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TOWARDS A SUSTAINABLE CLIMATE AND ENERGY POLICY MIX: INSIGHTS FROM THEORY AND THE CASE OF JAPAN

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TOWARDS A SUSTAINABLE CLIMATE AND ENERGY POLICY MIX: INSIGHTS FROM THEORY AND THE CASE OF JAPAN[2]

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1 Introduction

The 2011 Fukushima nuclear disaster and rapid global warming emphasize the necessity of reorganizing our energy system; but how do we get there? Energy and climate policy are obviously interlinked, e.g. via carbon dioxide (CO_2) emissions from fossil fuel burning in electricity generation. Policy targets are interdependent, sometimes even contradicting: The environmental soundness of current energy use has been seriously challenged by nuclear contamination and by greenhouse gas (GHG) emission reduction barriers from low coal prices, power grid insufficiencies, and oligopolistic market structures. Energy security has been threatened by military conflicts and volatile resource prices, while carbon pricing has made energy use more expensive.

In order to achieve the variety of climate and energy policy targets, a multitude of instruments has been implemented: market-based programs such as carbon cap-and-trade or energy taxes, command-and-control policies such as energy efficiency standards, support schemes such as feed-in tariffs. Obviously these policies directly affect each other: Climate policy cap-and-trade makes electricity generation from fossil fuels more expensive and increases electricity prices. Energy policy feed-in tariffs change the relative prices in power production and make carbon free technologies more attractive. Also, the low-cost provision of electricity has been heavily debated in the face of trade-offs between policy induced power price increases and the call for a fair distribution of energy transformation burdens.

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But although interdependencies between climate and energy targets, instruments, and impacts on the economy, environment, and society are manifold, the theory on these issues is relatively new, in many parts incomplete, and practical experiences are few. While against this background some economists claim that using multiple policies only causes inefficiencies, others are strongly in favor. So is a mix of multiple policies really necessary? How can sustainability criteria be applied to such a policy mix? And what are the political chances and barriers of a sustainable climate and energy policy mix? This is the first set of questions we are going to discuss in this paper.

In practice, Japan remains to be a key global player in climate and energy policy: It is still the third biggest economy in the world, the seventh biggest GHG emitter, and keeps more than 50 nuclear power plants ready for use. Energy and climate policy targets are yet not finalized, market-based instruments are sparsely used, but efficiency standards and the recent feed-in tariff are quite advanced. Hence, a case study makes an interesting trial case for evaluating some of the preliminary theoretical insights of this paper. So does Japan follow a comprehensive climate and energy policy strategy? To what extent can the policy mix be considered sustainable? And what have been the political challenges? This represents the second set of questions dealt with in this paper.

In order to answer the questions, we aim at merely mapping in-depth future research by reviewing selected literature on an energy-climate-policy-mix, discussing sustainability criteria, and adding a political economy perspective. We mainly argue that a policy mix is necessary, that sustainability criteria are indispensable but still hard to define, and that the political feasibility of such an approach is critical but still higher than for carbon pricing alone. Hence, we call for a stronger research emphasis on social justice and political feasibility questions of a climate and energy policy mix.

2 Insights from theory

2.1 The necessity of a policy mix

Because the aims of providing both a stable global climate and a sustainable energy supply are faced with many aspects of market failure such as the public good character of the global climate, monopolies in the energy market, and external costs of electricity use, government action is inevitable. In terms of the ultimate goal, we will later argue that only a nuclear-free de-carbonization by the end of this century can be considered a sustainable strategy. In terms of concrete targets, Germany has exemplified what this means (BMU 2011):

- the phase-out of nuclear energy by 2022
- a share of renewable energy in power consumption of 35% by 2020 and 80% by 2050
- a reduction of primary energy consumption by 20% in 2020 and 50% in 2050 (base 2008)
- a reduction of GHG emission by 40% by 2020 and 80-95% by 2050 (base 1990)

Following the Tinbergen Rule (Tinbergen 1952), already this gigantic task with its multiple objectives calls for multiple instruments. But some scholars already lament an "instrument invasion" (Hansjürgens 2012: 7). While the influx of a multitude of policy instruments certainly cannot be denied, the question remains, if we are faced with a necessary and well-planned policy mix or with a more or less chaotic and ineffective policy mess. So is a mix of policies actually necessary? Here, for simplicity reasons, we focus our discussion on combining the EU Emissions Trading Scheme (EU ETS) with the German-style feed-in tariff (FIT).

Critics of a policy mix mainly claim, that in view of a fixed climate target, an efficient cap-and-trade scheme should be the one and only policy, because any added instrument would only increase overall compliance cost without producing additional environmental benefits (Sinn 2008, Weimann 2008).

Proponents of a policy mix (Diekmann/Kemfert 2005, Fischedick/Samadi 2010, Lehmann/Gawel 2011, SRU 2011, Weber/Hey 2012), on the other hand, first and foremost, argue on the basis of welfare economics. According to this, in energy and climate policy multiple externalities exist and they cannot be internalized by an isolated carbon market. Besides climate change, additional externalities of energy conversion processes arise e.g. from sulfur dioxide (SO_2) or nitrogen oxides (NO_X) emissions, from possible nuclear contamination, and from impacts of digging for energy resources. In addition to negative externalities, positive externalities arise from an energy transformation such as a greater independence from undemocratic oil and gas producing regimes as well as knowledge spillovers from innovation in renewable energy and energy efficiency technologies. In order to internalize externalities, proponents of a policy mix consider complementary instruments to carbon pricing such as efficiency standards or feed-in tariffs justified.

Second, applying evolutionary economics, path dependencies matter (Kosinowsky/Groth 2011). Investments in the energy sector are highly asset specific: They are only designated for this specific purpose and, once made, are irreversible. But current investment decisions are made based on a cost structure that distorts competition in many ways, e.g. due to substantial subsidies for fossil fuels and nuclear energy vs. the externalization of respective negative environmental and health effects in the past. In this artificial situation, distortions lead to investments in a long-term sub-optimal electricity generation path and prevent investments in fundamentally new technologies. A carbon pricing scheme such as the EU ETS alone cannot provide a sufficient remedy for this "carbon [and nuclear] lock-in" (Fischedick/Samadi 2010: 24). Instead, as long-term oriented investments are needed, a renewable energy support system such as the German FIT provides planning reliability and helps overcoming established structures.

Third, according to political economy reasoning (Gawel et al. 2014), it is very likely that decisions on crucial design features of carbon pricing schemes such as the ETS cap size are rather based on the political acceptability than on environmental necessities or overall abatement costs. Hence, real-world cap-and-trade schemes will probably never be neither cost efficient nor sufficiently effective. But instead of utterly condemning the instrument, complementing a politically weakened ETS with additional measures could be a more reasonable alternative.

Forth, political consulting has to take into consideration real-life political and institutional constraints instead of asking the world to adapt to economic models (Hansjürgens 2012: 11). Besides the above mentioned barriers to perfect carbon markets, institutional constraints have to be taken into account. In politics, these involve policy making styles, institutional arrangements, and multi-level governance structures. In the latter case, modern literature on environmental federalisms suggests that supranational carbon markets should be complemented by national or even regional policies in order to cope with specific local circumstances (Morotomi 2014).

And fifth, the energy transformation towards a nuclear-free low carbon society calls for profound changes in the socio-technological system (Hansjürgens 2012: 11). Carbon price signals alone might not be enough to trigger the changes necessary, spanning from technological infrastructure issues such as the power grid structure to socio-economic questions on the sustainability of modern lifestyles.

Weighing the arguments, we are convinced that in order to realize a nuclear-free de-carbonization by the end of this century we need to rely on a well-balanced policy mix. But if so, what could be criteria for the design of such a policy mix?

2.2 The sustainability of a policy mix

Sustainability was established as an important guiding principle for public policy at the Rio Summit in 1992 (Lerch/Nutzinger 2002). Ever since, besides intra- and intergenerational justice, three pillars – environment, society, economy – and five notions of stringency – from very weak to very strong – have been emphasized. In the latter case, even the rather unpretentious concept of critical sustainability calls for boundaries, safe minimum standards or environmental guardrails.

Applying these basic ideas to energy and climate policy, environmental effectiveness, economic efficiency and social justice should be guiding principles (Rudolph et al. 2012). Concerning the environment, issues such as climate protection, air pollution control, responsible resource and land use or nuclear safety have to be considered. Exemplifying for the first and the last, fairly clear criteria can be identified. In climate protection, the Intergovernmental Panel on Climate Change (IPCC 2007) scientifically founded – and the global community even publically acknowledged at the Copenhagen Summit – the 2°C target as a safe minimum standard, which calls for emission reductions of 80-90% in industrialized countries by 2050. This de-carbonization of energy supply calls for a fuel switch from fossil fuels to renewable energy. Nuclear energy, although carbon-free, cannot be considered sustainable, because of the high risk related to nuclear accidents and the still unsolved questions around nuclear waste treatment. Thus, any climate and energy policy mix has to be evaluated against the guardrail of a nuclear-free de-carbonization. While the operationalization of such a guardrail is certainly still quite a challenge, some evaluation criteria such as a policy's accuracy in reaching pre-given targets, its suitability for target adjustment in the case of new knowledge, its capability to set long-term innovation incentives, its ability to deal with carbon leakage, and its fitness to prevent rebound effects have already been developed and applied to carbon cap-and-trade (Rudolph et al. 2012). For policy interaction Oikonomou/Jepma (2008) developed a framework and additionally pointed to the importance of energy effectiveness, which refers solely to specific energy targets such as security of supply.

In the case of economic criteria, the definition of an optimal level of pollution and a complete internalization of externalities remains impossible, leaving cost efficiency as the guiding principle (Baumol/Oates 1971). Market-based approaches such as energy taxes or carbon cap-and-trade are considered cost-efficient and have reduced compliance cost by up to 50% compared to command-and-control in various cases in practice (Ellerman et al. 2000). But as outlined above, even many economic arguments support the call for complementing measures in order to cope with multiple externalities, lock-ins, and politics-induced problems. Again, nuclear energy must be excluded, simply because of actual costs being higher than those of many alternative energy resources (Oshima 2014). Thus, a nuclear-free de-carbonization needs well-designed market-based approaches, combined with other instruments in such a way that the combination does not set perverse incentives jeopardizing carbon pricing's cost efficiency. In addition to overall cost-efficiency and company-level flexibility, the minimization of administrative and transaction costs, the prevention of (further) competitive distortions, and the definition of clear property rights are important criteria (Rudolph et al. 2012). For policy interaction, Oikonomou/Jepma (2008) also point to the importance of preventing double regulation – a situation, in which one target group is affected by more than one policy instrument that achieve the same objectives – and double counting – which occurs when the targets for the same emissions are assigned to different obligated parties. Double counting can be further differentiated into double coverage, double crediting, and double slippage. Double coverage occurs when the same emission allowance is required twice in order to address the same target quantity in e.g. two interlinked carbon cap-and-trade schemes; double crediting happens when two allowances are generated from one reduction action; and double slippage occurs when an emission is neither covered by one nor the other scheme. Also, a climate-energy policy mix can be evaluated against its ability to foster an energy market liberalization.

The main line of discussion on social justice aspects of the energy transformation in Germany has so far focused on the criteria of electricity price effects (Heindl et al. 2014). At least two arguments support the notion that the financial burden resulting from the energy transformation is significantly higher for poor households than for rich households. First, energy prices are regressive in so far as the relative burden for poor households is bigger than for rich households. Second, poor households are less capable of short-run reactions to higher energy prices such as buying more efficient appliances or replacing heating systems. In addition, due to the trend of a widening income spread, the share of households threatened by poverty has increased in many industrialized countries. Thus, poor households appear to shoulder a bigger part of the energy transformation than rich households, a steadily increasing share of low-income households have to spend a steadily increasing part of their income on energy, and altogether the energy transformation so far can be considered unfair – a specifically obvious example being poor people living in small apartments subsidizing solar panels of house owners by paying the feed-in tariff apportionment. This notion is also underlined by a multi-level governance perspective, because e.g. in the case of renewable support schemes not all European power producers are treated equally, some German Länder subsidize other Länder, and German energy intensive industries are at least partly exempted from the apportionment. Hence, energy price effects have to be a major criteria for judging the sustainability of a climate and energy policy mix. In addition, for policy interaction, Oikonomou/Jepma (2008) also mention employment, business opportunities, and government revenues as relevant criteria.

However, it should not be forgotten that the energy transformation also fosters social justice, because a nuclear-free, decarbonized energy supply would significantly lower the ecological rucksack passed on from the current to future generations. In addition, several other aspects of social justice such as procedural vs. result-based justice, have to be taken into consideration when evaluating the fairness of a climate and energy policy mix (Lerch 2011). In an attempt to solve related issues, Rawls (1971) groundbreaking contribution calls for equality in terms of rights and freedom as well as chances and opportunities, and only accepts inequalities in income and capital, if they provide the highest benefit to the poorest compared to a situation of equality where the poorest benefit less. However, operationalizing this idea for policy mix design still remains a big challenge.

Altogether, we think it critically important to unequivocally define and apply sustainability criteria for a climate and energy policy mix. And as research as well as policy discussion on economic efficiency and environmental effectiveness are far more advanced than debates on social justice, we consider it necessary to put a stronger focus on the latter issue.

2.3 The feasibility of a policy mix

Public Choice wisdom has it that market-based environmental policies such as tradable emission permits or environmental taxes are difficult to implement (Kirchgässner/Schneider 2003). As a consequence, it seems very unlikely that carbon pricing schemes ambitious enough to incentivize a nuclear-free de-carbonization by the end of this century are politically feasible (Weber/Hey 2013); a fact also clearly supported by several empirical studies on cap-and-trade in the US (Ellerman et al. 2000), the EU (Rudolph 2009) and Japan (Rudolph/Schneider 2012). In line with these arguments, some economists claim that e.g. combining the EU ETS with other instruments such as the German feed-in tariff raises overall compliance costs and thus further increases covered industries' resistance to ambitious carbon pricing (Weimann 2008).

However, several arguments support the view that an ambitious policy mix might be easier to implement than a single adequate carbon pricing scheme (Gawel et al. 2014). First, if industries' would really care about total climate protection costs, they should support a least cost instrument such as carbon cap-and-trade or taxation; but in reality they don't. Public Choice already tells us that overall cost-efficiency features characteristics of a public good and that, instead, the attribution of costs to sectors or even individual economic units is the key factor for mobilizing opposition. Therefore, in many countries industry resistance to carbon pricing has been one of the major obstacles of cost-efficient climate policy (Rudolph 2009, Rudolph/Schneider 2012).

Second, if opposition against carbon pricing is mobilized by sectoral abatement costs borne by well-organized interest groups rather than by overall climate protection costs, and if abatement cost in the regulated sectors are lower the smaller their share of total climate protection costs is, shifting burdens from well-organized industry groups to less organized groups such as households could increase the political feasibility of more ambitious carbon pricing schemes. Subsidizing renewable energies by a feed-in tariff mainly paid by households, although highly questionable from the fairness perspective, lowers sectoral abatement costs for industry covered by a carbon pricing scheme. Thus, it might even weaken industries' opposition to more ambitious carbon pricing scheme designs compared to the case of a sole economic instrument.

Third, technology support programs such as the German feed-in tariff, by overcoming path dependencies and carbon-nuclear lock-ins, could provide clean technologies on a large scale in time, which in turn might prevent sudden carbon price hikes and reduce cost uncertainty for industry.

Forth, supporting renewable energy and thus fostering the renewable energy industry creates a new potent political player in the energy policy discourse and weakens the relative influence of traditional fossil-fuel based utilities. And as providers of renewable energy greatly benefit from carbon pricing that burdens fossil-fuel based power production, they are possible proponents of ambitious carbon pricing schemes, providing the necessary stakeholder support.

And fifth, the necessary de-carbonization by a sole carbon pricing instrument would cause prohibitively high political costs. A carbon price capable of completely de-carbonizating energy supply would have to be between 70 (production costs of wind onshore) and 300 Euro per ton of CO_2 (production costs of photovoltaic). Compared to current price levels, the financial burden of an average German entity covered by the EU ETS would increase by at least 30 million Euros. This is because in the case of decarbonizing by a single pricing instrument, the energy transformation is organized by financially punishing established technologies and devaluing productive capital of politically influential industries. Instead, partially de-carbonizing by financially supporting renewable energies might be politically less costly.

Altogether, while a policy mix still faces a lot of political barriers, there are reasons to believe that the political barriers of an energy transformation based on a single sufficiently stringent market-based instrument are higher than complementing insufficient carbon pricing with other policies such as renewable energy support schemes. However, the real political costs, related interests, and the actual power balance in the climate and energy policy realm still have to be analyzed in more detail.

3 Climate and energy policy in Japan

3.1 Policy programs and targets

In order to achieve a nuclear-free low-carbon society in Japan, energy-related CO_2 emission control measure have to be strengthened and the use of renewable energy has to be enhanced. Today, CO_2 emissions account for around 90% of Japanese GHG emissions and are still increasing (+2.8% in 2012 from the previous year). And despite of the one year anniversary of Japanese electricity supply without nuclear power on September 15, 2014, a phase-out strategy is not yet available.

In Japan, climate and energy policy issues used to be – and are partly still – discussed separately. Even before the Fukushima nuclear disaster on March 11, 2011, the former Japanese government led by the Democratic Party of Japan (DPJ) proposed the "Basic Act on Climate Change Countermeasure" on May 12, 2010. The Act outlined mid- and long-term GHG reduction targets:

- –25% by 2020 (base 1990)
- –80% by 2050 (base 1990)

In addition, the Act included the renewable energy goal of a 10% share in total primary energy supply by 2020. A target for nuclear energy, however, was not set, because Japan's climate protection strategy at the time very much relied on the continuation of nuclear power use. Anyway, while the Act had passed the Lower House on May 18, 2010, it later failed in the Upper House.

After 3/11 significant doubt in the Japanese energy system led to DPJ's "Innovative Strategy for Energy and the Environment" (EECJ 2012) on September 14, 2012; a major step towards interlinking energy and climate policy. The green energy revolution was considered the main linkage, as the promotion of energy efficiency and renewable energy would both lower CO_2 emissions and the dependence on nuclear energy, while at the same time securing a stable and inexpensive power supply. The Innovative Strategy referred to the 2010 Climate Act's GHG targets, and concretized energy policy targets:

- phase-out by of nuclear energy by the 2030s
- 30% share of renewable energies in electricity production in 2030
- 20% reduction of total final energy consumption by 2030 (base 2010)

In order to achieve these aims, besides the feed-in tariff and the carbon tax, first and foremost, the government intended to liberalize the electricity market by eliminating regional monopolies, decentralizing power supply, and decoupling generation and distribution. The nuclear phase-out was to be advanced by a strict limitation of the operating permits for nuclear power plants to 40 years, the limited re-start of plants considered safe by the newly established independent Nuclear Regulation Authority, and the abandonment of any plans to construct new plants.

Major policy changes arrived with the currently ruling Liberal Democratic Party (LDP) in 2012. On February 28, 2013, Prime Minister Abe announced a revision of the Innovative Strategy from the scratch in order not to interfere with economic recovery. As a consequence, on November 15, 2013, the GHG reduction commitment was reduced to 3.8% by 2020 (base 2005), an actual emission increase by 3.1% compared to 1990 levels. While holding on to the renewable energy target, a decision on the future of nuclear energy has still not been made.

Altogether, while the eventually unsuccessful Innovative Strategy for the first time interlinked climate and energy policy and set rather ambitious targets, current goals are not the least in line with the necessities of limiting global warming to the 2°C target and phasing out nuclear energy. The continuing failure has been mainly due to the strong resistance from the well-known Iron Triangle of energy intensive industries and utilities, the Ministry of Economy and Trade, Industry (METI), and the now ruling Liberal Democratic Party (LDP) (Rudolph/Schneider 2012).

3.2 Policy instruments

Already the unsuccessful 2010 Climate Act proposed three specific policies to achieve its targets:

- domestic emissions trading scheme (ETS)
- carbon tax
- feed-in tariff (FIT)

ETS was tested in Japan between 2005 and 2012 (MoE 2012). The Japan Voluntary Emissions Trading Scheme (JVETS), a baseline-and-credit scheme without a fixed overall emission cap, was administered by Japan's Ministry of the Environment. Participants received subsidies for achieving self-set absolute volume CO_2 reduction targets and were rewarded with free tradable credits for over-compliance. In 2008, however, JVETS was merged with the Integrated Domestic Market of Emissions

Trading (IDMET), administered by both MoE and METI. In order to increase voluntary participation, IDMET, other than JVETS, allowed credit borrowing, extensive offset use, and specific emission intensity targets but did not offer subsidies. Experiences with the trading programs were ambivalent: While IDMET never took off, JVETS' participants achieved their voluntary targets, but overall emission reductions, participation, and trading activities remained very limited to the end.

Following the 2009 change in government, preparations for the Domestic Emissions Trading Scheme intensified. A government committee report proposed several design options for a mandatory scheme starting from 2013 and aiming at emission reductions in line with Japan's former 25% reduction target for 2020. However, crucial design issues such as the overall cap size, the possibility of intensity targets, and the initial allocation scheme were not solved. Anyway, in December 2010 the DPJ government called off the implementation of the Domestic ETS; the major reason again being the Iron Triangle's opposition (Rudolph/Schneider 2012). Instead of an ETS, the DPJ went for a carbon tax and a feed-in tariff, mainly in order to overcome this opposition while at the same time at least partly fulfilling its former commitment to GHG and nuclear power dependency reduction.

With the aim of controlling energy-related CO_2 emissions, the Tax for Climate Change Mitigation was introduced in 2012. The tax is imposed on the consumption of fossil fuels such as petroleum, natural gas and coal. Specifically, by using the CO_2 emissions factor of each fuel, the tax rate per quantity unit is set in a way that each tax burden equals 289 Yen per ton of CO_2. Hence, carbon tax rates vary between fuels. The carbon tax isadded onto the pre-existing petroleum and coal tax, the tax base of which is all fossil fuels (760 Yen/kl crude oil and petroleum products, 780 Yen/t for gaseous hydrocarbons, 670 Yen/t for coal). To mitigate the burden, carbon tax rates are only to be raised gradually in the future (Table 1) and exemptions and refunds are provided for certain fields such as imported and domestic volatile oil for petrochemical production.

Table 1: Carbon tax rates in 2012

object of taxation	Petroleum and Coal Tax	Carbon Tax		
		Oct, 2012	April, 2014	April, 2016
Crude Petreoleum and Petroleum Products (per kilo liter)	2,040 yen	250 yen (2290 yen)	500 yen (2,540 yen)	760 yen (2,800 yen)
Gaseous Hydrocarbon (per ton)	1,080 yen	260 yen (1,340 yen)	520 yen (1,600 yen)	780 yen (1,860 yen)
Coal (per ton)	700 yen	220 yen (920 yen)	440 yen (1,440 yen)	670 yen (1370 yen)

Source: MoE (2010)

Tax revenues are to be used for various measures of energy-related CO_2 emission control, such as energy-saving measures, the promotion of renewable energy, and the clean and efficient use of fossil fuels. Thus, in terms of emission reductions, a revenue effect will add to the price effect.

As the carbon tax only started its operation on October 1, 2012, empirical results are limited. However, revenues are estimated to be 39.1 billion Yen for 2012 and 262.3 billion Yen for each year after 2016. Thus, MoE (2010) estimates the sum of the revenue and the price effect to be a CO_2 reduction of 0.5% to 2.2% by 2020 compared to 1990 levels. Lee et al. (2012) modelled the potential economic and environmental effects and confirmed a 1-3% emission reduction but found no significant impact on the Gross Domestic Product (GDP) and employment.

The Japanese feed-in tariff (FIT) for renewable energy was launched on July 1, 2012. It obliges utilities to purchase electricity generated from photovoltaic, wind power, hydraulic power (below 30 MW), geothermal, and biomass based on a fixed-period fixed-price contract. Purchase rate and contract period are determined corresponding to the type and the form of installation as well as the scale of renewable energy resources (Table 2). The rates and periods are announced by METI, based on considerations by an independent committee and the ministries concerned. For the benefit of renewable energy electricity suppliers, special consideration are given in decisions on FIT rates for three years from the FIT-introduction.

Table 2: FIT Tariffs and Durations in 2014

Energy source	Solar PV		Wind power			Geothermal power		Small- and medium-scale hydraulic power			Small- and medium-scale hydraulic power (utilizing installed water-introducing passage)		
Procurement category	10kW or more	Less than 10kW	20kW or more	Less than 20kW	Floating wind turbine	15MW or more	Less than 15MW	1MW or more but less than 3MW	200kW or more but less than 1MW	Less than 200kW	1MW or more but less than 3MW	200kW or more but less than 1MW	Less than 200kW
Tariff (per/kWh)[a]	32 yen[b]	37 yen[c]	22 yen	55 yen	36 yen	26 yen	40 yen	24 yen	29 yen	34 yen	14 yen	21yen	25 yen
Duration (years)	20	10	20			15		20			20		

Energy source	Biomass				
Biomass type	Biogas	Wood fired power plant (Timber from forest thinning)	Wood fired power plant (Other woody materials)	Waste (excluding woody wastes)	Wood fired power plant (Recycled wood)
Tariff (per/kWh)	JPY 39	JPY 32	JPY 24	JPY 13	JPY 17
Duration (years)	20				

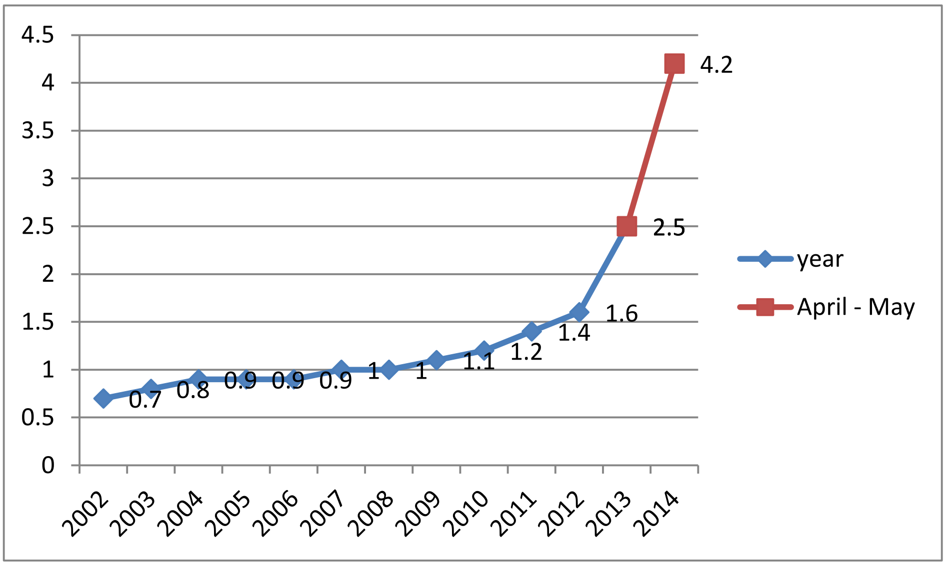
Note:
a. Tax-exclusive price
b. 40 Yen in 2012, 36 Yen in 2013
c. 42 Yen in 2012, 38 Yen in 2013

Source: http://www.enecho.meti.go.jp/category/saving_and_new/saiene/kaitori/kakaku.html

In order to cover additional costs of renewable energy, utilities may request customers to pay the Surcharge for Renewable Energy on top of the electricity price in proportion to electricity usage. However, customers affected by the 2011 earthquake and energy-intensive industries are exempted from the surcharge.

In terms of effects, while there have only been few studies, the Japan Renewable Energy Foundation presented early ex-post study results (JREF 2014a, b). According to these studies, the share of renewable energy, mainly photovoltaic, in power generation has rapidly increased up to 2.5% in 2013 and 4.2% in the period April to May 2014. This is remarkable, because this share increased by only 0.7% between 2002 and 2011. This increase has reduced fossil fuel costs by 325.7 billion yen and CO_2 emissions by 12.3 million tons or around 1% compared to 1990 levels in 2013.

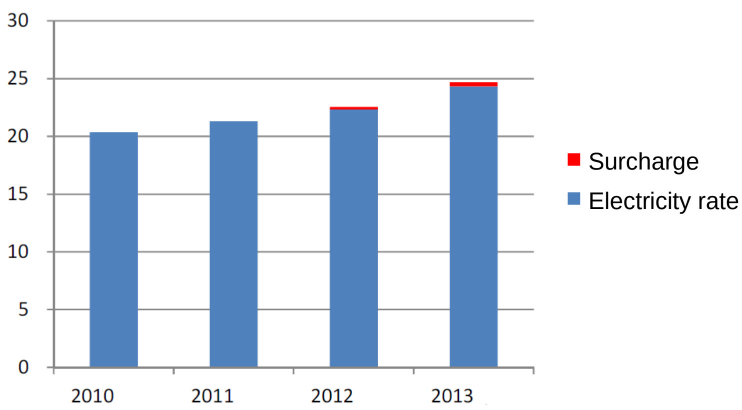
Figure 1: Share of renewable energy in total power generation, excluding hydro (% in fiscal years)



Source: JREF 2014a: 2, JREF 2014b: 4

The share of the surcharge in the total electricity rate is very low (Figure 2). Between 2010 and 2013 the final electricity rate has increased by 4.31 yen per Kilowatt hour for households, but the share of the surcharge is only 8% of the electricity rate (0.35 yen/kWh). Instead, the main factor for an increase in power prices is the increase of fossil fuel market prices.

Figure 2: Electricity rate and surcharge for renewable energy (Y/kWh)



Source: JREF 2014b: 8

In sum, at the policy level, while an ambitious ETS failed due to the opposition of the Iron Triangle, the Japanese government implemented a low-level carbon tax and combined it with a rather ambitious FIT. While it is yet too early to judge the results, ex ante estimations show a very small emissions reduction effect by the carbon tax, which is mainly caused by the use of revenues for climate protection; the FIT, however, is more promising in terms of environmental effects. But it is most certain that the emission reduction contribution even of the two instruments together is insufficient considering the challenges of climate protection. In terms of economic efficiency, carbon pricing continues to play only a minor role, so that market forces can only partially play their role in (re)directing resources to the most efficient use. In terms of social justice, major parts of the climate and energy policy costs are now born by Japanese households, while industry is protected from extra burdens in many ways. However, it should not go without mentioning that, despite of the failure of a domestic ETS, combining a carbon tax with a feed-in tariff may have significantly increased their political feasibility after almost two decades of intense, but politically fruitless discussion on carbon pricing.

4 Conclusions

In search of guidance on the pathway to a sustainable climate and energy policy future with the sufficiently plausible target of a nuclear-free de-carbonization by the end of the century, we have found the theoretical arguments on the necessity of a policy mix convincing. The main reasons are the existence of multiple externalities, carbon and nuclear lock-ins, and the insufficiency of the political process to provide sufficiently ambitious carbon pricing schemes.

However, defining sustainability criteria for a policy mix remains a great challenge. While environmental economics has provided economic and environmental criteria for single climate policy instruments such as accuracy in meeting the target, innovation incentives, and cost efficiency, already defining criteria for a policy mix poses new questions. Still, as an interim result, we argue that market-based approaches are preferable to support and regulation approaches and that, due to its environmental advantages, cap-and-trade is the most promising carbon pricing option. In addition, double regulation has to be avoided as well as setting contradicting incentives. For social justice issues, the challenges appear to be bigger. Already for single climate policy instruments justice criteria are not well defined, let alone for the use of multiple energy and climate policies. Still, as preliminary insights, we think that regressive effects of carbon pricing should be avoided as much as possible. But at carbon price levels sufficient to stimulate a nuclear-free de-carbonization, revenues of taxes or auctions most certainly have to be used for compensating poor communities or households. However, it also has to be kept in mind that a rapid nuclear-free de-carbonization even at currently high costs contribute to inter-generational justice, because it may prevent more serious climate and energy consequences in the future. Considering politics, we have found convincing arguments that the feasibility of a policy mix is higher than that of an equally ambitious sole carbon pricing. Major reasons for this belief are that a policy mix mobilizes new actors groups, spread compliance costs more widely, and provides early low-cost green technology alternatives.

In our case study on Japan, we have shown has neither targets ambitious enough to organize a nuclear-free de-carbonization be the end of this century nor an integrated energy and climate policy strategy do exist. In addition, Japan still does not use efficient, effective, and possibly even socially just market-based approaches as the main pillars of its climate and energy policy. Hope however persists, as the year 2012 saw the introduction of a low-level carbon tax and an ambitious feed-in tariff. But still, emission reductions are expected to be insufficient, efficient market allocation of scarce resources will be limited, and current generation households as well as future generation will continue to carry heavy burdens in terms of possible negative impacts of global warming and continuing nuclear energy use. However, while strong opposition to a nuclear-free de-carbonization persists in Japan, the debate around the 2010-2012 climate and energy proposals showed that the combination of instruments might actually increase the feasibility of a sustainable climate and energy policy mix.

But without doubt fairness and feasibility questions will dominate future discussions on a nuclear-free de-carbonization. Hence, we think that research efforts should reflect this focus more convincingly.

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