

2019

The 24th AIM
International
Workshop

Discussion of Long-term, Low-emission Pathways in Korea

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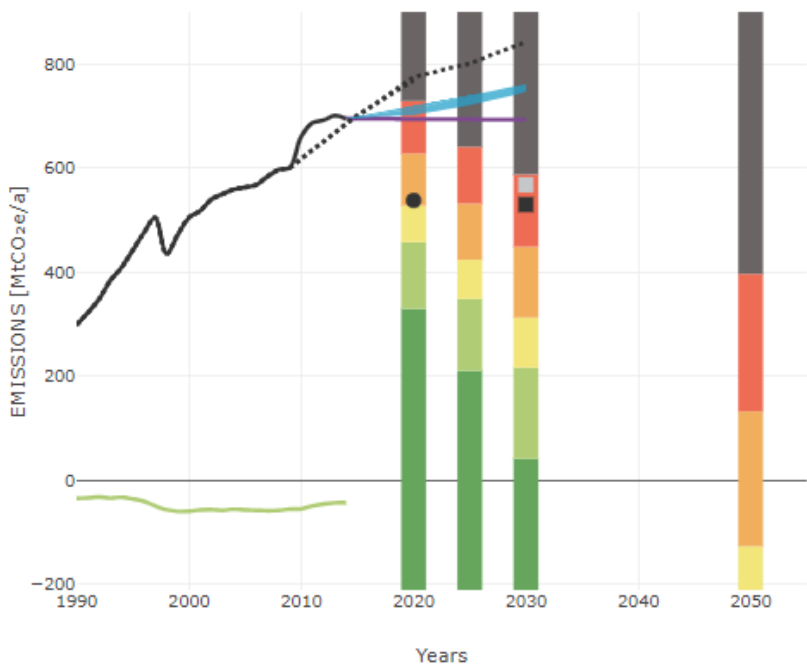


1 AIM-Korea activities in 2019

- Korea's 1.5/2 scenario development and modeling
- COMMIT
- ENGAGE

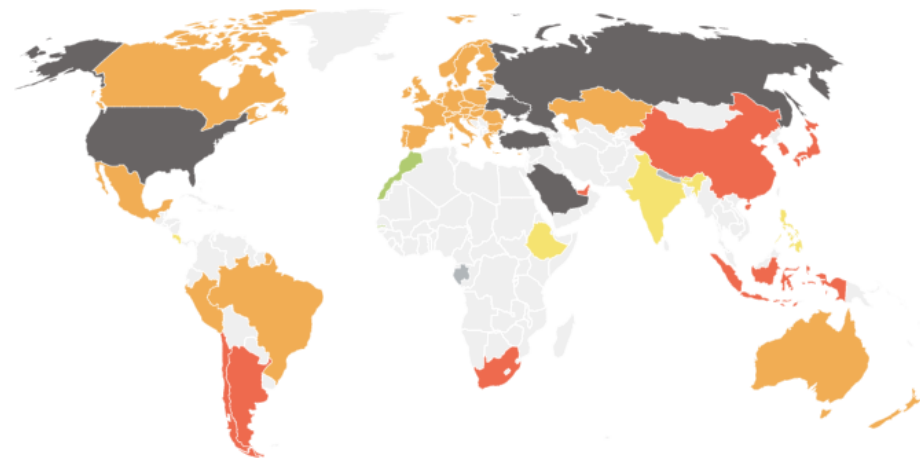
2 Mid-century pathway

» Korea's NDC and evaluation



- Historical emissions, excl forestry
- Historical emissions/removals from forestry
- Current policy projections
- 2020 pledge
- - - - Reference for 2020 pledge
- NDC
- NDC, domestic reduction
- - - - Reference for NDC
- Planned policy projections

Korea's NDC



The maps displayed are for reference only.

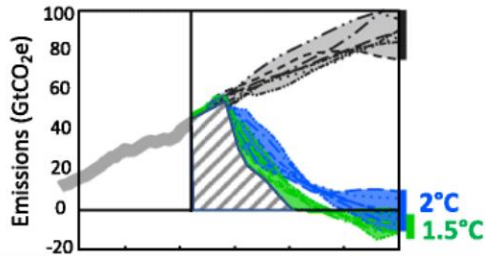
LAST UPDATE: September 2019

CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL
4°C+ WORLD	< 4°C WORLD	< 3°C WORLD	< 2°C WORLD	< 1.5°C WORLD	<< 1.5°C WORLD
RUSSIAN FEDERATION	ARGENTINA	AUSTRALIA	BHUTAN	MOROCCO	
SAUDI ARABIA	CHILE	BRAZIL	COSTA RICA	THE GAMBIA	
TURKEY	CHINA	CANADA	ETHIOPIA		
USA	INDONESIA	EU	INDIA		
UKRAINE	JAPAN	KAZAKHSTAN	PHILIPPINES		
	SINGAPORE	MEXICO			
	SOUTH AFRICA	NEW ZEALAND			
	SOUTH KOREA	NORWAY			
	UAE	PERU			

Source: <https://climateactiontracker.org/>

2 Mid-century pathway

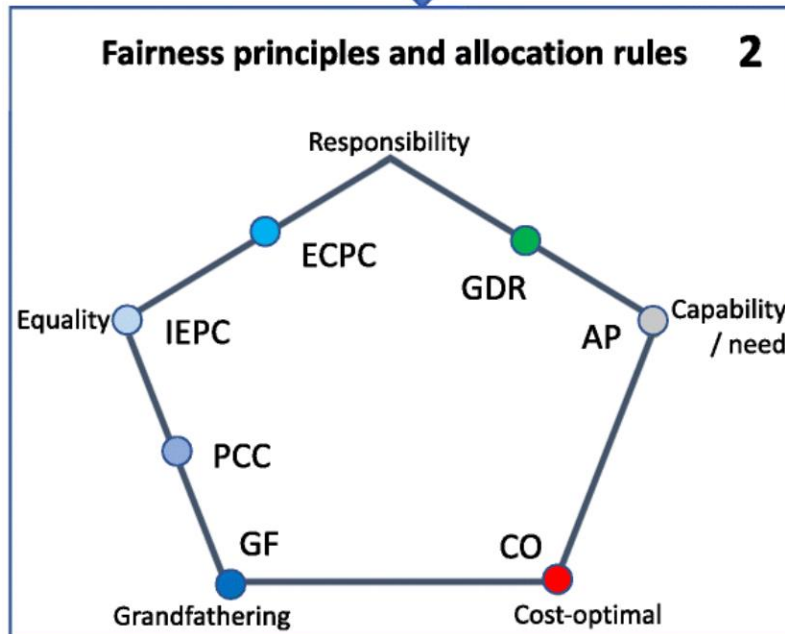
» Korea's carbon budget allocation rule



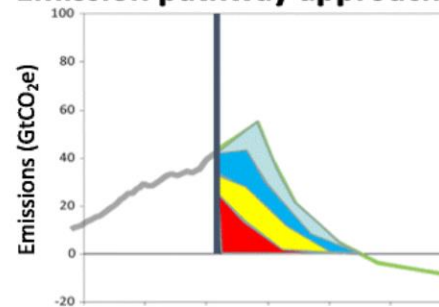
Global emission scenarios

Information on carbon budgets and emission pathways consistent with the Paris Agreement from a set of global models

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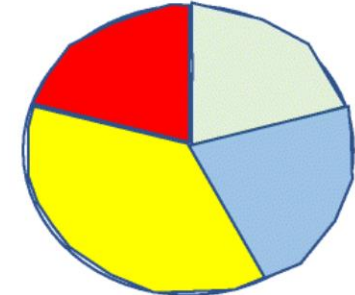


Emission pathway approach



- Based on dynamic, scenario dependent allocation factors
- Can be easily applied to all GHGs
- Uses time-profile for emissions
- Budgets can be derived by calculating integral over emissions

Carbon budget approach 3



- Based on static allocation factors
- Best applicable to long-lived GHGs
- Time-independent: allows for decisions within region
- Profiles can be derived by regional modelling or using stylized assumptions

2 Mid-century pathway

➤ Korea's carbon budget allocation rule

Unit: MtCO₂-eq

Emission pathway scenario	2010	2030	2050
Cost optimal solution	656.6	536.0	551.6
Research Institute outcomes (KEEI, KEI)	656.6	536.0	369 ~ 550
Asian region (50%) in IPCC AR5	656.6	536.0	328.3
Equal cumulative per capita emissions	656.6	536.0	223.5
Per capita convergence	656.6	536.0	249.6
Greenhouse development rights (GDR)	656.6	536.0	7.9

2 Mid-century pathway

➤ 8th Power generation plan

Source	Unit: ratio		
	2017	2030	2050*
Nuclear	30.3	23.9	15.1
Coal	45.3	36.2	16.5
LNG	16.9	18.8	27.5
Renewable	6.20	20.0	39.1
Others	1.30	1.1	1.8

*estimated

2 Mid-century pathway

➤ Prospects for Economic & Social Developments

Indicator	Unit	2010	2050*	changes
Population	Mil-Persons	49.1	47.1	-4%
GDP	US Billion\$(2005)	1,015	2,275	124%
GDP per capita	US\$/person(2005)	20,538	57,234	179%
Industrial value added	US\$/person(2005)	437	1,170	168%
Residential floor area	Mil-square meters	1,173	1,017	-13%
Commercial floor area	Mil-square meters	694	1,510	118%
Passenger transport	Billion p-kolometers	485	451	-7%
Freight transport	Billion t-kolometers	0.8	1.2	50%

*estimated

2 Mid-century pathway

» Costs and Carbon Intensity

Emission pathway scenario	GDP loss compared to CO	Carbon Intensity
Asian region (50%) in IPCC AR5	2.8%	37.5
Equal cumulative per capita emissions	4.9%	28.3
Per capita convergence	4.2%	30.6
Greenhouse development rights (GDR)	12.2%	6.0

*estimated

2 Mid-century pathway

➤ Renewable energy share and its' issue

Power Mix Share:
46% ~ 77%

Area: 2400km² ~ 5100km²
(5~11% of manageable land in Korea)



태양광 발전 환경 파괴

- GW당 1320만m²(서울 여의도 4.55배) 부지 필요
- 중금속인 카드뮴과 납 포함된 태양광 모듈 폐기물
- 태양전지 원료 폴리실리콘 생산 시 전력(원가의 40%)



풍력발전 환경 파괴

- GW당 500만m²(서울 여의도 1.72배) 부지 필요
- 산을 깎아내고, 바다에 구멍을 뚫어 발전기 설치
- 풍력발전기 날개(블레이드) 소음



Solar PV = 1.32 km² /1GW

WIND = 0.5 km² /1GW

2 Mid-century pathway

» Climate Technology Roadmap for Korea

	Climate Technology	Measures
Carbon reduction	BECCS, Solar/Fuel Cell, Smart grid	Climate industry CCS test-bed project
Carbon Utilization	CO2 mineralization, COG/BFG, CO2 conversion	CCU test-bed project
Climate adaptation	-	-

3 Discussion

» Measures for deep decarbonization

Service

Demand
management

Device

High efficiency dev.
use

Energy

Non fossil fuel use

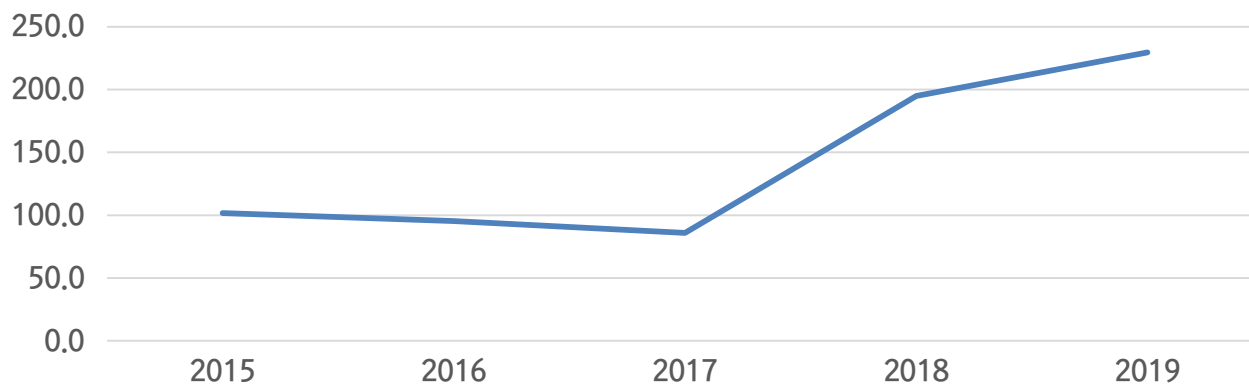
Carbon
removal

REDD+

CCS/CCSU

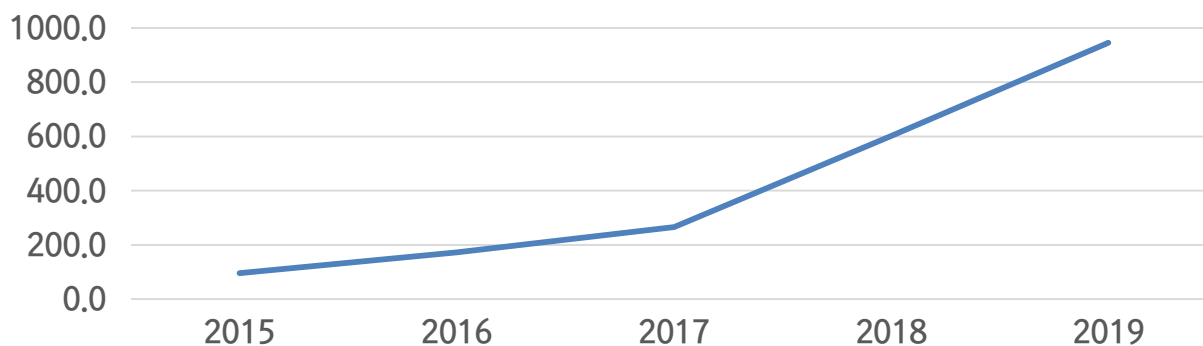
➤ Social transformation (Subsidies)

Home Solar Electric System (unit: mil-dollar)



Space heating device (1.7 mil-dollar/yr)

Vehicles (Hybrid / Electric / Fuel cell) (unit: mil-dollar)



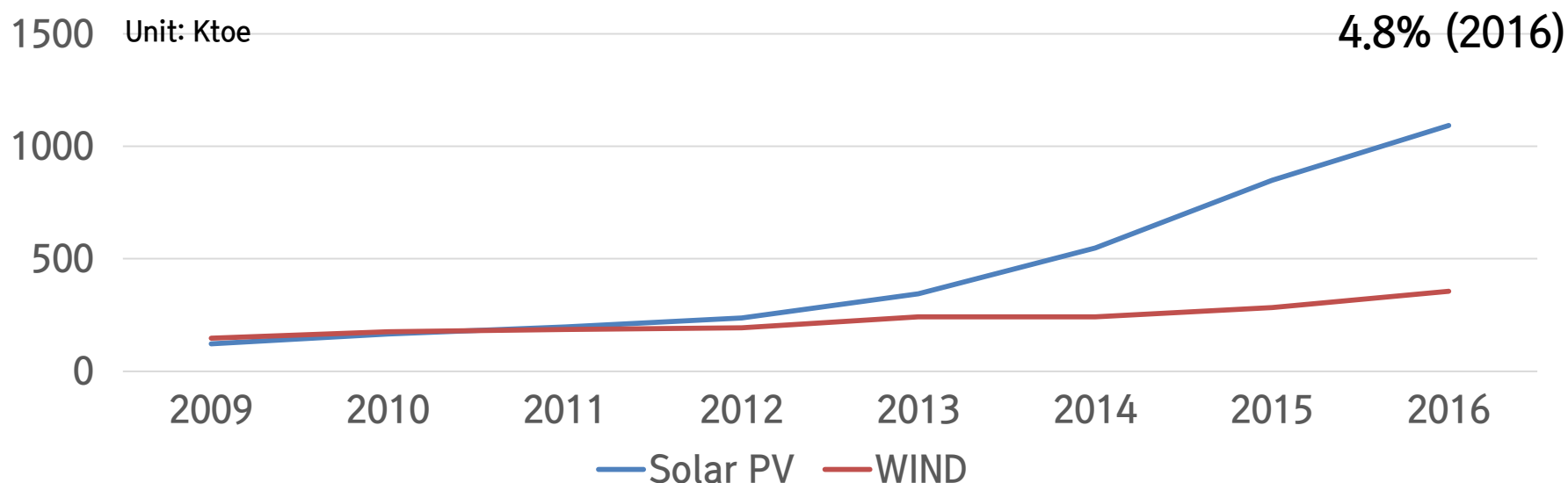
➤ Social transformation (Energy policy)

Renewable Energy Portfolio Standard

Obligatory renewable service supply ratio

Year	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22~
Ratio(%)	2	2.5	3	3.2	4	5	6	7	8	9	10

Penetration of renewable energy



3 Discussion

» An uncertain future (SDGs and energy demand)

Sustainable Development Goals

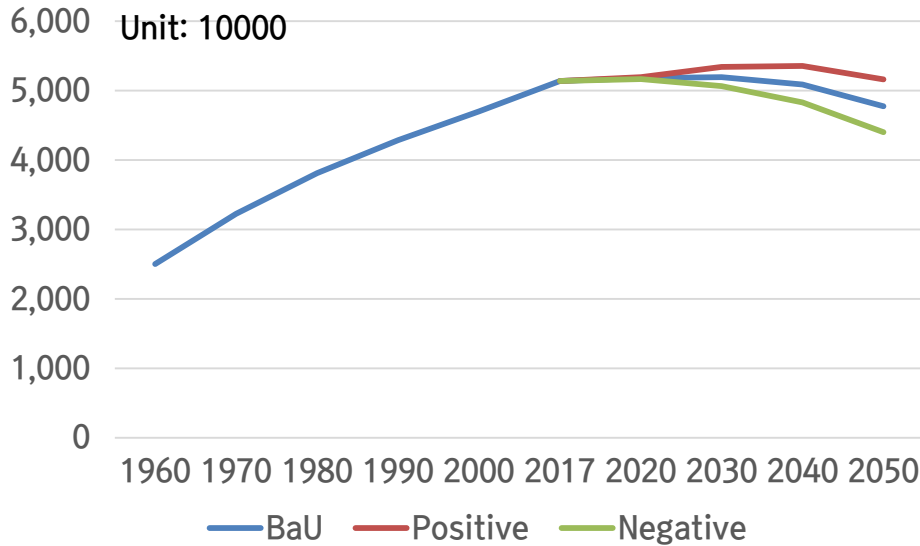


- Climate change adaptation (heating, cooling energy)
- Infrastructure (rail, road, airport, ...)
- Decent work (Energy consumption industry)
- Well-being (Energy device)

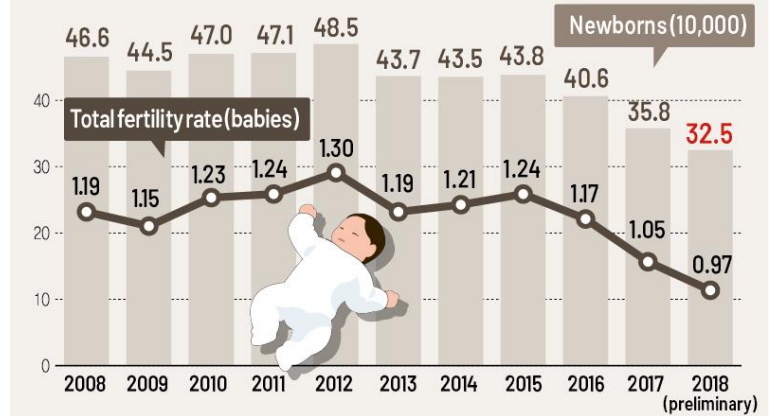
3 Discussion

➤ An uncertain future (Population projection)

Total Population



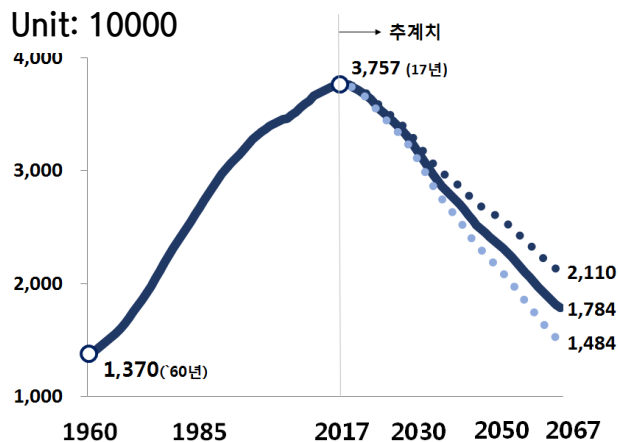
S. Korea's total fertility rate



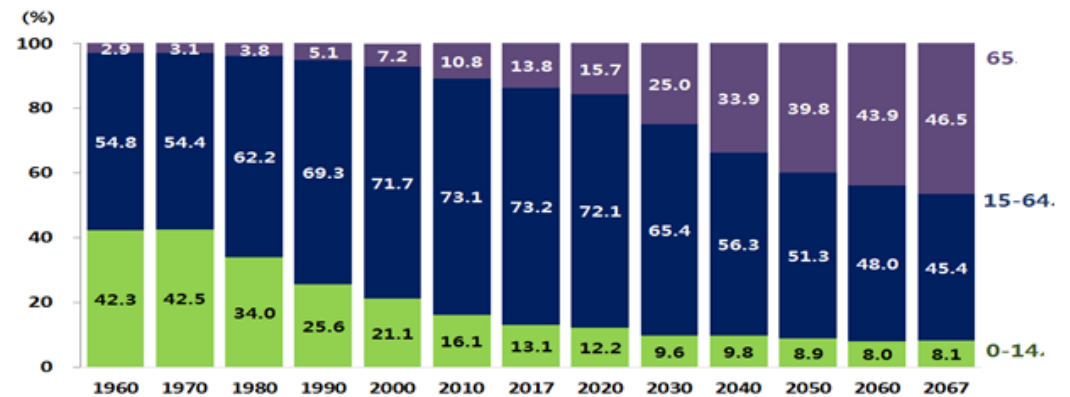
Total fertility rate (TFR) is the average number of children predicted to be born to a woman over her lifetime

Sources / Statistics Korea, Presidential Committee on Aging Society and Population Policy

Working age population



Working age population



3 Discussion

» An uncertain future (Household income)

Fourth Industrial
Revolution
By Bigdata and AI



Household income

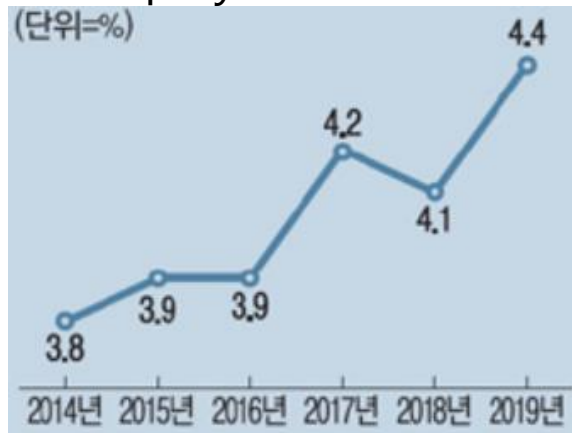


Industry

While some displaced workers may ultimately gain retraining and new opportunities, others will be left behind. The numbers of the displaced could be significant and a reactionary backlash can be expected.

...

Unemployment rate



The impact of the AI-powered employment transition will almost certainly have far-reaching social and political implications.

...

3 Discussion

» An uncertain future (Machine Learning)

	Causal inference	Computer vision	Interpretable models	NLP	RL & Control	Time-series analysis	Transfer learning	Uncertainty quantification	Unsupervised learning
1 Electricity systems									
Enabling low-carbon electricity		•	•		•	•		•	•
Reducing current-system impacts		•				•		•	•
Ensuring global impact		•					•		•
2 Transportation									
Reducing transport activity		•				•		•	•
Improving vehicle efficiency		•			•				
Alternative fuels & electrification					•				•
Modal shift	•	•				•		•	
3 Buildings and cities									
Optimizing buildings	•				•	•	•		
Urban planning		•				•	•		•
The future of cities				•			•	•	•
4 Industry									
Optimizing supply chains		•			•	•			
Improving materials									•
Production & energy		•	•		•				
5 Farms & forests									
Remote sensing of emissions		•							
Precision agriculture		•			•	•			
Monitoring peatlands		•							
Managing forests		•			•	•			

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