Is 1+1 more than 2? The German–Japanese Energy Transition Council (GJETC), a role model for bi-national cooperation

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Abstract
In spite of differences in energy policies and supply, Japan and Germany have to master similar challenges: To reorganize the energy supply system towards – in the long term – being reliable, affordable, low in risks and resource use, and climate-neutral. At the same time, the ecological modernization should maintain or even strengthen international competitiveness. To better address these challenges, a bi-national expert council has been established between the two high-tech countries in 2016 – the GJETC.

The aim of the GJETC is to show that despite different starting points, a national energy transition can be more successful, if both countries learn from their strengths and also weaknesses, to avoid the latter. If the implementation of an energy transition in the two countries is socially and economically sound and advances technology innovation and deployment, it may not only double success, but can also serve as blue prints for other countries, especially due to learning from similarities and differences. For example: Why is per capita energy consumption higher in transport in Germany, but energy intensity higher in Japan's building sector? How can variable renewable energies be integrated in an efficient energy system at lowest costs?

The Council meets twice a year, holds stakeholder dialogues and outreach events, and prepares policy papers on strategic topics of mutual interest. Four comprehensive studies, each in cooperation of a German and a Japanese research institute, have been the basis for 15 joint key recommendations during the 1st phase. The 2nd phase to 2020 will study the role of hydrogen and digitalisation for the energy transition, as well as other topics.

The paper presents the findings and recommendations of the GJETC of the first phase 2016–18 as well as first results of the second phase. It also reviews the setup of the GJETC and the way it works, to assess if and how it can serve as a role model of bilateral cooperation on the energy transition.

Introduction

BACKGROUND
In spite of differences in energy policies and supply, Japan and Germany have to master similar challenges: To reorganize the energy supply system towards – in the long term – being reliable, affordable, low in risks and resource use, and climate-neutral. At the same time, the ecological modernization should maintain or even strengthen international competitiveness. To better address these challenges, a bi-national expert council has been established between the two high-tech countries in 2016 – the GJETC.

The German-Japanese Energy Transition Council (GJETC) is a non-governmental initiative by individuals from research institutions, energy policy think tanks, and practitioners in Germany and Japan, which has been established for two years initially (2016 to 2018) and is now in its second phase (2018 to 2020).

OBJECTIVES OF THE GJETC
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Figure 1. The GJETC and its secretariat at the 1st Council meeting in Tokyo, 28–30 September, 2016.

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AIM AND CONTENT OF THIS PAPER

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How the GJETC works

The GJETC has six to eight Members from academia or civil society and one Co-Chair from each country. It works independently of interference from politics and businesses. The main activities of the Council and the supporting secretariats are to identify and analyze current and future issues regarding policy frameworks, markets, infrastructure, and technological developments in the energy transition and hold council meetings to exchange ideas and propose better policies and strategies.

The Council meets twice a year, holds stakeholder dialogues and outreach events, and prepares policy papers on strategic topics of mutual interest. The Wuppertal Institut, ECOS Consult, and the Institute of Energy Economics, Japan (IEEJ) provide the scientific and organisational secretariat. Four comprehensive studies with a total of 800 pages, each in cooperation of a German and a Japanese research institute, together with three stakeholder dialogues and eight input papers by GJETC members, have been the basis for 15 joint key recommendations during the 1st phase. The 2nd phase to 2020 will study the role of hydrogen and digitalisation for the energy transition, as well as other topics (see below in the section on the 2nd phase).

All information and reports by the GJETC are published on the website www.gjetc.org.

Key findings of the study program

The following four strategic topics (ST) and their objectives have been identified by the Council as key topics for a comprehensive German-Japanese study program. Their objectives and key findings are briefly summarized below. The full studies are available on the GJETC's website.

ST1: ENERGY TRANSITION AS A CENTRAL BUILDING BLOCK OF A FUTURE INDUSTRIAL POLICY – COMPARISON AND ANALYSIS OF LONG-TERM ENERGY TRANSITION SCENARIOS

The objective given to the study (Wuppertal Institut, IEEJ, and DIW-Econ 2017) by the GJETC was to identify (1) the official national energy transition targets, (2) the range of existing research-based, long-term scenarios, including scenarios that could be different from official national targets, and (3) the reasons behind the differentiation of scenarios.

Key findings:

1. Long-term energy policies in both countries are based on selected scenarios from a range of projected energy futures. A difference is that by 2017, in Japan only scenarios until 2030 were officially published based on the deliberation at the Advisory Committee of METI, while Germany has several scenarios until 2050 available, from both governmental and non-governmental entities.

2. In Japan, there is an ongoing debate on the long-term (2050) CO_2 reduction goal and ways and means for achieving it. Germany has decided on a CO_2 reduction target range of 80–95 % for 2050.

3. One key difference is the expectations regarding future system costs and potentials of wind and photovoltaic (PV) energy: Germany expects high shares in energy supply due to low costs and high potentials, while up to now Japan has expected higher costs and lower shares (in 2017, 16 % from renewables in electricity consumption vs. 36 % in Germany). In Japan, there is an ongoing debate as to the future role of renewable energies, based on different assumptions on the future development of costs, including those of system integration. Germany's target for renewable energies in

power generation for 2030 was recently increased to 65 %, while Japan now expects them to be a major power source but currently keeps the 2030 target at 22–24 %.

4. In addition, Japan's island nature restricts grid connection to neighboring countries as an available flexibility mechanism in the electricity system. The country therefore sees different challenges potentially arising from very high shares of variable wind and PV generation.
5. Up to now, Japan has decided on an electricity generation mix with a 20 %–22 % share of nuclear energy by 2030; Germany has decided to phase out all nuclear by 2022.

ST2: STRATEGIC FRAMEWORK AND SOCIO-CULTURAL ASPECTS OF THE ENERGY TRANSITION

The objective of the study (IZES, Arepo Consult, IGES, Nagoya University, and NIES 2017) as decided by the GJETC was (1) to identify the targets, strategies, and strategic framework conditions in Germany and Japan for a successful energy transition. (2) It also analyzed the respective socio-cultural preconditions in both countries and the approaches to changes of lifestyle and actors' behavior in the fields of consumption, habitation, mobility, products, production, and services. (3) The perception of the energy transition by the general public and geographical differences between Germany and Japan were examined.

Key findings:

1. In both countries, energy policy is based on the principles of economic efficiency, energy security, and environmental sustainability ("Three E").
2. The citizens of both countries view the energy transition favorably.
3. An intensified bilateral policy research dialogue between the two countries has been identified as crucial, complemented by a national multi-stakeholder dialogue with businesses, civil society, and the research community.

ST3: NEW ALLOCATION OF THE ROLES AND BUSINESS SEGMENTS OF ESTABLISHED AND NEW PARTICIPANTS IN THE ENERGY SECTOR BOTH CURRENTLY AND IN A FUTURE ELECTRICITY MARKET DESIGN

The objective the GJETC gave to this study (IZES and JEPIC 2017) was to analyze (1) the national framework conditions in both countries, especially for the electricity market design influencing the role of established and new participants in the energy sector, (2) the technical and economic challenges for new electricity market arrangements and designs, and (3) the conditions regarding a decentralized energy market for Japan and Germany, so there is a fair playing field for new actors to develop robust business models.

Key findings:

1. While Germany has gained more in-depth experience of the restructuring of electricity markets over a longer period of time, triggered by the liberalization of the EU's electricity system, both countries face similar challenges for the electricity market design of the near future.
2. These challenges concern a robust economic basis for the electricity system, which addresses (1) the coordination of a more decentralized system with significant shares of variable wind and PV generation and significant needs for flexibility options, (2) the payback of investments in a system characterized by very low short-term marginal costs, (3) the need for integration of the power, heat, and transport sectors to make use of electricity from renewable energies, and (4) the need for an appropriate regulatory framework to trigger the necessary grid adjustments. Views on the future role of conventional power generation, particularly coal and nuclear, diverge. On nuclear, see above; while Japan is building new coal-fired power plants, Germany is bound to also phase out coal power plants, probably by 2038.
3. New business and consumer concepts, such as prosumers, municipal utilities, and energy cooperatives, provide opportunities.

ST4: ENERGY END-USE EFFICIENCY POTENTIALS AND POLICIES AND THE DEVELOPMENT OF ENERGY SERVICE MARKETS

The objective of this study (Ecofys and IAE 2017) was to identify (1) cost-effective energy end-use efficiency potentials in buildings, appliances, industry, and transport, and the main barriers preventing them from becoming reality and (2) the potential for demand response in the different sectors, and the effects of ICT, Internet of Things, and Big Data on the potentials for energy efficiency and demand response. (3) The respective policy packages were analyzed to support energy end-use efficiency and demand response in the buildings, heating/cooling, industry, transport, and electricity usage sectors in Japan and Germany and good practice experiences. (4) The current state of providers of Energy Performance Contracting and Energy Supply Contracting and the market were analyzed, as well as how to push the development of energy service markets and remove barriers. (5) Finally, the study examined energy efficiency-induced rebound effects, the Setsuden initiative (realized in Japan after the Fukushima Daiichi NPP accident), the role of energy *sufficiency*[1], and expected energy savings from behavioral approaches.

Key findings:

1. Both countries are already world-leaders in energy productivity, also due to their existing policies.
2. Both countries have ambitious energy efficiency targets for the future, based on the large potentials that still exist. Both have to strengthen their packages of energy efficiency policies to overcome barriers, including those hindering demand response.
3. While Germany could learn from Japan on energy efficiency in the transport sector (particularly public transport; per capita transport energy use is 32 GJ/yr in Germany but only 24 GJ/yr in Japan), Japan could learn from Germany on energy-efficient buildings (e.g. from concepts such as Passive

1. Satisfaction with fewer or other energy-using services/products that already adequately meet basic human needs, with the aim of reducing the absolute amount of energy demand.

House and nZEB; despite less heating need, higher share of electricity, and not heating the whole house all the time in Japan, per capita final energy use in the building sector overall is 34 GJ/yr in Japan, which is not so much lower than the 45 GJ/yr in Germany; Ecofys/IAE 2017).

Key recommendations 2018

In its Report 2018 entitled 'Intensifying German-Japanese Cooperation in Energy Research, and Policy Recommendations' (Wuppertal Institut and IEEJ 2018), the GJETC wishes to highlight 15 key recommendations on strategic issues for both countries. These recommendations may be seen as a top-level key guidance towards a successful energy transition and may also be relevant – a model – for other countries.

For reasons of space, we can only present the headlines and key texts of the 15 key recommendations here. The Report 2018 includes further text for each of them, as well as further specific recommendations for policy implementation (including also other sectors such as industry and transport) and research needs based on the study program.

(1) JOINT EFFORTS TO DECARBONIZE THE ENERGY SYSTEMS

Both Germany and Japan are Parties to the UN Paris Agreement on Climate Change, which aims to limit global temperature rise in this century to well below 2 degrees Celsius above pre-industrial levels. This implies that industrial nations need to take the lead by substantially reducing GHG emissions by 2050 and continuously pursuing carbon neutrality. Starting to achieve reduction goals early on, namely in the coming years, will be of particular importance. Hence, in the coming decades and beyond, both Japan and Germany will have to substantially transform their energy systems.

Based on their long-standing friendship and basis as technologically-oriented industrial nations, Germany and Japan should work together on the 'man-to-the-moon-challenge'[2] of a carbon-neutral energy system. However, the specifications for mid-century-reduction targets have differed between the two countries to date. More in-depth exchange on these differences is needed.

(2) THOROUGH ANALYSIS AND PERIODICAL REVIEW

Both Germany and Japan should conduct a thorough analysis of domestic resource availability (potentials), technological capabilities, economics including cost-benefit-comparisons, and implications for energy security in defining their long-term targets/goals[3] and energy transformation strategies, taking into account climate science and international energy markets.

Given that there are many uncertainties with regard to the above factors, policy makers should exercise resilience and flexibility through the periodical review of long-term pathways reflecting the best available information and encouraging innovation. Although the choice of energy mix and implementation strategies may differ by country, experiences in each country can be mutually complementary.

(3) RENEWABLE ENERGIES AND SYSTEM INTEGRATION

A robust market and regulatory framework should be established, which allows for the large-scale expansion of renewable energies for electricity generation (RES-E) in the context of a nation's appropriate energy mix, and reflects the specifics of variable and low-marginal cost renewables. These specifics will create significant barriers for the different types of RES-E, even if they are highly competitive in terms of levelized costs of energy (LCOE). The remuneration mechanisms should be designed in a way that supports (1) cost reduction in the generation and supply of variable RES-E, total system and integration costs, and (2) the roll-out of the non-technical infrastructure (planning, designing, permitting, financing) for the different types of RES-E, especially in the early phases of deployment. Institutional, legal, and administrative aspects should be taken into account.

To ensure security of supply, a balanced buildup of flexibility options is needed, such as transmission network expansion to balance PV and wind feed-in, demand-side management and smart distribution grids, energy-efficient power to heat (e.g. using heat pumps), cogeneration of electricity, heating and cooling, energy storage, and, in the long run, potential technologies for the carbon-neutral production of hydrogen or synthetic fuels.

(4) ENERGY EFFICIENCY GOVERNANCE

The governance of energy policy, especially with regard to reaping cost-effective energy savings, and the energy efficiency policies themselves should be further developed in both countries in order to close the implementation gap in both countries and achieve ambitious absolute energy savings targets (the 'Efficiency First' principle).

(5) RESTRUCTURING THE ELECTRICITY AND GAS SECTOR

The restructuring process for the electricity (and gas) sector should be continued to achieve structural changes that provide major benefits for the energy transition as early as possible: enabling free customer choices, opening up the market for more and more diverse participants, making networks neutral parts of the system, creating a robust economic framework for coordination and investments in a much more diverse system, triggering more technical innovations, achieving more transparency for all market and system participants.

(6) INTEGRATION ENERGY AND RESOURCE EFFICIENCY POLICIES

The integration of energy and resource efficiency policies should be vigorously pursued in both countries.

(7) EFFICIENCY AND SUFFICIENCY

An ambitious efficiency strategy should be combined with an energy sufficiency policy to make energy consumption reduction targets easier to achieve.

(8) ENERGETIC RENOVATION OF BUILDINGS

The necessary state funding to incentivize investments, as well as for consultancy, education, and training should be ensured for "deep renovation" of the building stock as well as to increase

2. The GJETC sees achieving a carbon-neutral energy system as a similar societal challenge as it was to carry the first men to the moon.

3. While Germany has adopted firm targets for both 2030 and 2050, Japan differentiates between firm targets for 2030 and, to date, more aspirational goals for 2050. Therefore, we use both words, i.e. targets/goals, throughout the text when referring to targets and goals.

the annual renovation rate. In addition, renovation roadmaps and timetables for "low to plus energy houses" are necessary, for non-residential buildings too.

(9) CENTRALIZED AND DECENTRALIZED ENERGY SYSTEMS

National energy policy should promote the co-existence of centralized and decentralized energy systems, taking into consideration the characteristics of each. In the decentralized energy system, innovative energy transition efforts in regions/municipalities, citizens' finance models (e.g. energy cooperatives), and civic participation should be encouraged. The experiences of numerous municipal utilities ("Stadtwerke") and the growing decentralized sector in Germany provide examples of these.

(10) ROBUST AND ACCOUNTABLE TARGETS/GOALS, STRATEGIES, AND THE CORRESPONDING POLICY MIX

Each country should increase efforts to create a set of targets/goals, strategies, and implementation mechanisms in order to enable a robust policy mix that is effective, efficient, predictable, and accountable for the general public as well as businesses and investors.

(11) CONTINUOUS EVALUATION AND INVOLVEMENT OF ALL STAKEHOLDERS

The successful implementation of the energy transition and climate protection policy requires continuous evaluation of conformity with the targets/goals, the widest possible involvement of all stakeholders, as well as transparent accountability and proactive communication with citizens. Both countries need to harness these driving forces for the energy transition more effectively.

(12) DISSEMINATING LOW-CARBON TECHNOLOGIES TO OTHER COUNTRIES

Both Germany and Japan should seek to maximize their technological contribution to GHG emissions reduction by supporting and disseminating efficient, sustainable[4], and low-carbon technologies to other countries, offering these technologies to global supply chains and developing innovative technologies enabling long-term GHG emissions reduction.

(13) JOINT SCENARIO MODELING.

A continuous working group on joint German-Japanese scenario modeling should be established.

(14) BILATERAL AGREEMENT ON AN EDUCATIONAL EXCHANGE PROGRAM

A bilateral agreement, budget, and marketing concept for a German-Japanese support program for the exchange of students, joint master's and doctoral theses, and in general for vocational training and school education are strongly advised. This could be modeled on the European Union's Erasmus Programme. With regard to an ambitious Japanese-German exchange program, attractive financial support for acquiring language skills and for accommodation abroad would be essential.

4. German experts do not include nuclear energy into the definition of "sustainable technologies".

(15) CONTINUOUS DIALOGUE

The Council recommends intensified and continuous dialogue, including that of the GJETC, on technologies, social innovations, and policies to speed up sustainable energy transformation in both countries.

The 2nd phase 2018 to 2020: objectives and first results

The 2nd phase to 2020 will study the role of hydrogen and digitalisation for the energy transition, as well as other topics including the monitoring of energy transition processes, long-term scenarios, and energy efficiency in buildings.

On hydrogen, in the first year until spring 2019, the following topics were studied in comparison between Germany and Japan: (1) the Status Quo of hydrogen in Germany and Japan, the most relevant applications in each sector where hydrogen can be used and these uses in comparison to direct electricity use and synthetic fuels; (2) the role of hydrogen in long-term energy scenarios; and (3) sustainable domestic and foreign supply chains for hydrogen, potential supply partners, as well as standards and regulation for sustainable supply.

Key findings include:

- Both countries expect an important role for hydrogen in a carbon-neutral energy system of the future. Both are active in developing technologies and solutions for both the use and the supply of hydrogen. Currently, Japan is somewhat more advanced with market introduction of fuel cells for residential CHP systems (currently 230,000) and cars (currently 25,000). It also has a hydrogen strategy with 2030 installation targets.
- However, there are notable differences between the countries: Germany expects the use of hydrogen primarily in transport and industrial processes. It also expects to use only 'green' hydrogen, produced from electricity from renewable energies via electrolysis, either in Germany/Europe in times when power supply exceeds demand or in countries with abindant and cheap solar and wind power. Japan, in addition to transport and residential buildings, expects to use large quantities of hydrogen in power generation, replacing LNG and coal. It also expects to import 'blue' hydrogen, produced from coal or natural gas via steam reforming and CCS.
- Both types of hydrogen supply bear significant challenges: For 'green' hydrogen during the transition to 100 % renewables-based power generation, how to guarantee that only 'green' power is used to produce the hydrogen? And for 'blue' hydrogen, is the capacity of secure storage sites for CCS large enough, or do these sites need to be reserved for CO_2 from industrial processes and biomass energy with CCS?

The study on digitalization focused on virtual power plants (VPP) and uses of blockchain technologies for the first year. VPPs are already in commercial use in Germany and other EU countries. There are two big aggregator companies, one of which already has almost 7,000 units with around 6,000 MW connected, including renewables, gas CHP, demand response, and batteries. In Japan and the USA, in contrast, there are only pilot projects. As the main reasons for this difference, we iden-

tified: (1) the high share of renewables together with the legal requirement for medium and large plant to sell the electricity in the power market created the business for the aggregators. (2) The EU's balancing group model for the electricity market provides incentives for flexible power generators to generate when electricity prices are high, and VPPs can further maximise revenues. (3) The legal requirement for TSOs to organise a market for reserve control power provides additional revenue potential for VPPs. Both Japan and Germany are also testing the use of blockchain technologies, but no commercial operation is in place yet.

Why the GJETC could be a role model

When comparing the format and working method of the GJETC with the variety of successful dialogues, conferences and workshops between Germany and Japan, the GJETC has the following *unique characteristics* which could make it a role model for binational cooperation.

- The approach in terms of format, knowledge generation and energy policy discussion, comparable with a scientific Advisory Panel (e.g. in Germany: Enquete Commissions), but without a political mandate and therefore more **scientifically independent**.
- The enabling of dialogical and (self-) critical dealing with **controversial topics** that go beyond the scope of the usual diplomatic search for consensus.
- The **continuity and research depth** of the work (study program, input papers, the analysis of special key topics of common interest), which clearly go beyond ad-hoc events of both policy dialogues and economic contacts.
- The indirect support to policy-makers, NGOs, and civil society with reference material and science-based arguments through the publication and **the wide communication** of all research results.
- The development and deepening of personal networks with the **energy research landscape** in both countries (e.g. the consortia of German and Japanese research institutes within the study program).
- Including relevant stakeholders by their answers to the GJETC questionnaire and the discussions at the **stakeholder dialogues**.

Therefore, the GJETC is – in terms of format, working method and objective – an **innovation unknown in this form before**. Its science-based, continuous policy advice concept can effectively support the diversity of governmental, societal and business activities. It can advance the implementation of the energy transition in both countries through mutual learning on technologies, business concepts, and governance, but also through joint development of techno-socio-economic innovation. Both its format, and its results and impacts could therefore be a role model for cooperation on energy and low-carbon transitions in many countries, and possibly also for other fields of sustainable development.

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