



京都大学
KYOTO UNIVERSITY

Toward Sustainable Regional Development through Renewable Energy

The First International Workshop on
Open Energy Systems

14-15 January 2014

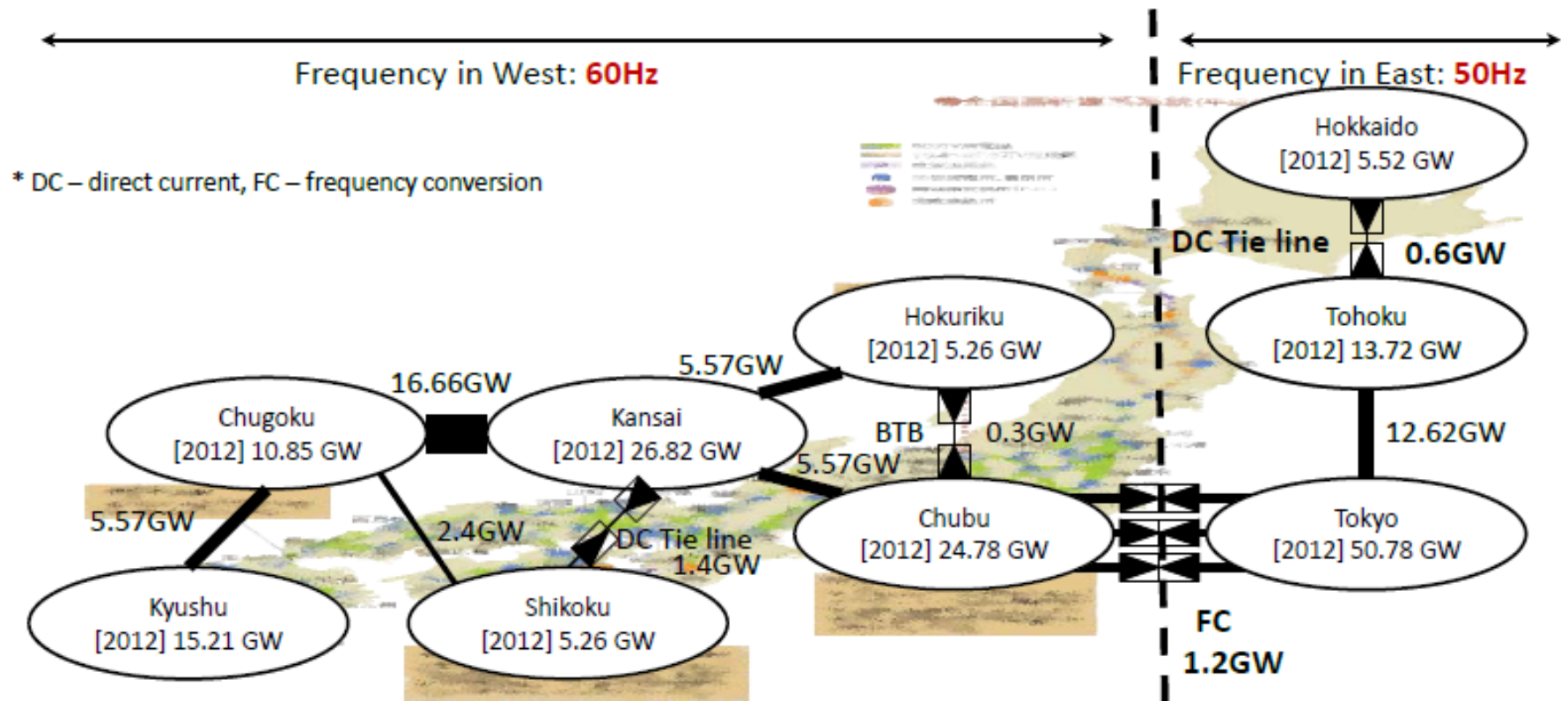
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Electricity Market Reform in Japan

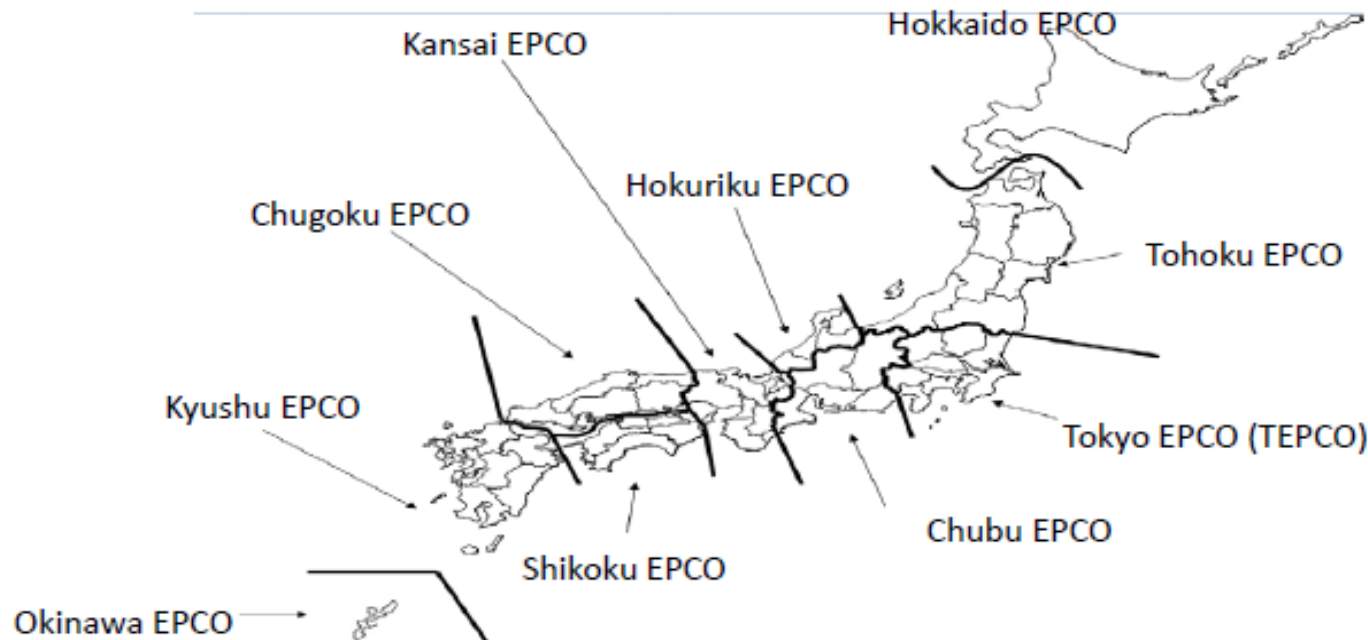
Current electricity system

- Partial liberalization: retail competition for over 50kW customers
 - Retail Players: 10 big EPCOs (vertically integrated, regional monopoly), PPS, etc.
 - Reality is...
 - Share of non-EPCO power producer and supplier : 3.6%
 - 0.6% of the total retail market sales is transacted at JEPX
- <Cf.>
- Market volume: 1000TWh/ 280GW
 - Electricity price (2011): 16.8 yen (average), 21.3yen (household), 14.6yen (industry)



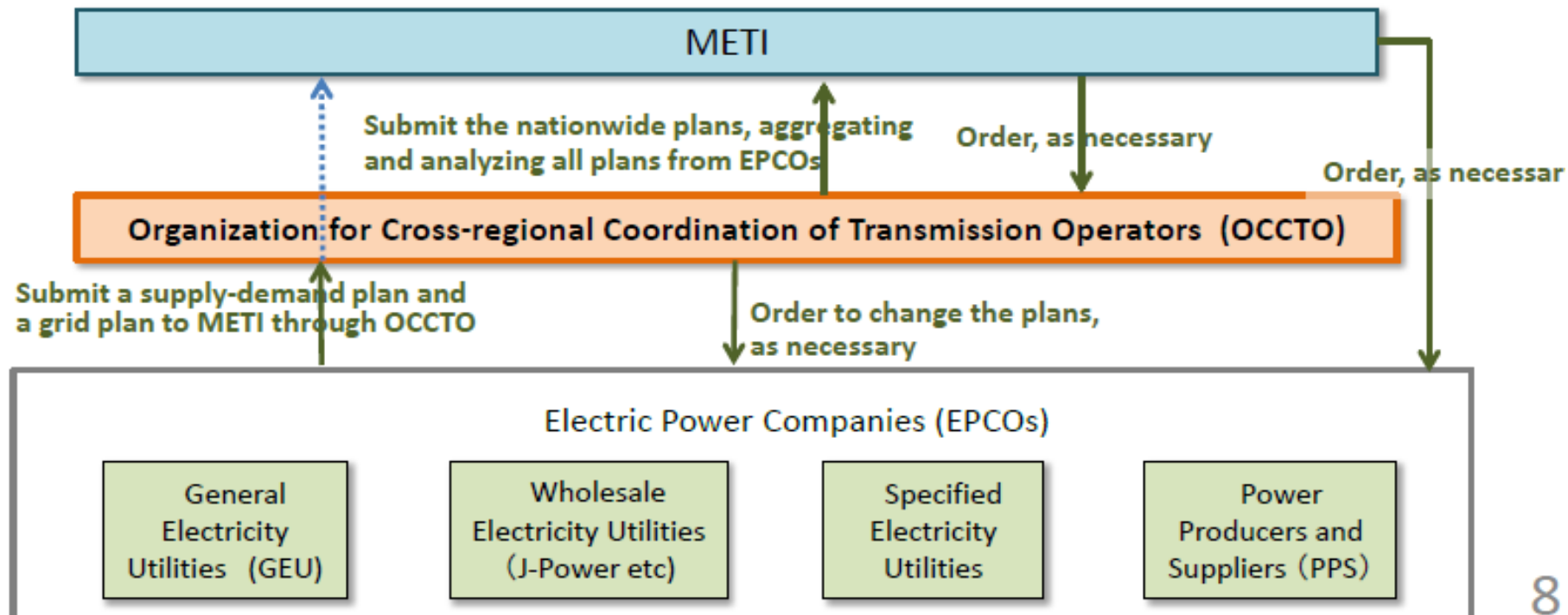
Problems Revealed by 3.11

- Negative aspects of regional monopoly system were revealed:
 1. Lack of system to transmit electricity beyond regions
 2. Little competition and strong price control
 3. Limit in digesting the change in energy mix including the increase in renewables



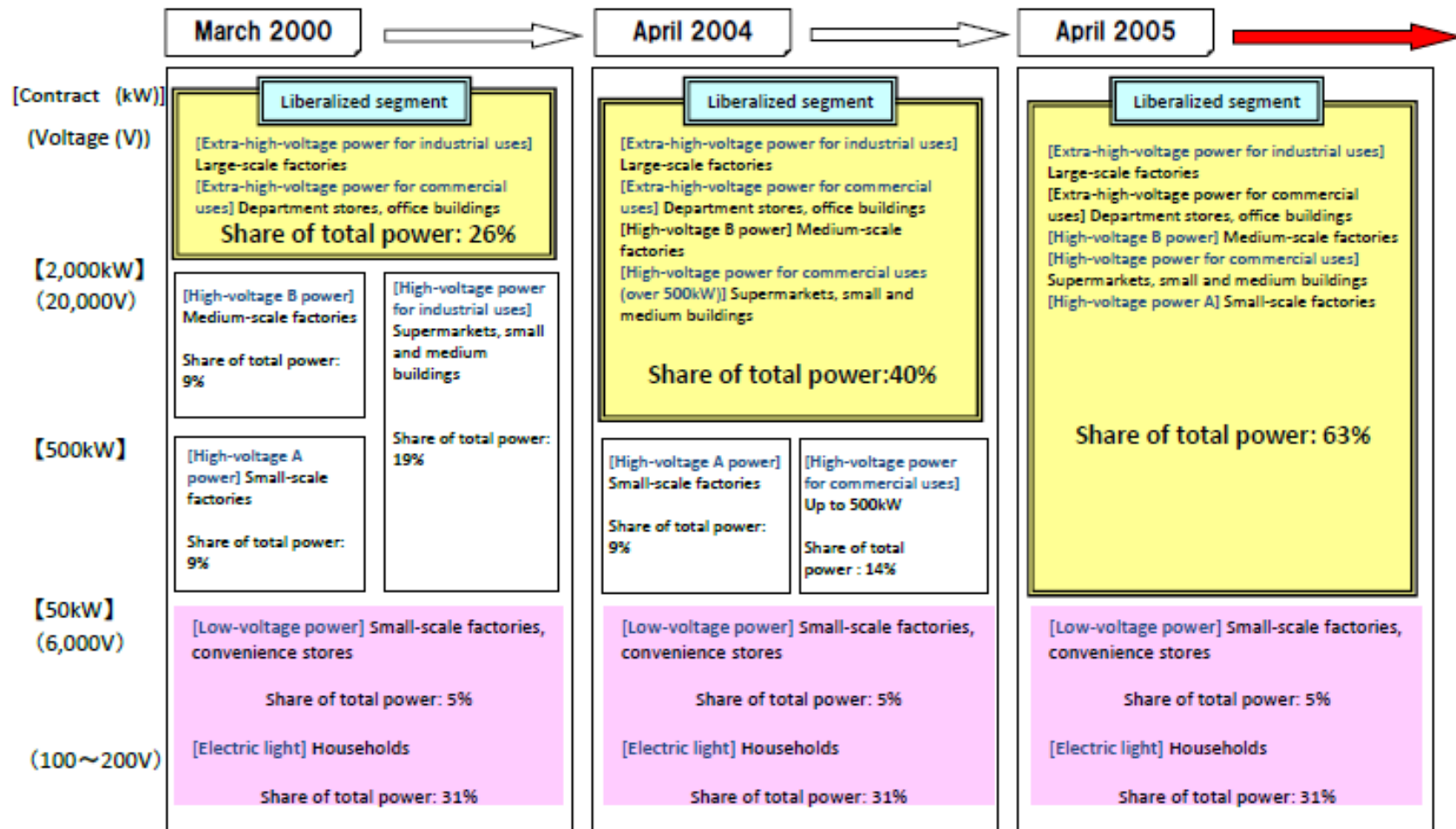
Agenda 1: Cross-regional Coordination of Transmission Operators

- Establish the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) by about 2015
- Main functions of OCCTO: Detailed designing is ongoing
 1. Aggregate and analyze the EPCO's supply-demand plans and grid plans, and order to change EPCO's plans such as tie lines construction
 2. Coordinate the supply-demand balancing and the frequency adjustment by T/D sectors (T/D sectors are responsible to balance the supply-demand in each area)
 3. Order EPCOs to reinforce generations and power interchanges under a tight supply-demand situation



Agenda 2: Full Retail Competition

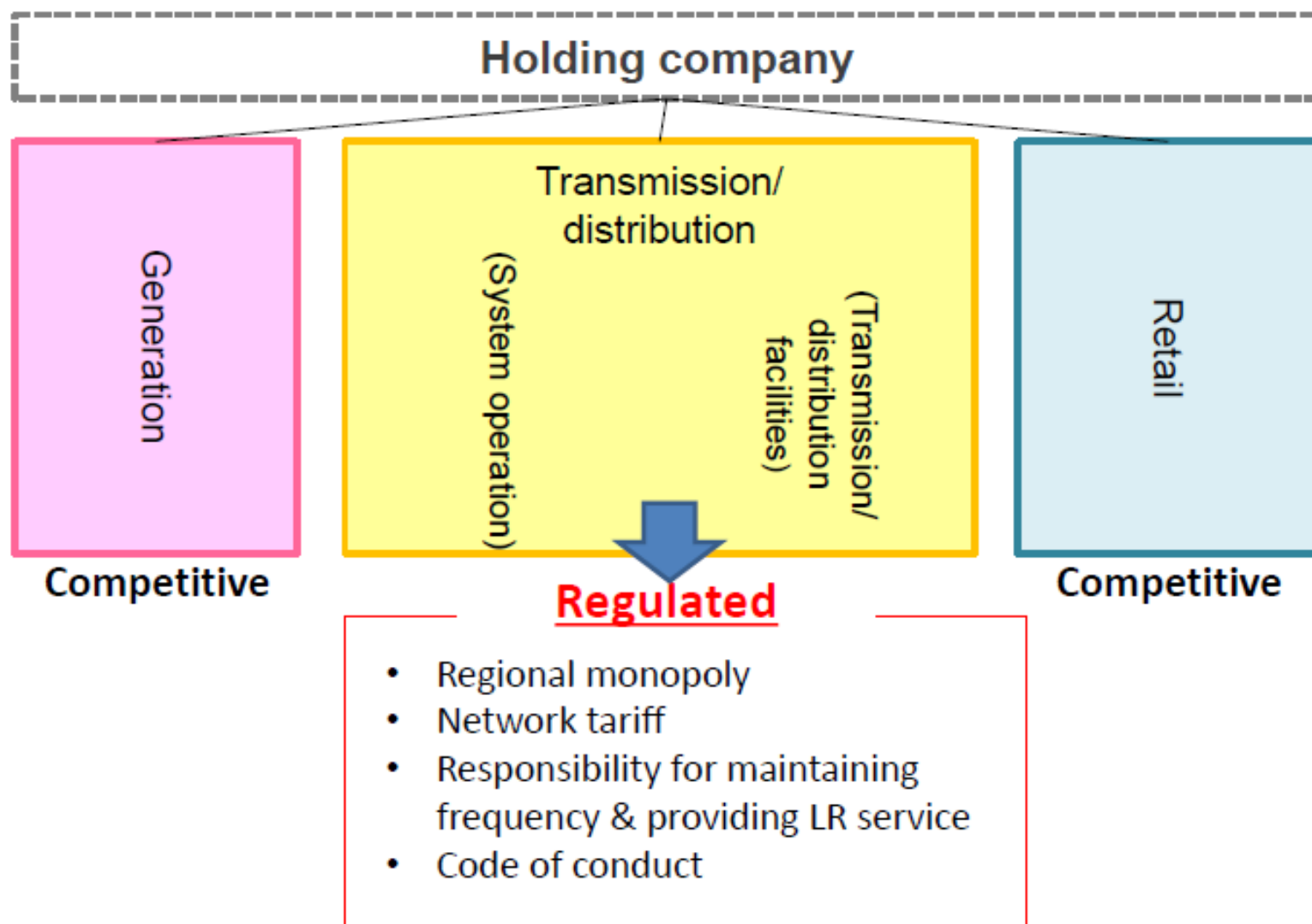
- Expand the retail competition to the residential sector at around 2016
- Remain the regulated tariff to 10 big EPCOs until around 2018-2020



(Note) The scope of liberalization of Okinawa Electric Power Company was expanded in April 2004, from users of power over 20,000kW, 60,000V, to extra-high-voltage power users (over 2,000kW, in principle).

Agenda 3: Unbundle the transmission/distribution sector

- Unbundle the transmission/distribution sectors by ITO-style (legal unbundling) at around 2018-2020

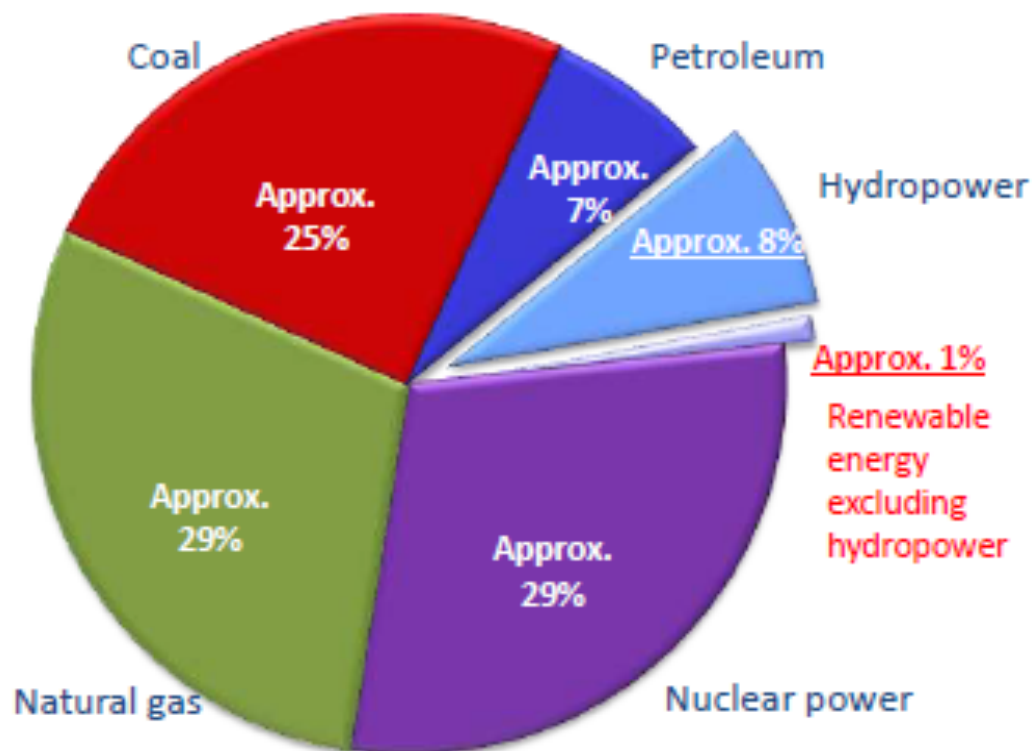


Feed in Tariff Scheme in Japan

Current Composition of Power Sources in Japan

- Among the total electricity generated in fiscal 2009, renewable energy, etc. accounted for approximately 9%; approximately 8% of which is hydraulic power generation.
- Other renewable energy is still cost prohibitive.

Composition of annual electricity generated in Japan (FY 2009)



Note: "Etc." of "Renewable energy, etc." includes the recovery of energy derived from waste, refuse derived fuel (RDF) products, heat supply utilizing waste heat, industrial steam recovery, and industrial electricity recovery.

Source: Prepared based on the Agency for Natural Resources and Energy's "Outline of Electric Power Development in FY 2010"

Current Tariff Rates by Power Sources (Fiscal Year 2013)

Power Source	Purchase Price	Purchase Period
Solar (10 kW or more)	37.8 Yen/kWh	20 years
Solar (less than 10 kW)	38 Yen/kWh	10 years
Wind (20 kW or more)	23.1 Yen/kWh	20 years
Wind (less than 20 kW)	57.75 Yen/kWh	20 years
Hydro (1,000kW to 30,000kW)	25.2 Yen/kWh	20 years
Hydro (200kW to 1,000kW)	30.45 Yen/kWh	20 years
Hydro (less than 200kW)	35.7 Yen/ kWh	20 years
Geothermal (15,000kW or more)	27.3 Yen/kWh	15 years
Geothermal (less than 15,000kW)	42 Yen/kWh	15 years
Biomass (methane)	40.95 Yen/kWh	20 years
Biomass (unused trees)	33.6 Yen/kWh	20 years
Biomass (other than unused trees)	25.2 Yen/kWh	20 years
Waste Construction Materials	13.65 Yen/kWh	20 years
General Waste	17.85 Yen/kWh	20 years

Rapid Increase of the Approved Installed Capacity

<Status of Renewable energy installation at July, 2013>

	Already installed capacity by June, 2012		Newly installed capacity from July, 2012 to July, 2013	
Residential PV	Approx. 4.7GW	22.8%	+ Approx 1.8GW	7.6%
Non-Residential PV	Approx. 0.9GW	4.4%	+ Approx 20.3GW	86.0%
Wind	Approx. 2.6GW	12.6%	+ Approx 0.8GW	3.4%
Small and Medium scaled hydro	Approx. 9.6GW	46.6%	+ Approx 0.08GW	0.3%
Biomass	Approx. 2.3GW	11.2%	+ Approx 0.7GW	3.0%
Geothermal	Approx. 0.5GW	2.4%	+ Approx 0.0GW	0.0%
Total	Approx. 20.6GW	100%	+ Approx 23.6GW	100%

Summary of the First Year Japanese FIT

FIT Stimulated RE more than Expected

- Japanese FIT started on July 1st, 2012
- Installed capacity of the 1st year only exceeded the accumulated capacity before FIT
- Especially Non-Residential PV has drastically increased since the introduction of FIT

Some Problems to Be Tackled

- More than 93% of the total installed capacity is PV
- Rejection of grid connection by power companies

Toward Sustainable Regional Development by Renewable Energy

-Case Study of Iida City, Nagano Prefecture-

Information about the City of Iida

- Population: 104,575 (February, 2012)
- Located in southern part of Nagano Prefecture, and fourth largest city of the Prefecture
- Iida has long tradition from the Edo Period as a castle town
- Iida is basically characterized by rural area, even though some famous manufacturing companies are located
- Since 2004, the city has been famous for one of the most successful city in promoting renewable energy (currently 6% of the energy consumption comes from PV)



Discussion Points

- How can we use renewables, not only for electricity generation, but also for regional development?
- FIT is a very important precondition for all the following discussions
- However, large establishments might dominate the renewable markets under the FIT, and the regions would simply provide resources for them without appropriate compensation
- For avoiding the problem above, it is important to establish business organizations by inhabitants, and reinvest their profits for region's sustainable development

Development of Solar Power Business in the City of Iida

【1】First Solar Power Generation Facility by Donation



- Establishment of Environmental NPO
A group of city inhabitants established an environmental NPO for tackling climate change issues in September, 2001
- This NPO was converted to a Limited Liability Company in February 2004, for conducting solar projects and installed a first small PV system on the roof of a Kindergarten by donation
- This had a significant educational impact on the children

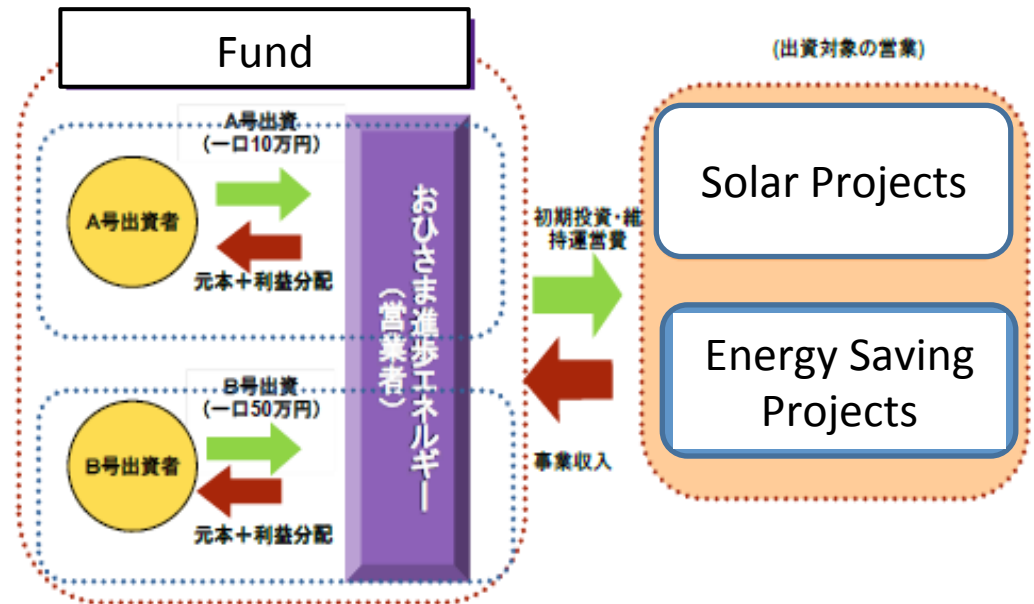
寄付型の第一号おひさま発電所 「さんぽちゃん1号」



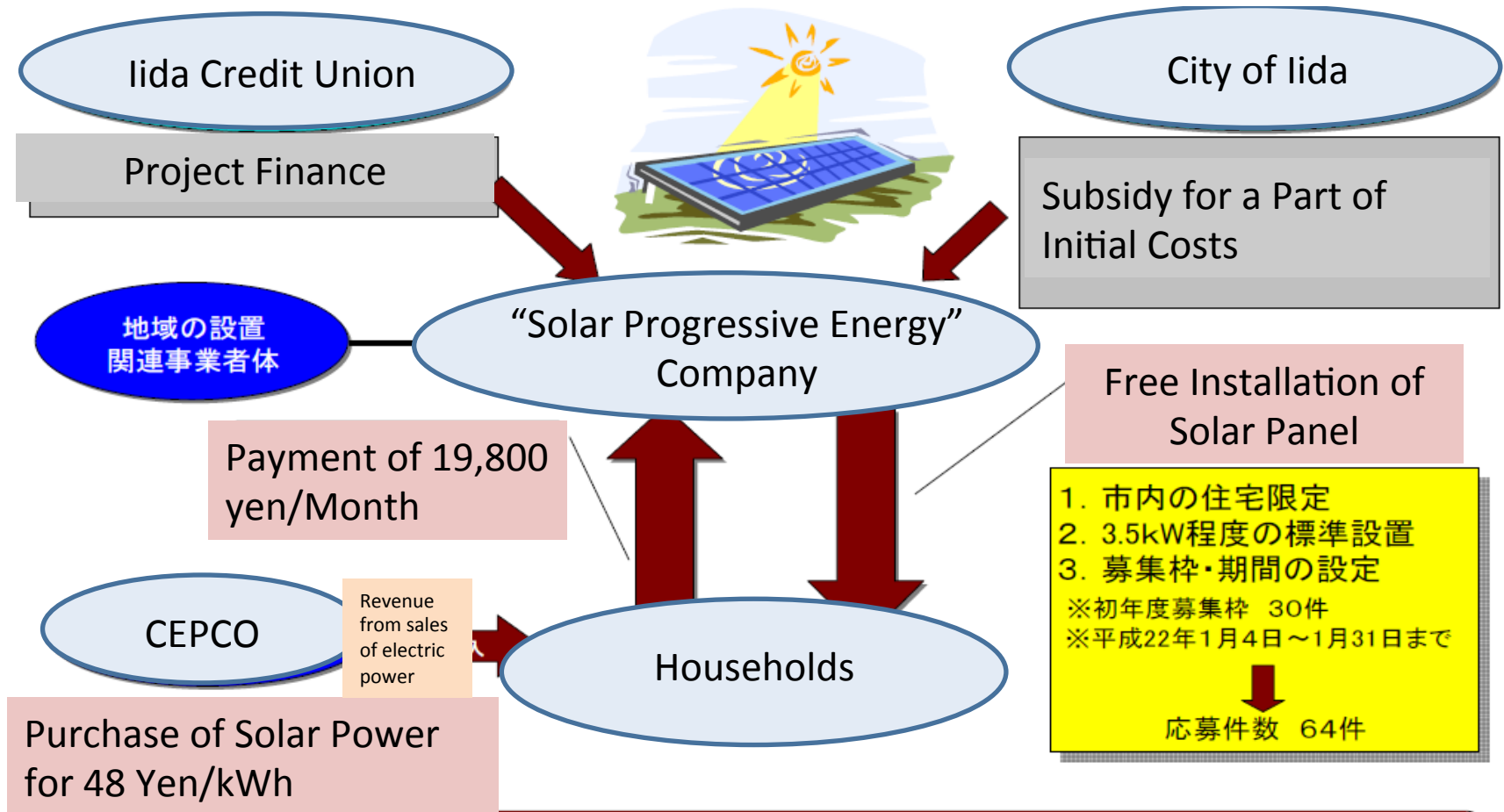
2004年5月 飯田市内の私立「明星保育園」に寄付型でNPOが設置

【2】Solar and Energy Saving Projects Financed by Citizen's Investment Fund

- Changing Society by Citizen's Joint Investment
 - Call for Investment started from February 2005
 - 200 Mio Yen had been collected only within 2 months
 - Money collected was invested for both solar and energy saving projects, and their profits are distributed to the investors as the dividend of the investment
 - Dividend yields were around 2~3% , which are not bad under the current very low interest rate condition



【3】Project Finance by Local Financial Institutions



誰もが身近な太陽光エネルギーを気軽に使い、エネルギーの地産地消をみんなで実践し、CO2を削減して低炭素で活力ある地域社会を目指す

Iida City's Ordinance on “Regional Environmental Rights”

What is “Regional Environmental Right” ?

Proclamation of the City’s Ordinance on “Sustainable Regional Development through Introduction of Renewable Energy” (March 25th, 2013)

【Article 1】

This ordinance secures inhabitants’ right to promote regional sustainable development by utilizing regional natural resources in a harmonized way with the environment of Iida area

【Article 2】

“Regional natural resources” means resources to generate renewable energy

Policy Instruments by the City

- “Inhabitants’ right” does not intend to exclude the outsiders
- The ordinance promotes and supports both inhabitants’ initiatives for renewable energy enterprise and private business trying to develop renewable energy business in corporation with the inhabitants in Iida

【1. Advisory Committee】

Committee selects good business enterprises from the proposals on renewable energy development, and gives advices from technical, legal, economic and financial points of view

【2. Finance from the City’s Fund】

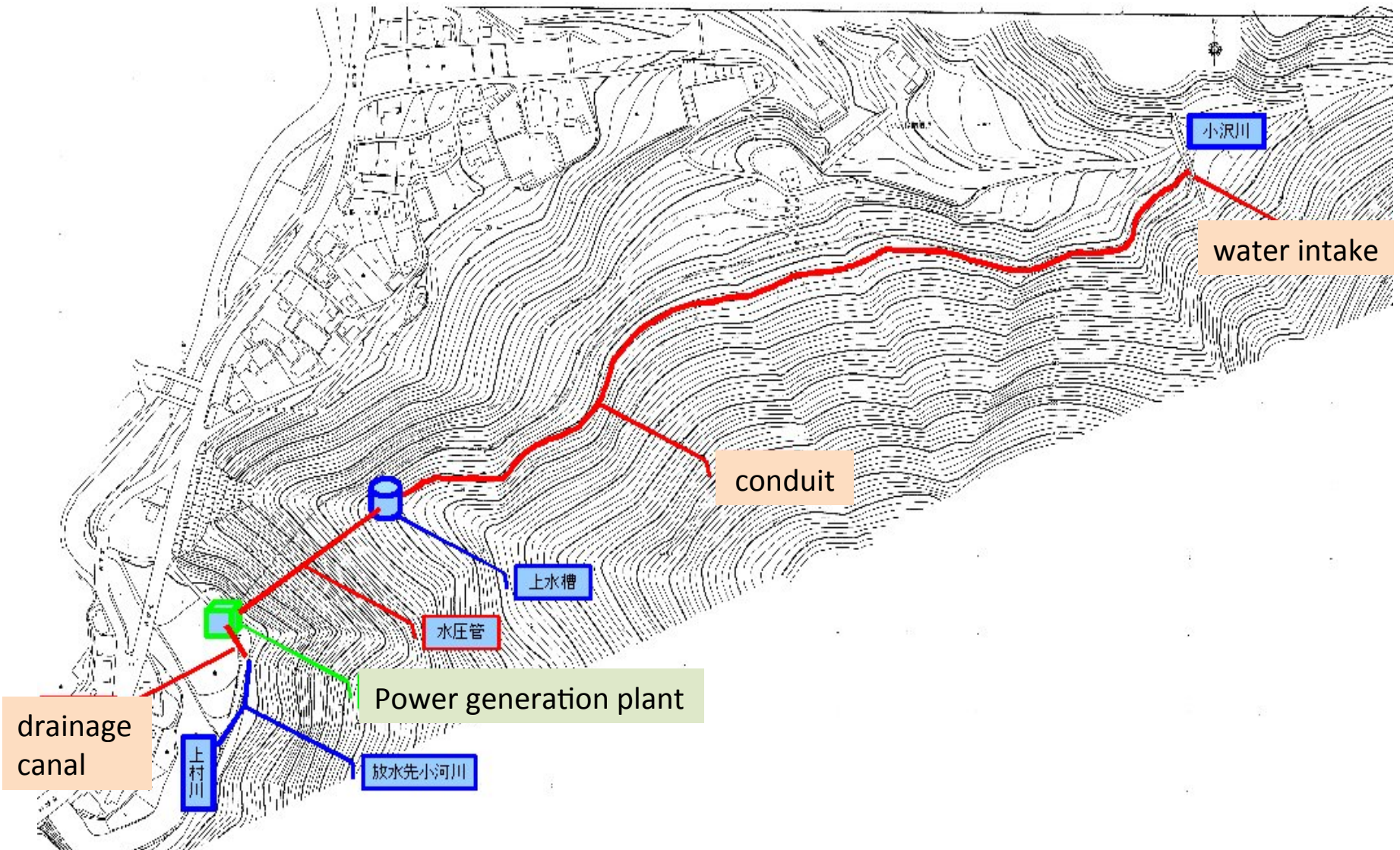
The city created a fund based on donation, to finance selected renewable energy projects, especially for early stages before starting up businesses

A Test Case of the Ordinance:
Toward Establishing Inhabitants'
Corporation for Hydro Power
Generation

“Ozawa River”: Candidate Site for Small and Medium Sized Hydro Power Station



Hydro Power Generation Plan in “Ozawa River”



Profitability Investigation

- Results of the Investigation
- Assuming a power plant that generates 147 kilowatts of electricity
- 【Scenario 1】 Sales Price 20 Yen/kWh
 - On the condition that risks could be appropriately managed by the city, profitability could be secured
- 【Scenario 2】 Sales Price 15 Yen/kWh
 - No chances for profitability
- In reality: current purchase price is 35.70 Yen/kWh !

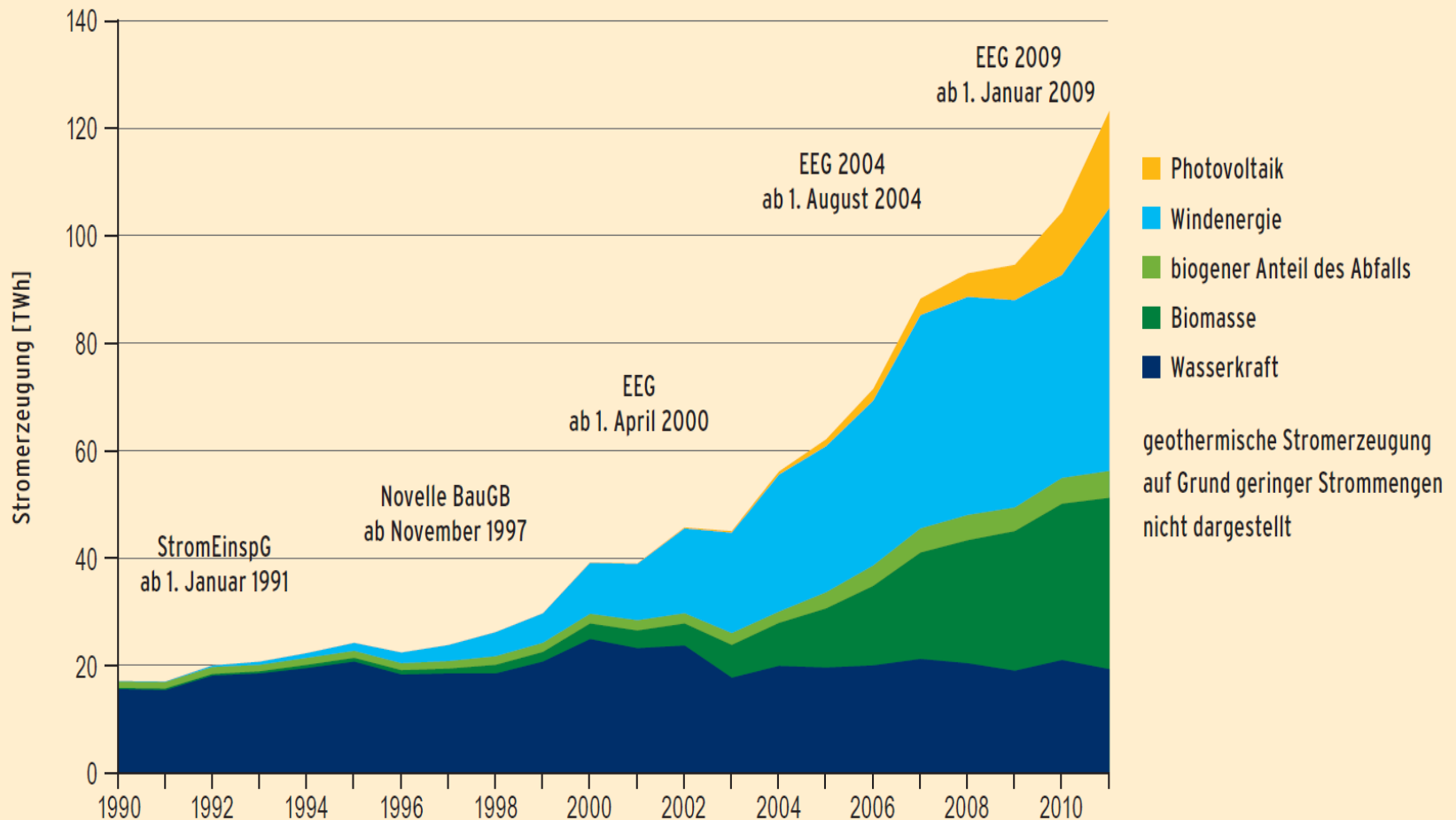
Natural Capital, Human Capital and Social Capital

- Software (knowledge, information, institutions, financing etc.) is decisively more important and difficult than hardware (power plant, infrastructure, etc.)
- Accumulation of “human capital” and “social capital” in the region is key factor for success of the sustainable regional development, especially for uniting inhabitants toward common purposes and managing business enterprises
- Supporting organization like the Iida’s experts committee is important since the inhabitants lack expert knowledge

Toward Future Distributed Energy Networks

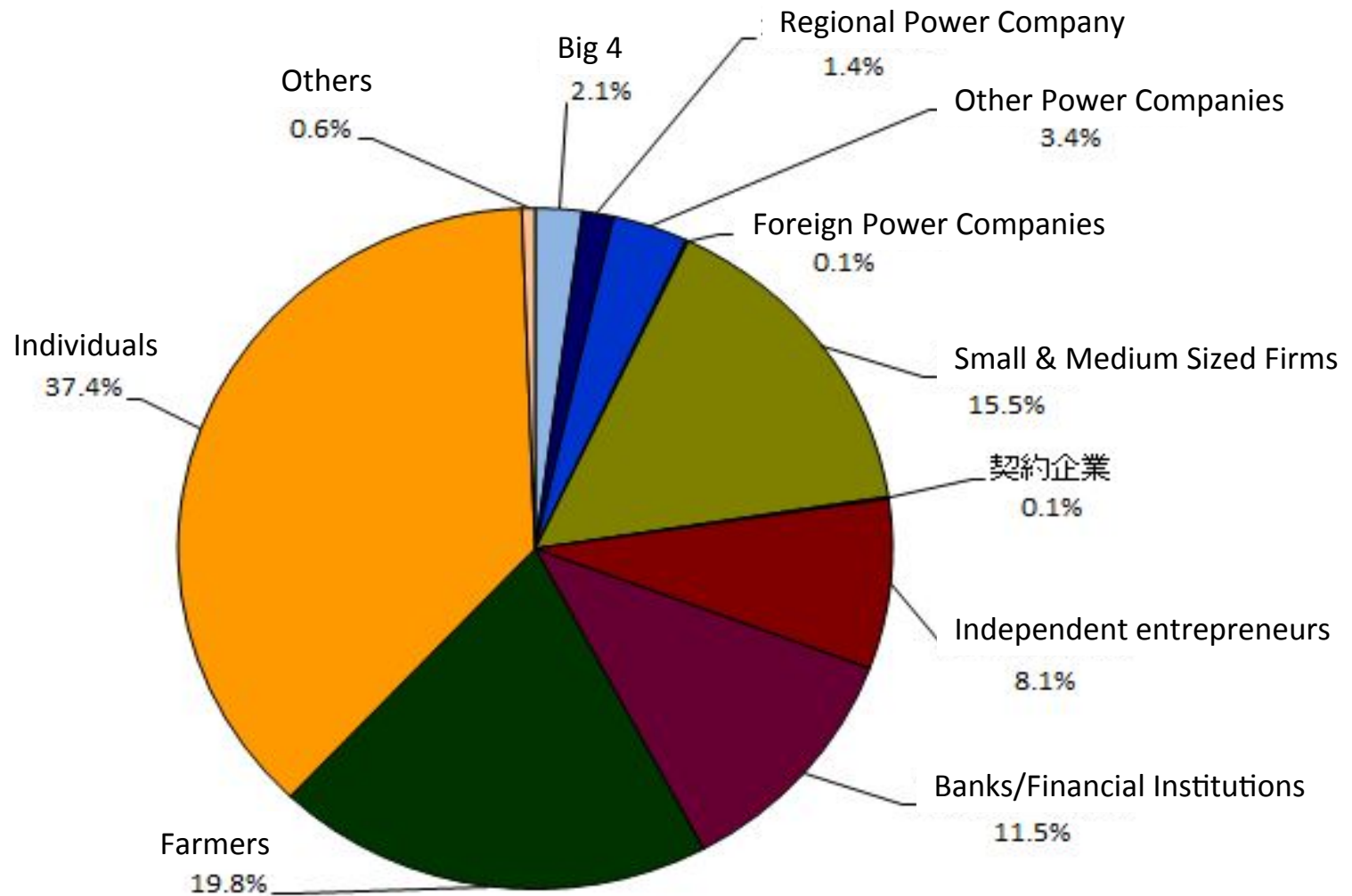
Rapid Increase of RE in Germany under FIT since 1990

Entwicklung der Stromerzeugung aus erneuerbaren Energien in Deutschland seit 1990



Investment Entities for Renewable Energy plants in Germany, 2010

(Total Installed Capacity: 9.1GW)



“Energy Cooperatives” as a Entity for RE Business of Inhabitants

- What are “Energy Cooperatives”?

A form of business organizations based on “Self Responsibility”, “Self Governance”, and “Self Help” which were proposed and created around 1850 by two German entrepreneurs

- Its Characteristics

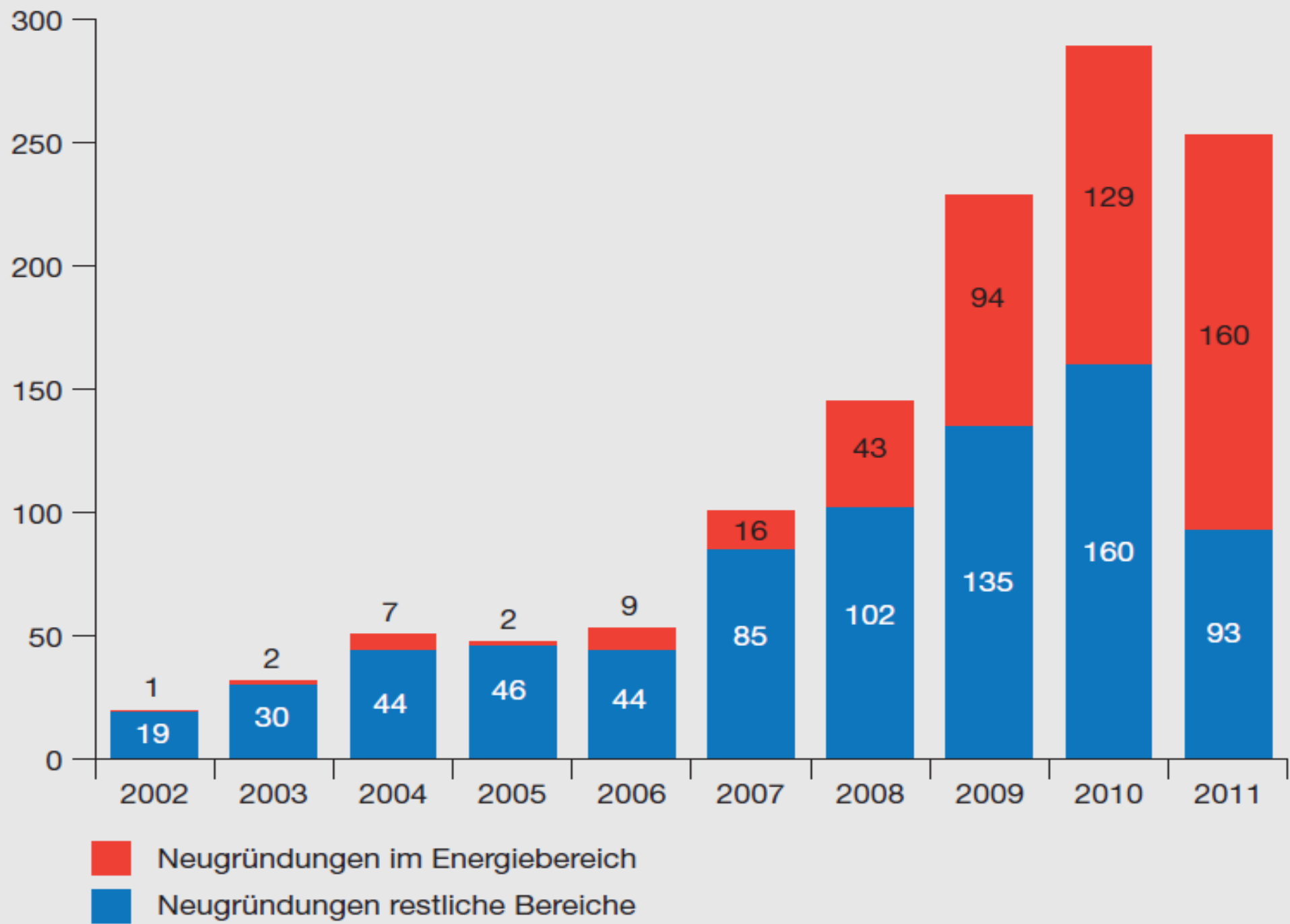
【1】Spontaneous and open participation form

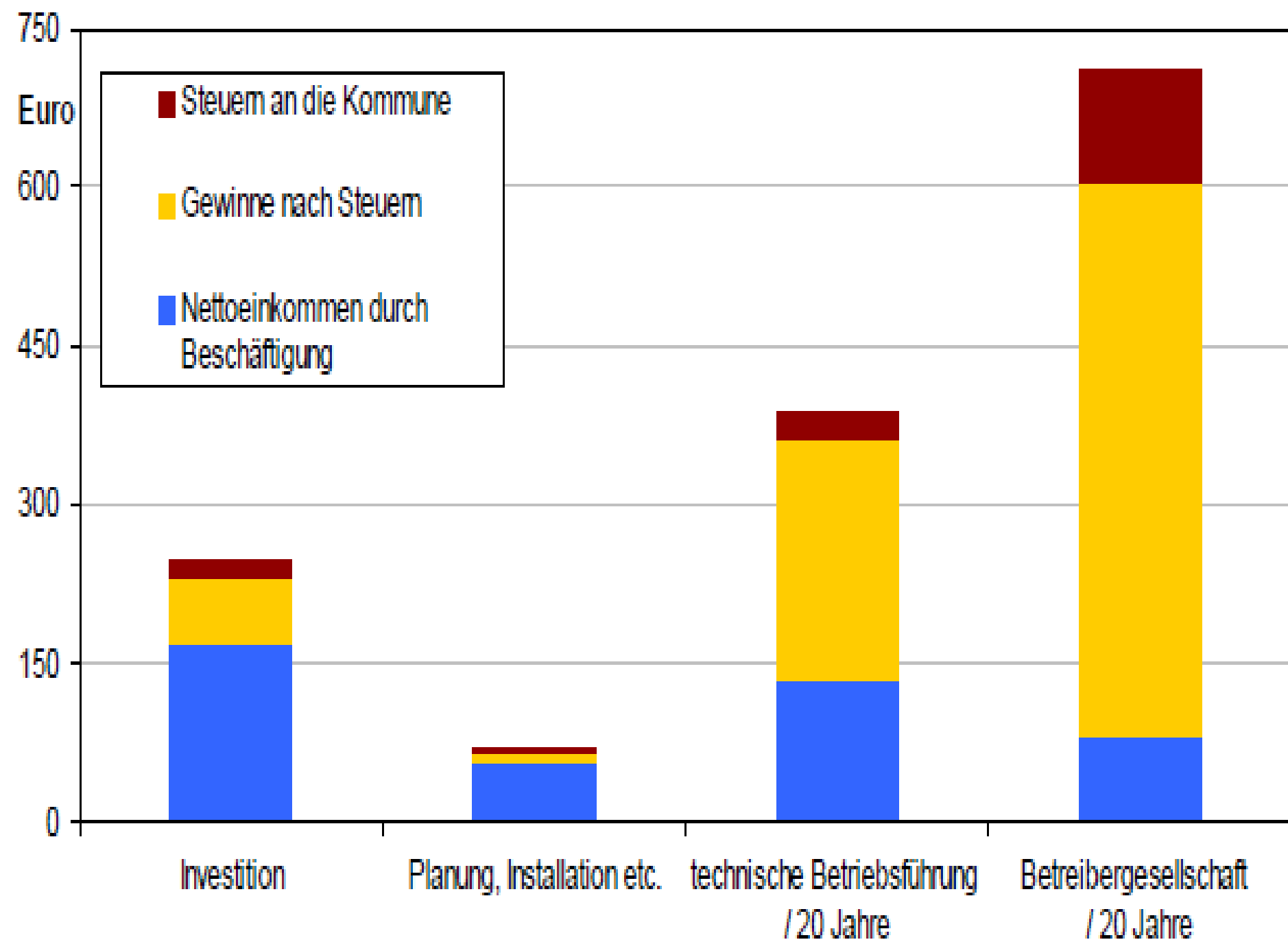
【2】“One person one vote” principle

【3】Democratic control of the organization and its management by membership

【4】Joint investment by membership

【5】Limited liability





Conclusion: Local Governments' Role for Regional Sustainable Development

- Role of bringing up players
 - Local governments could leave RE business to the hands of organizations of inhabitants or private enterprises and support them
 - Important things are human capital and social capital. Local governments could help the inhabitants and the enterprises to accumulate these capitals and organize themselves (organizations, know-how, management abilities, expert knowledge, establishment of good human relations for close cooperation).
- Role of Rule making of RE market
 - Local governments could give incentives players to participate in RE market on one hand, and they should make rules for fair market competition and regional sustainable development
- Role of supporting reinvestment by the inhabitants