

China cleans up its environment

Rolf Schmid and Xin Xiong

Bio 4 Business

Evening lecture at Lions-Club Stuttgart-City, May 17, 2023

China's Environmental Solution

Schmid | Xiong



China's Environmental Solution

Policy, Technologies, and Perspectives

Rolf Schmid | Xin Xiong



Bio 4 Business

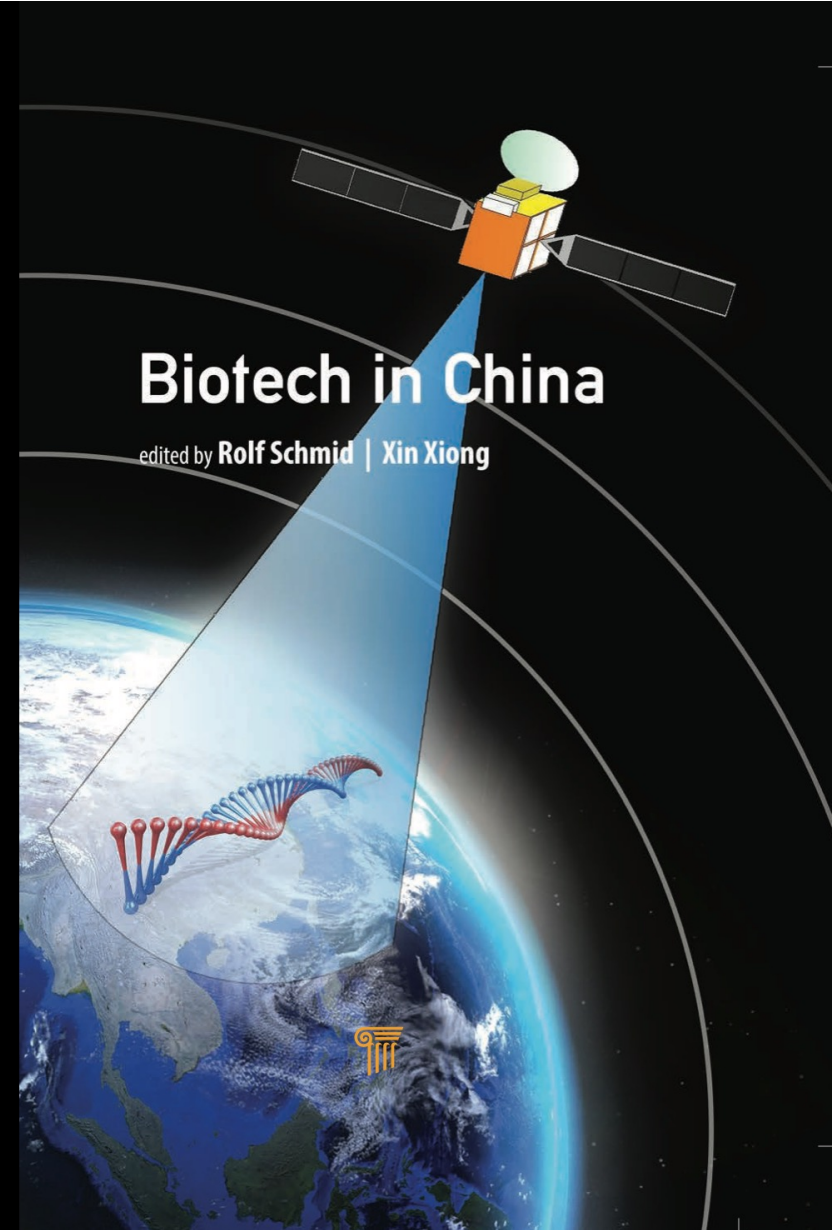
Biotech in China

Schmid | Xiong



Biotech in China

edited by Rolf Schmid | Xin Xiong



- Stormy growth
- Air and water
- Ecosystems
- Decarbonisation
- Outreach along the New Silk Road
- „Beautiful China“

40 Years of stormy growth....

	1980	2000	2020
Population (million)	981	1263	1402
Urbanization (%)	19	36	61
GDP (billion US\$)	191	1215	14.700
F&E expenditure (% of GDP)	0,7	1	2,4
R&D personnel (full time equivalents)	670,000	920,000	5,240,000
STEM students		5,094,000 (62%)	8,620,000 (41%)

and economic success....

	1980	2000	2020	% global share
Concrete production (million t)	80	597	2,395	57
Steel production (million t)	37	129	1,064	58
Energy consumption (million t of coal)	603	1,971	4,983	26
Private cars	200,000	6,300,000	280,000,000	19
Highways, km	-	16,000	161,000	
Railroad tracks, km	50,000	69,000	146,000	
5G base stations			2,384,000*	70

*03/2023

The life of farmers is changing...

satellite-based tea plucking robot in Zhejiang



Using binocular stereo vision, the tea-picking robot can position where the target bud and leaf are, cut them off precisely, then suck the leaves into its basket via its negative-pressure pipette.[Photo/CRI Online]



Workers harvest hydroponic lettuce in a plant factory in Nantong, east China's Jiangsu province. (People's Daily Online/Xu Congjun)

Hydroponic „salad factory“ in Jiangsu

Bio 4 Business

...as are activities of workers

As recent as 2015
„workbench of the
world“

2023: in Zhejiang
province alone
52 „Future factories“

Bio 4 Business



Digitalisation everywhere...



Students have a science class wearing virtual reality headsets in a primary school in Qinhuangdao, north China's Hebei province. (Photo by Cao Jianxiong/People's Daily Online)

School children in Qinhuangdao use AR
(over 90 % of all schools completely digitalized)

Bio 4 Business



Drones surveying a high-voltage system in Guilin



A „digital twin“ of a river in Gansu for flood control

January 2013: „The Great Beijing Smog“

$PM_{2.5} > 500 \mu g/l$



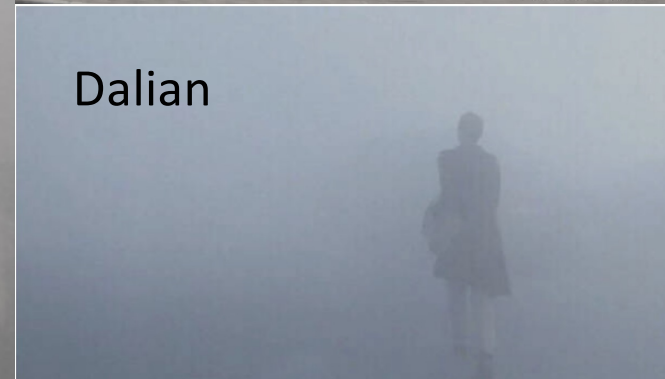
Photo taken on Jan. 13, 2013 shows the fog-shrouded buildings at the Central Business District in Beijing, capital of China. Dense fog on Sunday hit China's east and central regions from the northeast to the south, causing serious air pollution. [Xinhua]

Bio 4 Business

Changchun

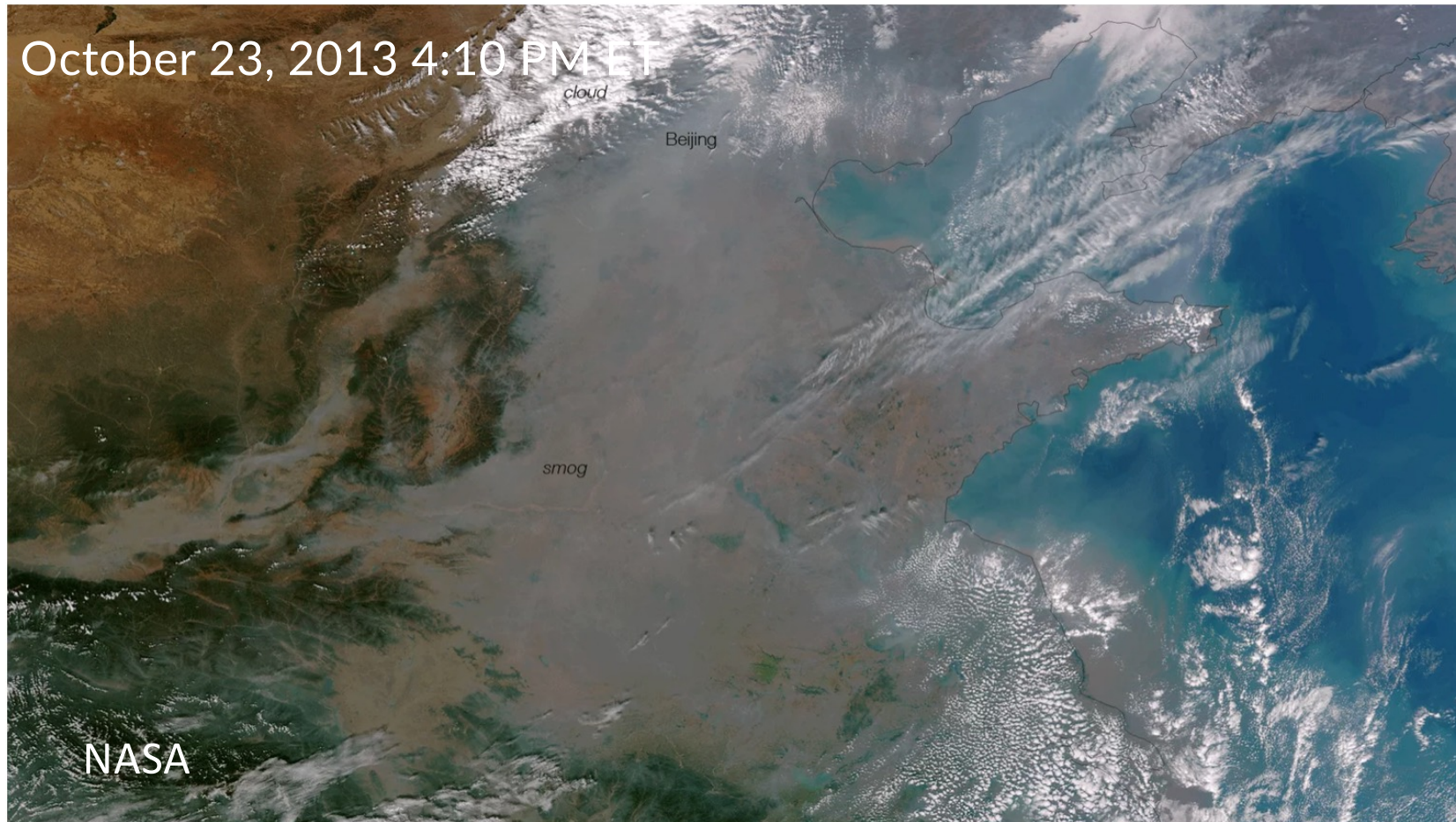


Dalian



Nanjing





Heavy smog has shrouded much of eastern China, and air quality levels have been dropped to extremely dangerous levels. The heavy smog is caused by industrial pollution, coal and agricultural burning, and has been trapped by the mountains to the west and wind patterns. The thick haze of smog is clearly visible as the murky gray color in this true color satellite image.

NASA/NOAA

Bio 4 Business

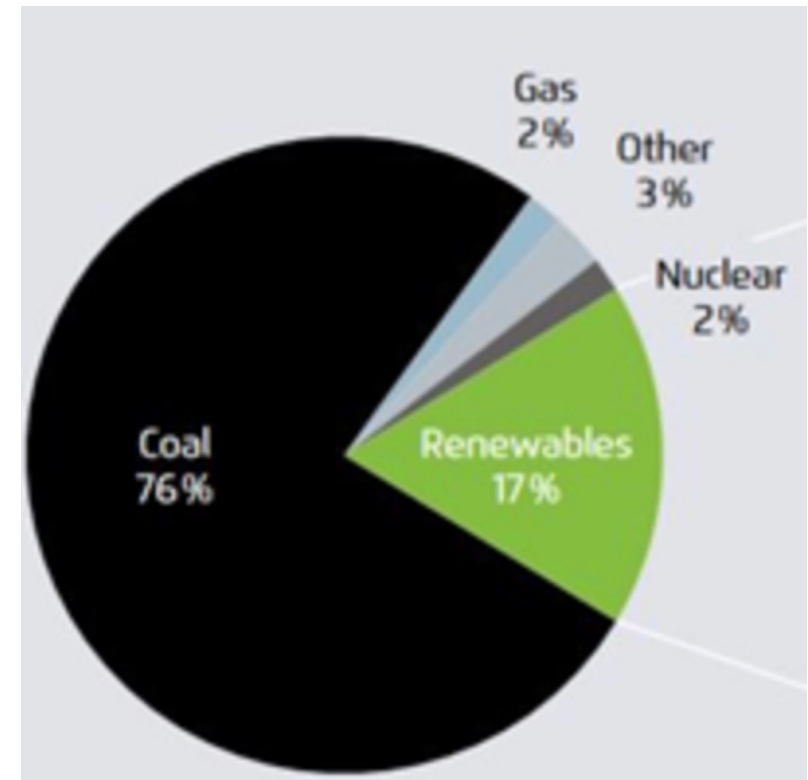
„Emission Inventory“ 2010

industry	43 %
households	35 %
traffic	11 %
power plants	8 %
agriculture	4 %

1100 power plants !

700 Mill. t Stroh pro Jahr

Energy sources 2010



Bio 4 Business



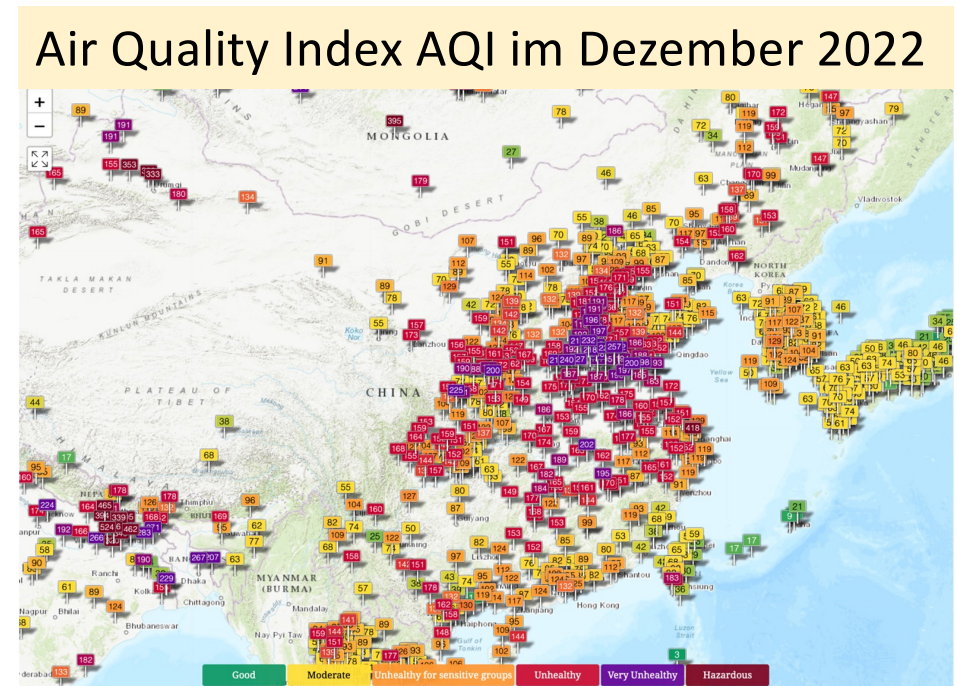
Bio 4 Business



The air quality monitoring team at the U.S. Embassy in Beijing, led by Erica Keen Thomas (front row, second from right), helped put pressure on the Chinese government to increase its standards for measuring air pollution. (Courtesy of U.S. Embassy Beijing)

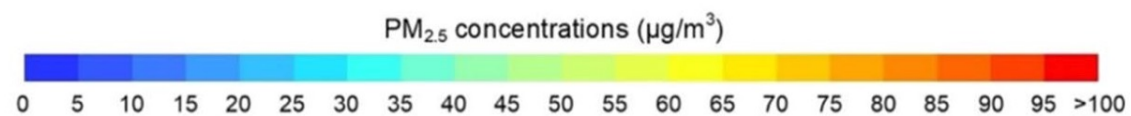
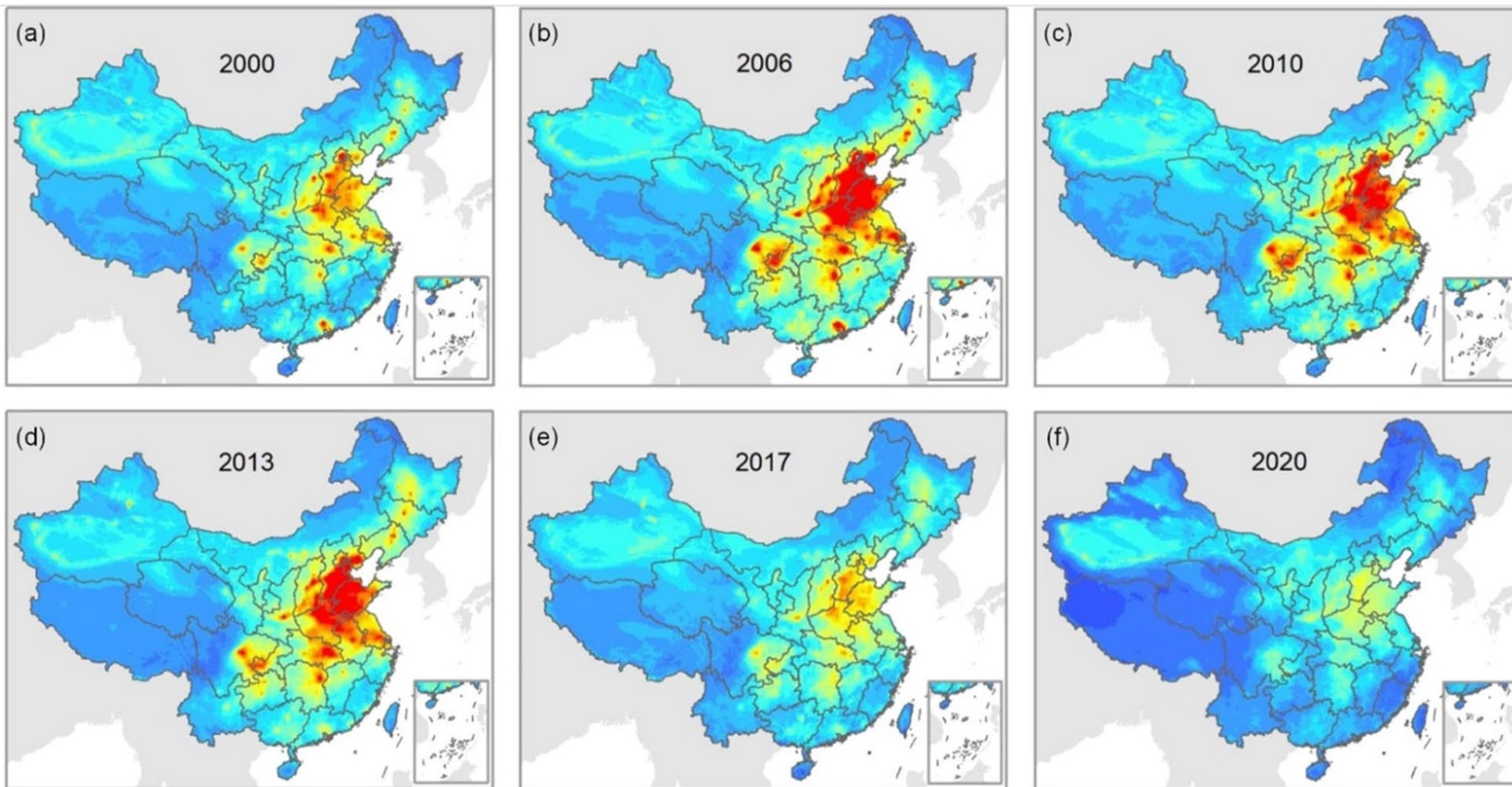
2013 Air Pollution Prevention and Control Plan 大气污染防治行动计划

- National air quality data in real time
- increasingly stricter emission standards for power plants, industry and traffic
- financial support to replace old boilers “away from burning coal”: buildup of non-fossile energy resources
- fostering electromobility
- strict controls and fines



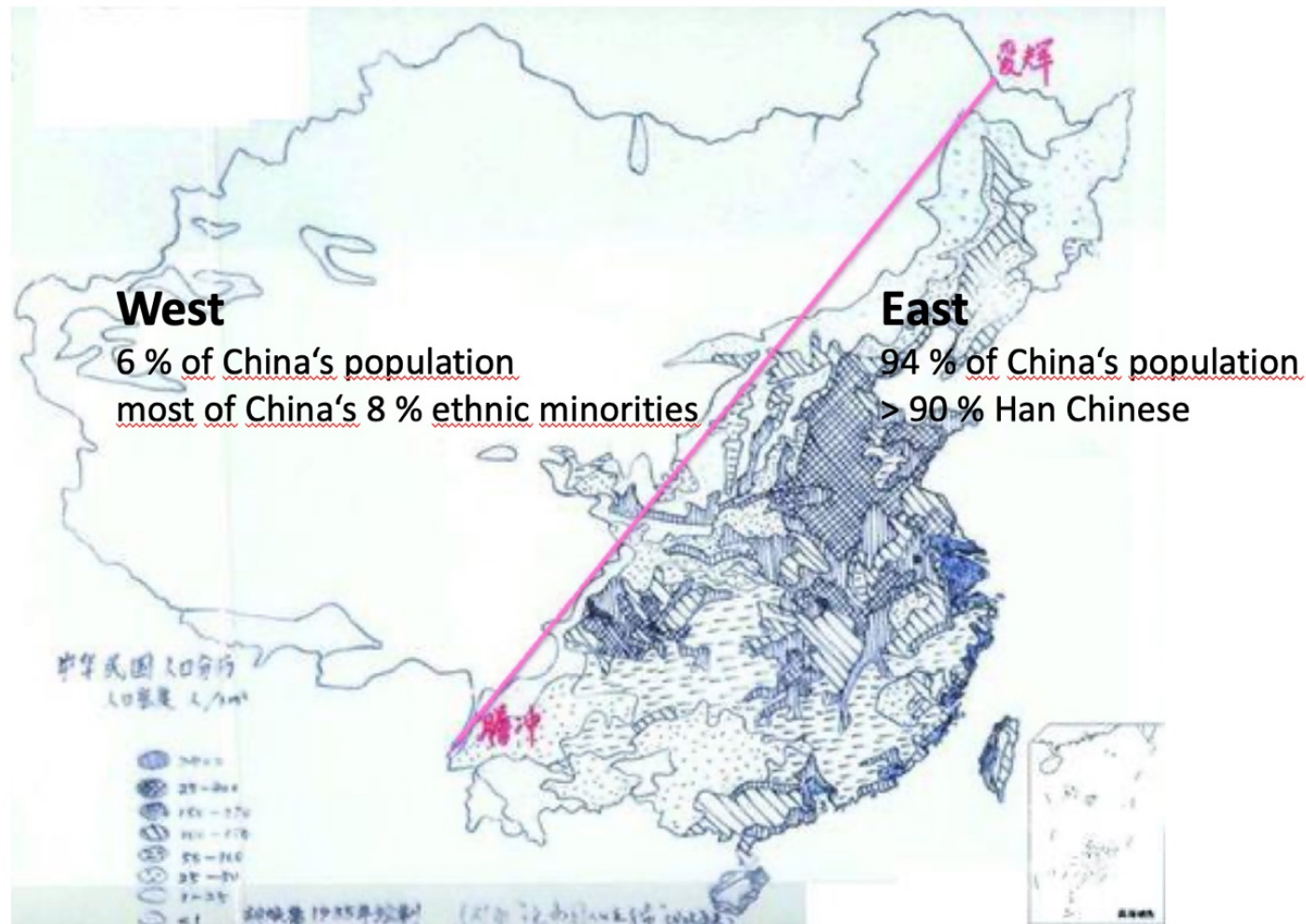
- 
- over 10,000 factories were closed, 40,000 more on reduced operation
 - 6 days of vacation for employees of state-owned companies, government offices and schools
 - 400,000 cadres supervise 60,000 factories, 123,000 construction sites and all gas stations
 - 12,000 coal-fired heaters were turned off from November 7 – 15,
 - Cooking is only allowed with gas
 - Only half of all cars are allowed on the road (according to even and uneven number plates)
 - 524,000 trees were planted near the APEC meeting point

„APEC Blue“, November 10 – 12, 2014



Bio 4 Business

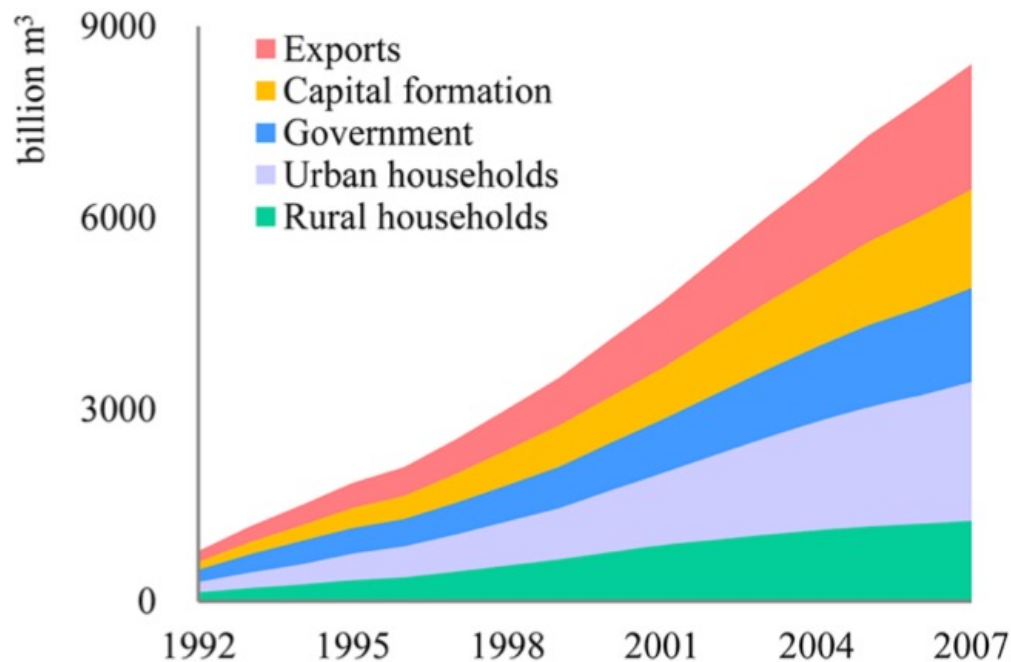
Hu Huanyong's line (1936)



Huanyong HU, Chinese Journal of Geography, 1935

Water supply

„Dirtwater footprint“



Result of > 12,000 samplings, 2012

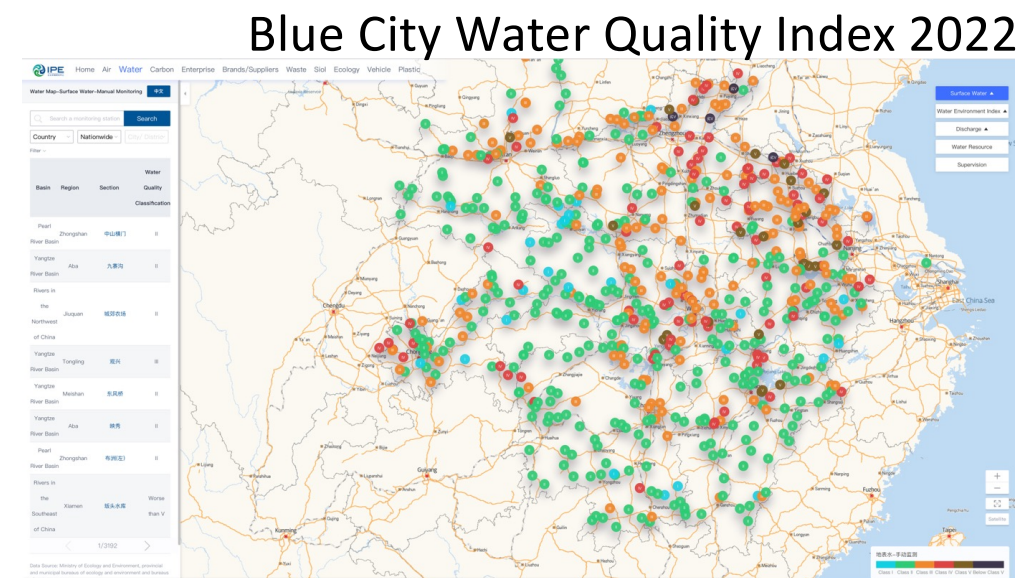
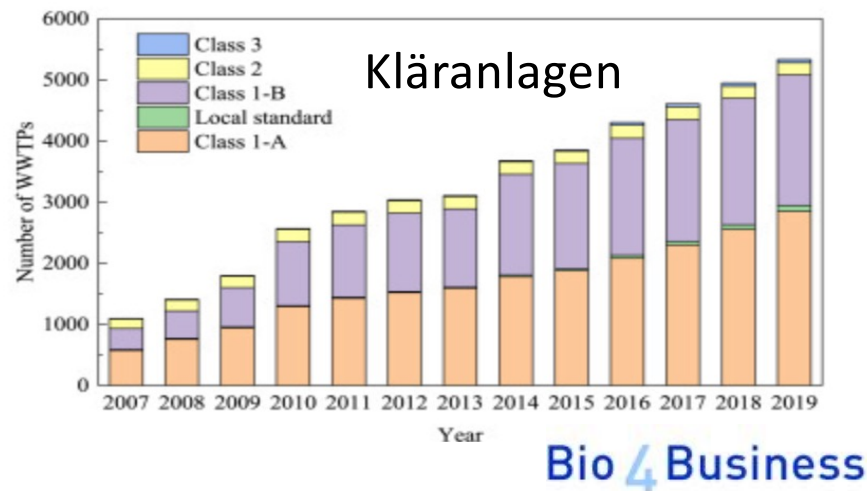
Good quality	35 %
Moderate quality	32 %
Useable for industry and agriculture	20 %
Unuseable	13 %

drinking water is also heavily polluted,
especially in rural areas
(heavy metals, antibiotics)

2015 Water Pollution Prevention and Control Action Plan

水污染防治行动计划

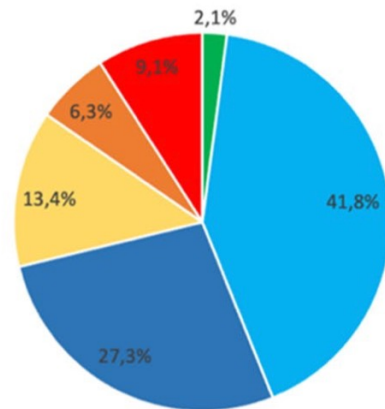
- by 2020, over 70% of the seven most important rivers must achieve water quality III
 - by the end of 2017 all industrialized regions along these rivers must have introduced central sewage treatment plants
 - no city may have more than 10% black water
 - 95% of all municipal drinking water facilities are required to produce Class III drinking water or better
 - water consumption is to be reduced by 23%
- Blue City Water Quality Index



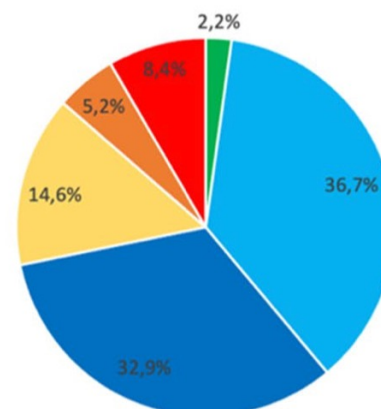


The Gaobaidian
Wastewater
Treatment Plant in
Beijing treats the
wastewater of
2.4 million people

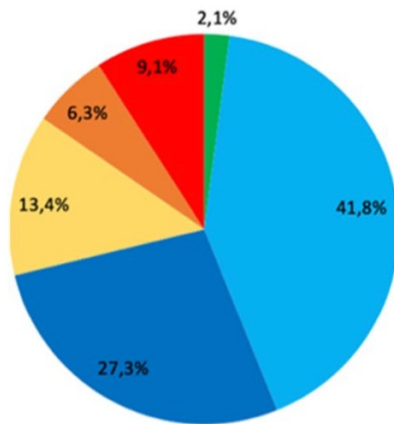
2016



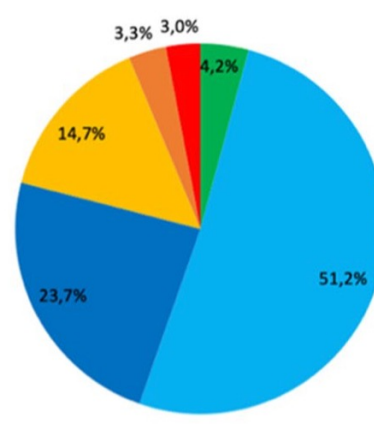
2017



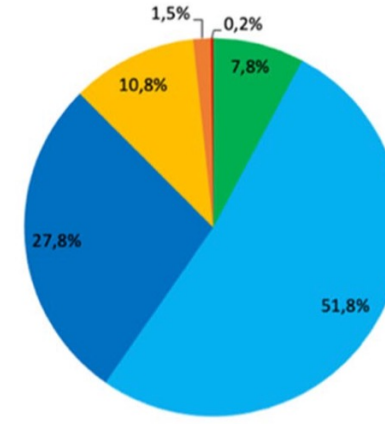
2018



2019



2020



Surface water quality class

1 2 3 4 5 5-

Bio 4 Business

The South-to-North Water Diversion Project

since 2014 the main source of water for over 40 cities and over 140 million people in 280 counties in the north



Photo Credit: The western route will transform 17 billion m³ and *according to official reports*, the eastern and middle routes divert 14.8 billion m³ and 13 billion m³ of water per year, respectively. In practice, *the volume of water appears to be much less*, with annual diversions of only around 1 billion m³ in the eastern route and 6 billion m³ in the middle route. Map provided courtesy of *China Dialogue*.



Satellite image taken on December 26, 2022 shows the Yellow River-crossing tunnel, a vital part of the middle route of the

Bio 4 Business



Satellite image taken on March 5, 2023 shows an aqueduct of the middle route of the Project in Xinzheng City, central China's Henan Province. (Image by AIR)

Deforestation, desertification, loss of black soil



Bio 4 Business



Desertification control workers make straw checkerboard barriers in the Tengger Desert along the construction site of the Qingtongxia-Zhongwei section of the Wuhai-Maquin highway in northwest China's Ningxia Hui Autonomous Region, Sept. 7, 2020. (Xinhua/Feng Kaihua)



Since 1999: "Grain for Green"- Project 退耕还林

About 20% of the rural population in 25 provinces is involved

Between 2013 and 2018 alone, 415,000 km² of forests were planted

In 2020, 23% of China's territory consisted of forests again, in 1990 it was only 17%

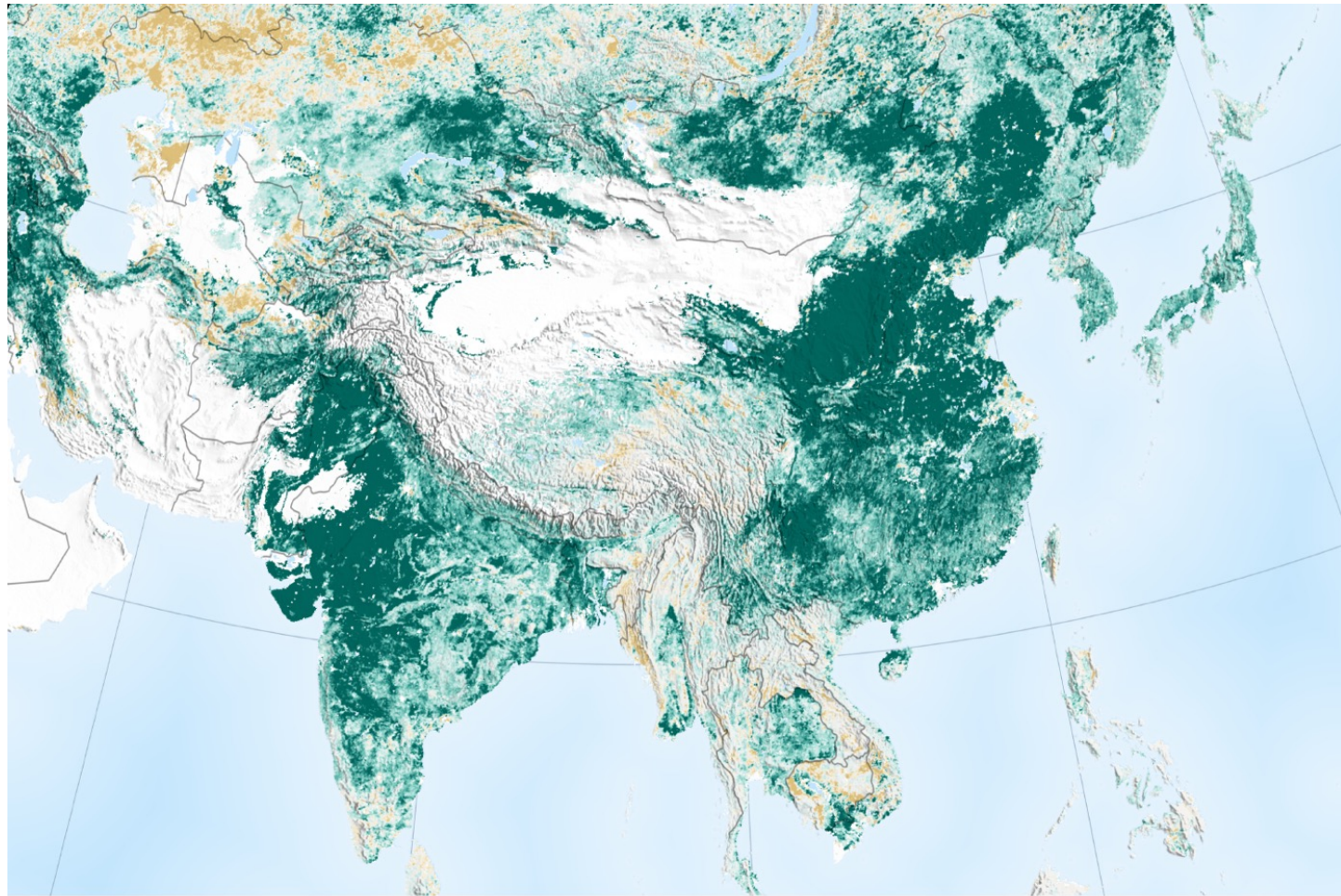


2700 km ring railway
around the Taklamakan
desert

534 km of the track is
sandstorm area



Satellite recordings Of NASA, 2000 - 2017



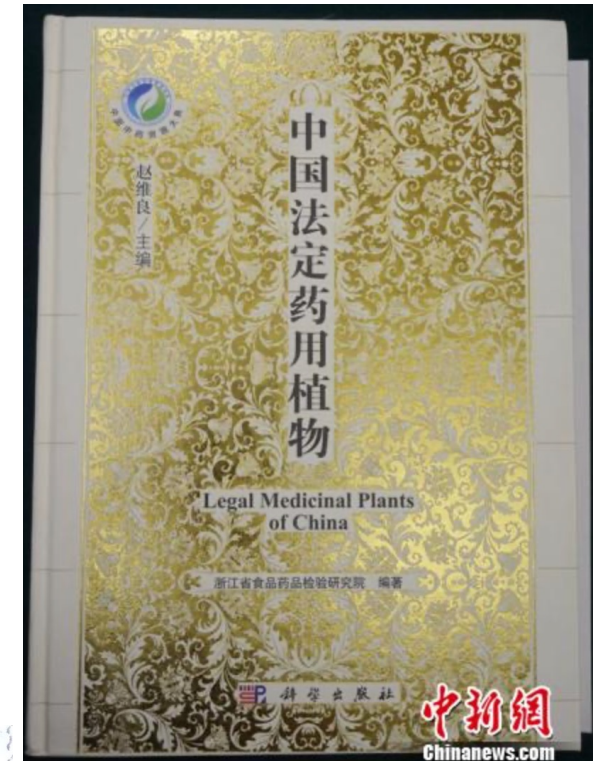
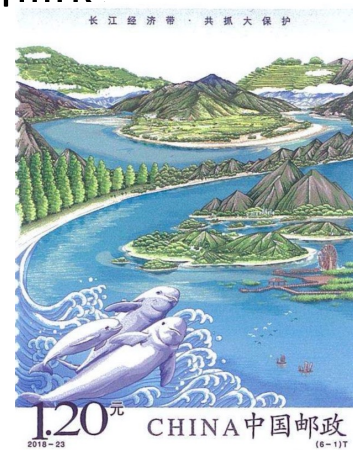
Trend in Annual Average Leaf Area (% per decade, 2000-2017)



Bio 4 Business

Biodiversity

- many climate zones, rich biodiversity
- since 1994 China is a member of the UN Convention on Diversity
- 2020 Chair of COPD15 and Kunming Declaration:
“Ecological Civilization: Building a Shared Future for All Life on Earth”
- 11 national parks with over 200,000 km²
- 474 nature reserves
- CAS Guardians of the Earth 地球守护人: online network with 275 ranger stations



TCM: Traditional Chinese Medicine

Bio 4 Business



600 ha National Botanical Garden, Beijing



National Botanical Garden, Guangzhou

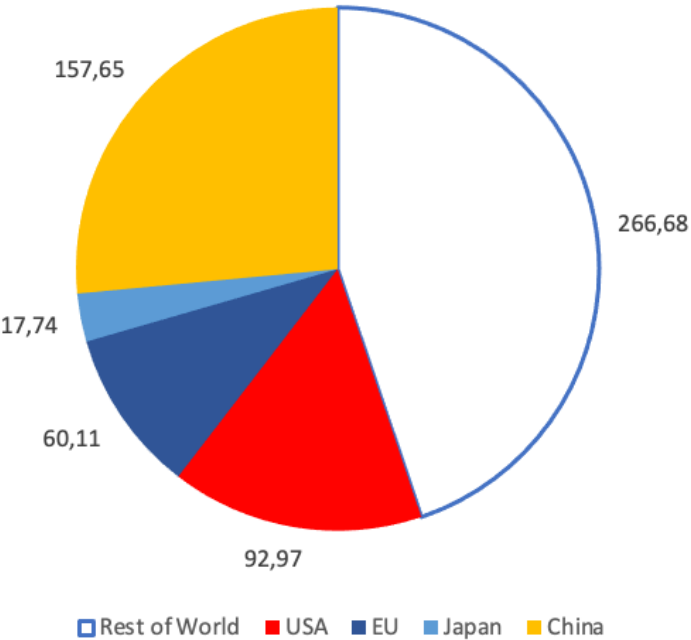


National Gene
Center, Shenzhen

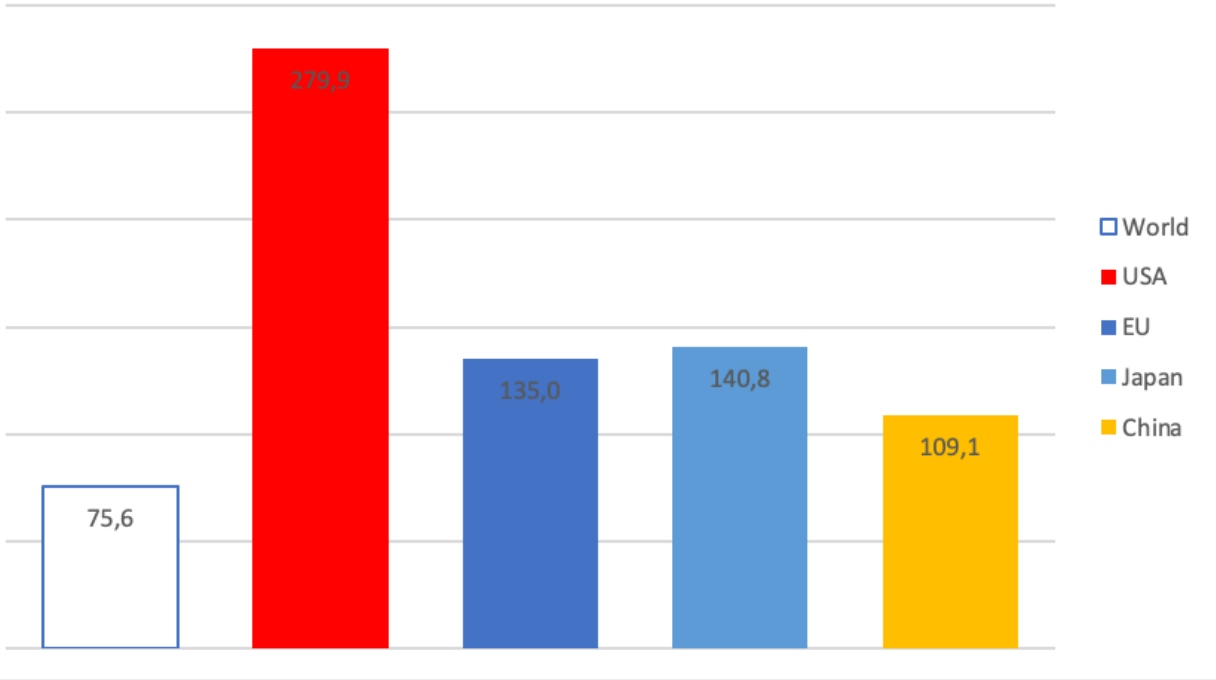
Bio 4 Business

Decarbonisation

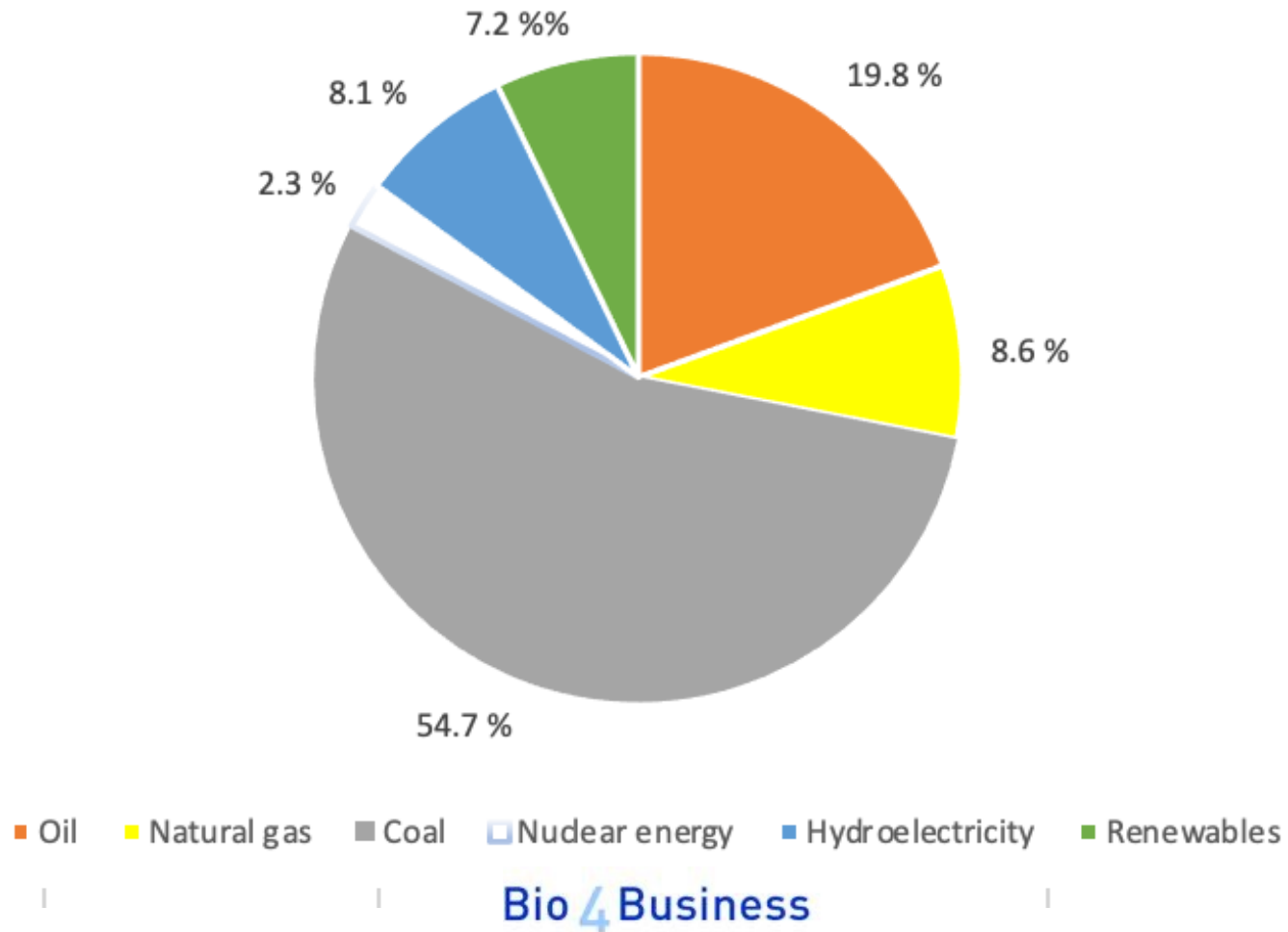
Primary energy demand
2021 (EJ)



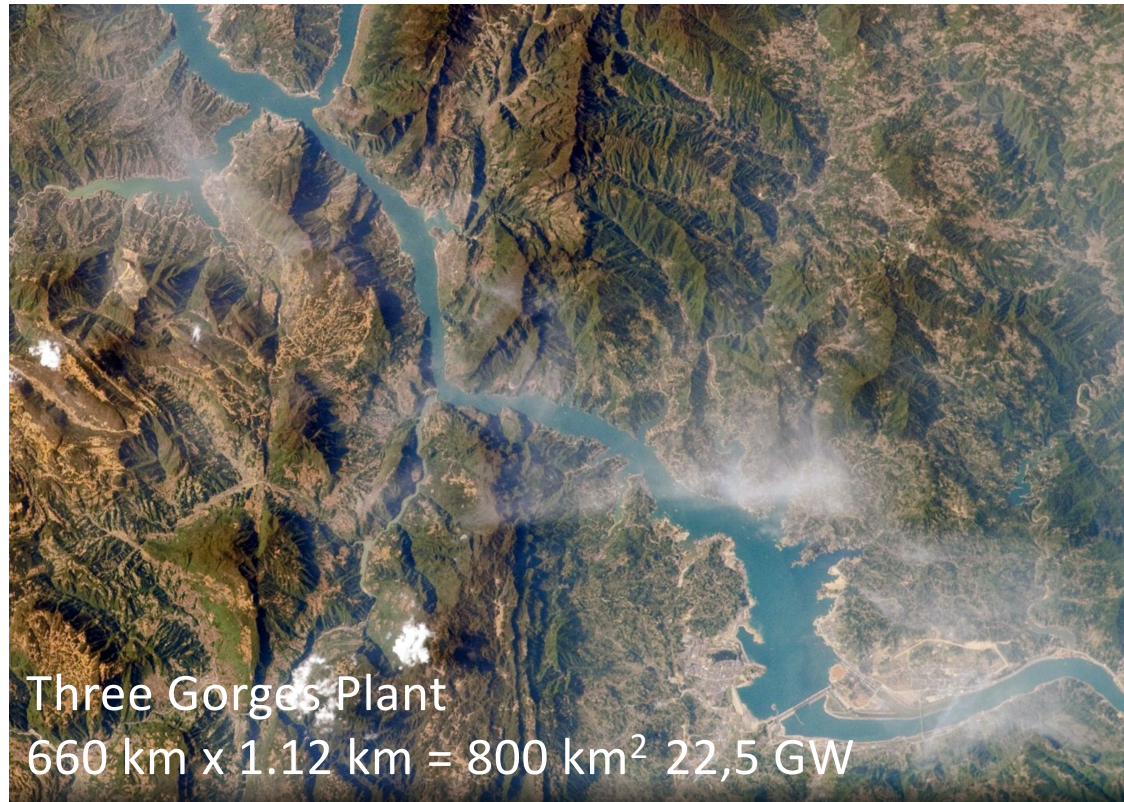
Primary energy consumption per capita, 2021 (EJ)



China's energy consumption 2021, by energy source



Hydropower



Three Gorges Plant
 $660 \text{ km} \times 1.12 \text{ km} = 800 \text{ km}^2$ 22,5 GW

38 hydropower plants over 3 GW

Bio 4 Business



Baihetan power plant, 16 GW

Photovoltaics

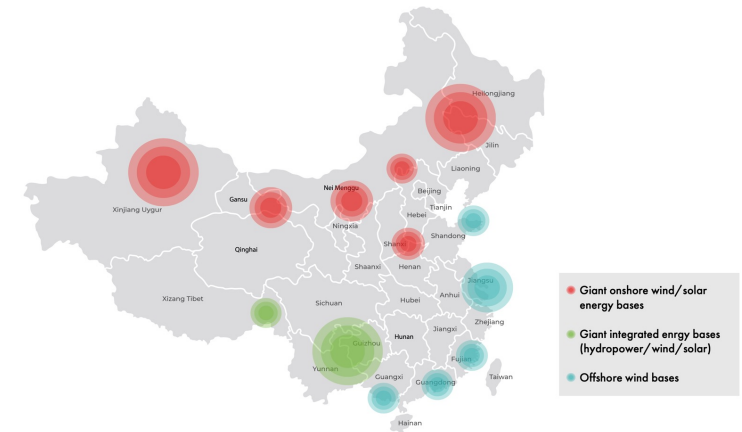


Bio 4 Business



Windfarms

Offshore windfarms: in March 2023, China had 124 windfarms in operation and 407 at different stages of construction



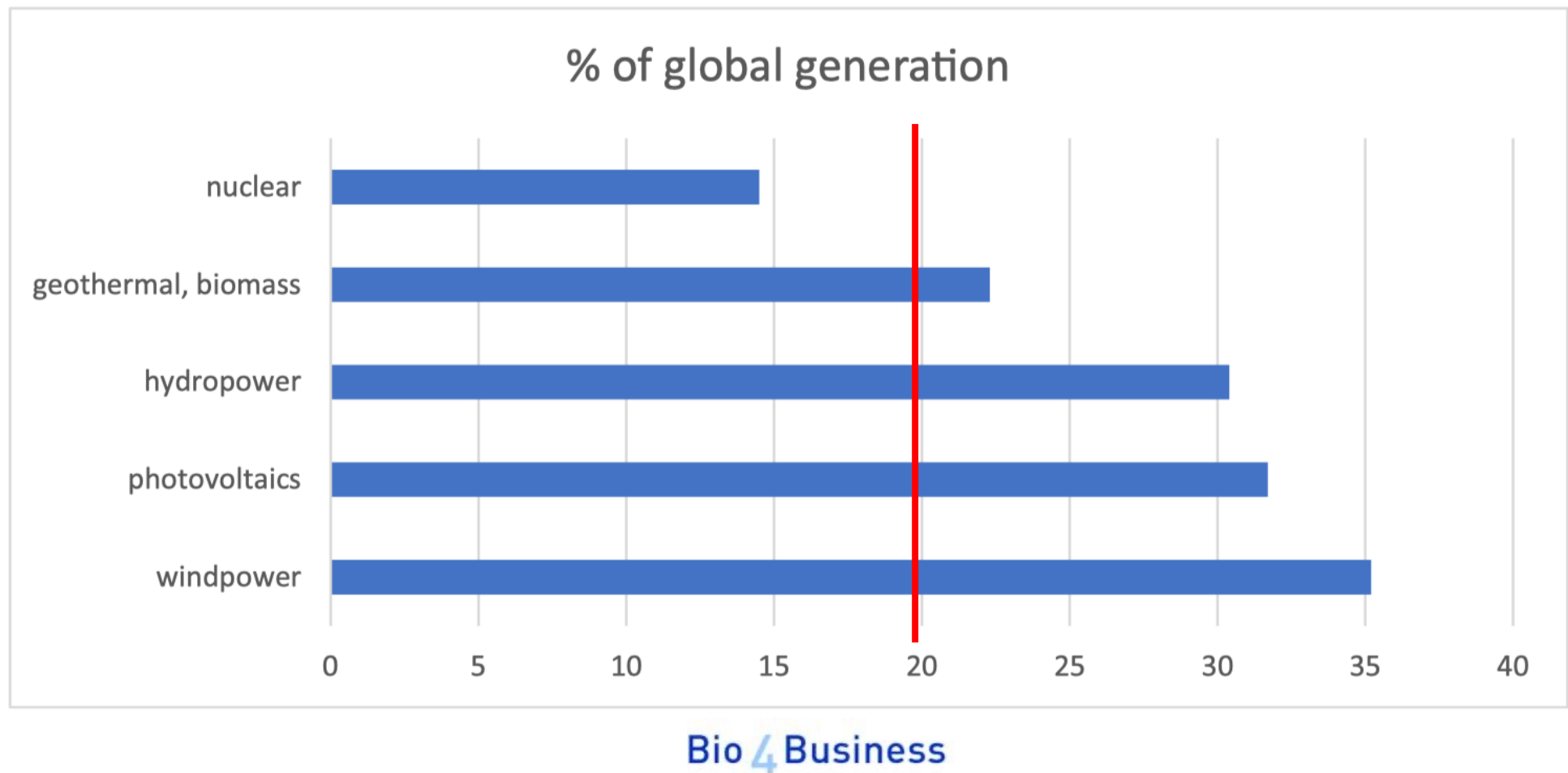
A wind power plant in East China Photo: VCG



Aerial photo taken on Dec. 1, 2021 shows nuclear power units under the China National Nuclear Corporation (CNNC) in Fuqing, southeast China's Fujian Province. (Photo/Xinhua)

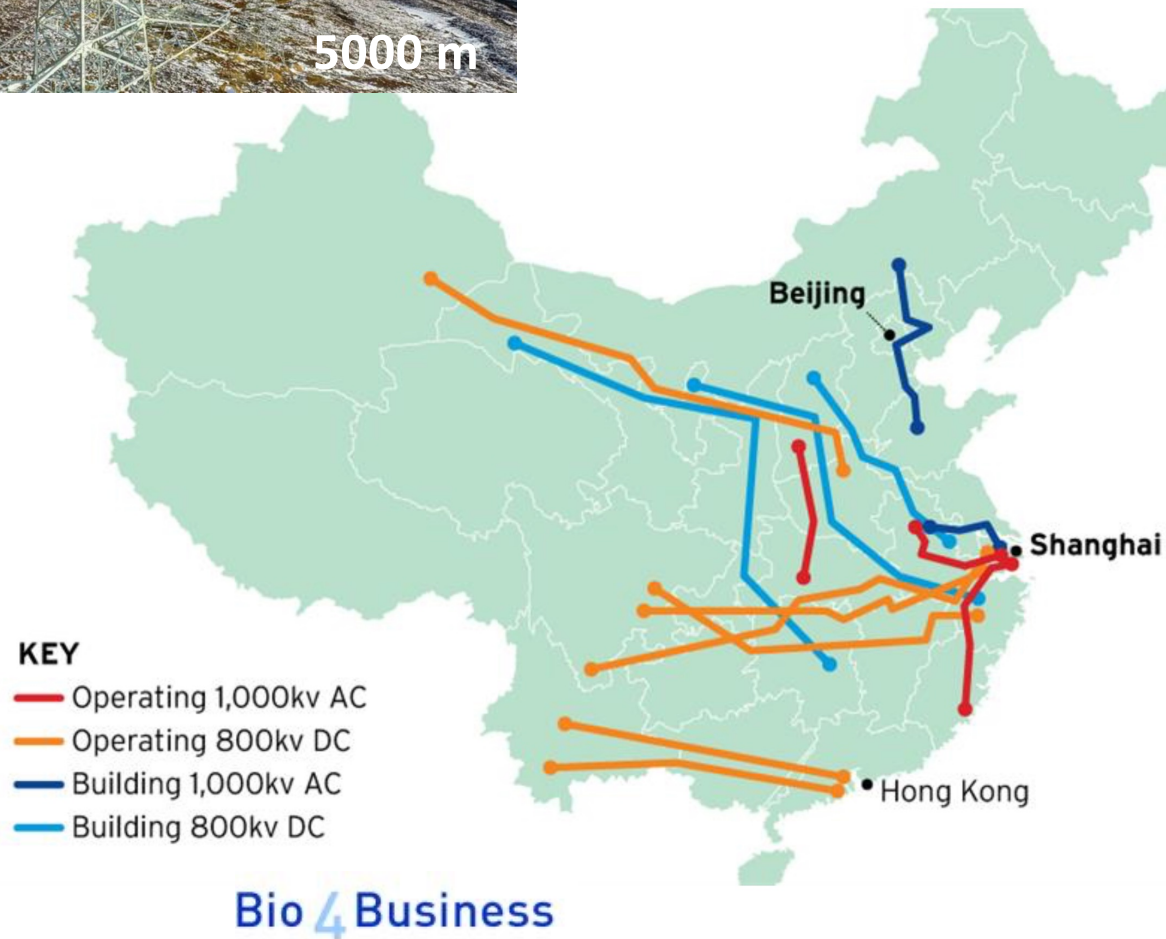
Global share of China in the generation of „clean energy“

2022 (BP)

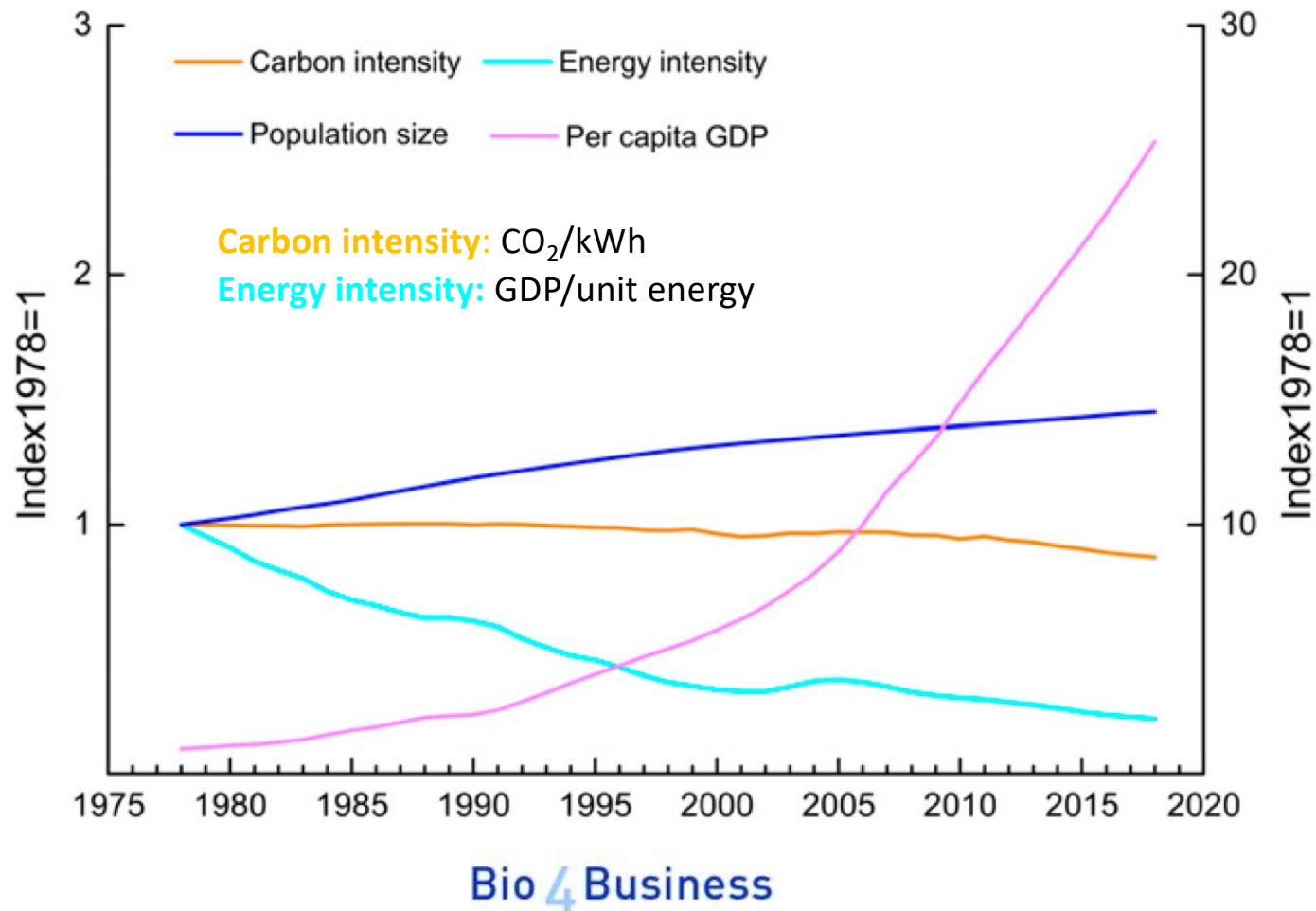




Transport of electricity to the industrial regions is also taken care of



Double carbon goal: „Carbon peak“ before 2030, carbon neutral by 2060



Hydrogen

- "Hydrogen consortium", since 2019 (manufacturing, vehicles, steel)
- Start at the Beijing 2022 Winter Olympics
- 50,000 FCV vehicles and 1000 H₂ filling stations by 2025
- world's largest producer of H₂ (currently 30 million t of gray H₂)
- 100,000 – 200,000 t by 2025, 35 million t of green H₂ by 2030
- Full cost of green H₂ in 2030: under 3,500 CN¥ per t (255 €)



Bio 4 Business

One Belt and One Road Runs through Europe and Asia

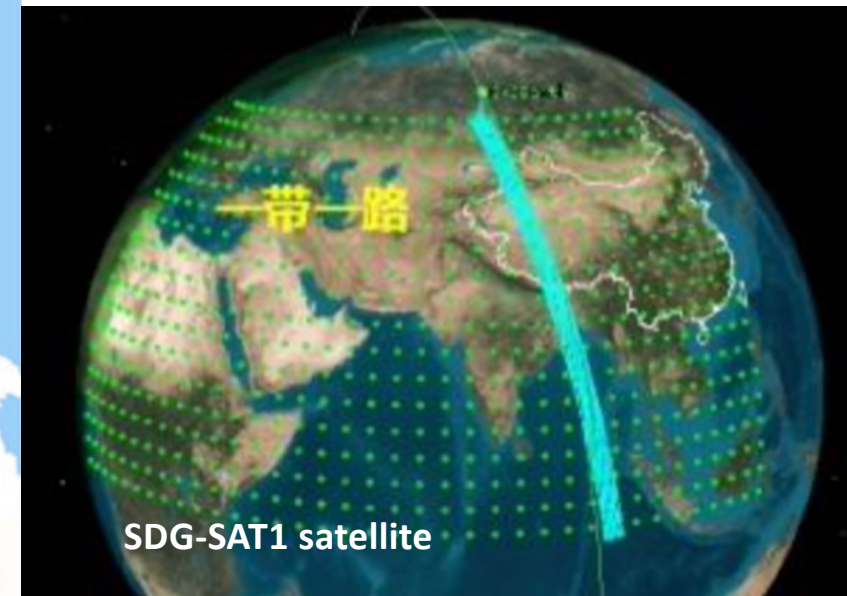


— Silk Road Economic Belt

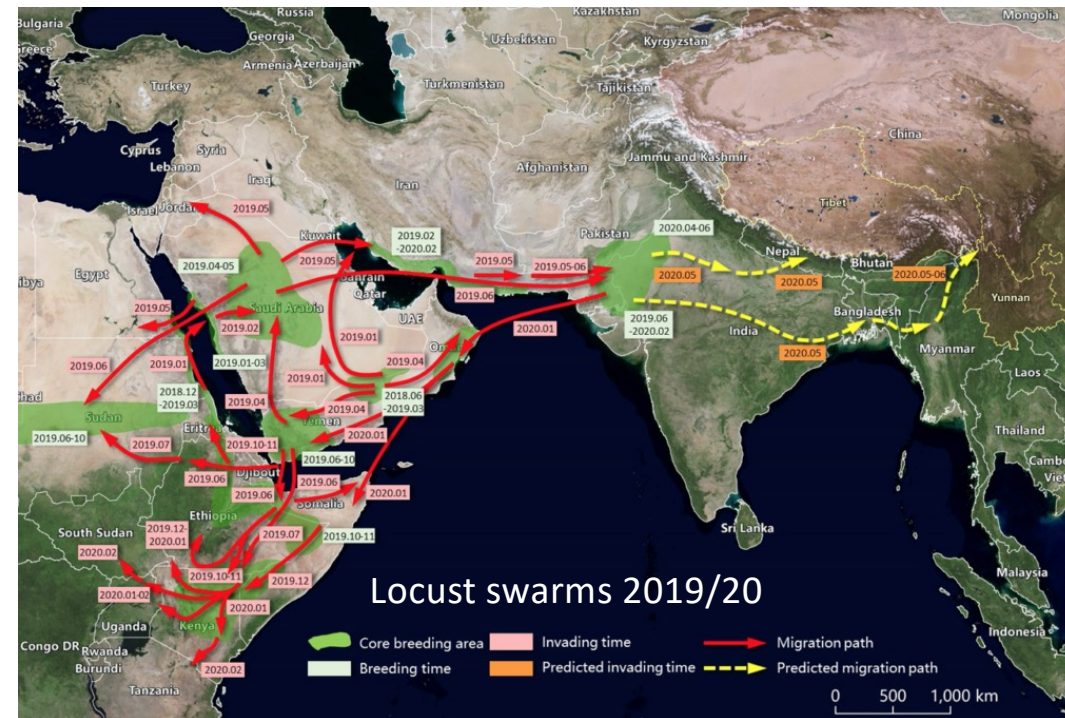
— 21st Century Maritime Silk Road



INTERNATIONAL RESEARCH CENTER OF BIG DATA
FOR SUSTAINABLE DEVELOPMENT GOALS
可持续发展大数据国际研究中心



Bio 4 Business



Molecular breeding of „Green Super Rice“

6 million ha in 15 African and Asian nations, 58 trainees in China's rice centers

Bio 4 Business

Science museum Addis Abeba, 2022



Nation	a) Topic
Mongolian Republic	Agriculture and animal breeding
Pakistan	Karot dam and hydropower
Pakistan	Earthquake and disaster prevention
Indonesia	Port facilities and civil protection, gas-cooled nuclear reactor
Cambodia	Food Safety
Nepal	Geo-mapping and safety
ASEAN	marine aquaculture
Sri Lanka	research in the tropical sea
Republic of Korea	industrial 5G and digital twins
Republic of Korea, Poland, United Arab Emirates	modern textile production
Thailand	industry 4.0 and digitalization
Philippines	bamboo technology
Russian Federation	Polar Silk Road, superconducting cyclotron, advanced energy and power machines
Belarus	electromagnetic safety, magnesium alloys
Ukraine	advanced production of metals compounds
Kasachstan	test methods for equine diseases
Tadjikistan	clean energy generation from coal
Uzbekistan	new APIs
Central Asia: Uzbekistan, Tadjikistan, Kyrgyzstan	Asia's people and environment, ancient DNA, cultural relic restoration.
Israel	population science and regenerative medicine
Romania	plant factories
Croatia	ecosystems and biodiversity
Czech Republic	traction, measurement and control
Hungary	brain research
Greece	protection of the cultural heritage
Austria	prevention and treatment of infectious diseases with TCM, digital manufacturing etc
Italy	pneumatics engineering in aeronautical, advanced manufacturing
Portugal	preservation of cultural assets
Belgium	climate change and sustainability, geoarchaeology, geosciences
Egypt	Renewable energy, photovoltaics, satellite-based agriculture
Nigeria	electrotechnical standards
Iran	combatting ater scarcity and pollution
Kenia	molecular biology of African crops
South African Union	mining research, waste utilization
New Zealand, Italy, France	improvement of Kiwi breeding
Costa Rica	biological breeding of fruits and vegetables

BRI Collaborative research
1 research center each from China and the partner country, plus Chinese enterprises

Goal 2049: „Beautiful China“ 美丽中国

– a digital, ecological civilization

1. stable environment
2. "green" development
3. social harmony
4. socialist system
5. cultural heritage

progress is measured
with the
“CAS Beauty Index”

