

# Scenario Assessment Interim Results from AIM (Asia-Pacific Integrated Model)

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Improving the Representation of Renewables in IAMs  
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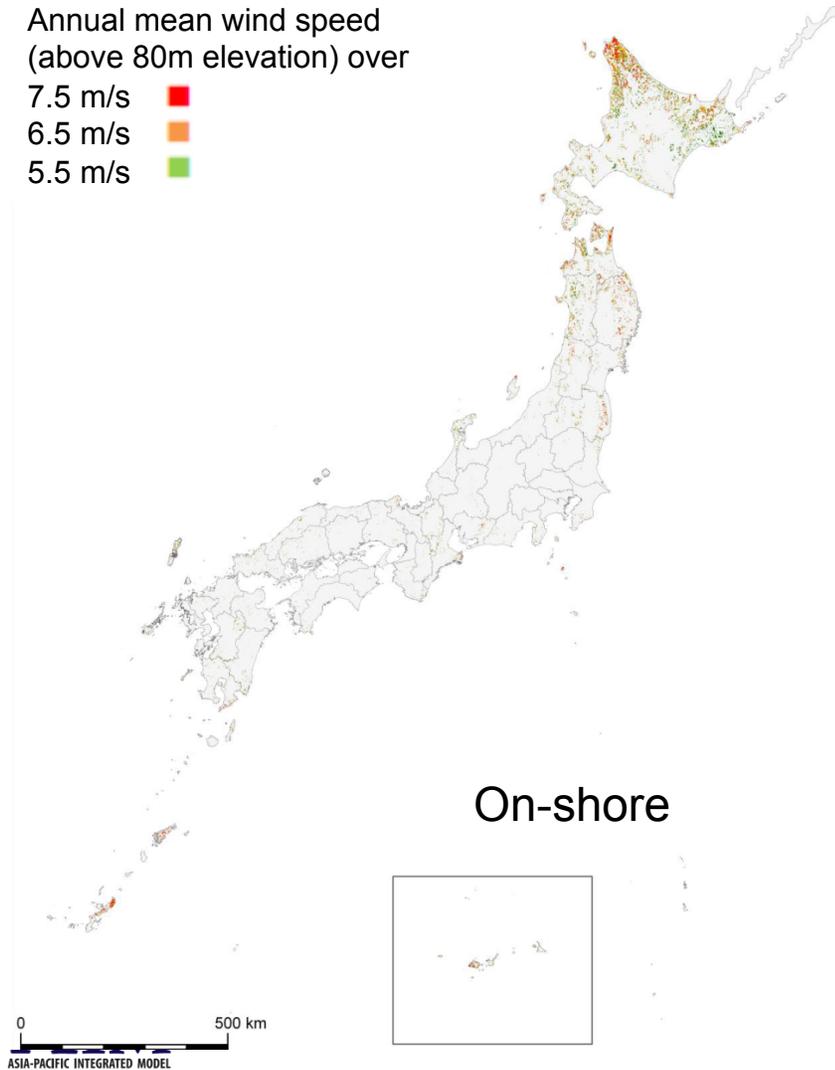
# Renewable energy for mid-term target in Japan

- Target of renewable energy share to total primary energy in 2020 is set to 10%.
- Based on AIM/Enduse [Japan], which is bottom-up type model, the energy mix to achieve 25% GHG reduction target is evaluated;
  - PV in household: 1.1MkW (in 2005) -> 16.2 – 24.4 MkW (in 2020)
  - PV in industry: 0.3 MkW (in 2005) -> 20.8 – 25.6 MkW (in 2020)
  - Wind: 1.1 MkW (in 2005) -> 11.3 MkW (in 2020)
  - Geothermal: 0.5 MkW (in 2005) -> 1.7 MkW (in 2020)
  - Small- & medium-scale hydro: 0.4 MkW (in 2005) -> 1.7 – 6.0 MkW (in 2020)
- For assessing above target, “Potential for the introduction of Renewable Energy” is investigated by the Ministry of the Environment.  
<http://www.env.go.jp/earth/report/h22-02/09-summary.pdf>

# Wind power generation potential

Annual mean wind speed  
(above 80m elevation) over

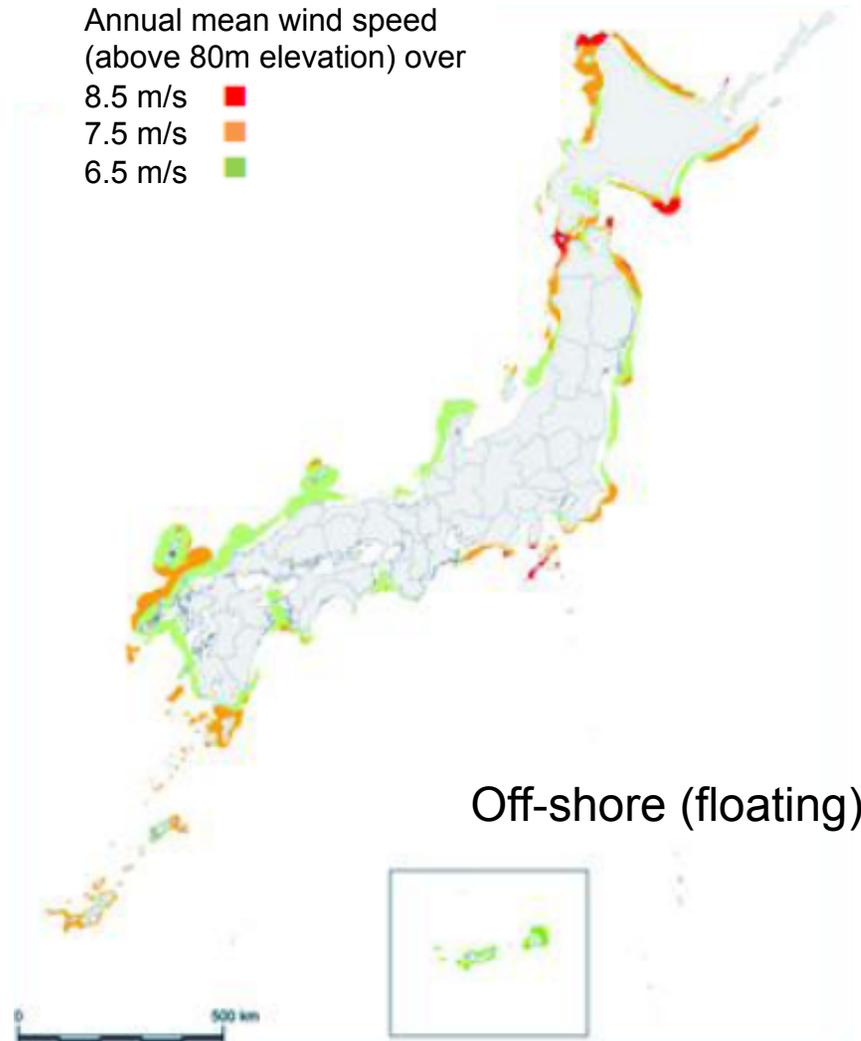
7.5 m/s ■  
6.5 m/s ■  
5.5 m/s ■



On-shore

Annual mean wind speed  
(above 80m elevation) over

8.5 m/s ■  
7.5 m/s ■  
6.5 m/s ■



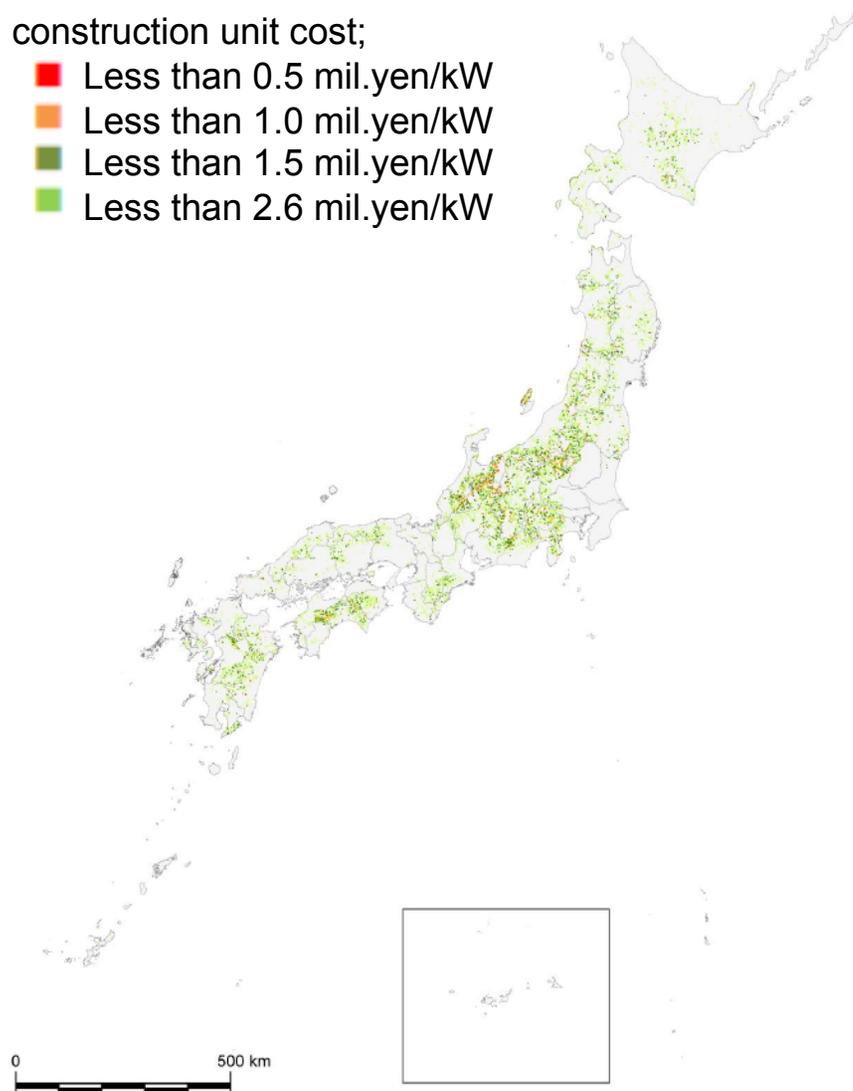
Off-shore (floating)

0 500 km  
ASIA-PACIFIC INTEGRATED MODEL

# Medium- & small-scale hydro power generation potential

construction unit cost;

- Less than 0.5 mil.yen/kW
- Less than 1.0 mil.yen/kW
- Less than 1.5 mil.yen/kW
- Less than 2.6 mil.yen/kW



# Renewable Energy Potential in Japan

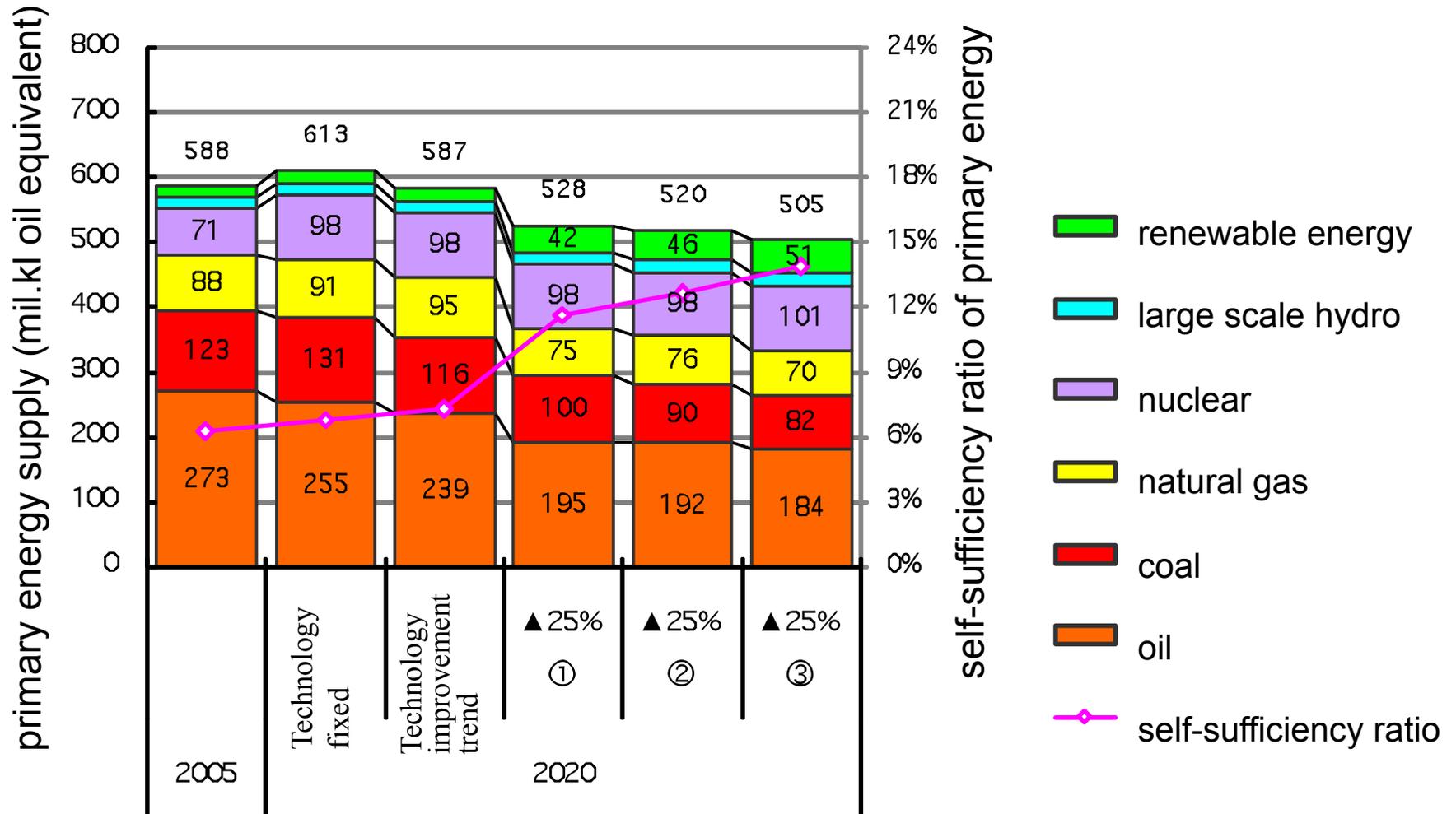
Unit: 10,000kW

		Wind Power Generation			Medium- and Small-scale Hydro Power Generation (*)	Geothermal Power Generation (* <sup>2</sup> )			(Reference) Generating Capacity of Electric Companies (FY2008)	
		Onshore	Offshore (Fixed type)	Offshore (Floating type)		Over 150°C	120 to 150°C	53 to 120°C		
<b>Potential</b>		140,000	770,000		1,800	2,400	110	850	20,218	
Introduction Potential (by electricity supply region)	<b>Summary Value by Scenario</b>	7,000 to 30,000	510 to 31,000	5,600 to 130,000	80 to 1,500	110 to 220	0.8 to 21	0 to 740		
	Hokkaido	3,000 to 15,000	470 to 12,000	3,800 to 28,000	2 to 130	39 to 71	0.6 to 7	0 to 246		650
	Tohoku	2,100 to 7,400	7 to 4,400	1,000 to 18,000	14 to 410	38 to 76	0 to 5	0 to 194		1,680
	Tokyo	100 to 450	32 to 2,800	640 to 5,200	15 to 220	10 to 18	0 to 1	0 to 112		6,398
	Hokuriku	44 to 520	0 to 420	0 to 5,900	19 to 190	0 to 0.3	0.1 to 3	0 to 26		796
	Chubu	250 to 870	0 to 1,900	110 to 1,900	16 to 270	1.2 to 5.5	0 to 1	0 to 88		3,263
	Kansai	330 to 1,300	0 to 160	0 to 2,400	2 to 38	0 to 0.2	0	0 to 8		3,386
	Chugoku	190 to 1,000	0 to 460	0 to 15,000	4 to 64	0	0	0 to 15		1,183
	Shikoku	110 to 530	0 to 390	0 to 3,800	3 to 73	0	0	0 to 4		666
	Kyushu	630 to 2,200	2 to 5,400	48 to 40,000	3 to 100	25 to 49	0.1 to 3	0 to 52	2,002	
Okinawa	280 to 560	1 to 2,800	1 to 6,300	0 to 0.2	0	0	0	192		

(\*) Less than 30,000kW of facility capacity: water supply, sewerage and water for industrial use (approximately 180,000kW of the potential) are not included.

(\*<sup>2</sup>) The potential of hot spring power generation is not included.

# Primary energy supply in Japan in 2020

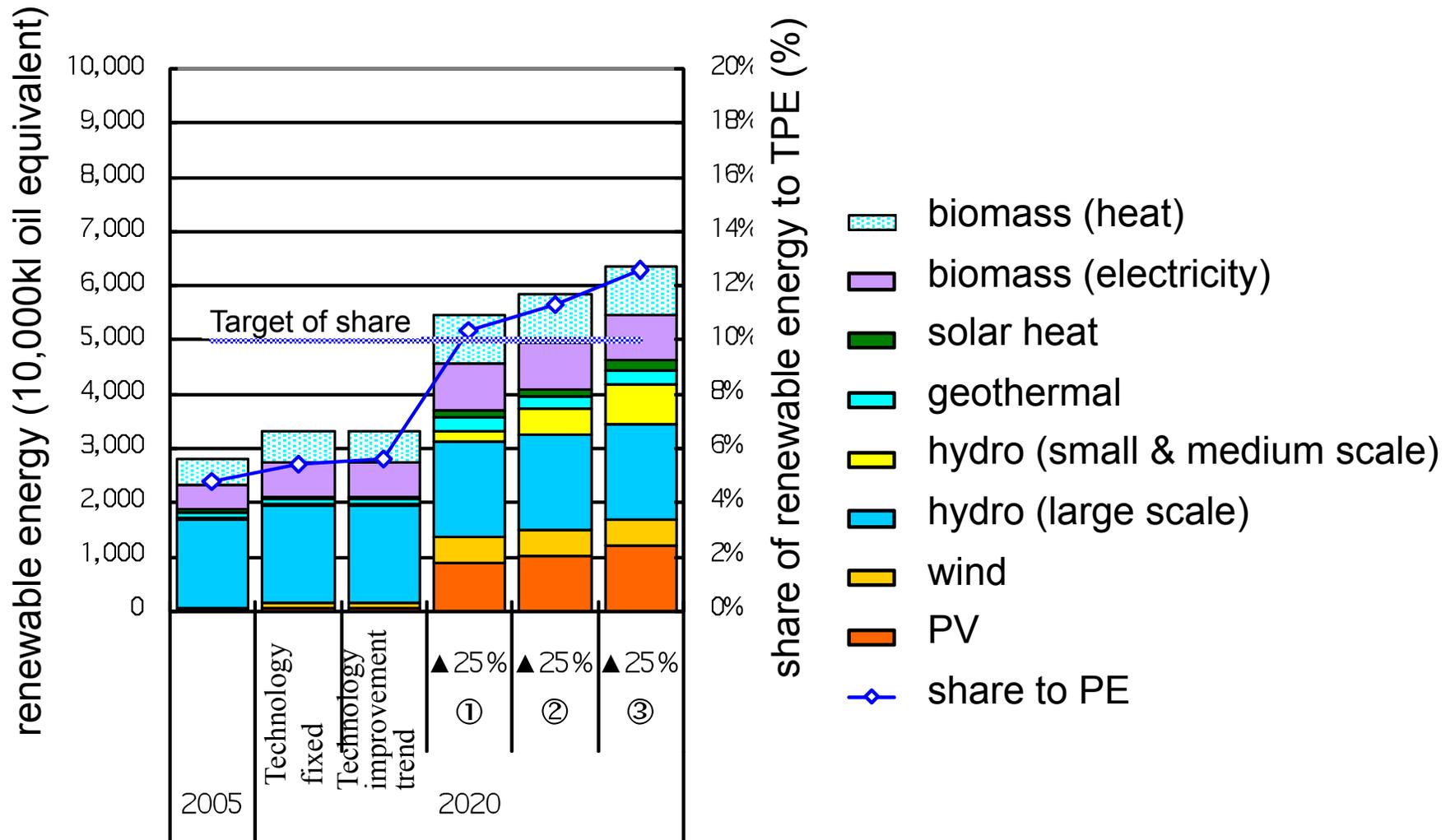


25%(1): 15% of domestic reduction + 10% of credit

25%(2): 20% of domestic reduction + 5% of credit

25%(3): 25% (all) of domestic reduction

# Renewable energy supply in Japan in 2020



25%(1): 15% of domestic reduction + 10% of credit  
 25%(2): 20% of domestic reduction + 5% of credit  
 25%(3): 25% (all) of domestic reduction

## Cost to introduce renewable energy to achieve mid-term target in Japan

	25%(1)	25%(2)	25%(3)
PV	13.0	18.3	22.6
Wind power	2.5	2.5	2.5
Small- & Medium- scale hydro and geothermal power	1.7	3.2	5.3
Biomass power	1.0	1.0	1.0
To solve power system problem (battery etc.)	3.1	4.0	5.6
<b>Total</b>	<b>21.2</b>	<b>29.0</b>	<b>36.8</b>

trillion yen, total from 2011-2020

25%(1): 15% of domestic reduction + 10% of credit

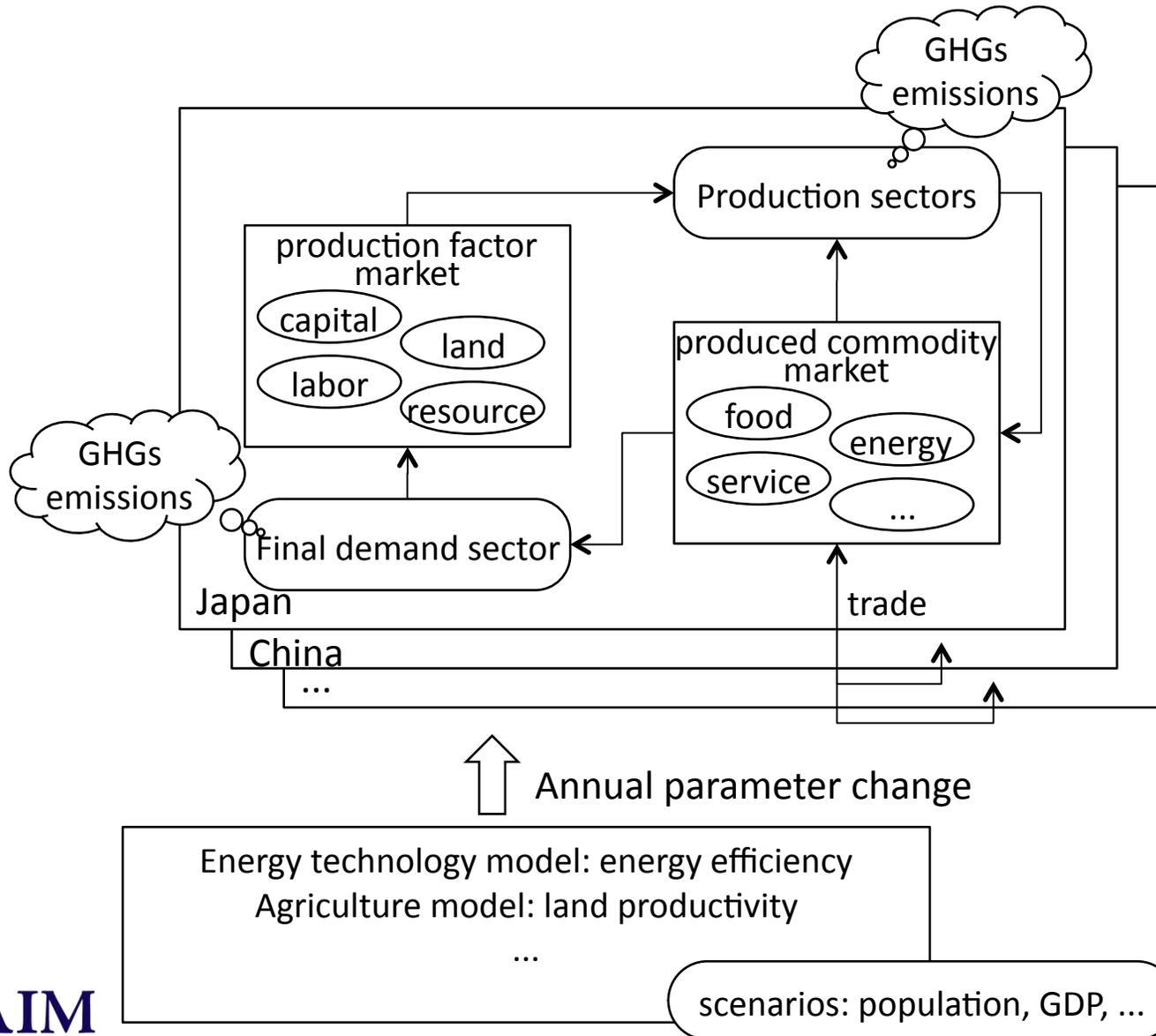
25%(2): 20% of domestic reduction + 5% of credit

25%(3): 25% (all) of domestic reduction

# Updating renewable energies in AIM for global assessment

- We are now updating the renewable energy potential.
- Solar power and wind power have been estimated by 30'' x 30'' using new methods.
  - Solar: grade by insolation (kWh/m<sup>2</sup>/yr)
  - Wind: grade by capacity factor (%)
- We desire the above energy potentials will be checked with other similar estimation in this project.
- Then, cost will be estimated, and linked with above data.
- Finally, all datasets will be installed in AIM models, and introduction of renewable energies by scenarios will be assessed.

# Structure of AIM/CGE [Global]



## Regional definition in AIM/CGE[Global]

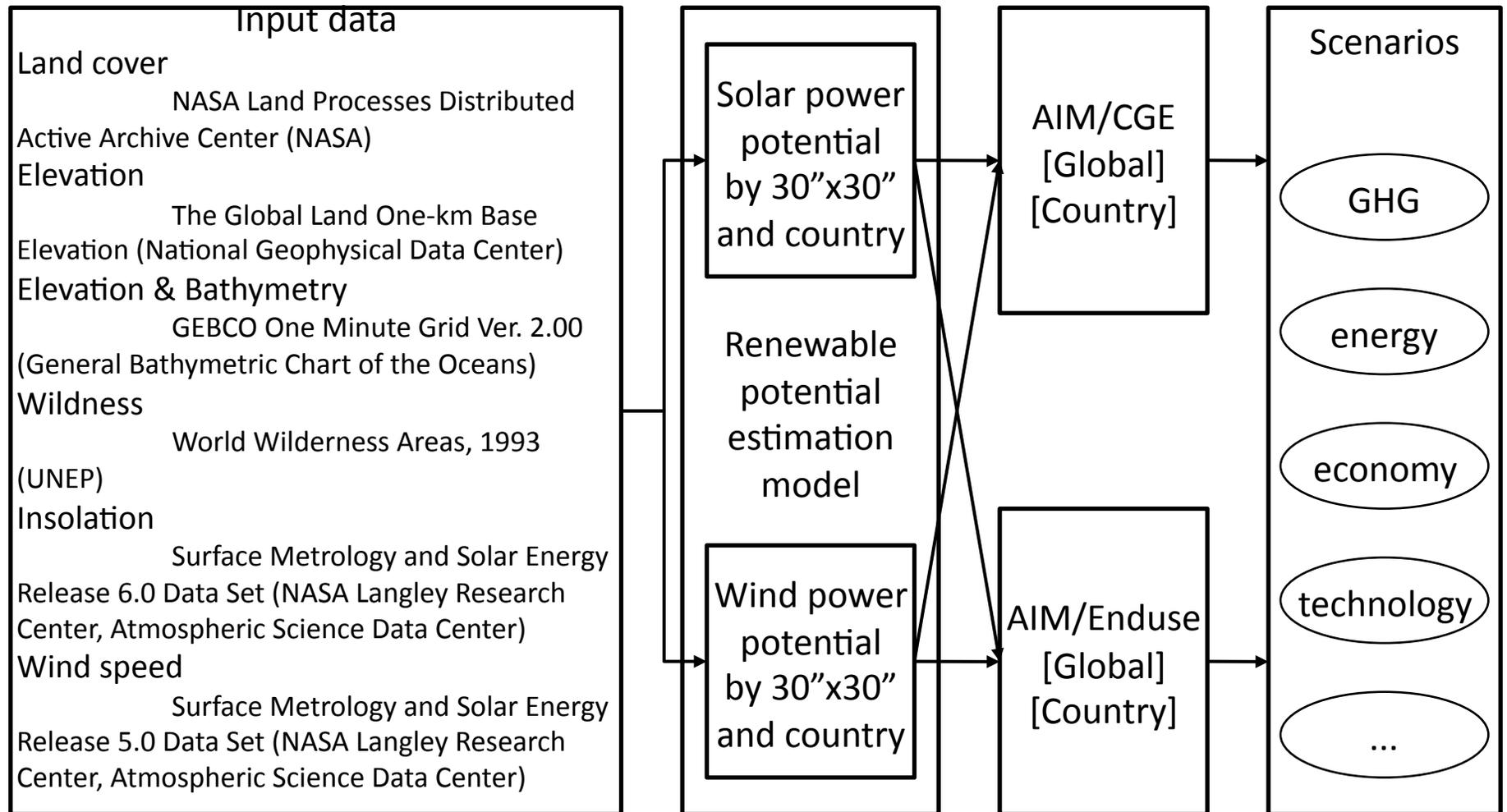
JPN	Japan	USA	USA
CHN	China	XE15	EU-15 in Western Europe
KOR	Korea	XE10	EU-10 in Eastern Europe
IDN	Indonesia	RUS	Russia
IND	India	XRE	Rest of Europe
THA	Thailand	BRA	Brazil
XSE	Other South-east Asia	MEX	Mexico
XSA	Other South Asia	ARG	Argentina
AUS	Australia	XLM	Other Latin America
NZL	New Zealand	XME	Middle East
XRA	Rest of Asia-Pacific	ZAF	South Africa
CAN	Canada	XAF	Other Africa

\* We are updating from above 24 regions to 35 regions.

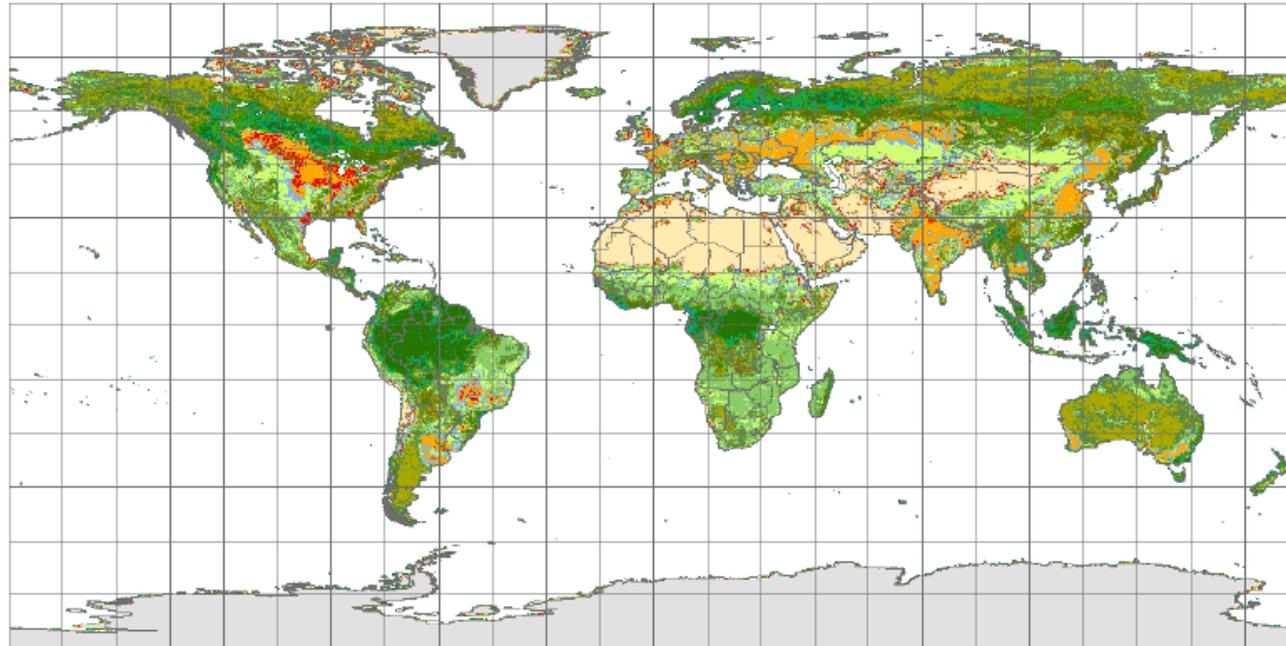
## Sectoral definition of AIM/CGE[Global]

non-electric sector		electric sector
agriculture	communication	coal fire (w/wo CCS)
livestock	public service	crude oil fire (w/wo CCS)
forestry	other service	oil fire (w/wo CCS)
fishing	coal	gas fire (w/wo CCS)
mining (except fossil fuels)	crude oil	nuclear
energy intensive products	petroleum products	hydro
metal and machinery	gas	biomass fire (w/wo CCS)
foods	gas manufacture distribution	waste fire (w/wo CCS)
other manufactures	biomass (liquid fuel)	geothermal
water	biomass (gas fuel)	solar
construction	biomass (solid fuel)	wind
transport		other

# Process to estimate solar/wind power potential

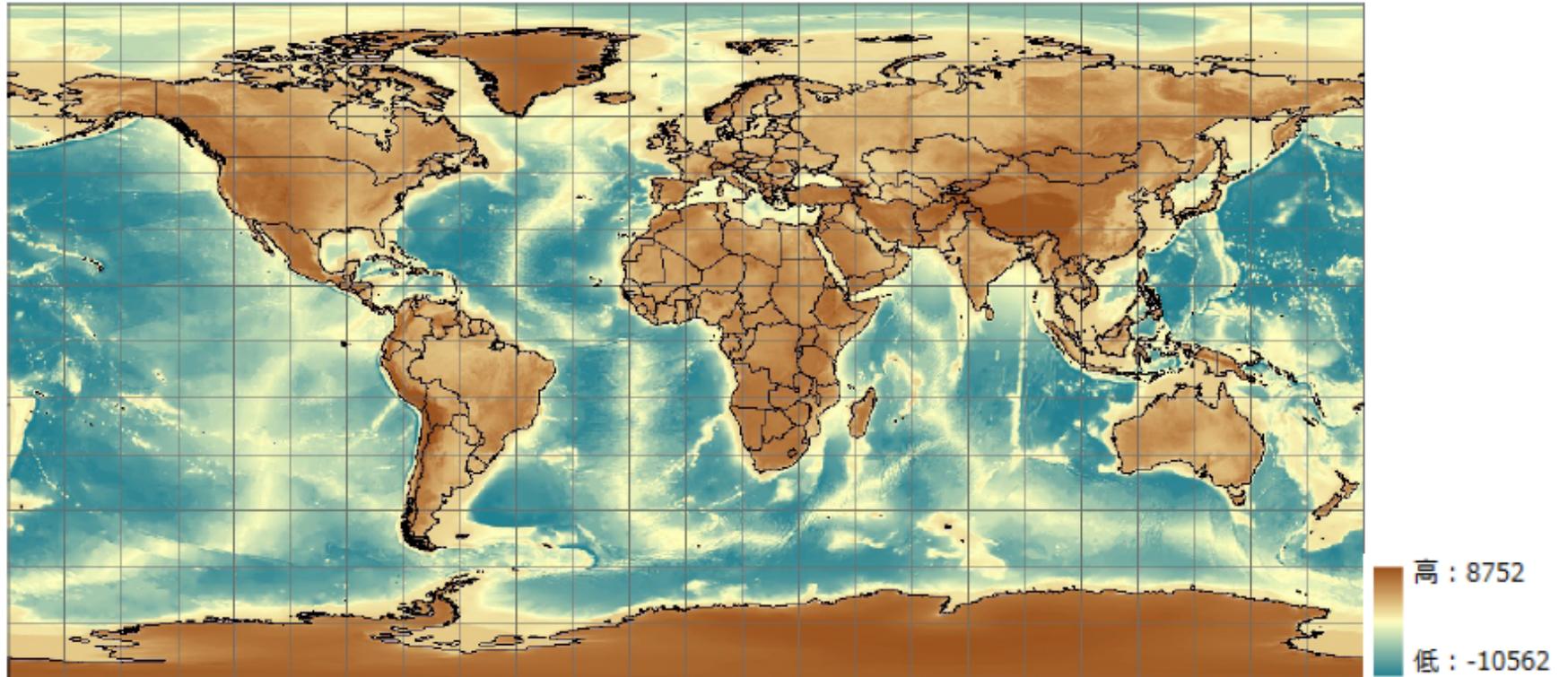


# Land cover data



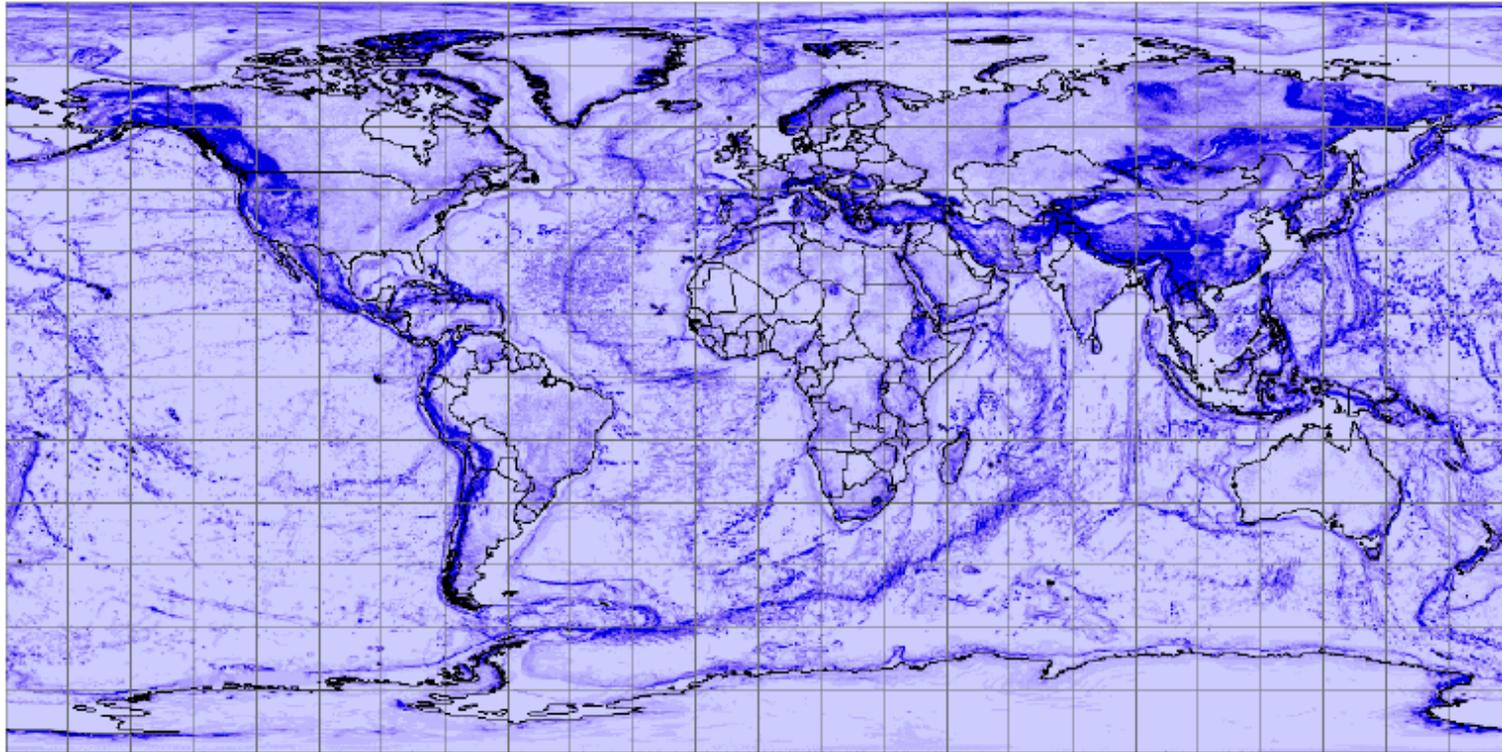
- |                               |   |
|-------------------------------|---|
| 1 Evergreen Needleleaf Forest | 10 Grasslands                           |
| 2 Evergreen Broadleaf Forest  | 11 Permanent Wetlands                   |
| 3 Deciduous Needleleaf Forest | 12 Croplands                            |
| 4 Deciduous Broadleaf Forest  | 13 Urban and Built-Up                   |
| 5 Mixed Forest                | 14 Croplands/National Vegetation Mosaic |
| 6 Closed Shrublands           | 15 Snow and Ice                         |
| 7 Open Shrublands             | 16 Barren or Sparsely Vegetated         |
| 8 Woody Savannas              | 17 Water Bodies                         |
| 9 Savannas                    |   |

# Elevation/Bathymetry



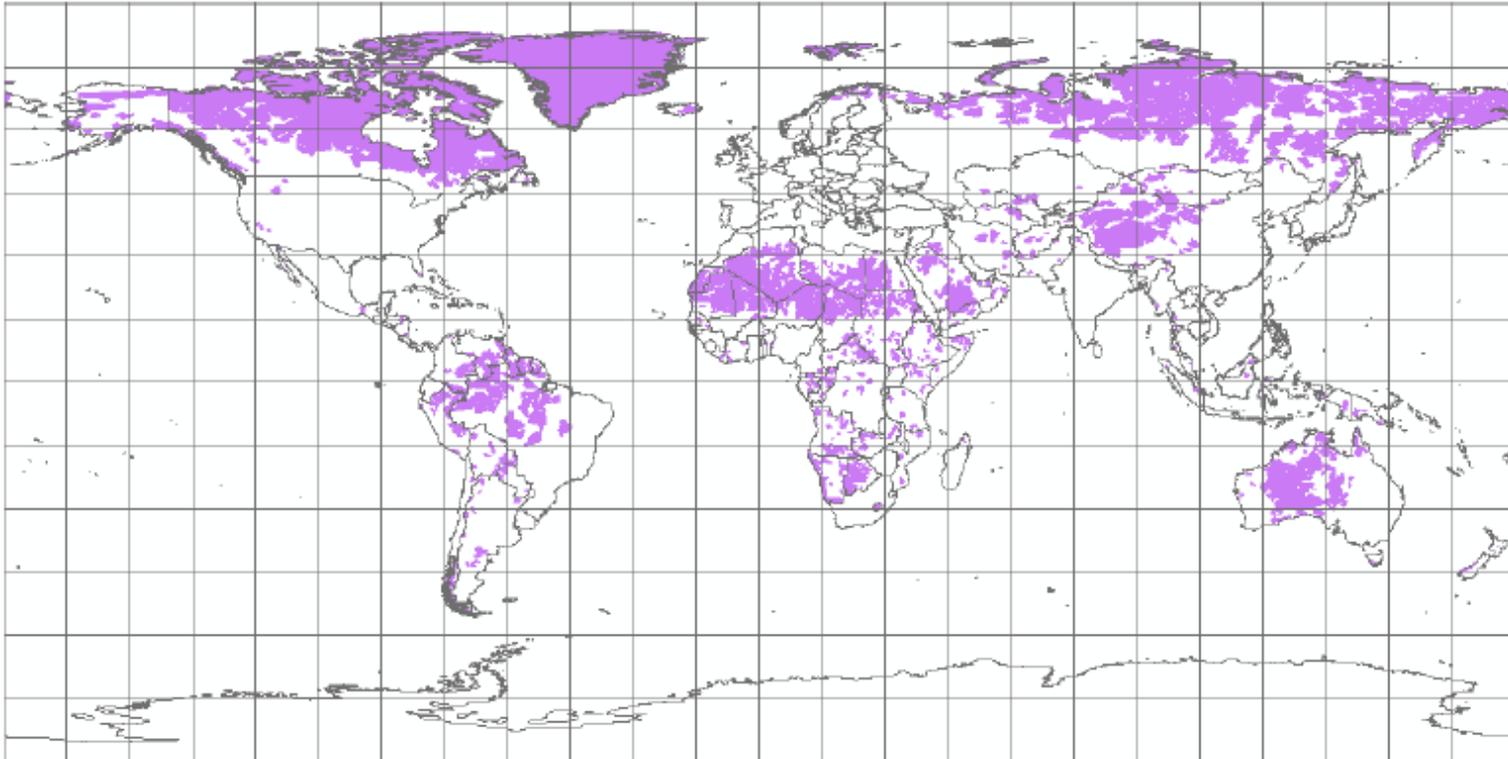
The Global Land One-km Base Elevation (National Geophysical Data Center)

# slope



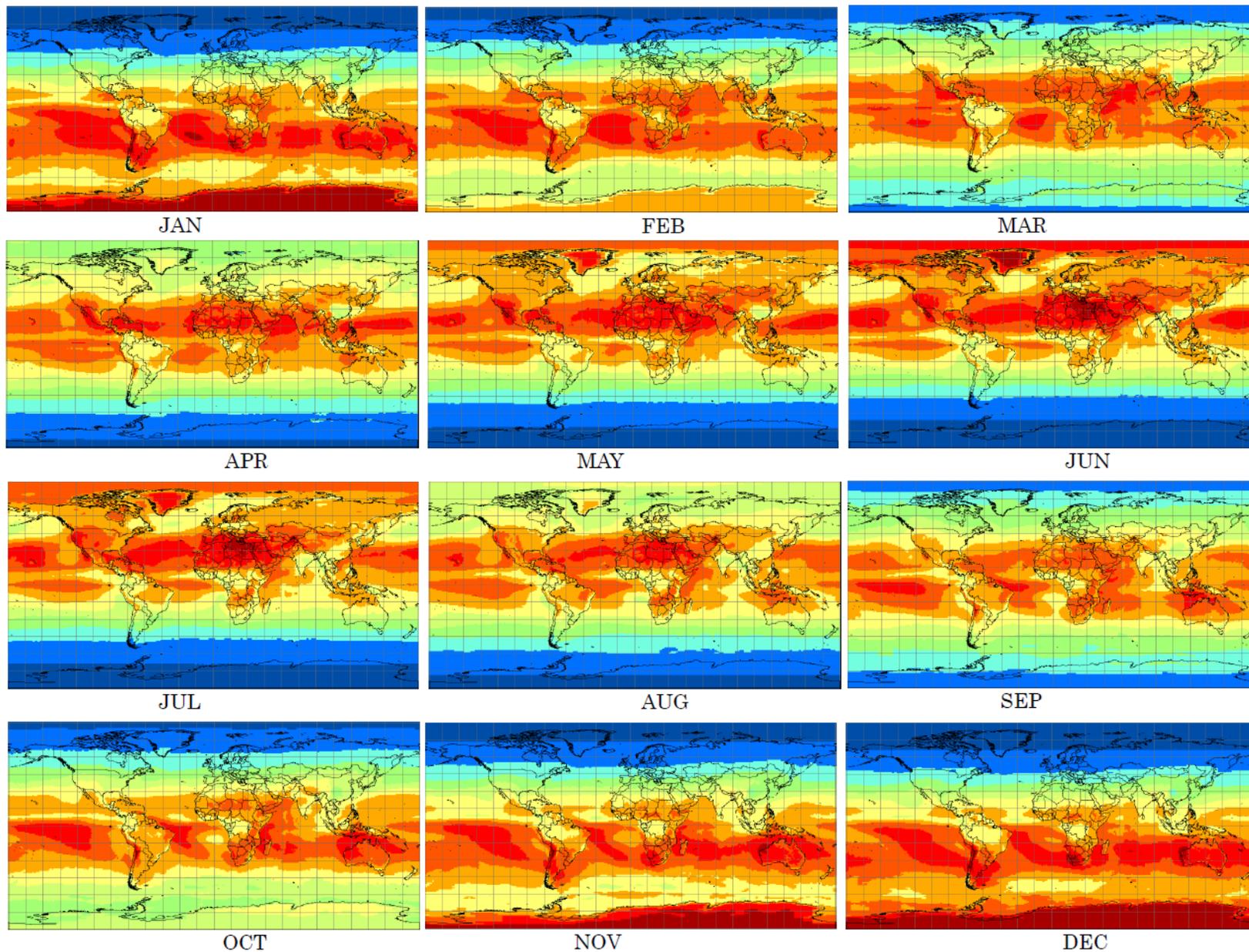
高 : 739  
低 : 0

# Wildness



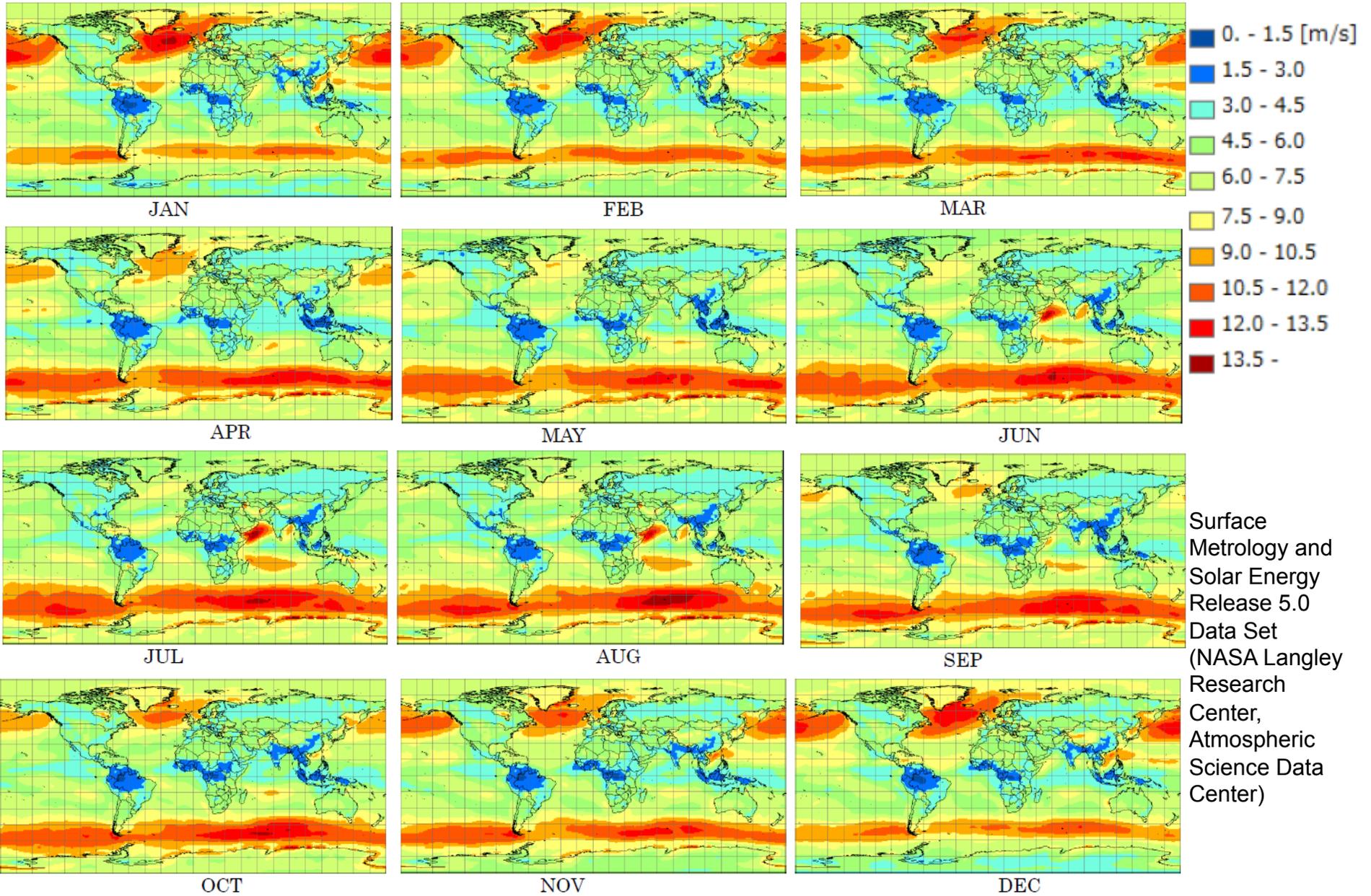
World Wilderness Areas, 1993 (UNEP)

# Insolation

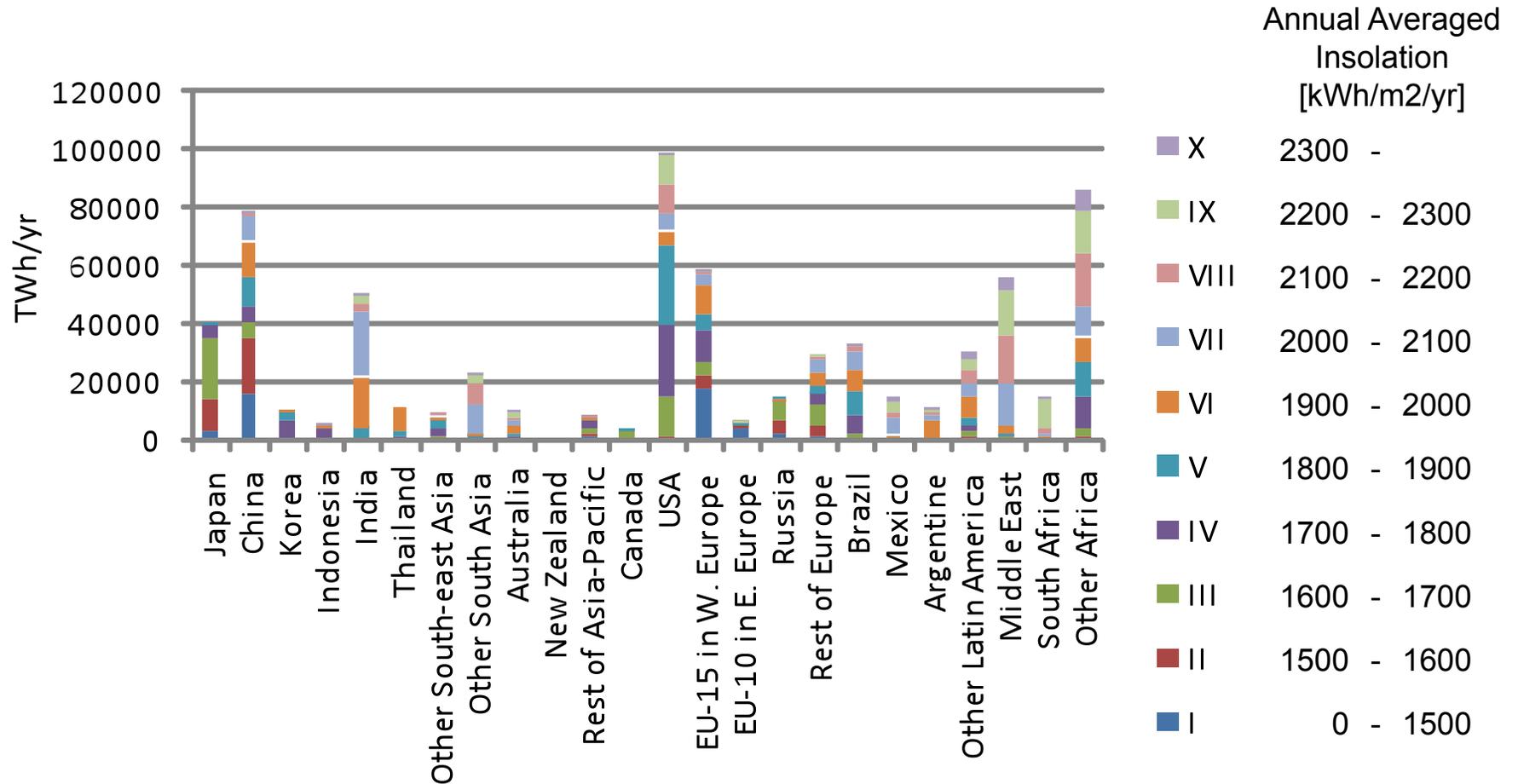


Surface Metrology  
and Solar Energy  
Release 6.0 Data  
Set (NASA  
Langley Research  
Center,  
Atmospheric  
Science Data  
Center)

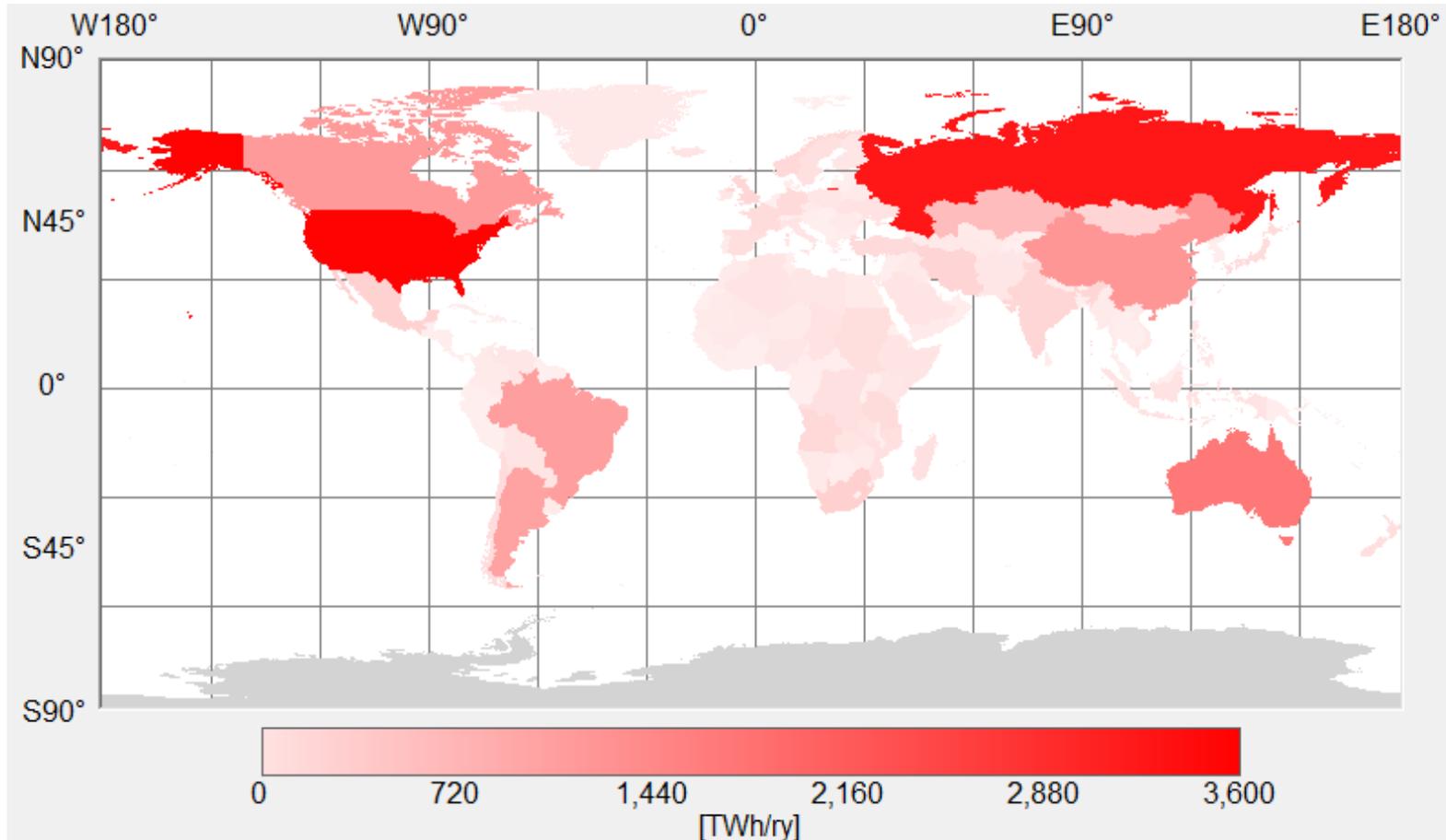
# average monthly wind velocity



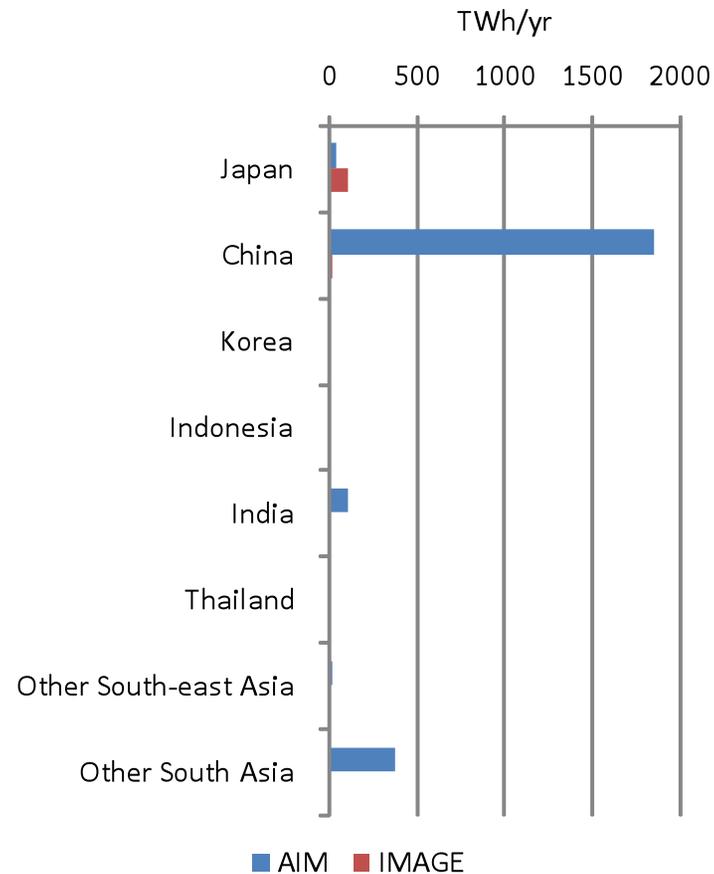
# Solar energy potential by grade



# Wind Energy Potential



# Data comparison of wind power for Asia between AIM & IMAGE



AIM: capacity factor 30-45%

IMAGE: class 3-7

# Necessary information for IAM

AIM/CGE (and the AIM/Enduse also) is macroscopic model.

The grid data of renewable energies are aggregated into country/region level in advance, then these aggregated data are input into the models.

Following data are necessary;

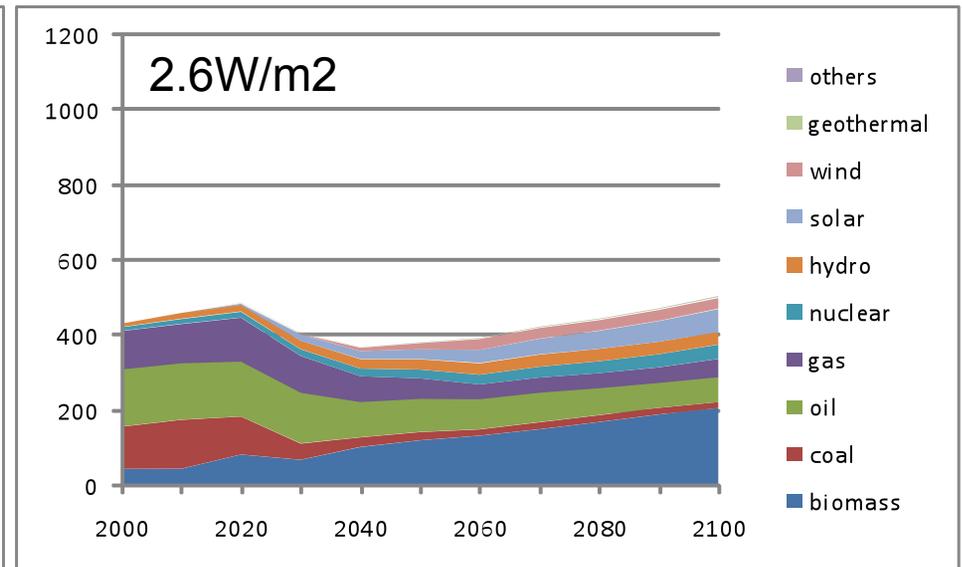
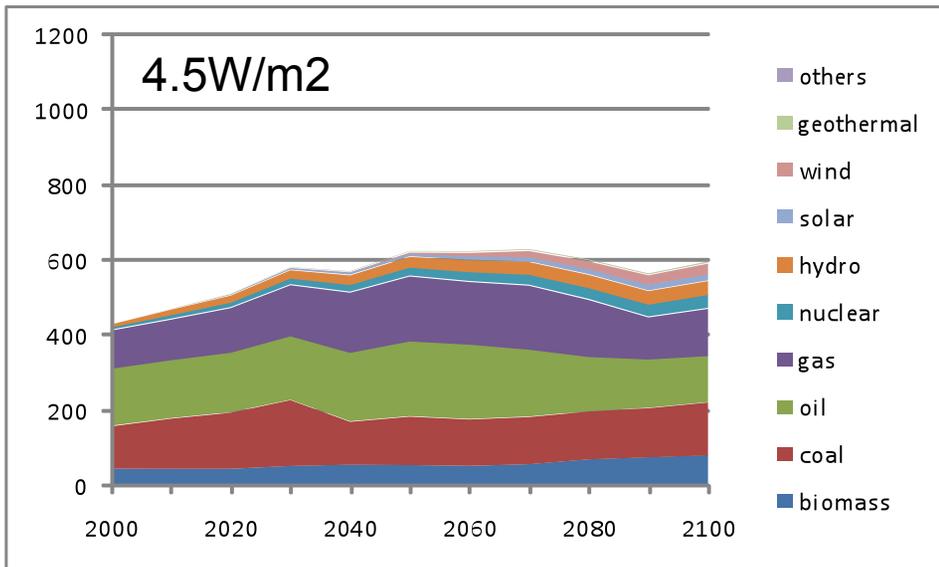
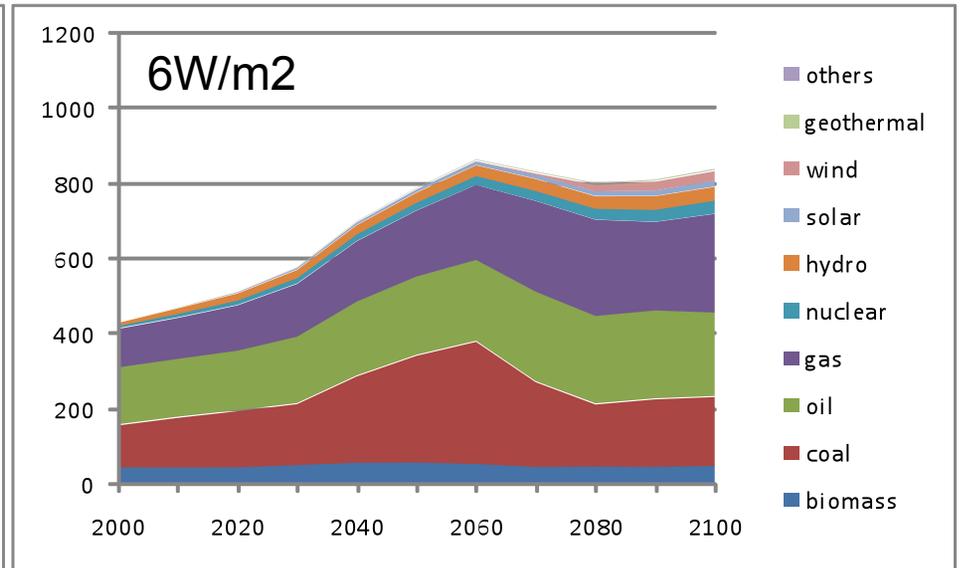
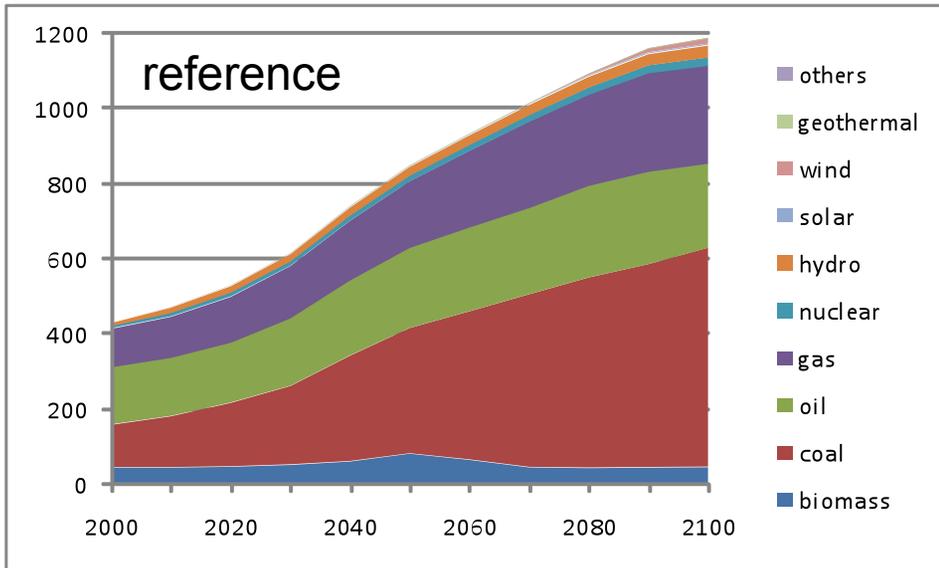
- Production: installed capacity, annual production potential
- Cost: investment cost, operation cost, learn by doing, ...

Following data are welcome;

- Solar: electricity and heat
- Wind: off-shore
- Biomass: land productivity
  
- Share of renewable energy in the future depend on their cost and potential.
- Definition should be unified among datasets
- Updated datasets will be replaced to old data.

Previous results

# World primary energy supply [EJ]



Previous results

# World electricity production by source [EJ]

