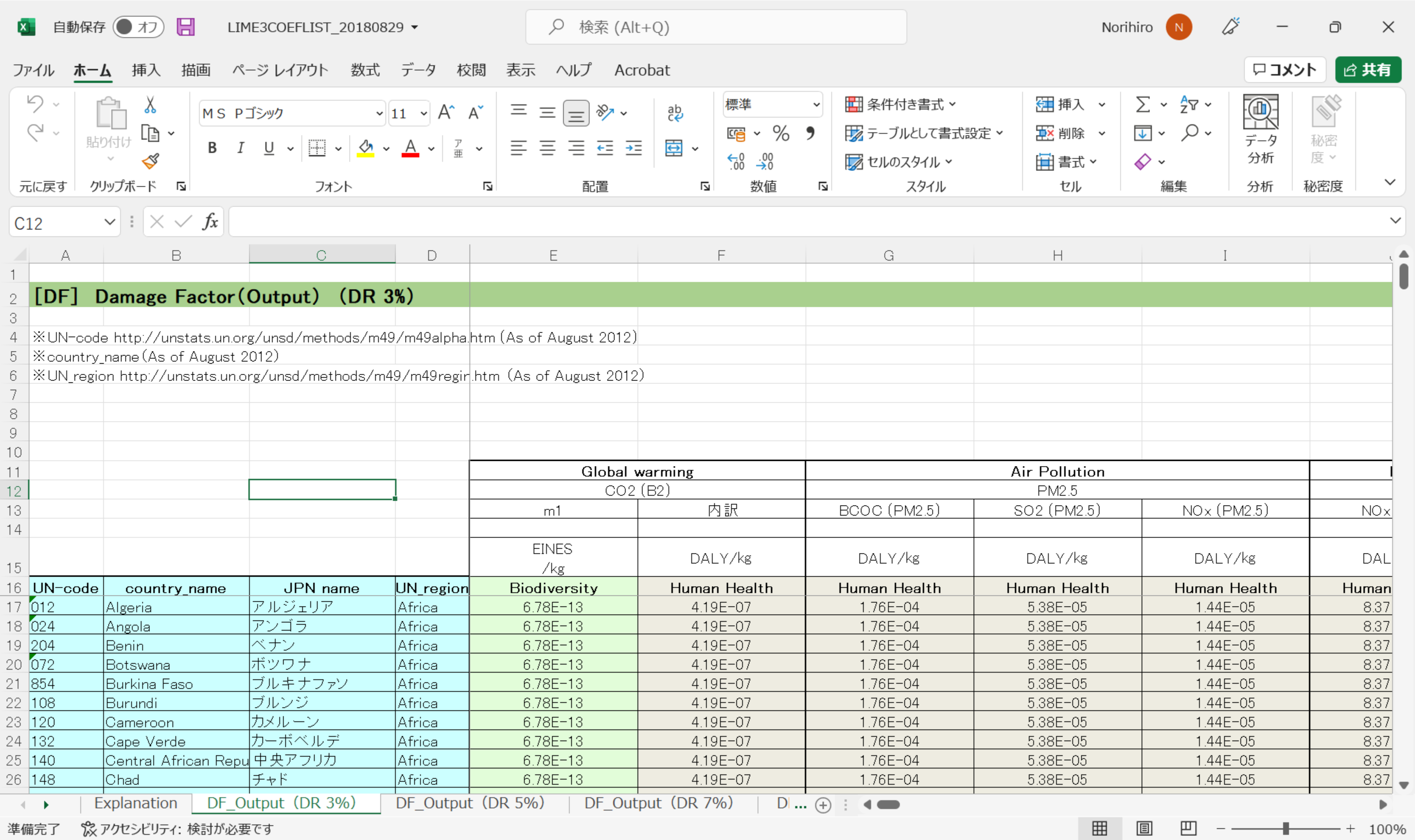
- 内閣府・日本学術振興会：最先端次世代研究開発支援プログラム(2010年～2014年)
- 世界版のLCAの影響評価手法
- 9影響領域 (気候変動、大気汚染、光化学オゾン、水、化石燃料、鉱物資源、森林資源、土地利用、廃棄物)
- 経済評価：G20各国国民の環境思想を反映
- 国際貿易を考慮した分析評価



伊坪徳宏、稲葉敦編: LIME3 ―グローバルスケールのLCAを実現する環境影響評価手法―丸善出版 (2018)



LIME3被害係数・統合化係数リスト



[DF] Damage Factor(Output) (DR 3%)

※UN-code http://unstats.un.org/unsd/methods/m49/m49alpha.htm (As of August 2012)
※country_name (As of August 2012)
※UN_region http://unstats.un.org/unsd/methods/m49/m49regin.htm (As of August 2012)

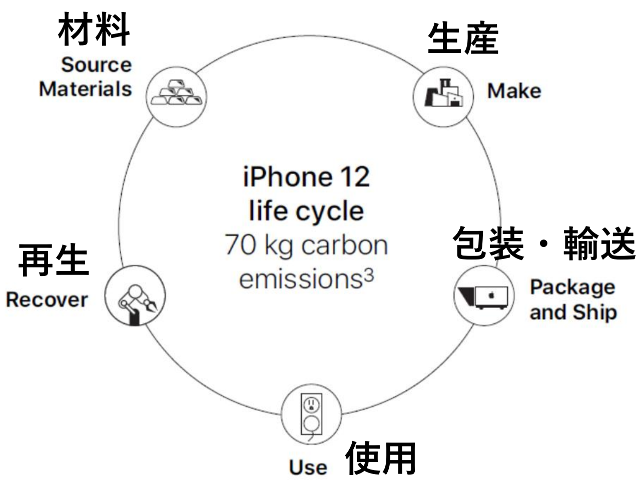
				Global warming		Air Pollution			
				CO2 (B2)		PM2.5			
				m1	内訳	BCOC (PM2.5)	SO2 (PM2.5)	NOx (PM2.5)	NOx
				EINES /kg	DALY/kg	DALY/kg	DALY/kg	DALY/kg	DAL
UN-code	country_name	JPN name	UN_region	Biodiversity	Human Health	Human Health	Human Health	Human Health	Human
012	Algeria	アルジェリア	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
024	Angola	アンゴラ	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
204	Benin	ベナン	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
072	Botswana	ボツワナ	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
854	Burkina Faso	ブルキナファソ	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
108	Burundi	ブルンジ	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
120	Cameroon	カメルーン	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
132	Cape Verde	カーボベルデ	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
140	Central African Repu	中央アフリカ	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37
148	Chad	チャド	Africa	6.78E-13	4.19E-07	1.76E-04	5.38E-05	1.44E-05	8.37

本日の講義内容

- LCAの意義
  - SDGsの目標設定、経営統合
- LCAの実施方法
  - 国際規格
  - インベントリ分析・データベース
  - 影響評価
- 今後の展望
  - カーボンプライシング
  - 自然資本、生物多様性

LCAの活用例

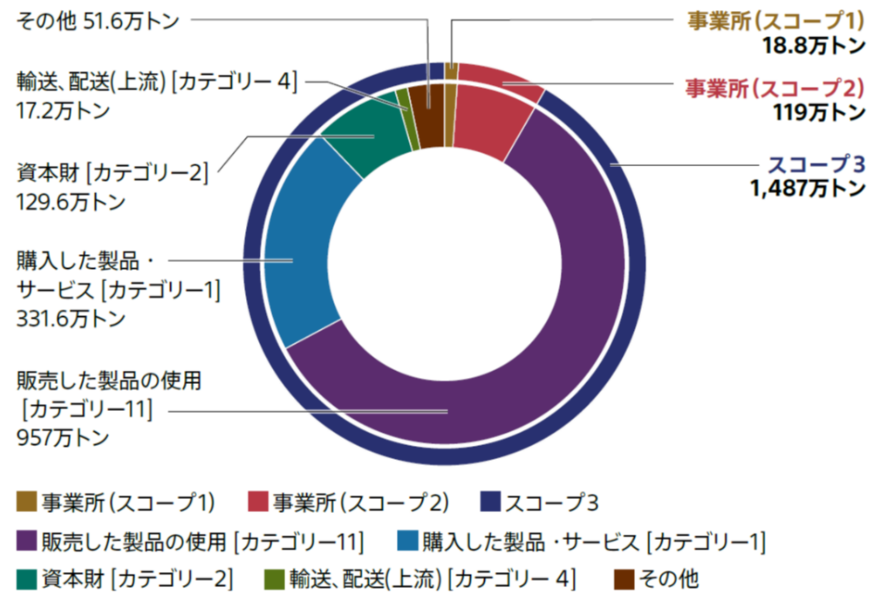
製品情報開示



SCOPE3

SONY

バリューチェーンにおける温室効果ガス排出量



環境フットプリント

気候変動

水消費
土地利用

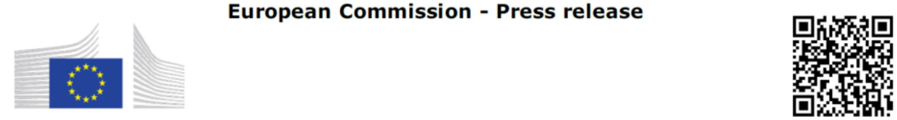
廃棄物

富栄養化

REGULAR STRAIGHT 505® JEANS / STEEL (LESS WATER) (PC9 00505-0352)

IMPACT CATEGORY	QUANTITY
Global Warming Potential	15 Kg CO2 - equivalents
Energy Use	170 Megajoules
Renewable Energy	15%
Water Use	5.9 Cubic meters
Land Occupation	6.6 Square meter a year
Qualified Sustainably Grown Fiber	0%
Primary Waste	0.09 Kg
Materials Efficiency	87%
Recycled Content	1%
Eutrophication	0.004 Kg Phosphorous equivalents
Land Transformation	0.002 Square meters
Restricted Substance List Compliance	Full Adherence

開示義務化



European Commission - Press release

Green Deal: Sustainable batteries for a circular and climate neutral economy

Brussels, 10 December 2020

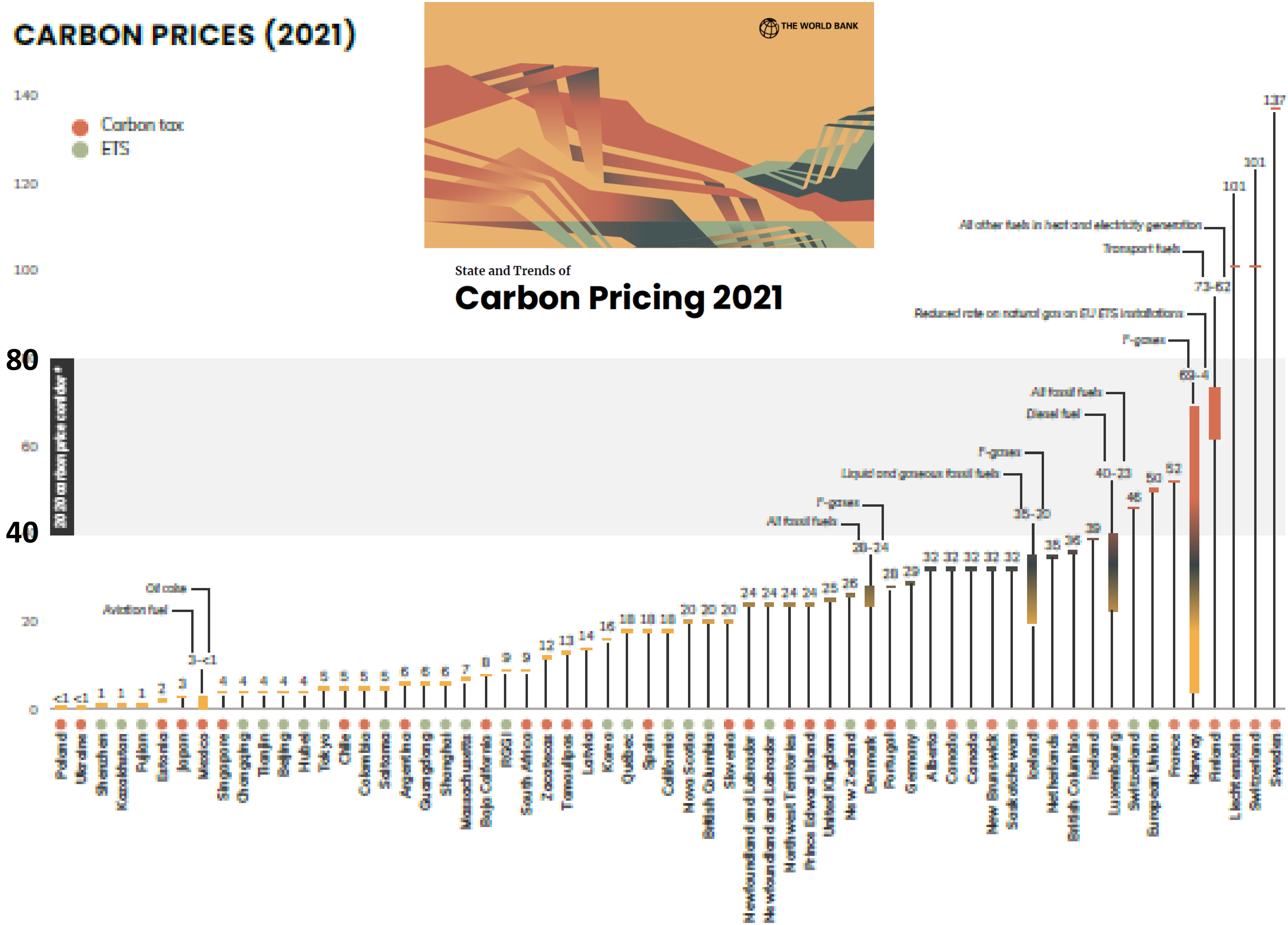
Today, the European Commission proposes to modernise EU legislation on batteries, delivering its first initiative among the actions announced in the new Circular Economy Action Plan. Batteries that are more sustainable throughout their life cycle are key for the goals of the European Green Deal and contribute to the zero pollution ambition set in it. They promote competitive sustainability and are necessary for green transport, clean energy and to achieve climate neutrality by 2050. The proposal addresses the social, economic and environmental issues related to all types of batteries.

Batteries placed on the EU market should become sustainable, high-performing and safe all along their entire life cycle. This means batteries that are produced with the lowest possible environmental impact, using materials obtained in full respect of human rights as well as social and ecological standards. Batteries have to be long-lasting and safe, and at the end of their life, they should be repurposed, remanufactured or recycled, feeding valuable materials back into the economy.

全ての電池でCFP開示義務化

EUETSの取引額推移

CARBON PRICES (2021)



IPCCAR5 (Social Cost of Carbon)

Climate Change 2014
Mitigation of Climate Change

Working Group III Contribution to the
Fifth Assessment Report of the
Intergovernmental Panel on Climate Change

Edited by

Ottmar Edenhofer
Working Group III Co-Chair
Potsdam Institute for
Climate Impact Research

Ramón Pichs-Madruga
Working Group III Co-Chair
Centro de Investigaciones de la
Economía Mundial

Youba Sokona
Working Group III Co-Chair
South Centre

Jan C. Minx
Head of TSU

Ellie Farahani
Head of Operations

Susanne Kadner
Head of Science

Kristin Seyboth
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Project Officer

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Senior Economist

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Scientific Editor

Benjamin Kriemann
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Jussi Savolainen
Web Manager

Steffen Schlömer
Scientist

Christoph von Stechow
Scientist

Timm Zwickel
Senior Scientist

Working Group III Technical Support Unit

CAMBRIDGE
UNIVERSITY PRESS

Climate Change 2014 Mitigation of Climate Change, Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

- **Chapter 3. Social, Economic, and Ethical Concepts and Methods**
  - **3.9 Metrics of Cost and Benefit**
    - **3.9.4 Social Cost of Carbon**

Equation 3.9.3 $$MDCC = \frac{\partial PVD}{\partial E_0}$$

When applied to CO_2 this equation gives the marginal damage from the change in climate that results from an extra tonne of carbon. It is also called the social cost of carbon (SCC). It should be empha-

- ➢ SCC = $CO_2$1トンの追加排出による被害の変化 = 1トン削減による便益
- ➢ 削減の費用<SCCであれば導入 →政策意思決定に利用
- ➢ 具体的な値に関する記述は無い

米国政権によるSCC

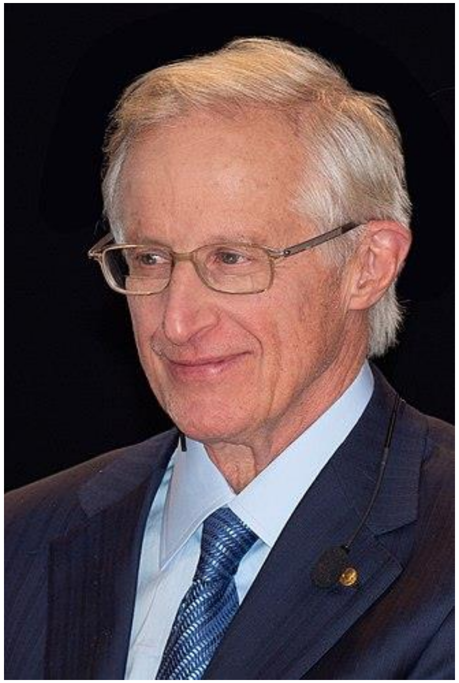
7　　42　　51

炭素社会費用 (Social Cost of Carbon) US$/t$CO_2$

$CO_2$1トン排出による被害額、もしくは、1トン削減による便益

IAMに基づくSCCの算定

W. Nordhaus



DICE

DICE 2013R:
Introduction and User's Manual

William Nordhaus
with
Paul Sztorc

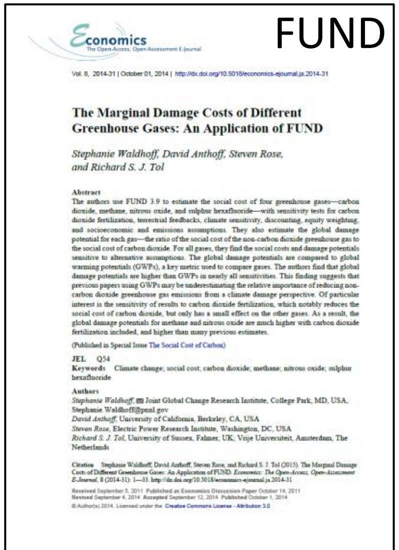
Second edition
October 2013

First edition: April 2013
Website: dicemodel.net

1

R. Tol

FUND



Economics
The Open-Access, Open-Assessment E-Journal

Vol. 8, 2014-31 | October 01, 2014 | http://dx.doi.org/10.5018/economics-ejournal.ja.2014-31

The Marginal Damage Costs of Different Greenhouse Gases: An Application of FUND

Stephanie Waldhoff, David Anthoff, Steven Rose, and Richard S. J. Tol

Abstract
The authors use FUND 3.9 to estimate the social cost of four greenhouse gases—carbon dioxide, methane, nitrous oxide, and sulphur hexafluoride—with sensitivity tests for carbon dioxide fertilization, terrestrial feedbacks, climate sensitivity, discounting, equity weighting, and socioeconomic and emissions assumptions. They also estimate the global damage potential for each gas—the ratio of the social cost of the non-carbon dioxide greenhouse gas to the social cost of carbon dioxide. For all gases, they find the social costs and damage potentials sensitive to alternative assumptions. The global damage potentials are compared to global warming potentials (GWPs), a key metric used to compare gases. The authors find that global damage potentials are higher than GWPs in nearly all sensitivities. This finding suggests that previous papers using GWPs may be underestimating the relative importance of reducing non-carbon dioxide greenhouse gas emissions from a climate damage perspective. Of particular interest is the sensitivity of results to carbon dioxide fertilization, which notably reduces the social cost of carbon dioxide, but only has a small effect on the other gases. As a result, the global damage potentials for methane and nitrous oxide are much higher with carbon dioxide fertilization included, and higher than many previous estimates.

(Published in Special Issue The Social Cost of Carbon)

JEL Q54
Keywords Climate change; social cost; carbon dioxide; methane; nitrous oxide; sulphur hexafluoride

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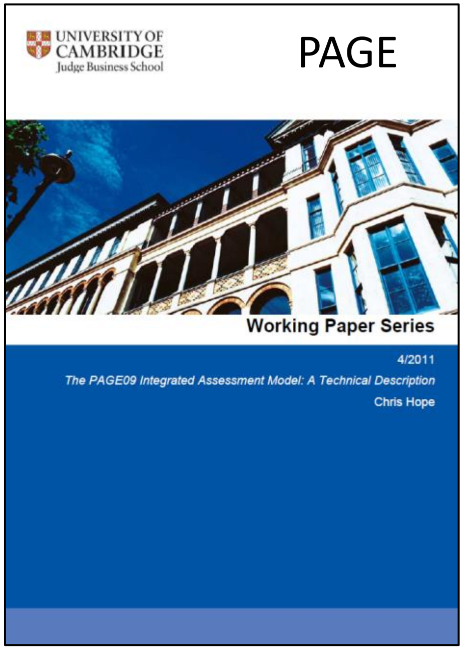
Citation Stephanie Waldhoff, David Anthoff, Steven Rose, and Richard S. J. Tol (2015). The Marginal Damage Costs of Different Greenhouse Gases: An Application of FUND. *Economics: The Open-Access, Open-Assessment E-Journal*, 8 (2014-31): 1—33. http://dx.doi.org/10.5018/economics-ejournal.ja.2014-31

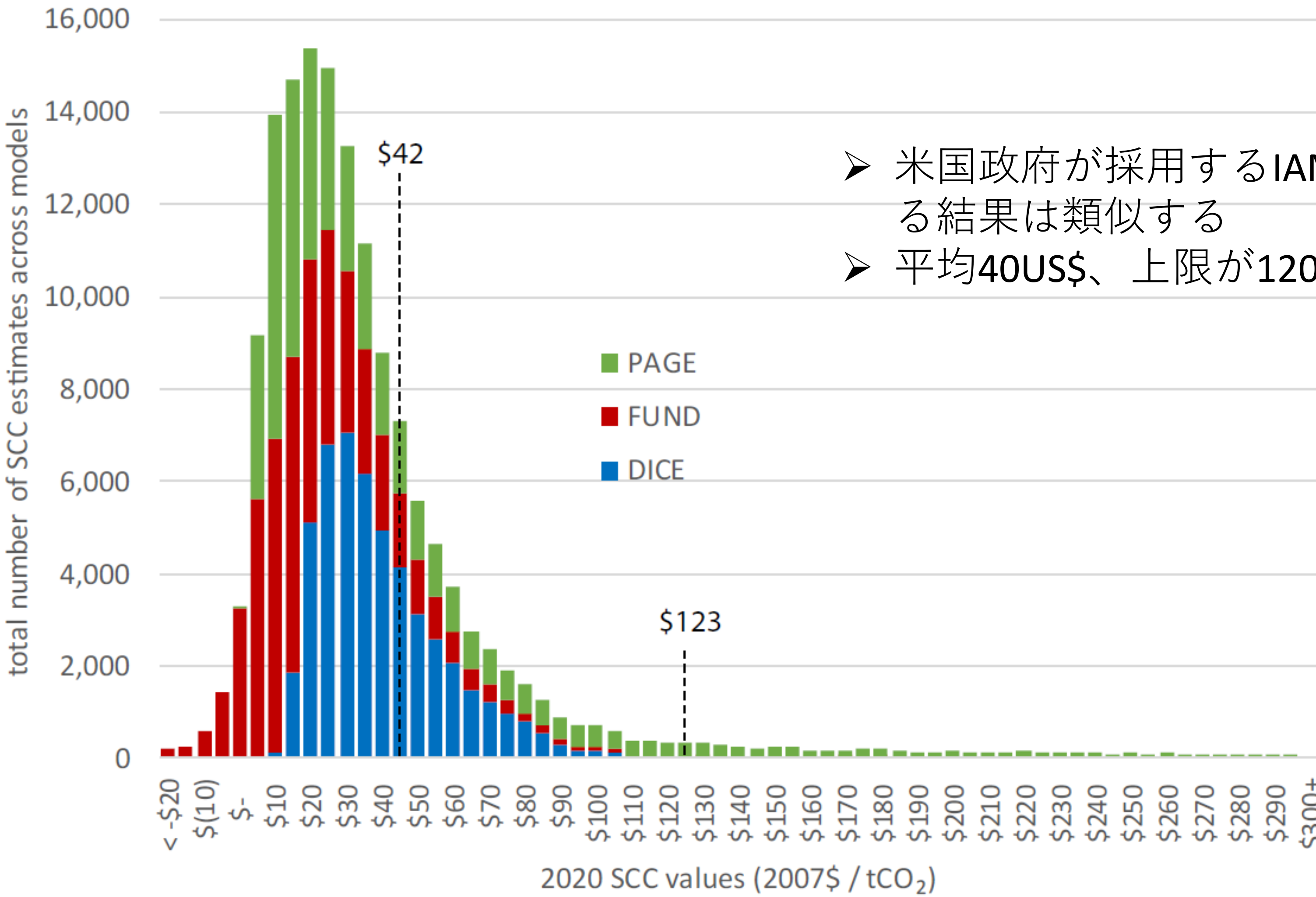
Received September 5, 2011 Published as Economics Discussion Paper October 14, 2011
Revised September 4, 2014 Accepted September 12, 2014 Published October 1, 2014

C. Hope

PAGE



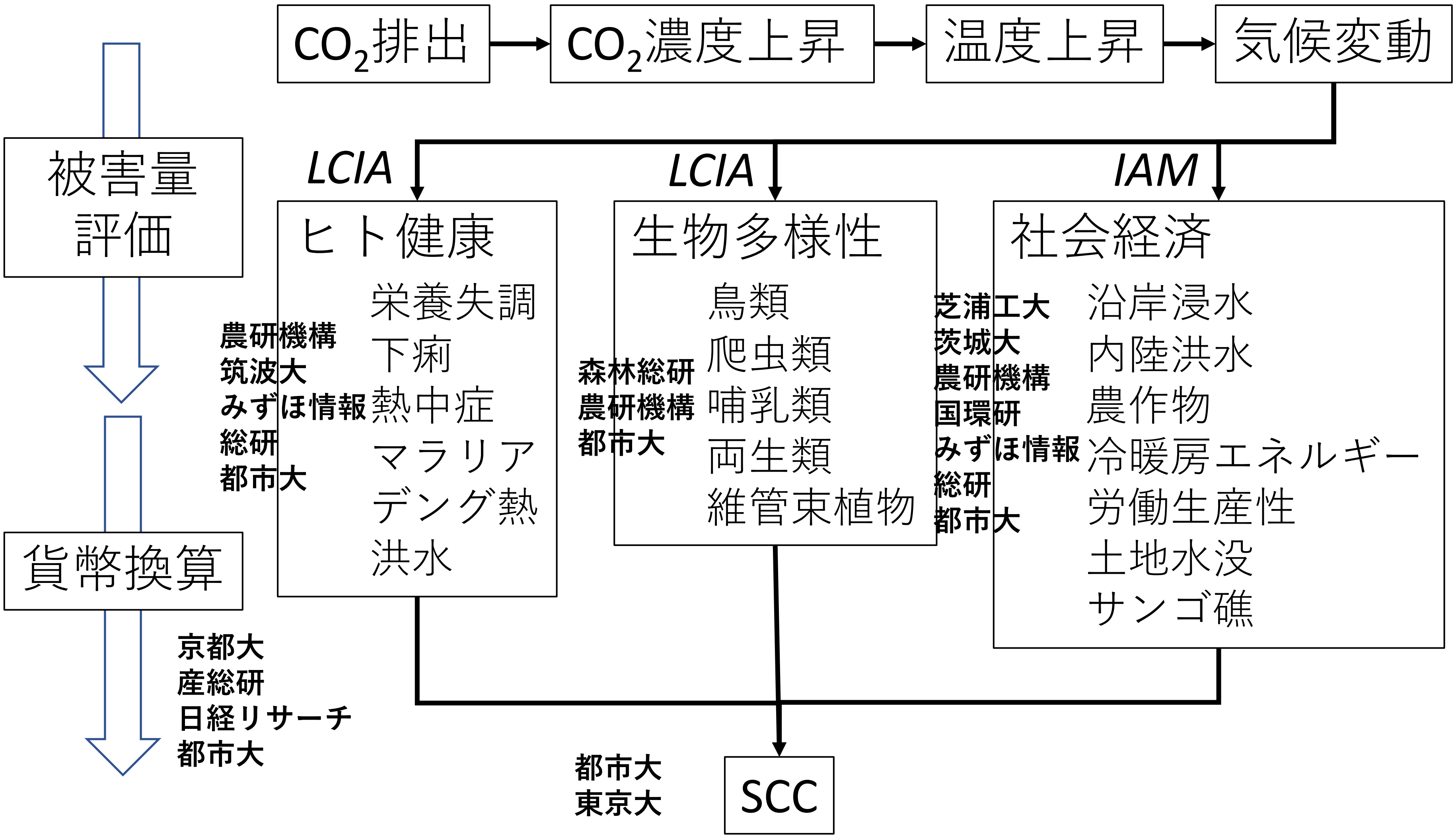
主なIAMに基づくSCCの分布



- 米国政府が採用するIAMモデルによる結果は類似する
- 平均40US$、上限が120US$程度

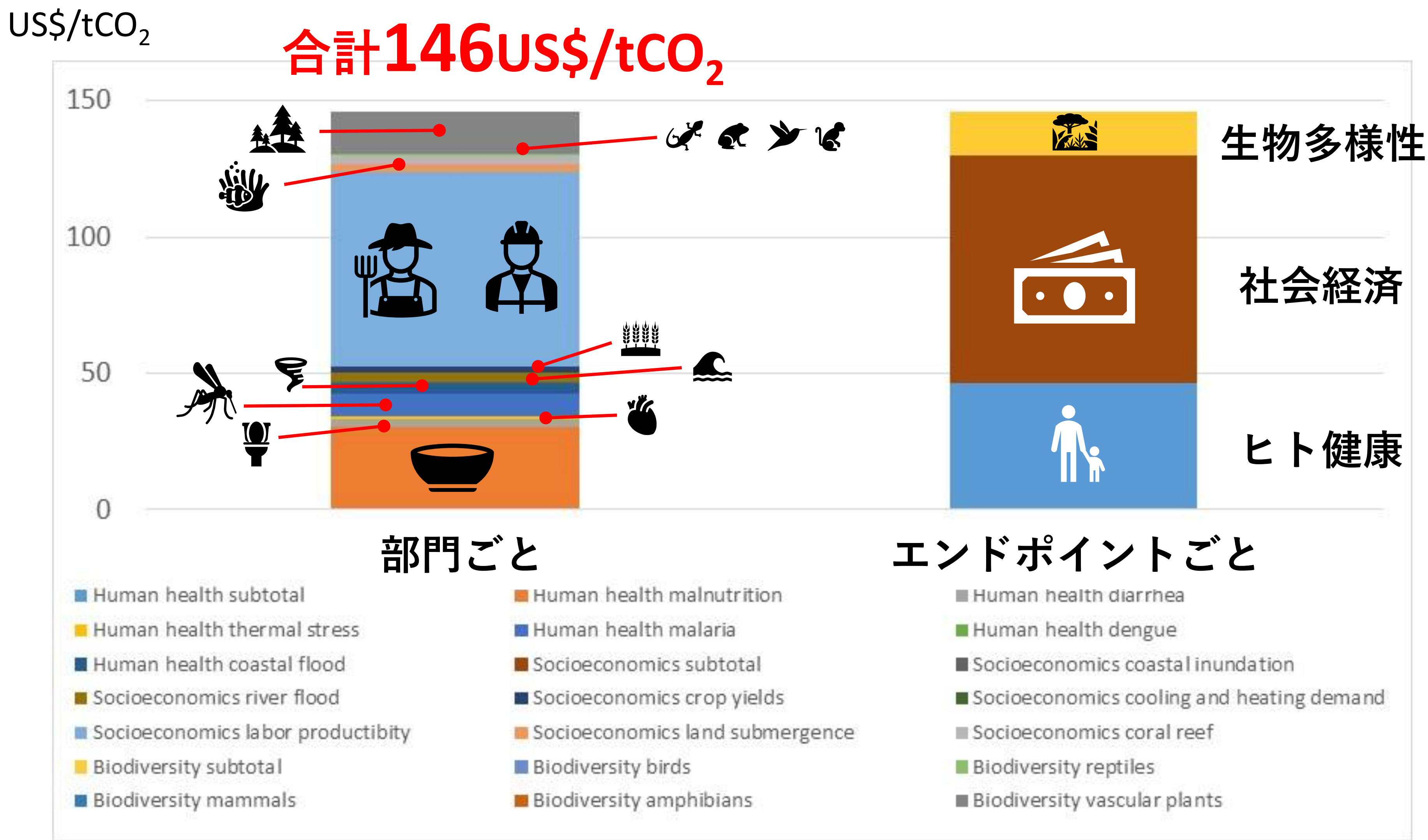
炭素社会費用算定の枠組み

環境省プロジェクトS-14において研究開発

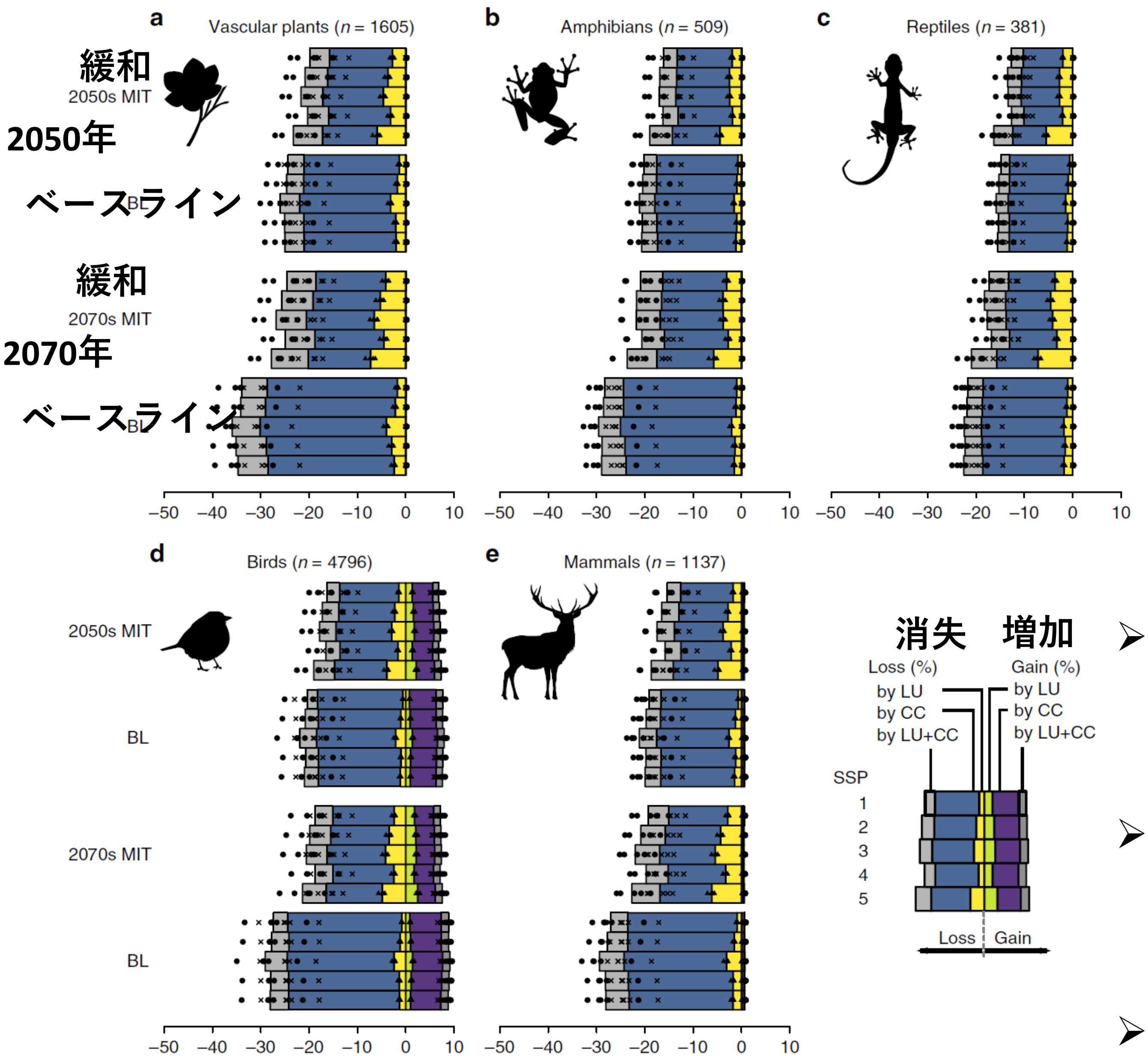


LCIA: Life Cycle Impact Assessment (ライフサイクル影響評価)
IAM: Integrated Assessment Model (統合評価モデル)

炭素社会費用(SCC)の算定結果



50年後に生息地を30%消失



nature COMMUNICATIONS

ARTICLE
https://doi.org/10.1038/s41467-019-13241-y OPEN

Biodiversity can benefit from climate stabilization despite adverse side effects of land-based mitigation

Haruka Ohashi[1*], Tomoko Hasegawa[2,3], Akiko Hirata[1,4], Shinichiro Fujimori[3,5,6], Kiyoshi Takahashi[3], Ikutaro Tsuyama[7], Katsuhiro Nakao[8], Yuji Kominami[9], Nobuyuki Tanaka[10], Yasuaki Hijioka[4] & Tetsuya Matsui[1]

Limiting the magnitude of climate change via stringent greenhouse gas (GHG) mitigation is necessary to prevent further biodiversity loss. However, some strategies to mitigate GHG emission involve greater land-based mitigation efforts, which may cause biodiversity loss from land-use changes. Here we estimate how climate and land-based mitigation efforts interact with global biodiversity by using an integrated assessment model framework to project potential habitat for five major taxonomic groups. We find that stringent GHG mitigation can generally bring a net benefit to global biodiversity even if land-based mitigation is adopted. This trend is strengthened in the latter half of this century. In contrast, some regions projected to experience much growth in land-based mitigation efforts (i.e., Europe and Oceania) are expected to suffer biodiversity loss. Our results support the enactment of stringent GHG mitigation policies in terms of biodiversity. To conserve local biodiversity, however, these policies must be carefully designed in conjunction with land-use regulations and societal transformation in order to minimize the conversion of natural habitats.

Ohashi et al. (2019)
Biodiversity can benefit from climate stabilization despite adverse side effects of land-based mitigation, nature comm.

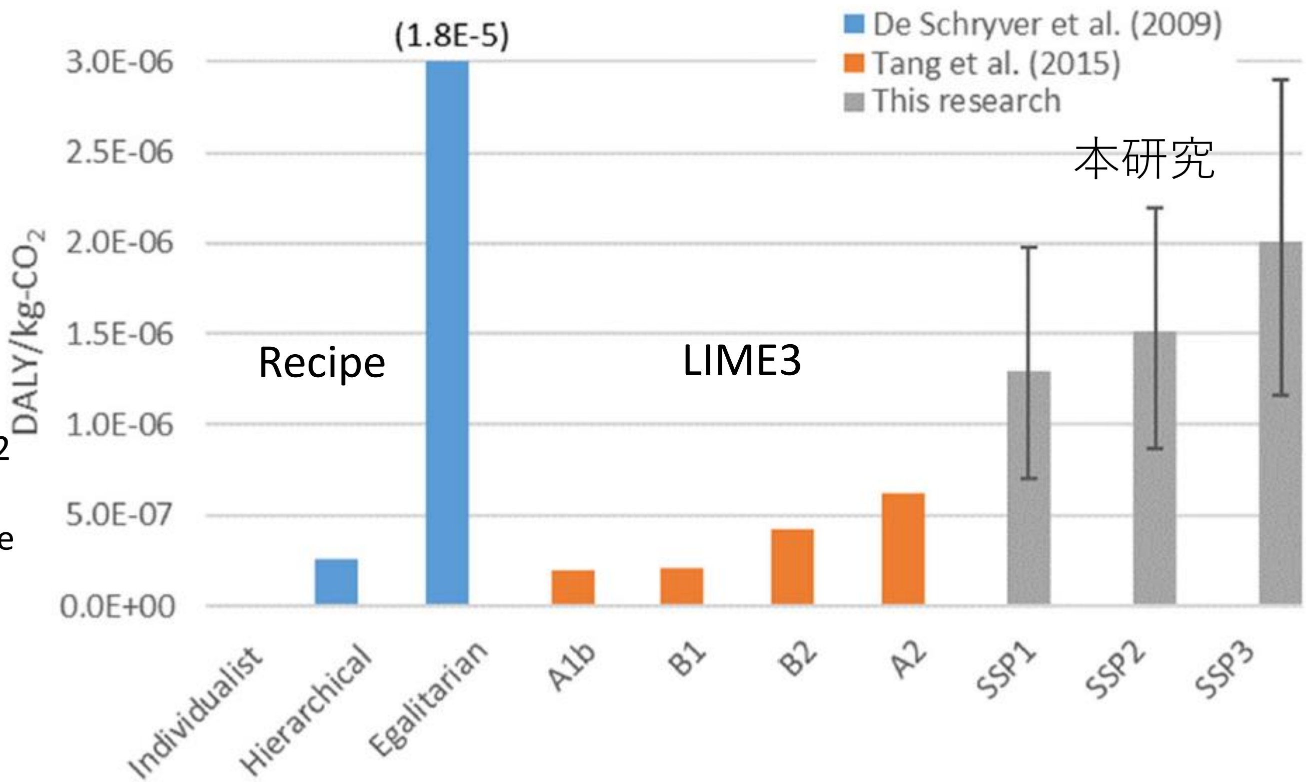
- 2050年、2070年における気候変動、土地利用による生息地の変化を評価
- 緩和策の実施により土地利用の影響は増えるが気候変動の影響低減効果の方が大きい
- 最大3割程度の消失

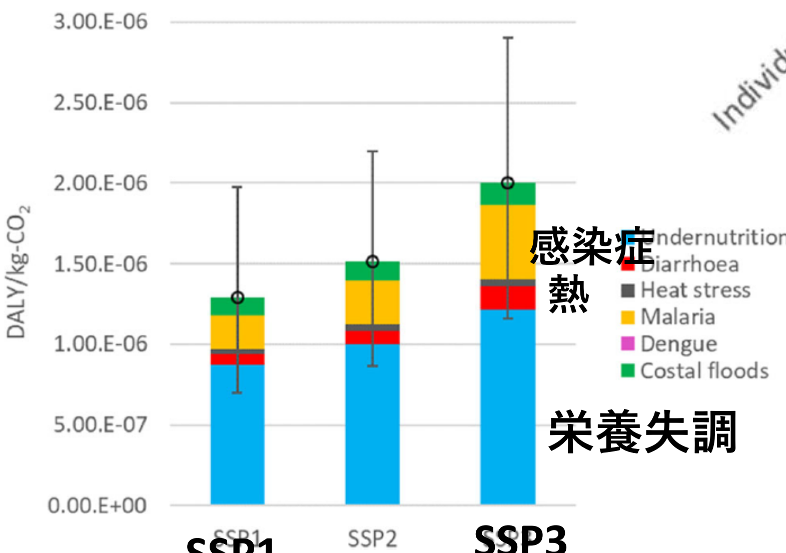
健康影響の被害評価を上方修正


LCA OF IMPACTS ON HUMAN HEALTH AND ECOSYSTEMS

Estimating human health damage factors related to CO_2 emissions by considering updated climate-related relative risks

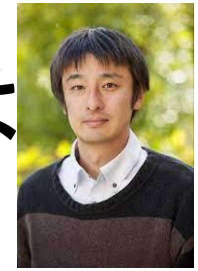
Tang et al. (2018) Estimating human health damage factors related to CO2 emissions by considering updated climate-related relative risks, Int J Life Cycle Assess (2019) 24 1118-1128

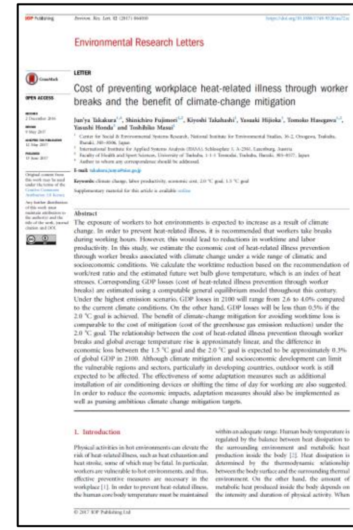




- LCIAの健康被害係数(DALYs/kgCO2)を算定
- リスク評価はWHO報告書を反映
- 社会経済シナリオSSP1-3まで評価
- 栄養失調、下痢を新規評価
- LIME3の被害係数に対して3倍程度

労働機会消失による影響は緩和により1/6に低減可能

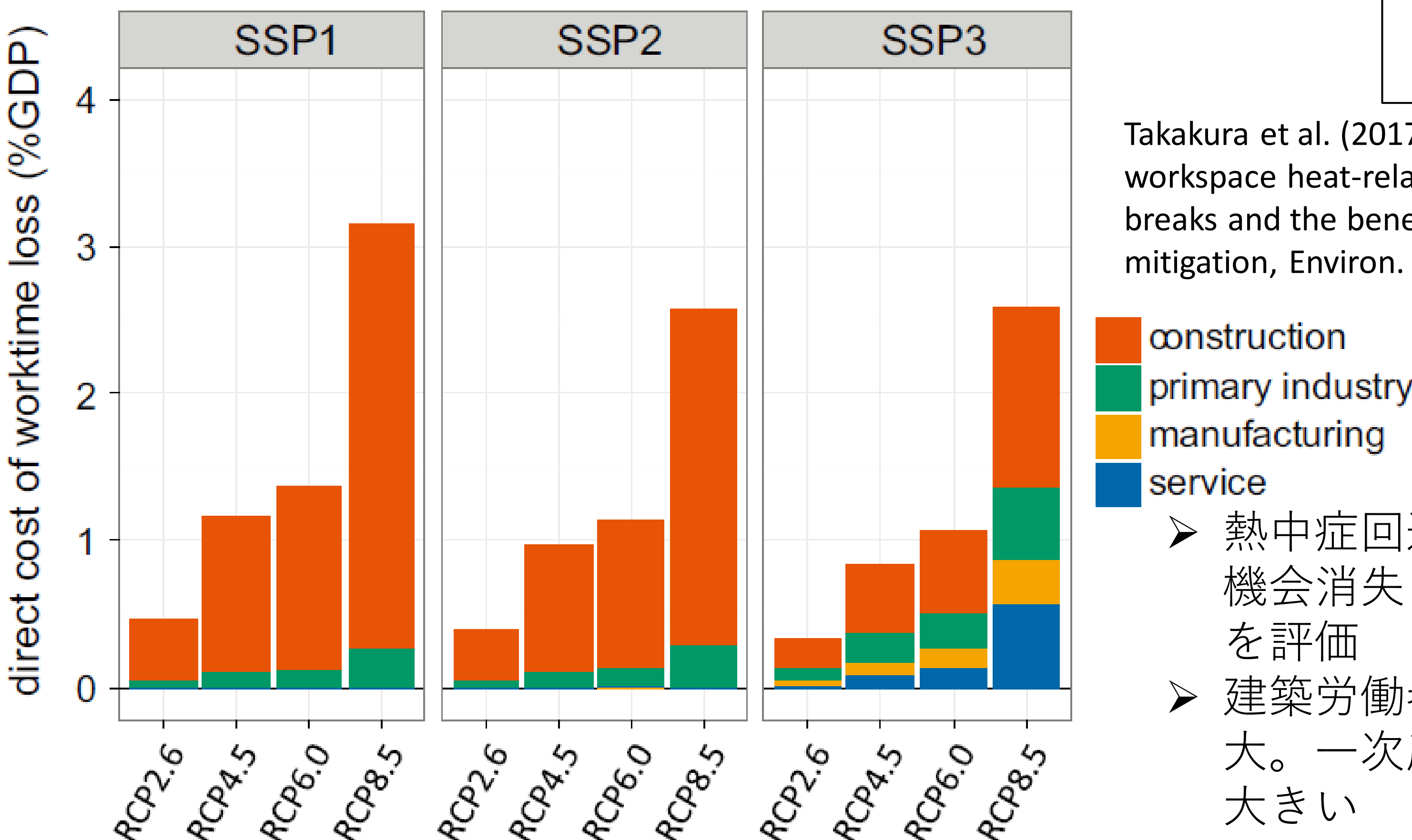



Environmental Research Letters

LETTER

Cost of preventing workplace heat-related illness through worker breaks and the benefit of climate-change mitigation

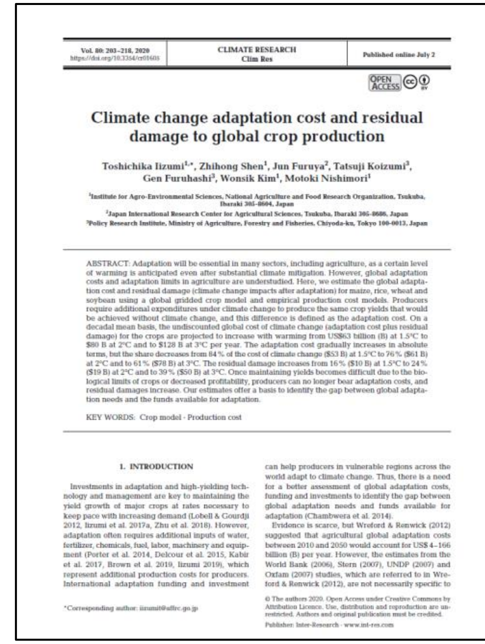
Takakura et al. (2017) Cost of preventing workspace heat-related illness through worker breaks and the benefit of climate change mitigation, Environ. Res. Lett. 12 064010



2020年世界GDP:-3.6% (IMF)

- 熱中症回避のための労働機会消失による経済影響を評価
- 建築労働者への影響が最大。一次産業への影響も大きい
- 緩和によりGDPロスを3%から0.5%まで削減

4℃上昇シナリオの農業被害は最大8倍



Vol. 80: 203–218, 2020
https://doi.org/10.3354/cr01605
CLIMATE RESEARCH
Clim Res
Published online July 2

OPEN ACCESS

Climate change adaptation cost and residual damage to global crop production

Toshichika Iizumi[1,*], Zhihong Shen[1], Jun Furuya[2], Tatsuji Koizumi[3], Gen Furuhashi[3], Wonsik Kim[1], Motoki Nishimori[1]

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[2]Japan International Research Center for Agricultural Sciences, Tsukuba, Ibaraki 305-8686, Japan
[3]Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries, Chiyoda-ku, Tokyo 100-0013, Japan

ABSTRACT: Adaptation will be essential in many sectors, including agriculture, as a certain level of warming is anticipated even after substantial climate mitigation. However, global adaptation costs and adaptation limits in agriculture are understudied. Here, we estimate the global adaptation cost and residual damage (climate change impacts after adaptation) for maize, rice, wheat and soybean using a global gridded crop model and empirical production cost models. Producers require additional expenditures under climate change to produce the same crop yields that would be achieved without climate change, and this difference is defined as the adaptation cost. On a decadal mean basis, the undiscounted global cost of climate change (adaptation cost plus residual damage) for the crops are projected to increase with warming from US\$63 billion (B) at 1.5°C to \$80 B at 2°C and to \$128 B at 3°C per year. The adaptation cost gradually increases in absolute terms, but the share decreases from 84% of the cost of climate change (\$53 B) at 1.5°C to 76% (\$61 B) at 2°C and to 61% (\$78 B) at 3°C. The residual damage increases from 16% (\$10 B) at 1.5°C to 24% (\$19 B) at 2°C and to 39% (\$50 B) at 3°C. Once maintaining yields becomes difficult due to the biological limits of crops or decreased profitability, producers can no longer bear adaptation costs, and residual damages increase. Our estimates offer a basis to identify the gap between global adaptation needs and the funds available for adaptation.

KEY WORDS: Crop model · Production cost

1. INTRODUCTION

Investments in adaptation and high-yielding technology and management are key to maintaining the yield growth of major crops at rates necessary to keep pace with increasing demand (Lobell & Gourdji 2012, Iizumi et al. 2017a, Zhu et al. 2018). However, adaptation often requires additional inputs of water, fertilizer, chemicals, fuel, labor, machinery and equipment (Porter et al. 2014, Delcour et al. 2015, Kabir et al. 2017, Brown et al. 2019, Iizumi 2019), which represent additional production costs for producers. International adaptation funding and investment can help producers in vulnerable regions across the world adapt to climate change. Thus, there is a need for a better assessment of global adaptation costs, funding and investments to identify the gap between global adaptation needs and funds available for adaptation (Chambwera et al. 2014).

Evidence is scarce, but Wreford & Renwick (2012) suggested that agricultural global adaptation costs between 2010 and 2050 would account for US\$ 4–166 billion (B) per year. However, the estimates from the World Bank (2006), Stern (2007), UNDP (2007) and Oxfam (2007) studies, which are referred to in Wreford & Renwick (2012), are not necessarily specific to

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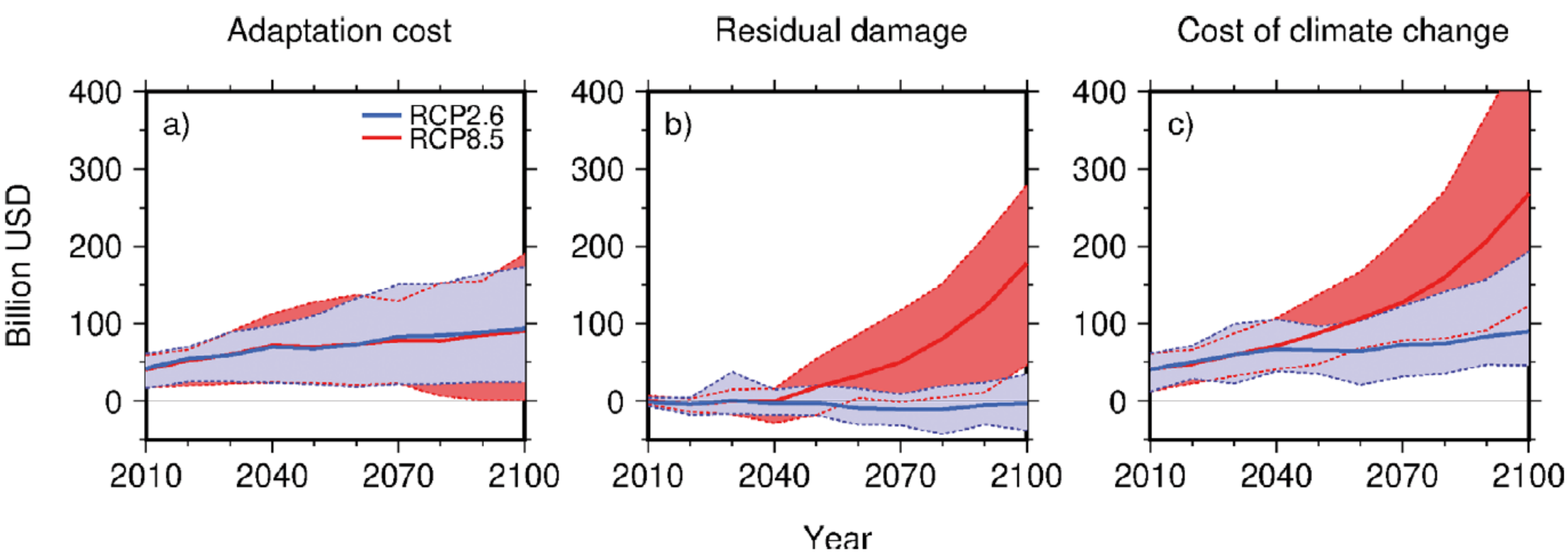
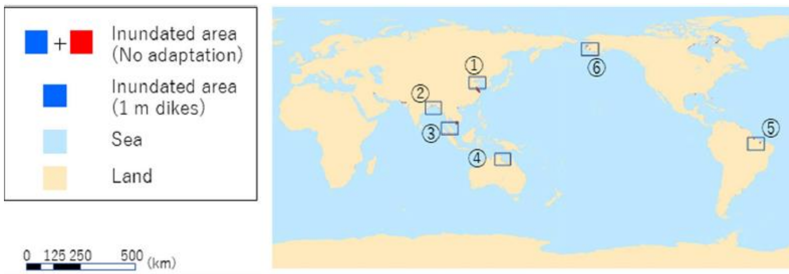
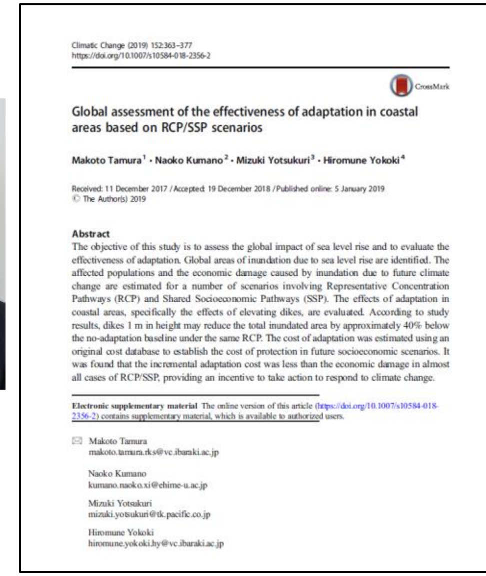
- 気候変動による農業への経済影響を評価
- 適応のための費用と残余被害の双方を評価
- 2℃シナリオは適応費用は掛かるが残余被害は少ない
- 4℃シナリオは残余被害が大幅に増加

Iizumi et al. Climate research (2020)



2050年浸水被害は最大4-5倍





Climatic Change (2019) 152:363–377
https://doi.org/10.1007/s10584-018-2356-2

Global assessment of the effectiveness of adaptation in coastal areas based on RCP/SSP scenarios

Makoto Tamura[1] · Naoko Kumano[2] · Mizuki Yotsukuri[3] · Hiromune Yokoki[4]

Received: 11 December 2017 / Accepted: 19 December 2018 / Published online: 5 January 2019

Abstract
The objective of this study is to assess the global impact of sea level rise and to evaluate the effectiveness of adaptation. Global areas of inundation due to sea level rise are identified. The affected populations and the economic damage caused by inundation due to future climate change are estimated for a number of scenarios involving Representative Concentration Pathways (RCP) and Shared Socioeconomic Pathways (SSP). The effects of adaptation in coastal areas, specifically the effects of elevating dikes, are evaluated. According to study results, dikes 1 m in height may reduce the total inundated area by approximately 40% below the no-adaptation baseline under the same RCP. The cost of adaptation was estimated using an original cost database to establish the cost of protection in future socioeconomic scenarios. It was found that the incremental adaptation cost was less than the economic damage in almost all cases of RCP/SSP, providing an incentive to take action to respond to climate change.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10584-018-2356-2) contains supplementary material, which is available to authorized users.

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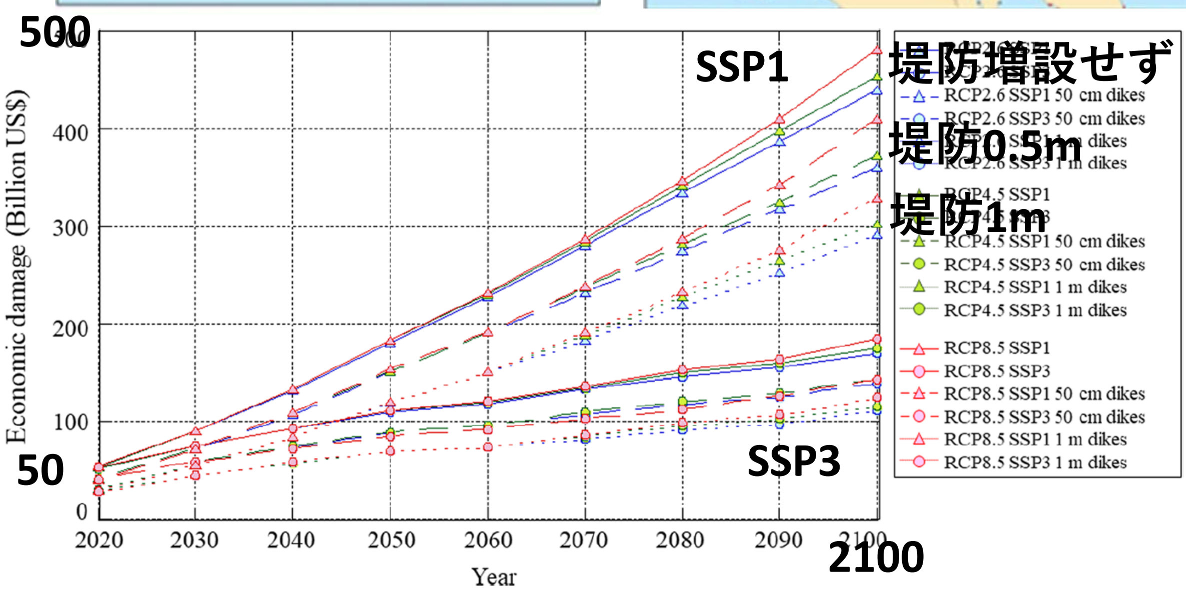
Tamura et al. Climate Change 20



Construction of elevation data in land and sea
- ETOPO1=> smoothing for land elevation and water depth
- TPXO7.2=> mean higher high water level (MHHWL)

Steric sea level rise
- MIROC-ESM and 3 GCM
- RCP(2.6, 4.5, and 8.5)

Calculation of inundation
- Compare land elevation with sea level
- Water intrusion from the coastline

Socioeconomic scenarios
- Downscaled SSP 1-3 (0.5 × 0.5 degrees)

Cost database of dikes

Impact assessment with and without adaptation

<No adaptation>
- Inundated area and coastline
- Affected population
- Economic damage

<Adaptation: dike>
- Inundated area and coastline
- Affected population
- Economic damage
- Cost of adaptation
- Benefit-cost of adaptation

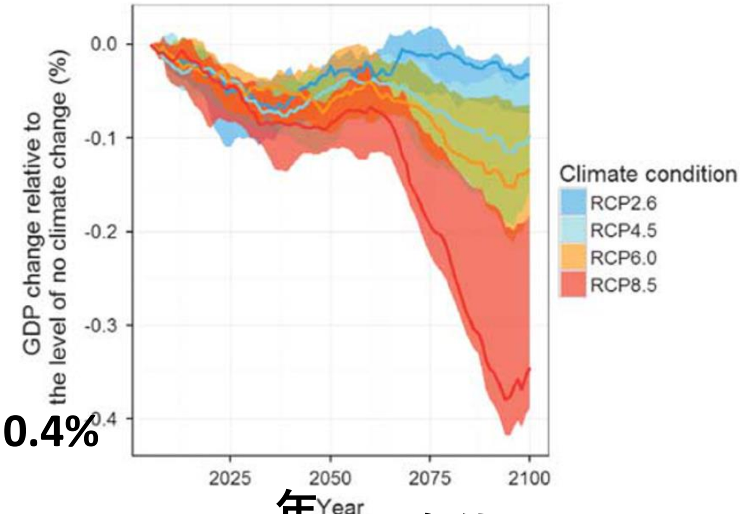
冷暖房需要の変化による経済影響

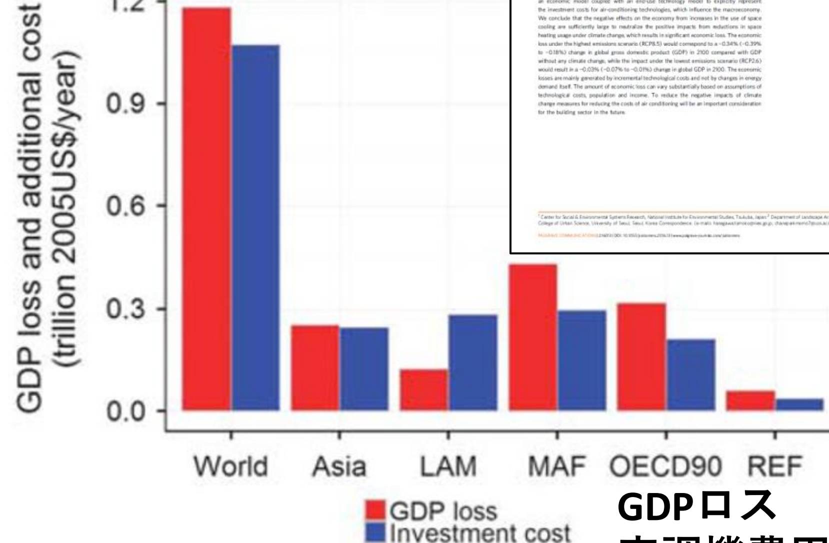

palgrave communications

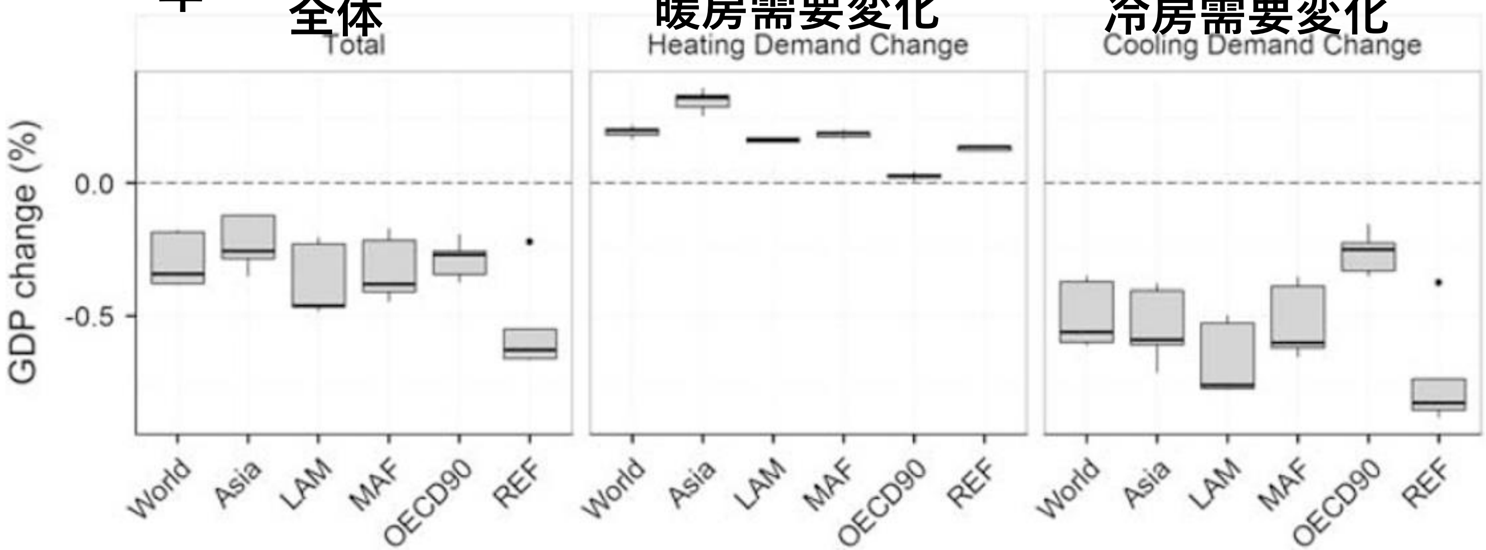
ARTICLE

OPEN

Quantifying the economic impact of changes in energy demand for space heating and cooling systems under varying climatic scenarios



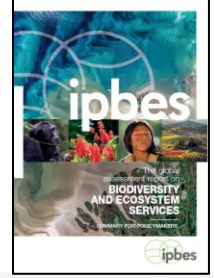




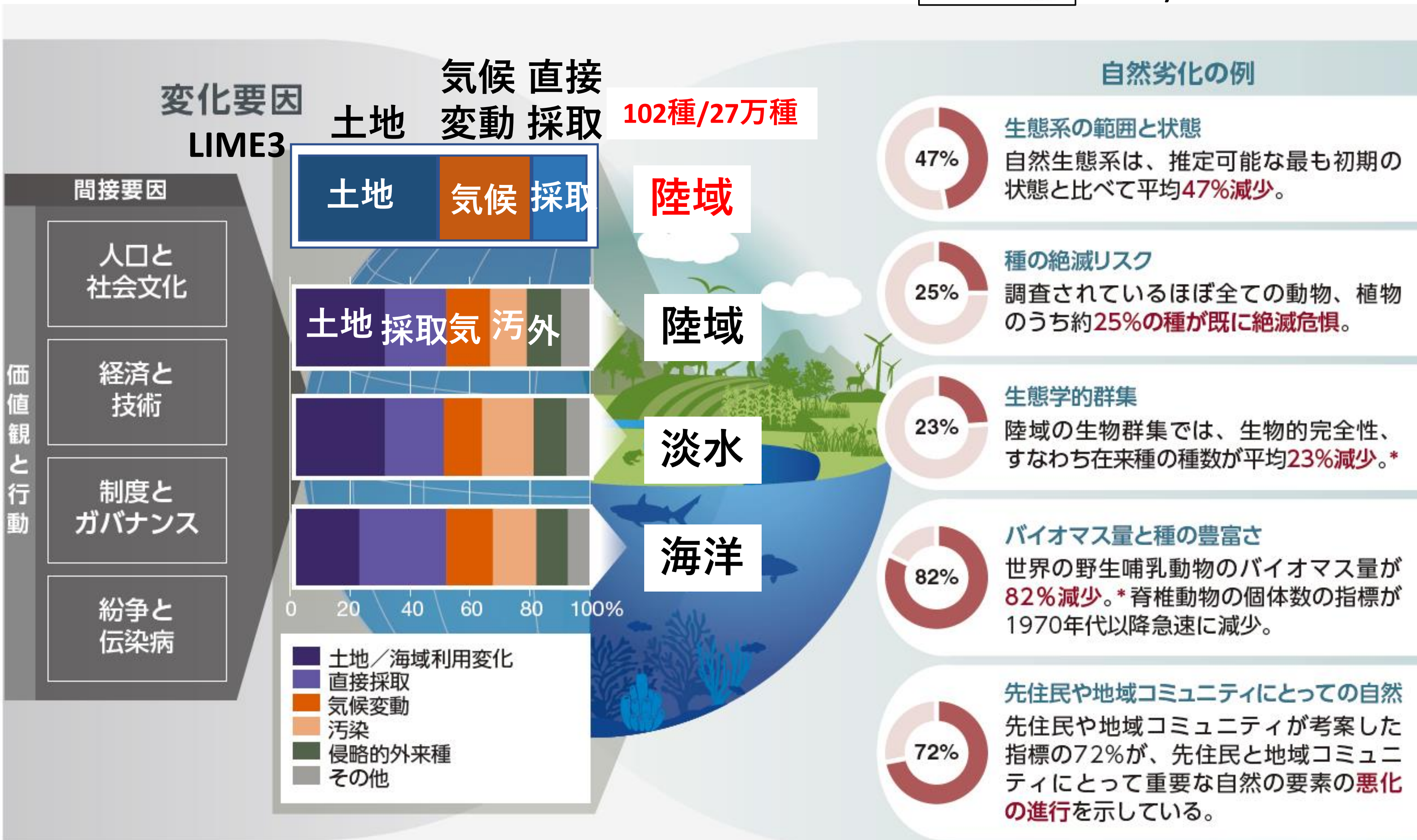
年間被害量と経済価値額 Annual damage of each endpoint and economic impacts

	人間健康	社会資産	生物多様性	一次生産
影響領域,単位	DALY(years)	Million US$	EINES(species)	Billion ton
気候変動	2.1E+7	-4.6E+4	3.4E+1	-
大気汚染	3.4E+7	-	-	-
光化学オゾン	1.9E+6	-	-	-
水使用	2.2E+7	-	-	-
土地利用	-	-	5.2E+1	1.3E+1
化石燃料	-	2.9E+5	3.2E-1	1.5E-1
鉱物資源	-	1.6E+5	4.5E-2	2.6E+0
森林資源	-	-	1.6E+1	4.6E+0
合計	7.9E+7	4.0E+5	1.0E+2	1.8E+1
貨幣換算 (US$)	7.67E+11	2.95E+11	6.41E+11	5.22E+11
	合計2.23E+12			
ひとりあたり (US$)	1.12E+2	4.29E+1	9.32E+1	7.58E+1
	合計3.23E+2			

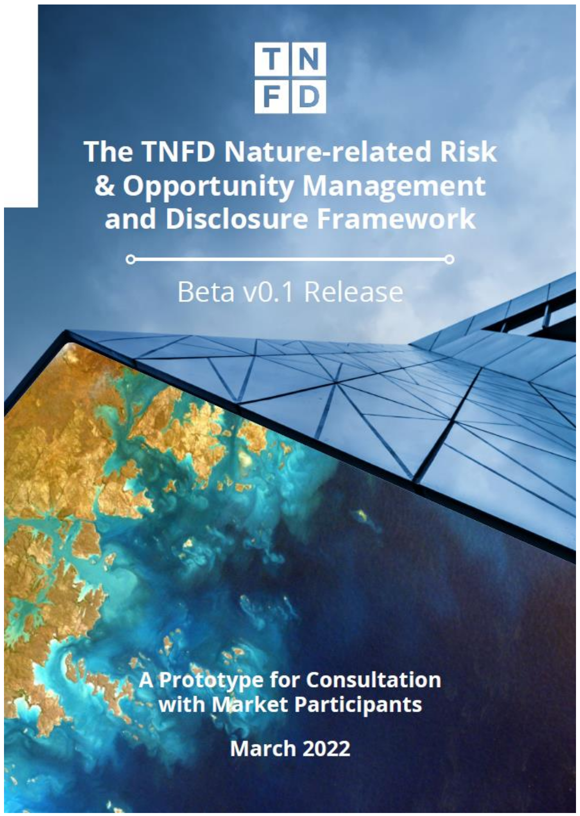
生物多様性影響の要因分析



IPBES (2019) the global assessment report on biodiversity and ecosystem services



TNFD　自然関連情報開示



The TNFD framework – Beta release v0.1

基礎　Fundamentals for understanding nature

推奨事項　The TNFD Draft Disclosure Recommendations

LEAPプロセス　The LEAP Process for Nature-related Risk & Opportunity Assessment

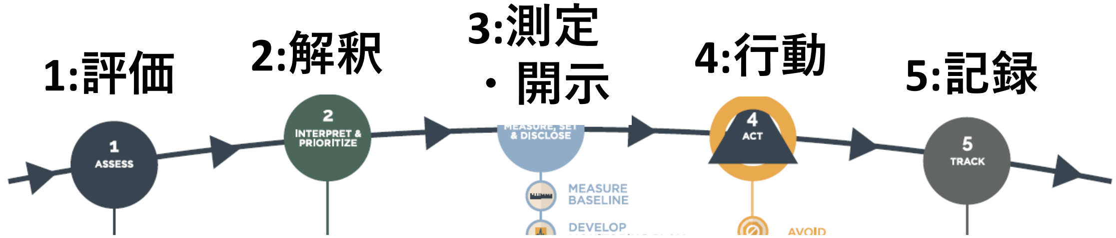
Landscape assessment and recommendations on nature-related data

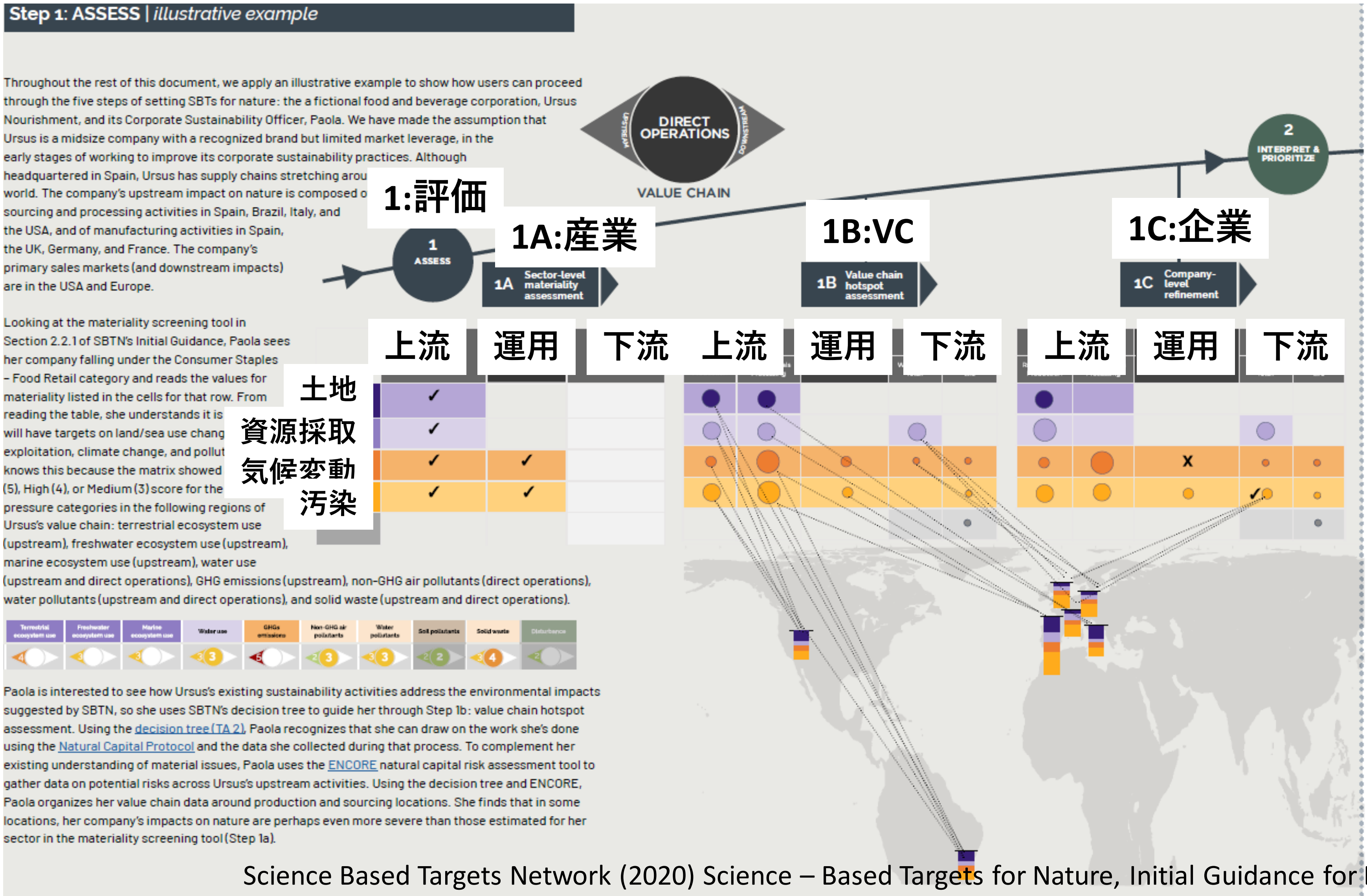
FAQs
What's in | What are we continuing to evaluate

LEAP (Locate Evaluate Assess Prepare)

依存と影響　リスクと機会

SBTNでの活用





Step 1: ASSESS | *illustrative example*

Throughout the rest of this document, we apply an illustrative example to show how users can proceed through the five steps of setting SBTs for nature: the a fictional food and beverage corporation, Ursus Nourishment, and its Corporate Sustainability Officer, Paola. We have made the assumption that Ursus is a midsize company with a recognized brand but limited market leverage, in the early stages of working to improve its corporate sustainability practices. Although headquartered in Spain, Ursus has supply chains stretching arou[...] world. The company's upstream impact on nature is composed o[...] sourcing and processing activities in Spain, Brazil, Italy, and the USA, and of manufacturing activities in Spain, the UK, Germany, and France. The company's primary sales markets (and downstream impacts) are in the USA and Europe.

Looking at the materiality screening tool in Section 2.2.1 of SBTN's Initial Guidance, Paola sees her company falling under the Consumer Staples – Food Retail category and reads the values for materiality listed in the cells for that row. From reading the table, she understands it is [...] will have targets on land/sea use chang[...] exploitation, climate change, and pollut[...] knows this because the matrix showed [...] (5), High (4), or Medium (3) score for the [...] pressure categories in the following regions of Ursus's value chain: terrestrial ecosystem use (upstream), freshwater ecosystem use (upstream), marine ecosystem use (upstream), water use (upstream and direct operations), GHG emissions (upstream), non-GHG air pollutants (direct operations), water pollutants (upstream and direct operations), and solid waste (upstream and direct operations).

Paola is interested to see how Ursus's existing sustainability activities address the environmental impacts suggested by SBTN, so she uses SBTN's decision tree to guide her through Step 1b: value chain hotspot assessment. Using the decision tree (TA 2), Paola recognizes that she can draw on the work she's done using the Natural Capital Protocol and the data she collected during that process. To complement her existing understanding of material issues, Paola uses the ENCORE natural capital risk assessment tool to gather data on potential risks across Ursus's upstream activities. Using the decision tree and ENCORE, Paola organizes her value chain data around production and sourcing locations. She finds that in some locations, her company's impacts on nature are perhaps even more severe than those estimated for her sector in the materiality screening tool (Step 1a).

Science Based Targets Network (2020) Science – Based Targets for Nature, Initial Guidance for Business

LIME3を用いたマテリアリティ分析

企業名	評価対象	影響領域								
		気候	大気	光化	水	鉱物	化石	森林	土地	廃棄
太平洋セメント	セメント(日本、インド、アメリカなど8国)	◎	◎	○		○	○			◎
サンメッセ	印刷物(日本、インドネシア)	○	○		○	○	◎	◎		
資生堂	ハンドソープ	○	○	○	◎	○	○	○	◎	○
日産	自動車	◎	○	○	○	◎	◎			○
積水化学	プラスチック成型加工品	◎	◎	○	○	○	◎	○	○	○

◎：重要な影響領域、○評価に含めた影響領域、空欄：評価対象外
CC: 気候変動、AP: 大気汚染、 PO: 光化学オキシダント、WU: 水資源消費、MR: 鉱物資源消費、 FF: 化石燃料消費、BR: 生物資源消費、LU: 土地利用、WA: 廃棄物

まとめ

- LCAの意義について解説した。科学的な情報を提供することで、SDGsの目標設定から経営統合の実現に貢献することが期待される。
- LCAの実施方法についてISOにおける要件や実施手順に基づきつつ解説した。インベントリの実施手順、影響評価の段階と特徴について具体例を含めつつ紹介した。それぞれの段階において評価結果から得られる内容と特徴が異なるため、目的に応じて選択する。
- LCAの今後の展望について解説した。特に、カーボンプライシングを通した政策への活用、自然資本・生物多様性への影響評価を通したビジネスへの活用が進むものと見込まれる。