

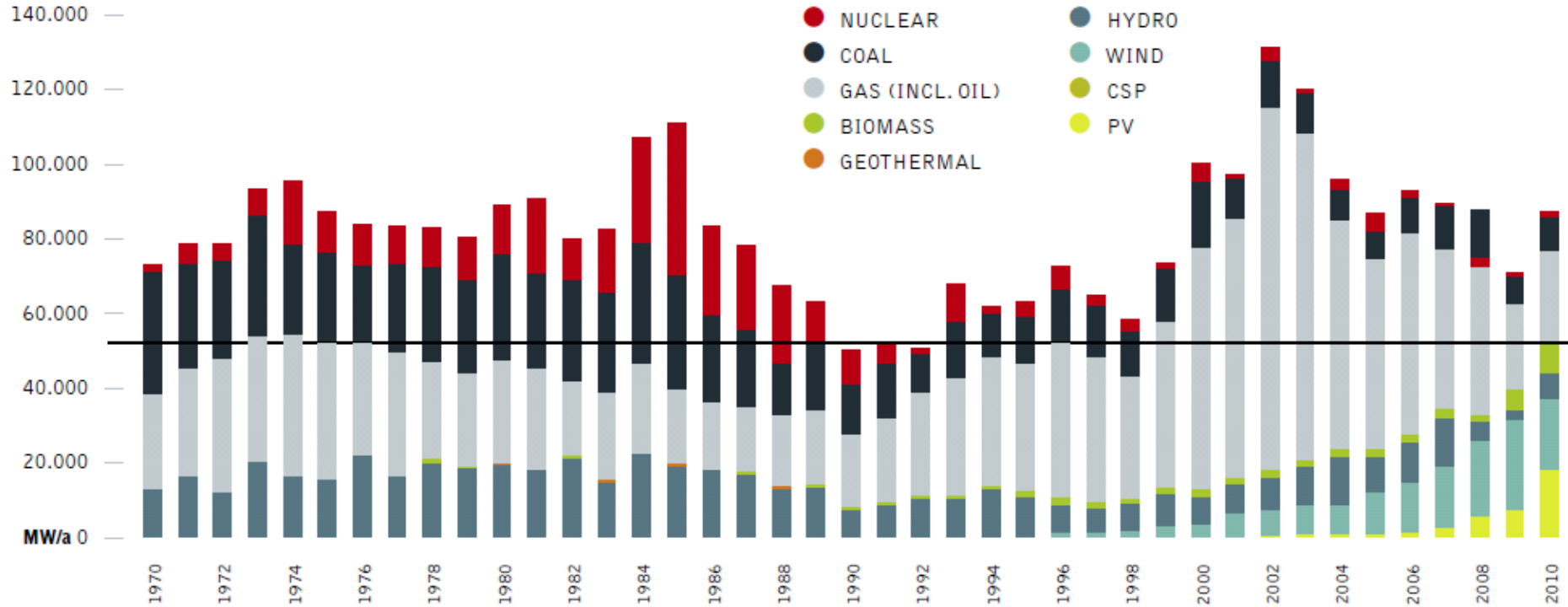
Future projections for Renewable Energy Markets

energy [r]evolution

A SUSTAINABLE GLOBAL ENERGY OUTLOOK

GREENPEACE

global power plant market 1970-2010, excluding china



- NUCLEAR
- COAL
- GAS (INCL. OIL)
- BIOMASS
- GEOTHERMAL
- HYDRO
- WIND
- CSP
- PV

source PLATTS, IEA, BREYER, TESKE.

Global annual power plant market - the past 40 years and a projection of the next 40 years

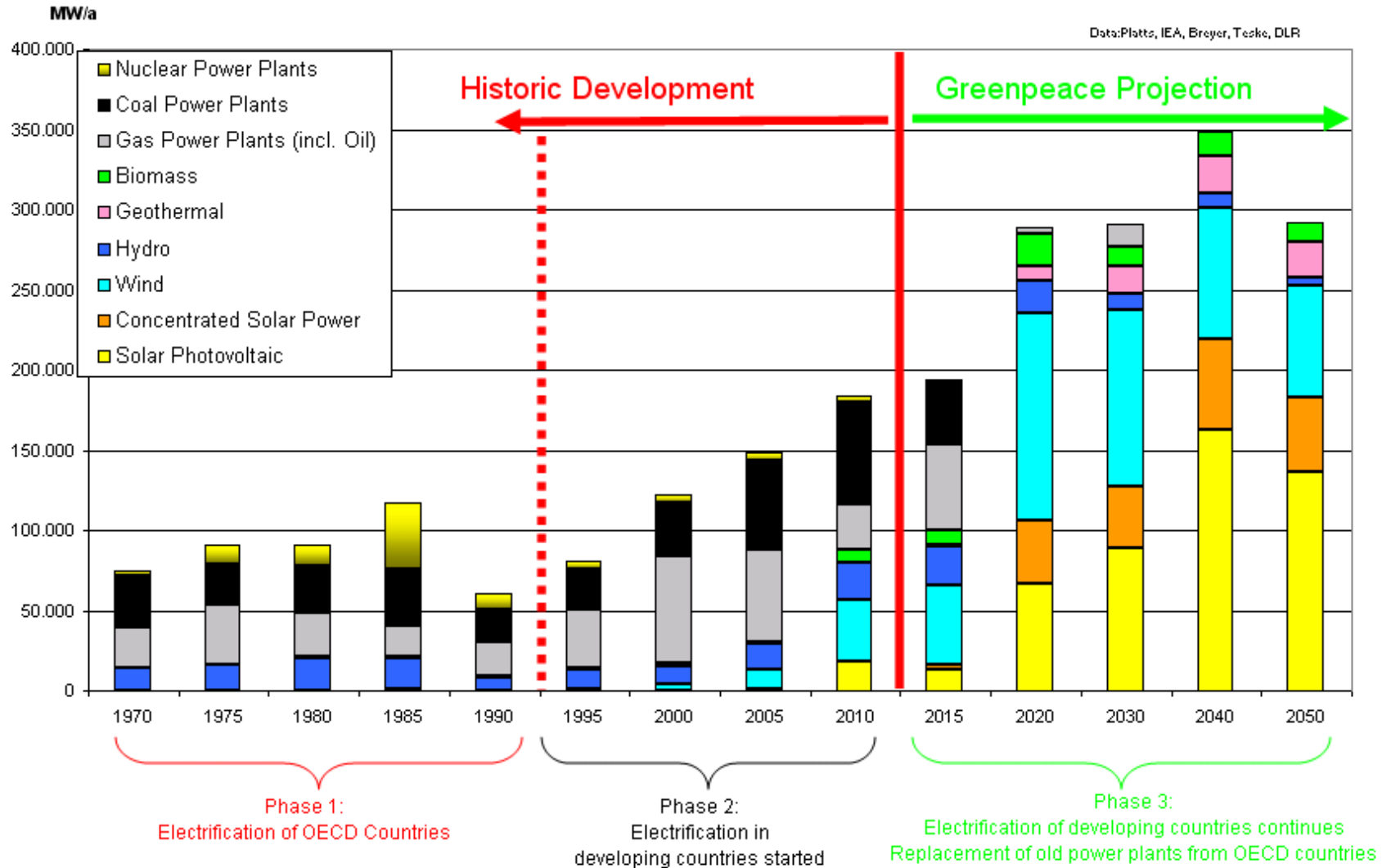
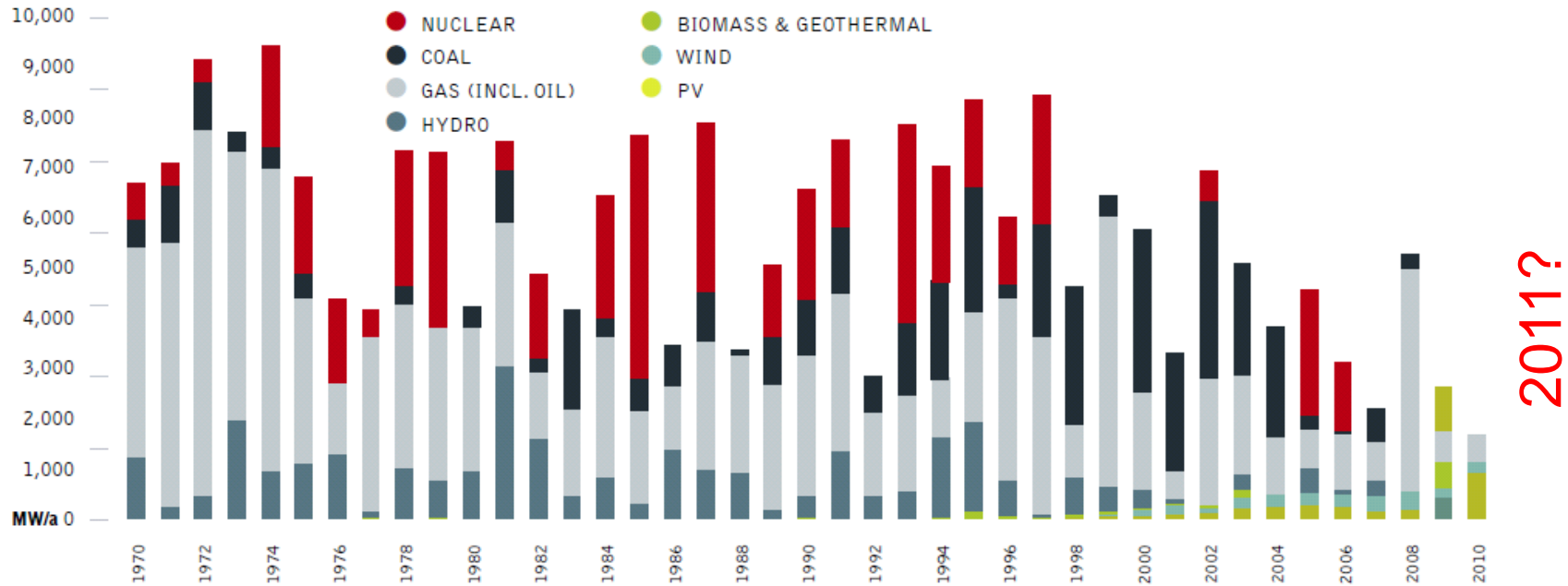


figure 6.7: japan: annual power plant market 1970-2010



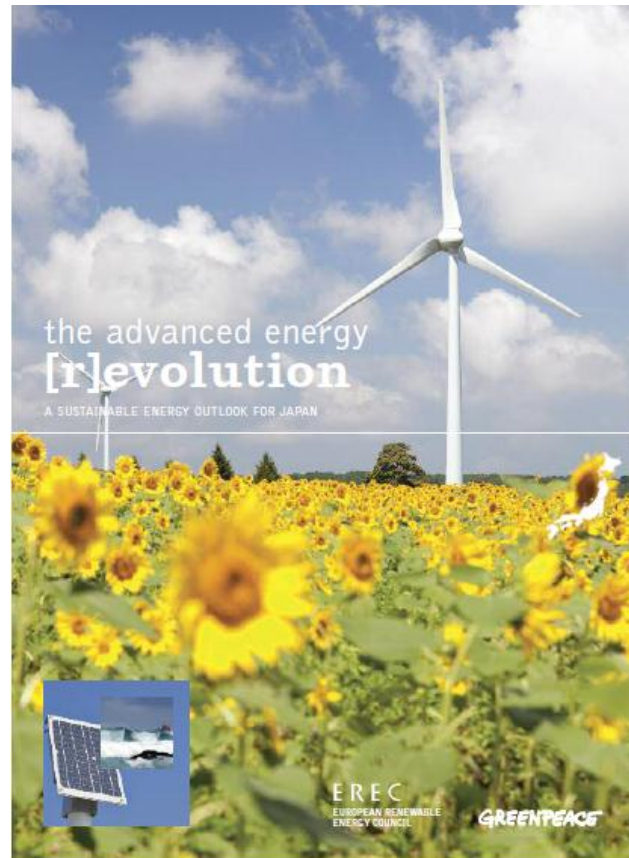
source PLATTS, IEA, BREYER, TESKE.

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Turning the nuclear crisis into an (renewable) opportunity:
the energy [r]evolution for Japan



report 2nd edition 2011 japan energy scenario

1. Energy Efficiency:

the advanced Energy [R]evolution scenario takes the ISEP efficiency concept into account:

2. Power Generation






-  Faster uptake of renewables (especially solar photovoltaic and wind power due to their short construction times) and increased capacity factors for existing gas power plants are at the core of the emergency concept
-  Gas: increase average capacity factor of all gas power plants and use them as base load power plants over the coming years. By 2020, the average capacity factor will be back on “standard levels”.
-  Back-up power: Use gas power plants to counter flexible generation. Gas power plants will be used to cover dips in flexible generation, and no additional capacity will be needed as current gas power generation capacity is more than enough to cover the entire time period 2012 – 2020.
-  Wind: increase average annual market from 220 MW in 2010 to 5000 MW/a between 2012 and 2015 and around 6000 MW/a between 2016 and 2020.
-  Photovoltaic: increase average annual market from 990 MW in 2010 up to 5000 MW/a between 2012 and 2015 and around 6700 MW/a between 2016 and 2020.

figure 1.4: japan - emergency plan: nuclear generation replacement strategy

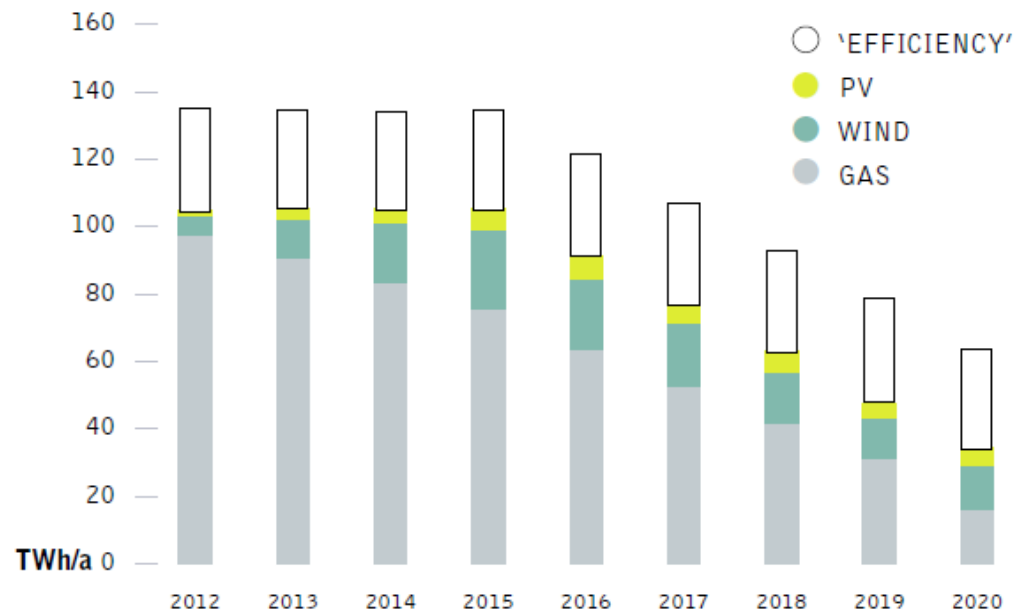


table 1.2: summary: power generation and installed capacity development between 2012 and 2020:

INSTALLED CAPACITY IN GW - EXCLUDING CHP	2007	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coal	49.6	48.1	47.3	46.5	45.7	40.4	35.2	29.9	24.6	19.3
Gas	54.7	58.0	59.7	61.3	63.0	62.2	61.5	60.8	60.1	59.4
Oil	46.4	46.2	46.0	45.9	45.8	44.4	43.1	41.7	40.4	39.0
Diesel	3.2	2.9	2.8	2.6	2.5	2.4	2.3	2.2	2.1	2.0
Nuclear	48.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biomass	3.1	3.7	4.1	4.4	4.7	4.8	4.9	5.0	5.1	5.2
Hydro	19.0	20.0	20.5	21.0	21.5	22.1	22.7	23.3	23.9	24.5
Wind	1.5	8.3	13.3	18.3	23.3	29.4	35.6	41.7	47.9	56.0
Photovoltaics	1.7	8.9	13.9	18.9	23.9	30.6	37.3	44.1	50.8	57.0
Geothermal	0.6	1.4	1.9	2.3	2.8	3.6	4.4	5.3	6.1	6.9
Ocean Energy	0.0	0.1	0.2	0.2	0.3	0.7	1.2	1.7	2.1	2.6

table 0.1: japan - overview energy [r]evolution immediate nuclear energy phase out

NUCLEAR PHASE-OUT 2012: REPLACEMENT STRATEGY										
	UNIT	2012	2013	2014	2015	2016	2017	2018	2019	2020
NUCLEAR GENERATION REPLACEMENT										
Increased power generation from gas power plants via higher capacity factors	TWh	98.0	90.8	83.7	76.3	64.1	53.1	42.3	31.7	17.3
Required capacity factor for gas power plants	h/a	7,565	7,335	7,115	6,900	6,780	6,675	6,570	6,465	6,290
Annual demand reduction 1.7% per year (Instead of 1% per year)	TWh/a	30	30	30	30	30	30	30	30	30
Wind electricity to replace nuclear	TWh/a	5.8	11.7	17.7	23.5	21.8	18.8	15.3	11.4	12.0
PV electricity to replace nuclear	TWh/a	1.2	2.5	3.8	5.0	5.0	5.1	5.1	5.1	4.5
Total additional Wind + PV generation	TWh/a	7.0	14.2	21.5	28.6	26.8	23.9	20.4	16.5	16.4
NUCLEAR CAPACITY REPLACEMENT										
Annual wind market	GW	5.0	5.0	5.0	5.0	6.1	6.1	6.1	6.1	6.1
Total wind capacity	GW	8.3	13.3	18.3	23.3	29.4	35.6	41.7	47.9	56.0
Annual PV market	GW	5.0	5.0	5.0	5.0	6.7	6.7	6.7	6.8	6.8
Total PV capacity	GW	8.9	13.9	18.9	23.9	30.6	37.3	44.1	50.8	57.0
Total additional Wind + PV capacity	GW	10.0	10.0	10.0	10.0	12.9	12.9	12.9	12.9	12.9
Annual CO ₂ emissions	million T CO ₂ /a	1,267	1,261	1,254	1,247	1,171	1,095	1,018	942	866
CO ₂ emissions compared to 1990 levels	%	111%	110%	110%	109%	102%	96%	89%	82%	76%

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figure 1.5: japan - development of electricity generation structure under three scenarios

(REFERENCE, ENERGY [R]EVOLUTION AND ADVANCED ENERGY [R]EVOLUTION) ["EFFICIENCY" = REDUCTION COMPARED TO THE REFERENCE SCENARIO]

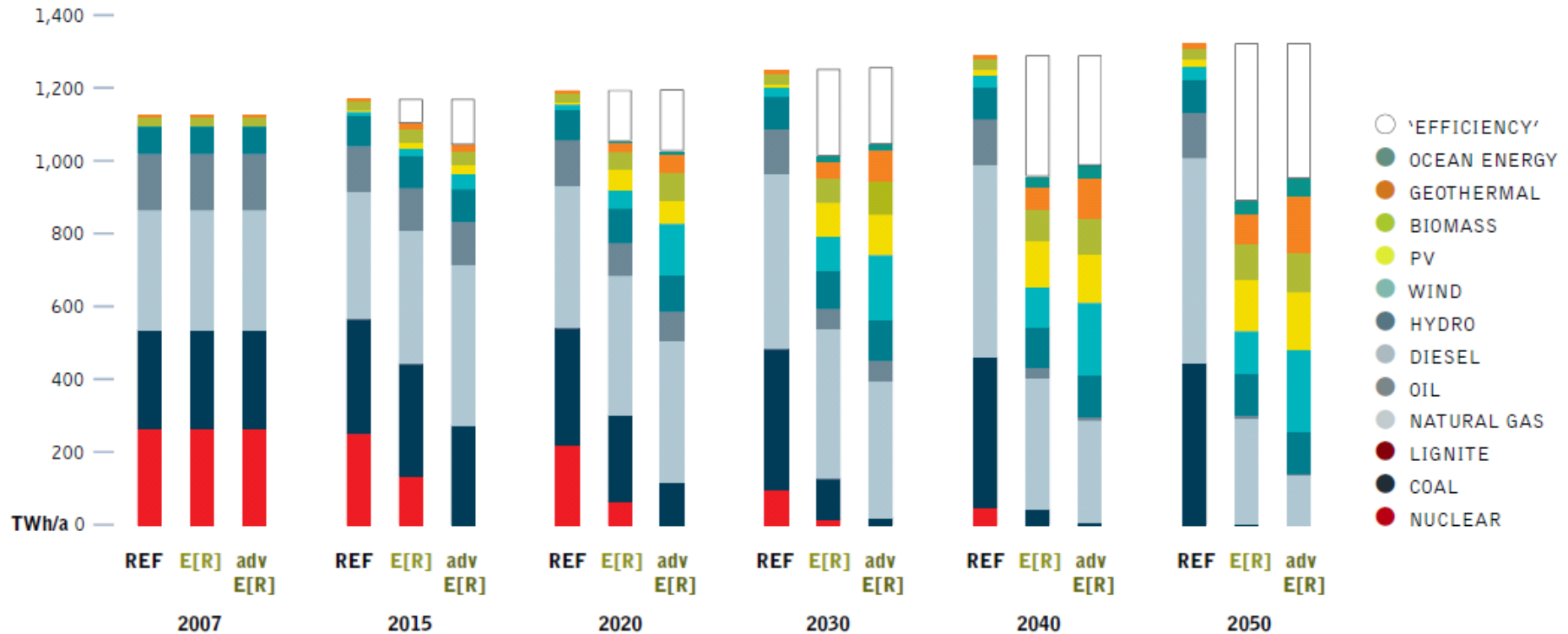


table 1.3: japan - projection of renewable electricity generation capacity under both energy [r]evolution scenarios

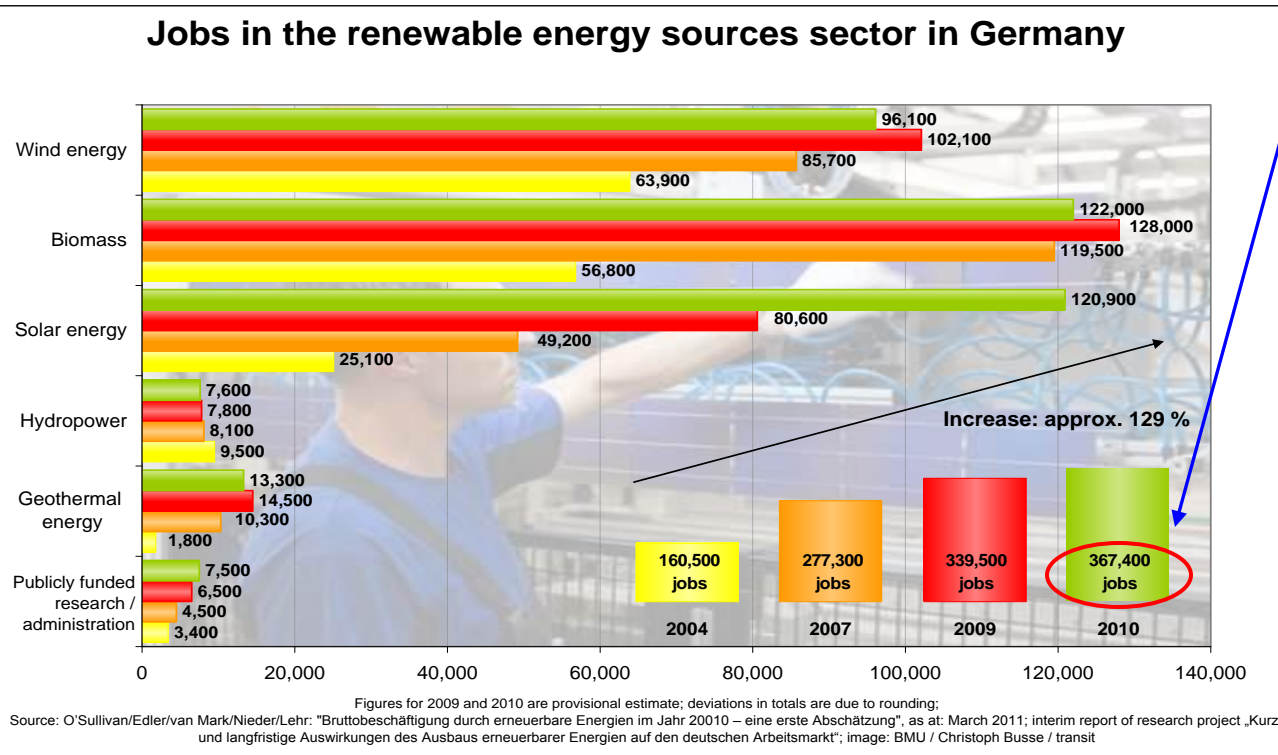
IN GW

		2007	2020	2030	2040	2050
Hydro	E[R]	19	23	25	26	27
	advanced E[R]	19	24	26	27	27
Biomass	E[R]	3	7	10	13	17
	advanced E[R]	3	13	14	15	18
Wind	E[R]	2	23	34	38	37
	advanced E[R]	2	51	64	68	71
Geothermal	E[R]	1	3	6	9	11
	advanced E[R]	1	7	12	16	22
PV	E[R]	0	51	80	104	113
	advanced E[R]	0	53	96	112	125
Ocean energy	E[R]	0	2	5	8	10
	advanced E[R]	0	3	5	10	14
Total	E[R]	24	110	161	199	215
	advanced E[R]	24	152	218	248	277

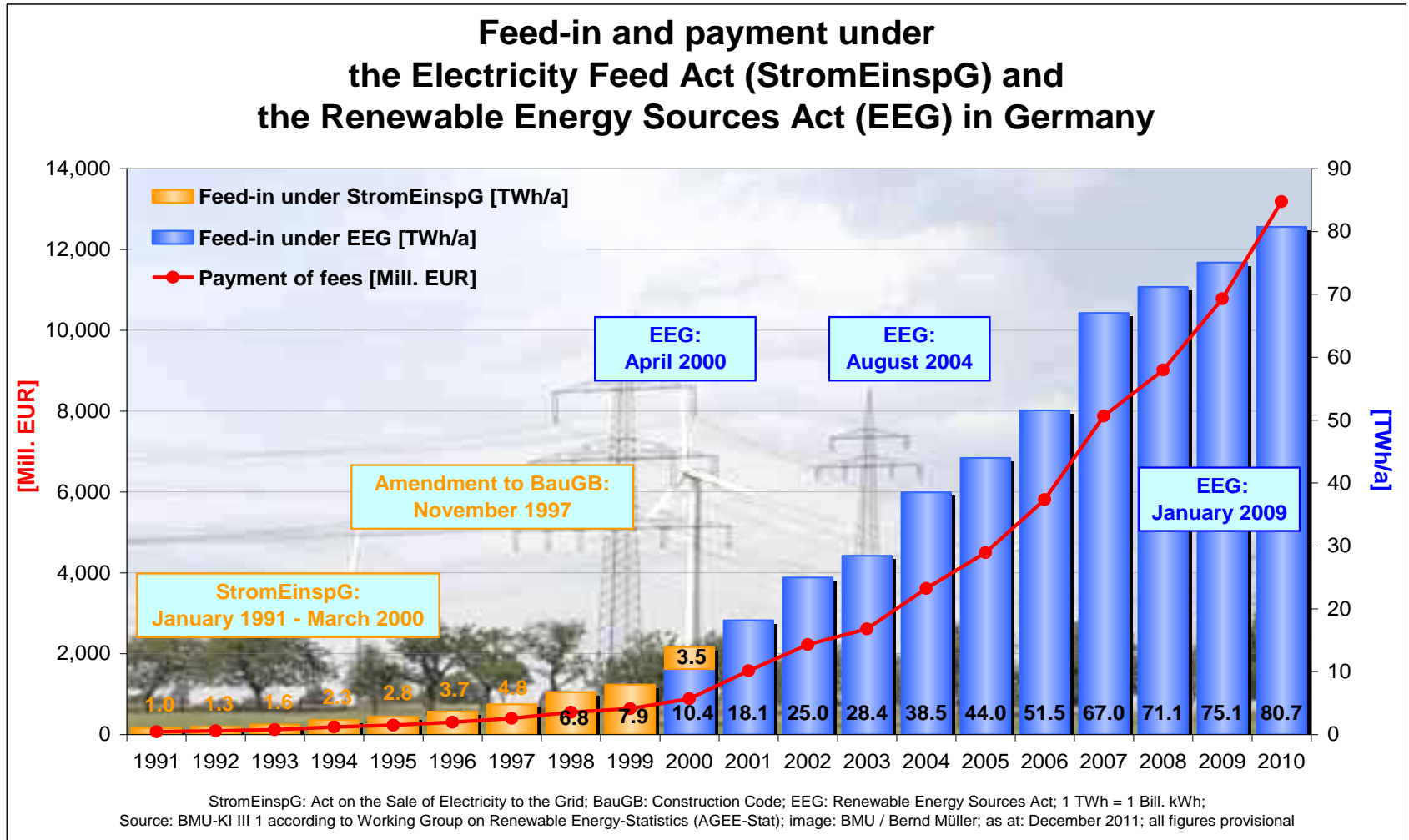
Renewable energy employment – Japan projection versus Germany’s status quo

table 2.1: electricity sector jobs in the three scenarios

Thousand Jobs	REFERENCE				ENERGY [R]EVOLUTION			ADVANCED ENERGY [R]EVOLUTION		
	2010	2015	2020	2030	2015	2020	2030	2015	2020	2030
Coal	4.9	10.0	11.4	7.6	5.1	3.8	1.8	4.5	1.9	0.3
Gas, oil and diesel	9.7	10.3	10.8	10.6	9.1	8.3	7.3	9.6	8.8	7.9
Nuclear	24.8	17.4	12.2	4.4	6.3	2.9	0.6	0.0	0.0	0.0
Renewables	42.3	44.0	42.3	34.8	240	131	109	312	188	136
Total Jobs	81.5	81.8	76.8	57.4	260	147	119	326	198	144



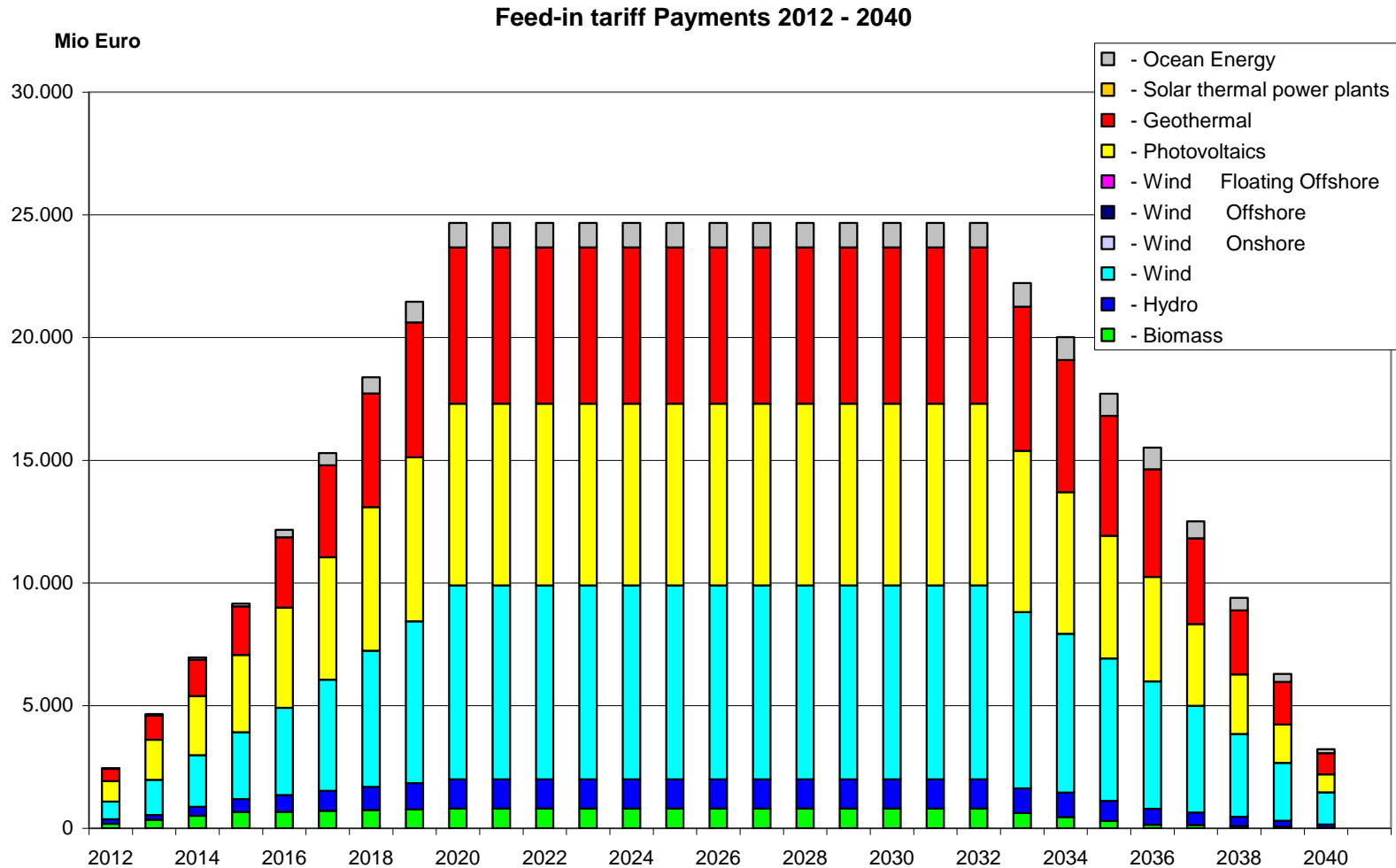
The „mother of all RE investments“: The Feed-in law



Feed-in Tariff Law for Japan

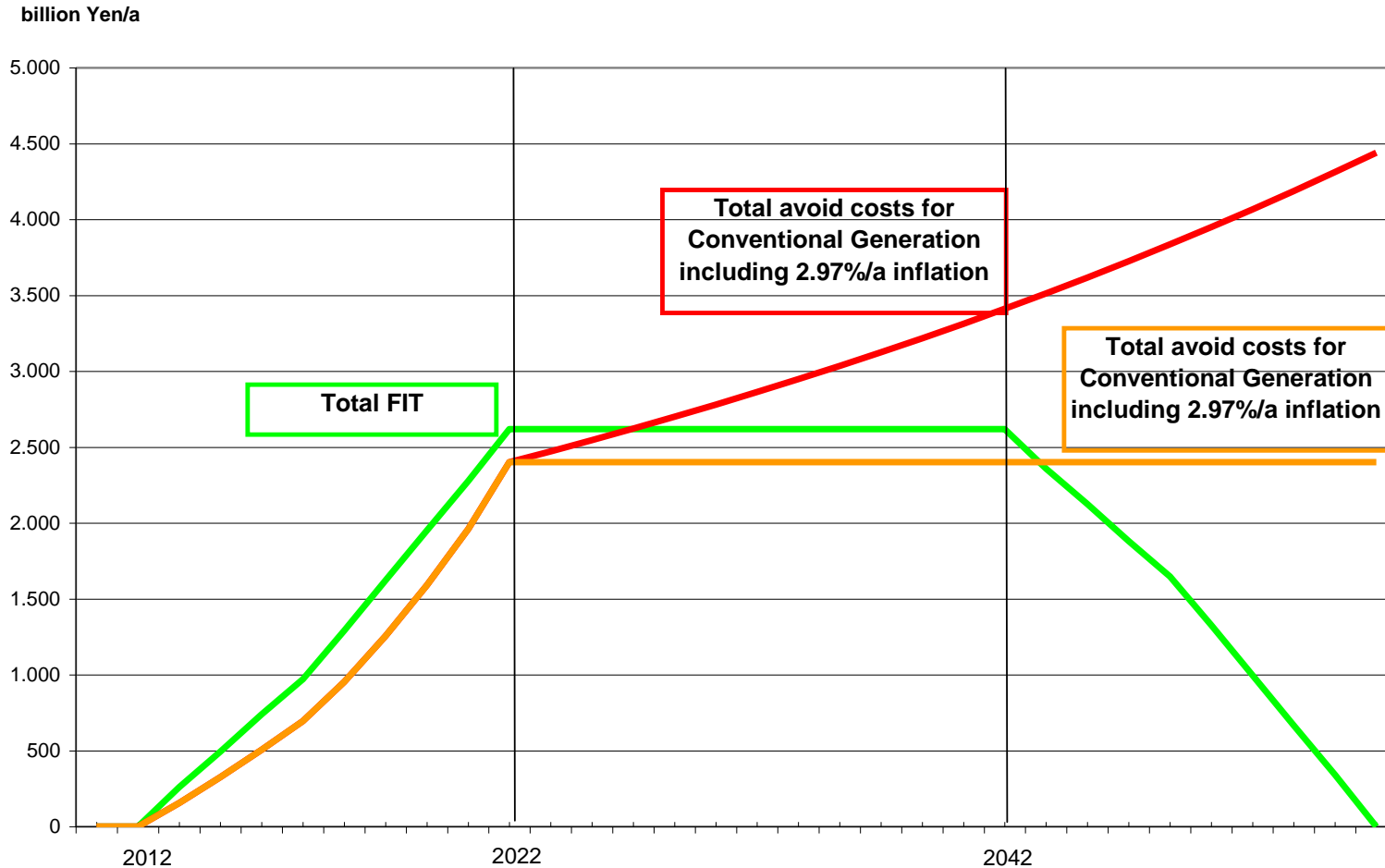
Technology	Investment Costs	Financing Costs								FIT	
Classification	Installed and connected to the grid - global average market price (example)	Credit share of the overall investment	Upfront Investment	Financial costs	Total Costs	Operation & Maintenance	Capacity Factor	Full Load Hours per year	FIT Payment	Required tariff	
Solar photovoltaic		Input				Input	calc	8760	Input		
	[Yen/kW]	[%]	[Yen]	[Yen]	[Yen]	[%/a]	[Yen/a]	[%/a]	[h/a]	[a]	[Yen/kWh]
< 30 kW	274.833	70	82.450	127.935	402.768	2,00%	8.055	19	1650	20	17
< 100 kW	247.350	70	74.205	115.141	362.491	2,00%	7.250	19	1650	20	15
> 100kW	197.880	70	59.364	92.113	289.993	2,00%	5.800	19	1650	20	12
Wind											
onshore	148.410	70	44.523	69.085	217.495	2,00%	4.350	20	1750	20	9
offshore	329.800	70	98.940	69.085	398.885	2,00%	7.978	40	3500	20	8
floating offshore	439.733	70	131.920	69.085	508.818	2,00%	10.176	51	4500	20	8
		0									
Small Hydro											
< 500 kW	439.733	70	131.920	204.696	644.429	2,00%	12.889	51	4500	20	10
< 10 MW	384.767	70	115.430	179.109	563.875	2,00%	11.278	51	4500	20	9
< 20 MW	351.787	70	105.536	163.757	515.543	2,00%	10.311	51	4500	20	8
< 50 MW	329.800	70	98.940	153.522	483.322	2,00%	9.666	51	4500	20	8
> 50 MW	329.800	70	98.940	153.522	483.322	2,00%	9.666	51	4500	20	8
		0									
Geothermal											
< 5 MW	1.319.200	70	395.760	614.087	1.933.287	2,00%	38.666	68	6000	20	23
<10 MW	1.209.266	70	362.780	562.913	1.772.180	2,00%	35.444	68	6000	20	21
< 20 MW	1.099.333	70	329.800	895.544	1.994.877	2,00%	39.898	68	6000	20	23
> 20 MW	989.400	70	296.820	460.566	1.449.965	2,00%	28.999	68	6000	20	17
		0									
Bio energy											
< 150 kW	384.767	70	115.430	179.109	563.875	2,00%	11.278	57	5000	20	8
< 500 kW	357.283	70	107.185	166.315	523.599	2,00%	10.472	57	5000	20	7
< 5 MW	329.800	70	98.940	153.522	483.322	2,00%	9.666	57	5000	20	7
5 MW - 20 MW	302.317	70	90.695	140.728	443.045	2,00%	8.861	57	5000	20	6

Total payment under advanced E[R] for a FIT regulation between 2012 and 2020



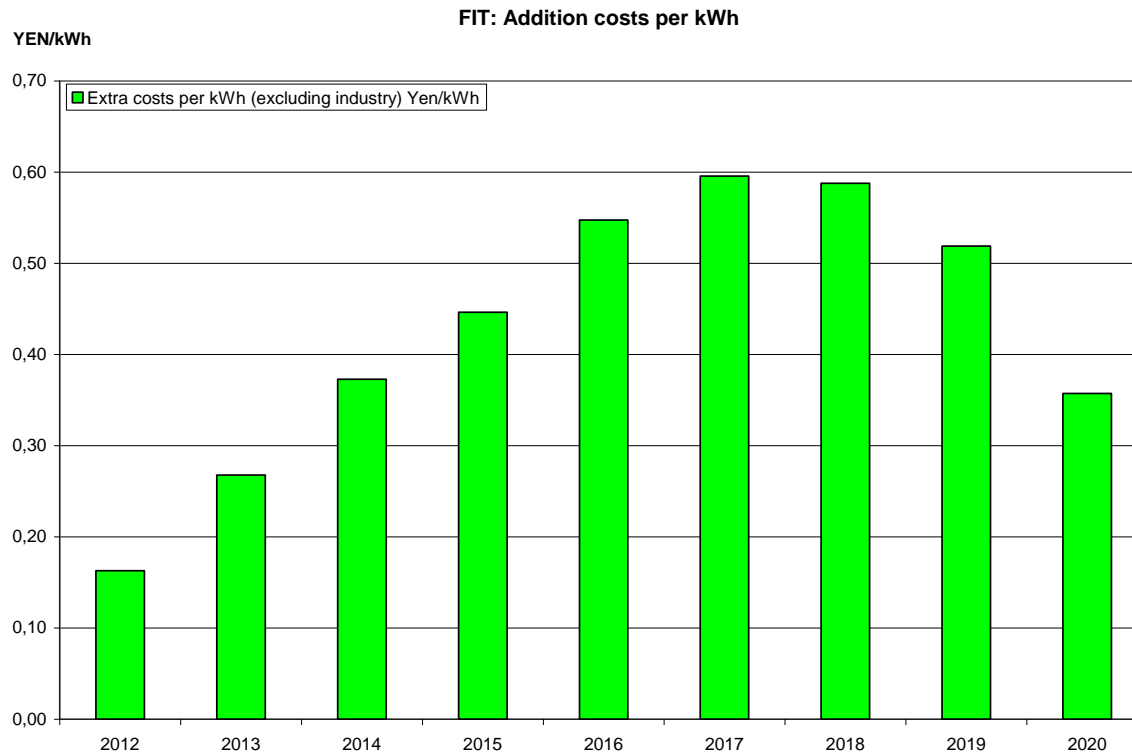
FIT versus Conventional generation costs

FIT Costs versus Conventional Generation Costs



Extra Costs per kWh

With an average consumption per household of 4000kWh/a this would mean that each house hold will not pay more than 2500 – 3000 Yen/a extra to finance the FIT program.



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Renewable Energy Director

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Thank you very much!

More information: www.energyblueprint.info

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