

# **Can Japanese Nuclear Power Be Restarted Sooner? A Simulation of Alternative Scenarios**

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The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology and the environment across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

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# Key Points

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This study assesses whether there are politically plausible paths to more quickly gain support for restarting Japanese nuclear power plants and considers alternative scenarios. It builds on the 2018 KAPSARC discussion paper, “The Policymaking Process to Restart Japanese Nuclear Power,” which detailed a baseline scenario for the political feasibility of restarting Japanese nuclear power plants.

The key findings of the first study were:

There is growing political will among Japanese stakeholders to restart nuclear reactors for power generation. Over the next several years, the current political trajectory indicates a growing political acceptance of nuclear power among municipal and prefecture-level political leaders.

The process of regaining national support for nuclear power in Japan is expected to take several years of domestic political debate.

Building on this prior work, the key findings from the current study are:

Altering the behavior of key actors significantly impacts how long the bargaining process takes, but it does not significantly change the ultimate consensus among actors in the baseline scenario.

The time taken to achieve a consensus can be shortened, and two possible solutions are demonstrated in this study. First, a Ministry of Economy, Trade and Industry (METI)-led strategy, in which METI actors make nuclear power a top priority. Second, those typically advocating for nuclear energy (pro-nuclear independent and nonprofit organizations) behave as though this issue has a much lower priority, which makes more room for central and local government stakeholders to adopt a larger role in the bargaining process.

The importance of the Nuclear Regulatory Authority (NRA) and its chairman Toyoshi Fuketa remain consistent with the previous study, in that these two actors are vital to moderating the views of those who are against nuclear power, and achieving a consensus that accepts the reopening of more nuclear power plants.

# Summary

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This paper is the second in a series of three describing different aspects of KAPSARC's findings in a project to model the collective decision-making process (CDMP) around restarting Japan's nuclear reactors.

The first KAPSARC study utilized the KAPSARC Toolkit for Behavioral Analysis (KTAB), an open source platform developed by KAPSARC, to assess the political feasibility of restarting the Japanese nuclear power reactors that were closed following the 2011 accident at the Fukushima-Daichii nuclear plant. It demonstrated that a wide-scale restart of Japanese nuclear reactors could be politically feasible. However, the duration of the simulation indicated that the process of achieving agreement on the restarts would be very lengthy.

This paper evaluates whether it is politically feasible to speed up the restart. To assess different bargaining process scenarios, the initial characteristics of actors found in the earlier study to be critical to the negotiations were modified. This was in an attempt to alter the outcome and/or shorten the estimated length of the bargaining process. A particular focus was placed on local government actors because of Japan's unique legal procedures and traditions, which essentially give these actors a veto on restarting a reactor within their jurisdictions.

A third paper will examine the implications of restarting Japanese nuclear power for global liquefied natural gas (LNG) markets.

Attempts at altering the results of the initial simulation are referred to as 'strategies.' Strategies need not simply shorten the duration of negotiations while maintaining a pro-nuclear consensus, but also ensure that prefecture governors and city mayors

are, as a minimum, occupying a neutral position regarding nuclear restarts and do not exercise a veto. Different strategies from the previous study were implemented in the final scenario. The dataset was modified following the reshuffle of Prime Minister Shinzo Abe's cabinet, reflecting the most up-to-date political environment in Japan a couple of months before the snap election won by Abe in October 2017.

Numerous strategies were tested, of which two proved successful:

First, a Ministry of Economy, Trade and Industry (METI)-led strategy increased the salience values for METI-affiliated actors to demonstrate that nuclear energy has now become their top priority. Second, a strategy where the interest of pro-nuclear independent and nonprofit organizations in nuclear energy is reduced to a level at which they might exercise little influence, leaving room for central and local government actors to take a larger role in the negotiations.

One behavior was observed throughout: three anti-nuclear local government actors were consistently late endorsers of a consensus. An agreement might have been achieved sooner had these actors not been slow to modify their opposition, something which is critical to the assessment because of the veto afforded to the local government stakeholders over their jurisdictions. Despite this, the application of these strategies successfully reduced the length of the bargaining process, while also maintaining the initial pro-nuclear consensus achieved. The "strategy development" and "strategy analysis" sections further explain the reasoning behind the implementation of these scenarios and their results.

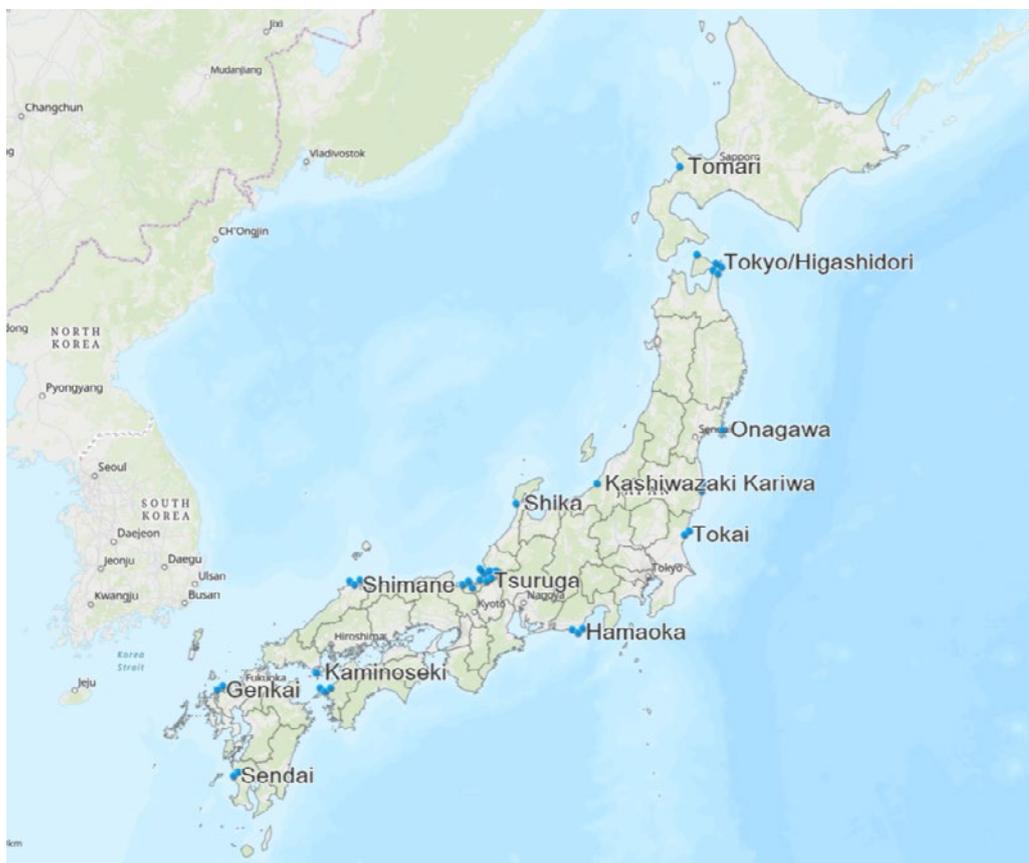
# Introduction

Nuclear power had been expected to play a major role in Japan's energy future in terms of addressing energy security concerns and helping to reduce carbon dioxide (CO<sub>2</sub>) emissions. However, after the Fukushima-Daiichi nuclear incident in 2011, the Japanese government quickly decided to close most of its reactors until a full safety assessment could be performed, temporarily removing nuclear power from its energy mix. In 2014, the Ministry of Economy, Trade and Industry (METI) adopted its fourth Strategic Energy Plan, where nuclear power was once again to be considered a safe base load power source. The following year it was announced that base load sources should be providing 60% of Japan's power by 2030, with one-third from nuclear energy. The fifth Basic Energy Plan, approved in

July 2018, required the same electricity percentages as had first been approved in 2015. It declared nuclear power "an important base load power source contributing to the stability of the long-term energy supply and demand structure" (Ishii 2018). Additionally, the plan provided for nuclear power to contribute 20%-22% of the country's energy mix by 2030 and recommended that Japan should move toward a low carbon economy by 2050.

Thus far, Japan has restarted nine reactors, 17 reactors are currently in the process of approval, and the remainder are pending applications. The first two became operational in August and October 2015, and others followed. Figure 1 displays the status of Japan's power plants.

**Figure 1.** Nuclear power plants in Japan, 2018.



Source: KAPSARC WebGIS Platform, Japan Atomic Industrial Forum (JAIF).

## Introduction

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This paper is the second of three looking into the political will in Japan to restart the country's nuclear reactors. The first, "The Policymaking Process to Restart Japanese Nuclear Power Plants" (Efird et al. 2018) evaluated the political feasibility of restarting Japan's nuclear reactors amid a continuously changing political climate in the aftermath of the Fukushima-Daichii accident. The KTAB data inputs used for that study meant that it was one of the more complex questions to be analyzed, and led to very interesting results. Ultimately, it was determined that restarting nuclear reactors in Japan is politically feasible, though the consolidation of political will necessary to bring this about would take years. This paper addresses the question, can the process of consolidating political support for nuclear power in Japan be achieved more quickly than is currently anticipated?

This study, as in the first paper, uses the KAPSARC Toolkit for Behavioral Analysis (KTAB) to simulate the collective decision-making process (CDMP) in Japan regarding the restart of nuclear power. Specifically, we applied the Spatial Model of Politics (SMP), developed within the KTAB framework. We use KTAB to simulate a series of strategies, each of which modifies the model inputs for critical actors in order to test whether a different configuration of assumptions might result in a faster outcome. In other words, this

study assesses the implications of changed starting parameters on the level of consensus and the duration of the simulation before a positive political will in favor of nuclear power is achieved.

The reader could think of these as strategies that a pro-nuclear advocate could implement to achieve a desired result, given theoretical full control over the behavior of a large set of actors. This paper shows how plausible alternative starting assumptions impact the model's results. It presents insights developed using the KTAB simulations, rather than providing a detailed description of the modeling used. Interested readers should consult two related KAPSARC technical papers for more detail:

"An Introduction to the KAPSARC Toolkit for Behavioral Analysis (KTAB) Using One-Dimensional Spatial Models" (Wise, Lester, and Efird 2015a); and

"Multidimensional Bargaining Using KTAB" (Wise, Lester, and Efird 2015b).

Both papers are available from KAPSARC's website, specifically the KTAB portal, as are the program's source code and documentation, which can be found at <http://www.ktab.software>.

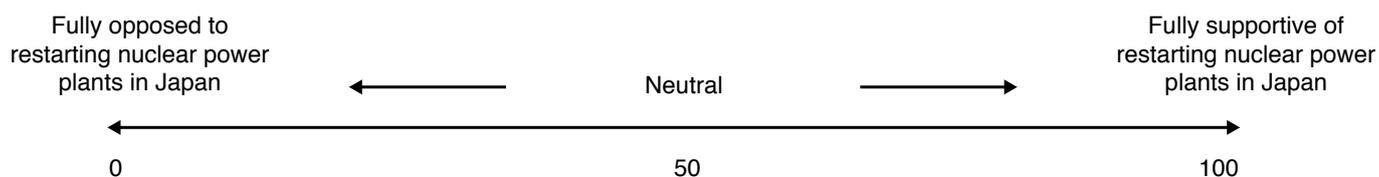
# Strategy Development

Following the completion of the earlier study, we made changes to the data to represent a series of plausible alternatives, which we compared with the initial (baseline) results, and tested each in turn. We treat each of these alternatives as a strategy that can be used to evaluate whether:

- an outcome that broadly favors nuclear power could be achieved more quickly, as defined by turns in the KTAB simulation;
- the degree of support and consequent consensus is more or less vigorously in favor of nuclear power; and
- the position of local government officials - governors and mayors - could be moderated to reduce the likelihood of their vetoing the restart of a nuclear reactor within their jurisdiction.

As described in the previous study, first, the spectrum of possible positions to evaluate the range of advocacy for the actors had to be defined. The same spectrum is used in all three papers in this series. Figure 2 provides a visual representation of the range of positions that actors can take on the question of restarting nuclear power. For example, actors taking a position close to 50 have a neutral view on the matter. Actors taking a position of 100, at the far right of the figure, are fully supportive of restarting nuclear power plants, while actors that take a position of 0 are fully opposed to this. Positions ranging from 50 to 0 reflect increasing opposition, and positions ranging from 50-100 reflect increasing support, with the strength of opposition or support dependent upon the distance between an actor's position and the two extremes on the scale.

**Figure 2.** Spectrum of positions: Range of advocacy opposed to or supportive of restarting nuclear power.



Source: KAPSARC.

# The KTAB Data Inputs

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As discussed in the earlier paper and the KTAB reference papers cited above, data for KTAB modeling are obtained through semi-structured interviews with subject matter experts. For the current paper, we took the expert-generated data that were the basis for the first paper in this series and modified them to reflect the strategies discussed below. The remaining sections will detail the changing assumptions for each scenario - that is, how the data are changed and how the changes represent a particular strategy - as well as the simulation results.

As with any KTAB study, the data include four elements:

Actors: a comprehensive list of individuals and groups, which includes policymakers,

stakeholders and influencers. Three specific quantitative attributes are also assigned to each actor.

Position: the location of an actor on the linear spectrum, as explained above. In other words, the extent of the actor's advocacy in terms of support for, or opposition to, restarting nuclear power in Japan.

Influence: the relative overall degree of political power, or clout, for each actor. The most powerful actor is assigned a value of 100, and other actors are weighted relative to that.

Salience: the relative priority each actor assigns to the modeled question as compared with other issues over which the actor must exert its influence.

# Strategy Analysis

**M**any strategies were tested in the KTAB simulation analysis that formed the basis for this paper. However, in the interest of brevity, we report on two strategies that resulted in an outcome measurably different from the results presented in the first paper. These strategies are:

- A Ministry of Economy, Trade and Industry (METI)-led drive to restart nuclear power.

- A reduced voice for pro-nuclear independent/nonprofit organizations.

The first strategy describes a METI-led initiative where it strongly and publicly pushes for a rapid nuclear restart. This is a change from its current behavior, which is more circumspect and politically cautious. The scenario assumes that METI-affiliated actors (METI, METI Minister Hiroshige Seko, the Agency for National Resources and Energy [ANRE], and the Institute of Energy Economics Japan [IEEJ]) treat the question of restarting nuclear reactors as their first priority, while ensuring that this high priority is clearly signaled publicly. As such, their salience figures were adjusted from their original values to 100. METI's significant influence was demonstrated in the initial study, and its stated mission is to develop the Japanese economy and its industry sectors and "to secure stable and efficient supply of energy and mineral resources (METI Fact Sheet)." These factors make METI the most relevant ministry with regards to achieving a nuclear restart.

The second strategy focuses on pro-nuclear independent and nonprofit organizations, and assumes that the intensity of their advocacy was substantially reduced. We reduced the salience scores of these actors by 50 points, which we interpret as a reduction in their focus on the issue. We chose not to remove the actors as a voice entirely, which would set their salience values to 0,

but merely to reduce the strength of their input to the issue. We reasoned that by reducing the intensity of this extreme view in the Japanese discourse, it might perhaps leave more room for discussions to find a middle ground. The actors thus adjusted included the Japan Nuclear Safety Institute (JANSI), the Nuclear Risk Research Center (NRRC), the Central Research Institute of Electric Power Industry (CRIEPI), the Japan Atomic Industrial Forum (JAIF), and the Atomic Energy Society of Japan (AESJ).

The third and final strategy focused on all of the pro-nuclear local government officials (governors and mayors), and substantially reduced the intensity of their advocacy, publicly signaling that the nuclear issue is no longer a priority for them. Expressed more technically, we reduced the salience values of each of these actors by 50 points. These changes imply that local government officials reduce the volume and intensity of their pro-nuclear rhetoric but remain in favor of nuclear power, in an attempt to leave room for more moderately positioned actors to try to find a middle ground on the issue.

It should be noted, however, that this is an implausible strategy as the assumptions made are unrealistic. This is because the majority of local government elections have proved to be ultimately decided by the candidate's view as to a nuclear restart, with many elected on a pro-nuclear platform. Thus it would not only be difficult for them to tone down their rhetoric, but they would also find significant pressure to ramp it up whenever their positions are up for re-election. For these reasons, this strategy will not be detailed in its own section below.

Summary results for each of these strategies compared with the baseline (the initial study) are provided in Table 1. In a KTAB simulation, a 'turn' is a loose measure of time. In the model, a turn

**Table 1.** Technology innovation ‘moon shots.’

Strategy	Simulation duration
Baseline (initial study)	40 turns
METI-led drive to restart nuclear power	26 turns
Reduced voice for pro-nuclear independent/nonprofit organizations	26 turns

Source: KAPSARC (KTAB analysis).

would require an exchange of information among all actors, such that they are aware of the positions and behavior of all other actors. In a nationwide study, where local prefecture and national-level politics all play a role, a turn may last a month or months.

A KTAB simulation is concluded following the rule covering the expected magnitude of change in the next turn. That is, if there are minimal changes expected in the next turn, then we can assume that the simulation has essentially reached a steady state, and the simulation ends.

In each of the simulations that we ran, the end result was the same, a positive trend among all actors favoring a restart of nuclear power. The difference was in the number of turns the KTAB simulation lasted. Consequently, we can infer that a simulation with a smaller number of turns would produce support for restarting nuclear reactors more quickly than a simulation with a larger number of turns.

Compared with the simulation in the initial study, each of our strategies resulted in a considerable reduction in the number of turns. The baseline simulation lasted 40 turns, and the duration of our strategies ranged between 24 and 26 turns at best, with 24 turns resulting from the infeasible third strategy.

### Strategy 1: METI-led drive to restart nuclear power

In this strategy, the METI-led initiative described in the previous section is implemented and assessed. The KTAB simulation lasted 26 turns, a reduction from the baseline simulation’s 40 turns. The result of the KTAB simulation yielded an essentially similar pro-nuclear consensus when compared with the original simulation

Initial (turn 0) actor positions, the positions actors hold before the simulation, which are set to reflect the views of experts, are unchanged from the original simulation, the baseline dataset shown in Table A1 in the Appendix. However, since the METI-related actors were assumed to be treating this issue as their top priority, their salience values were adjusted, as shown in Table A2 in the Appendix.

Figure 3 compares the final turn (turn 40) of the baseline simulation, the bar chart on the left-hand side of the figure, with the final turn (turn 26) of the Strategy 1 simulation, the bar chart on the right-hand side of the figure. For each bar graph, the vertical axis indicates the exercised power of an actor or coalition — a combination of its influence weighted by

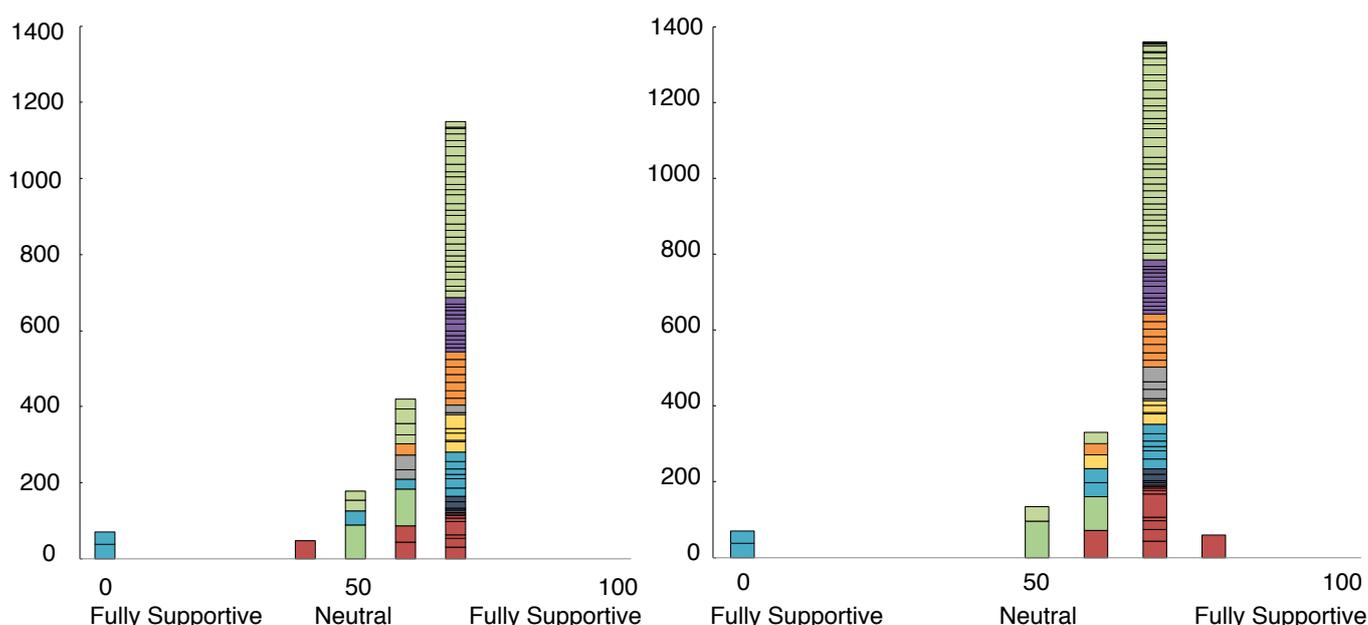
its salience. The horizontal axis for each bar chart depicts an actor’s final position at the conclusion of the bargaining process on the position spectrum defined in Figure 2.

Both simulations resulted in a moderately positive consensus around position 70, as seen in Figure 3. In other words, the majority of actors are positively advocating the idea of a nuclear restart, with a few maintaining a neutral stance on the issue. The NRA and the Tomari Mayor are the two actors occupying the neutral position of 50. As in the original simulation, only the small anti-nuclear non-governmental organizations (NGOs) and the Metropolitan Coalition Against Nukes stuck uncompromisingly to their initial anti-nuclear positions. We can thus infer that restarting nuclear power in Japan is politically feasible in this simulation, and in fewer turns; that is to say, more quickly than the baseline.

Prime Minister Abe was very active early in the simulation, reflecting his attempts to persuade other actors and garner their support. As in the baseline scenario, Abe remains focused on public perception during the beginning of the simulation, particularly media outlets, local government and non-media actors capable of altering public perception. Abe was influential in shifting numerous local government actors to more than a neutral position - i.e., a position greater than 50 - making those actors more inclined to support a nuclear restart.

With this strategy, achieving media support relies heavily upon the credibility of METI and ANRE in particular. As in the baseline scenario, it is critical that the central government continues to promote the high integrity and neutrality of the NRA and Fuketa, as these neutral actors are viewed and considered as ‘balanced and fair’ which, in turn, helps to consolidate views and gain public and local government support.

**Figure 3.** Comparison of turn 26 distribution of positions and exercised power: METI-led initiative strategy.



Source: KAPSARC (KTAB analysis).

## Strategy Analysis

Most importantly, though, the outcome is essentially the same as the baseline scenario in terms of the distribution of actors. The simulation lasted 26 turns for Strategy 1, as opposed to 40 turns for the baseline scenario. Thus, we can conclude that this scenario would be an effective way to achieve more rapid, positive support for restarting nuclear power plants.

### Strategy 2: Reduced voice for pro-nuclear independent/nonprofit organizations

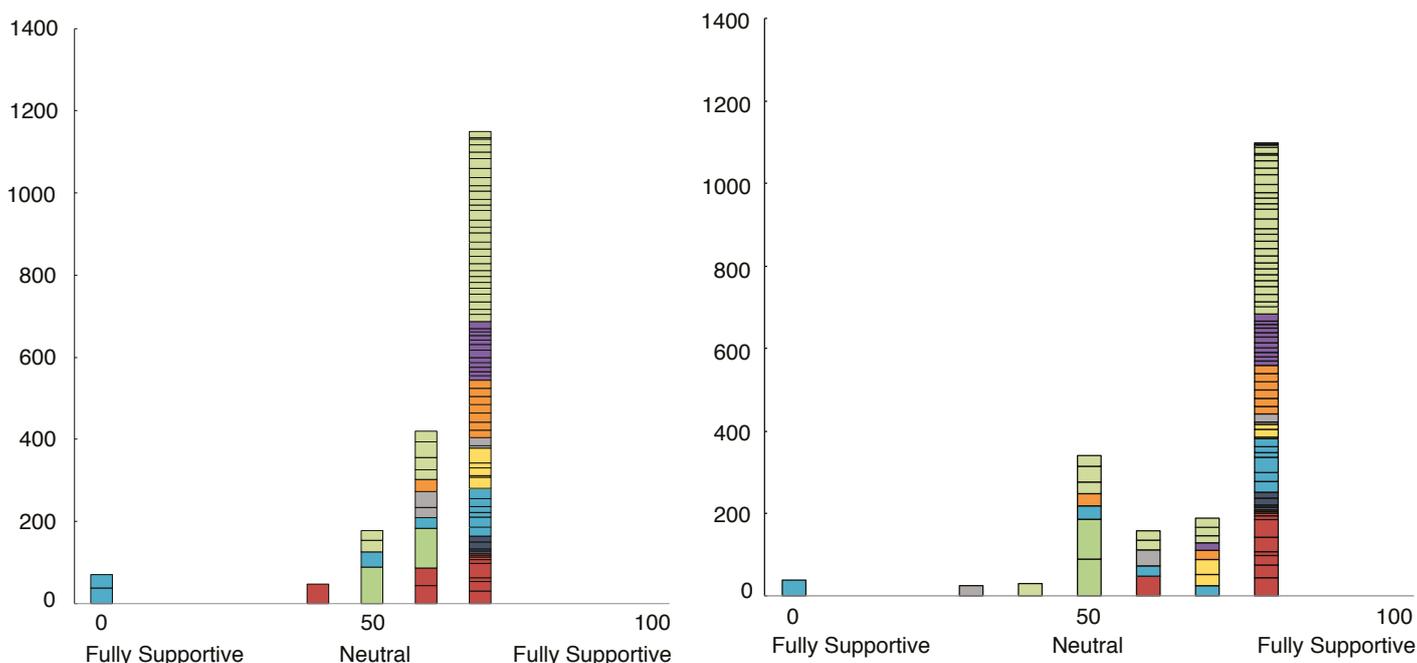
With this strategy, the reduction in the intensity of advocacy by pro-nuclear independent and nonprofit organizations, described previously, is implemented and assessed. The KTAB simulation lasted 26 turns, a reduction from the baseline simulation's 40 turns. The result of the KTAB simulation yielded a stronger pro-nuclear consensus when compared with the original simulation. The majority of actors achieved

a consensus near a position of 80, which is the most supportive position achieved among the strategies explored.

Anchored by Prime Minister Abe, the majority of media actors, utility companies and pro-restart local officials maintain supportive views as they end the simulation at a position of 80, representing the strong and favorable consensus. Like the baseline and the previous simulation, small anti-nuclear NGOs and the Metropolitan Coalition Against Nukes remain at their initial extreme anti-nuclear position. Once more, the simulation for this scenario suggests that the political will to further integrate nuclear energy in the Japanese energy mix will continue to gain traction over time.

In this simulation, Abe was less active in trying to build a consensus, allowing others to achieve a final consensus. This may be interpreted as Abe deciding to take a step back from pushing,

**Figure 4.** Comparison of turn 26 distribution of positions and exercised power: Pro-nuclear NGOs strategy.



Source: KAPSARC (KTAB analysis).

politically, toward a nuclear restart, thus providing an opportunity for neutral and less politically charged actors to consolidate their views. Unlike the baseline simulation, this strategy was not as successful in shifting the positions of all actors at or above the neutral position of 50, with anti-nuclear district court judges, the Metropolitan Coalition Against Nukes, small anti-nuclear NGOs and national newspaper Asahi Shimbun taking a more anti-nuclear position than the majority of actors.

The NRA was once more successful in moderating the views of a number of electric companies and businesses, again because of its perceived neutrality. This may be due to it imposing safety regulations on nuclear power plants owned by utility companies, further solidifying the NRA and central government's credibility regarding safety.

Finally, reducing the intensity of the voice of pro-nuclear organizations allowed more moderate stakeholders to play a more effective role in building a positive consensus more quickly. Overall, this scenario resulted in stronger support from the majority of actors for restarting nuclear reactors, but it did not build as robust a consensus in terms of the number of actors taking a highly favorable position by the end of the simulation. However, the simulation lasted 26 turns for Strategy 2 as opposed to 40 turns for the baseline scenario. Thus, we can conclude that this strategy is also an effective way to achieve more rapid, positive support for restarting nuclear power plants.

## Strongly held views delaying consensus

After simulating the many different strategies that underlie the analysis for this study (in addition to the three presented in this paper), three actors

were consistently shown in our simulations as the most difficult to persuade to support the restart of nuclear reactors - i.e., shift above a neutral position of 50. Those three actors are the Niigata Prefecture Governor, the Shizouka Prefecture Governor and the Omaezaki Municipality Mayor.

The Omaezaki Mayor occupies a very slightly opposed position of 40, and in our study we infer from this that he is highly unlikely to exercise a veto against a nuclear restart because he occupies a nearly neutral position. However, the two officials related to the Hamaoka plant, the Shizouka Governor and Omaezaki Mayor, were represented as much more negative in most of the scenarios we tested, with a high salience. It is unsurprising that they would have very cautious views, as the Hamaoka plant is constructed above a major fault line, where the possibility of a magnitude 8.0 earthquake occurring in the area within the next 30 years is estimated to be 87%.

In the vast majority of the strategies we tested, these actors consistently adhered to their anti-nuclear positions. Whenever consensus seemed to emerge at or above a neutral view of nuclear power, these three actors were unfailingly the last local government actors to join, if they did so at all, prolonging the consensus building process. In short, the numerous simulations tested identified these three actors as consistently opposed to achieving a broad consensus in favor of restarting nuclear reactors. In our simulations, their strongly held views also consistently lengthened the bargaining process.

# Conclusions

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In the original study, it became evident that the state of disarray in which the Democratic Party - the primary opposition to the ruling Liberal Democratic Party - found itself after the resignation of its leader, in fact gave central government actors from the ruling party more room to maneuver politically. However, despite the multiple strategies tested, the shortest bargaining duration was 26 turns, indicating that the various stakeholders involved in the process of a nuclear restart should plan for, and expect, a lengthy consensus building process.

When assessing the METI-led strategy, authorizing METI actors to undertake a stronger position led to a shorter bargaining duration. Reducing the voice of pro-nuclear independent and nonprofit entities provided the main stakeholders - central and local government actors - with the opportunity to directly negotiate between themselves, thus streamlining the bargaining process and significantly reducing the duration of the negotiations.

It also became evident that despite strategies positively impacting the duration of the bargaining process, the three actors with strongly held views continued to be late endorsers of any consensus.

One recommendation could be for the central government to offer concessions to these officials to further encourage a prompter nuclear restart, such as providing federal subsidies or an exogenous incentive outside of the modeled question.

While it is unlikely that it will be politically feasible to restart most nuclear power plants immediately, our simulations demonstrate that there is growing political will in Japan to restart nuclear energy. Transforming the nuclear regulatory body into a more credible and impartial organization represents a significant measure toward achieving consensus in favor of a nuclear restart, and will prove invaluable

in the future, as the impartial and politically resistant regulator has consistently proved effective in easing the concerns of anti-nuclear stakeholders.

Whether further measures will be required is unclear. As the strategies presented in this study confirmed, there are actions that could be taken toward reducing the length of the decision-making process. The simulations demonstrate that a successful strategy is not always the most obvious change in approach: reducing the voice of actors in favor of a restart led to a positive result, contrary to what might be assumed. This demonstrates that there is not always strength in numbers, as shown by the second strategy.

The argument for a nuclear restart is a compelling one, especially in a country with limited energy resources such as Japan. Restarting Japanese nuclear energy generation will likely have far-reaching implications, as Japan is currently the world's largest importer of liquefied natural gas. These will be assessed further in the third study of this series, projecting the effect of a Japanese nuclear restart on regional and global gas markets.

The unique structure through which restarts are determined allows KTAB analysis to anticipate the timing of specific reactor restarts by analyzing the behavior of the prefecture governor and city mayor under whose jurisdiction a reactor falls. The expected timing for the restart of individual nuclear power reactors can then be translated into electricity production figures, as demonstrated in Table 2.

The Japanese power mix will continue to shift away from liquefied natural gas as more nuclear reactors - and new coal plants - come online, possibly impacting global LNG markets. By calculating expected future nuclear generated electricity production figures, the displacement of

LNG may then be estimated. A future paper will evaluate the impact that the accelerated restarts anticipated in this study could have on future quantities of LNG required for power generation in

Japan and on global LNG markets, while comparing traditional forecasting models against a forecast that incorporates political feasibility.

**Table 2.** Expected numbers of reactors restarted and associated electricity production.

	Operational (as of October 2017)	Short-term	Medium-term	Long-term	Total expected
Gross gigawatt electrical (GWe)	3.7	7	4.9	2.9	18.5
Reactors	5	11	7	3	26

Source: KAPSARC (KTAB analysis).

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# Appendix: Data tables

**Table A1.** Post-cabinet reshuffle scenario actor data (Baseline).

Actor	Legend	Group	Position	Influence	Saliency	Exercised power
Shinzo Abe (Prime Minister)	Abe	Central govt.	90	98	45	44
Yoshihide Suga (Chief Cabinet Secretary)	Suga	Central govt.	72	84	37	31
Takaya Imai (Executive Secretary to the Prime Minister)	Imai	Central govt.	77	58	40	23
Taro Aso (Deputy Prime Minister, Minister of Finance)	Aso	Central govt.	80	35	26	9
Hiroshige Seko (Minister of Economy, Trade and Industry)	Seko	Central govt.	90	60	58	35
Ministry of Economy, Trade and Industry (METI)	METI	Central govt.	82	72	66	48
Agency for National Resources and Energy (ANRE) (part of METI)	ANRE	Central govt.	88	61	70	43
Taro Kono (Minister of Foreign Affairs)	Kono	Central govt.	0	18	50	9
Masaharu Nakagawa (Minister of Environment)	Nakagawa	Central govt.	60	18	35	6
Masayoshi Yoshino (Minister of State for Reconstruction)	Yoshino	Central govt.	25	18	22	4
Katsunobu Kato (Minister of Health, Labour and Welfare)	Kato	Central govt.	60	18	22	4
Toyoshi Fuketa - NRA Chairman	Fuketa	Regulator	56	93	96	89
Nuclear Regulation Authority (NRA) - organization	NRA	Regulator	51	100	97	97
Renho Murata (Democratic Party)	Murata	Politicians	6	23	30	7
Japanese Communist Party	Comm	Politicians	0	11	47	5
Liberal Democratic Party (LDP) - organization	LDP	Politicians	73	41	41	17
Komeito (political party forming a coalition with the LDP)	Komeito	Politicians	56	35	41	14
Japan Nuclear Safety Institute (JANSI)	JANSI	NGOs	100	28	93	26
Central Research Institute of Electric Power Industry (CIEPRI)/Nuclear Risk Research Center (NRRC)	NRRC	NGOs	100	23	94	22
Institute of Energy Economics Japan (IEEJ)	IEEJ	NGOs	91	37	67	25
Japan Atomic Industrial Forum (JAIF)	JAIF	NGOs	98	38	97	37
Science Council of Japan	SciCoun	NGOs	26	24	48	11
Japan Federation of Bar Associations	Jbar	NGOs	13	25	57	14
Atomic Energy Society of Japan	AESJ	NGOs	100	20	98	19
Greenpeace Japan	Green	NGOs	0	37	68	25
Small anti-nuclear NGOs	NGOs	NGOs	0	40	95	38
Metropolitan Coalition Against Nukes	Metro	NGOs	0	37	88	32
Hitachi	Hitachi	Business	95	48	56	27
Mitsui	Mitsui	Business	55	14	27	4

## Appendix: Data tables

Actor	Legend	Group	Position	Influence	Saliency	Exercised power
Mitsubishi	Mitsub	Business	94	33	57	19
Toshiba	Toshiba	Business	83	21	58	12
Japan Business Federation (Keidanren)	Keidanren	Business	92	55	66	36
Judges in District Courts - neutral	JudgeNeu	Judiciary	50	15	38	6
Judges in District Courts - anti-nuclear	JudgeAnti	Judiciary	32	32	77	25
High Courts	JudgeHigh	Judiciary	50	47	42	20
Supreme Court	JudgeSup	Judiciary	50	78	50	39
Asahi Shimbun	Aasahi	Media	7	42	70	30
Nikkei	Nikkei	Media	56	33	55	18
Yomiuri Shimbun	Yomiuri	Media	83	33	58	19
NHK TV	NHK	Media	41	42	53	22
TV Asahi	AsahiTV	Media	7	32	65	20
TBS Television	TBS	Media	20	40	50	20
Fuji Television	FujiTV	Media	78	40	50	20
Nippon TV	NipponTV	Media	73	40	50	20
Chubu Electric Power Company (Chuden) - Hamoaka NPP	ChubEPC	Electric Power cos.	89	14	74	11
Chugoku Electric Power Company - Shimane NPP	ChugEPC	Electric Power cos.	91	14	72	10
Hokkaido Electric Power Company (Hokuden) - Tomari NPP	HokkEPC	Electric Power cos.	100	14	79	11
Hokuriku Electric Power Company - Shika NPP Tokai NPP	HokuEPC	Electric Power cos.	100	14	81	11
Japan Atomic Power Company (JAPC) - Tokai NPP Tsuruga NPP	JAPC	Electric Power cos.	100	13	96	12
Kansai Electric Power Company (KEPCO) - Mihama NPP Ohi NPP Takahama NPP	KEPCO	Electric Power cos.	100	19	94	18
Kyushu Electric Power Company - Sendai NPP Genkai NPP	KyuEPC	Electric Power cos.	100	15	92	14
Shikoku Electric Power (Yonden) - Ikata NPP	ShikEPC	Electric Power cos.	100	13	81	11
Tohoku Electric Power - Onagawa NPP Higashidori NPP	TohEPC	Electric Power cos.	97	14	81	11
Tokyo Electric Power Company (Tepco) - Kashiwazaki-Kariwa NPP Fukushima Daiichi NPP	TEPCO	Electric Power cos.	90	12	74	9
J-Power (Electric Power Development Company) - Ohma NPP	Jpower	Electric Power cos.	93	10	81	8
Federation of Electric Power Companies (FEPC)	FEPC	Electric Power cos.	100	20	84	17
Satoshi Mitazono (Kagoshima Prefecture Governor) (Sendai NPP - Operational)	KagGov	Local govt.	58	29	60	18

Actor	Legend	Group	Position	Influence	Saliency	Exercised power
Satsumasendai Municipality mayor (Sendai NPP)	SatMay	Local govt.	100	24	100	24
Tokihiro Nakamura (Ehime Prefecture Governor) (Ikata NPP - Operational)	EhiGov	Local govt.	89	22	55	12
Ikata Town mayor (Ikata NPP)	IkaMay	Local govt.	100	22	80	18
Issei Nishikawa (Fukui Prefecture Governor) (Mihama NPP Ohi NPP Takahama NPP Tsuruga NPP)	FukiGov	Local govt.	94	25	76	19
Mihama Town mayor (Mihama NPP)	MihMay	Local govt.	100	18	80	14
Ohi Town mayor - Ohi NPP	OhiMay	Local govt.	100	18	80	14
Takahama Town mayor - Takahama NPP	TakMay	Local govt.	100	18	80	14
Tsuruga Town mayor - Tsuruga NPP	TsuMay	Local govt.	100	18	80	14
Shingo Mimura (Aomori Prefecture Governor) (Ohma NPP Higashidori NPP)	AomGov	Local govt.	86	24	70	17
Oma Town mayor - Ohma NPP	OmaMay	Local govt.	100	22	80	18
Higashidori Village mayor - Higashidori NPP	HigMay	Local govt.	100	22	80	18
Masaru Hashimoto (Ibaraki Prefecture Governor) (Tokai NPP)	IbaGov	Local govt.	32	27	62	17
Tokai Village mayor - Tokai NPP	TokMay	Local govt.	100	28	80	23
Masanori Tanimoto (Ishikawa Prefecture Governor) (Shika NPP)	IshGov	Local govt.	66	24	58	14
Shika Town mayor - Shika NPP	ShikMay	Local govt.	100	21	80	17
Ryuichi Yoneyama (Niigata Prefecture Governor) (Kashiwazaki-Kariwa NPP)	NiigGov	Local govt.	12	38	75	28
Kashiwazaki Town mayor - Kashiwazaki-Kariwa NPP	KashMay	Local govt.	87	32	75	24
Kariwa Town mayor - Kashiwazaki-Kariwa NPP	KariMay	Local govt.	100	32	75	24
Niigata Prefecture - population	NiigPop	Local govt.	0	24	55	13
Yoshinori Yamaguchi (Saga Prefecture Governor) (Genkai NPP)	SagGov	Local govt.	85	21	65	14
Genkai Town mayor - Genkai NPP	GenMay	Local govt.	100	20	100	20
Zenbee Mizoguchi (Shimane Prefecture Governor) (Shimane NPP)	ShimGov	Local govt.	43	23	58	13
Matsue Municipality mayor - Shimane NPP	MatsMay	Local govt.	93	20	100	20
Heita Kawakatsu (Shizuoka Prefecture Governor) (Hamaoka NPP)	ShizGov	Local govt.	21	30	75	22
Omaezaki Municipality mayor - Hamaoka NPP	OmaeMay	Local govt.	40	31	95	30
Harumi Takahashi (Hokkaido Prefecture Governor) (Tomari NPP)	HokkGov	Local govt.	71	33	72	24

## Appendix: Data tables

Actor	Legend	Group	Position	Influence	Saliency	Exercised power
Tomari Town mayor - Tomari NPP	TomMay	Local govt.	100	38	100	38
Yoshihiro Murai (Miyagi Prefecture Governor) (Onagawa NPP)	MiyGov	Local govt.	58	26	61	16
Ishinomaki Municipality mayor - Onagawa NPP	IshiMay	Local govt.	100	26	100	26
Masao Uchibori (Fukushima Prefecture Governor) (Fukushaimi Daiichi NPP)	FukuGov	Local govt.	4	26	68	18
Fukushima Prefecture - population	FukuPop	Local govt.	0	15	90	14
Public in Prefectures without NPPs (pro-nuclear)	PubPro	Local govt.	85	8	45	4
Public in Prefectures without NPPs (neutral)	PubNeu	Local govt.	46	42	35	15
Public in Prefectures without NPPs (anti-nuclear)	PubAnti	Local govt.	15	11	45	5
World Association of Nuclear Operators (WANO)	WANO	Foreign agency	100	4	68	3
International Atomic Energy Agency (IAEA)	IAEA	Foreign agency	100	5	68	3

Notes: govt. = government; NGOs = non-governmental organizations; cos. = companies.  
Source: KAPSARC expert interviews and analysis.

**Table A2.** Strategy 1: METI-led drive to restart nuclear power actor data.

Actor	Legend	Group	Position	Influence	Saliency	Exercised power
Hiroshige Seko (Minister of Economy, Trade and Industry)	Seko	Central govt.	90	60	100	60
Ministry of Economy, Trade and Industry (METI)	METI	Central govt.	82	72	100	72
Agency for National Resources and Energy (ANRE) (part of METI)	ANRE	Central govt.	88	61	100	61
Institute of Energy Economics Japan (IEEJ)	IEEJ	NGOs	91	37	100	37

Notes: govt. = government; NGOs = non-governmental organizations.  
Source: KAPSARC.

**Table A3.** Strategy 2: Reduced voice for pro-nuclear independent/nonprofit organizations actor data.

Actor	Legend	Group	Position	Influence	Saliency	Exercised power
Japan Nuclear Safety Institute (JANSI)	JANSI	NGOs	100	28	43	12
Central Research Institute of Electric Power Industry (CIEPRI)/Nuclear Risk Research Center (NRRC)	NRRC	NGOs	100	23	44	10
Japan Atomic Industrial Forum (JAIF)	JAIF	NGOs	98	38	47	18
Atomic Energy Society of Japan	AESJ	NGOs	100	20	48	10

Note: NGOs = non-governmental organizations.

Source: KAPSARC.

## About the Authors



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Dr. Brian Efir is the program director for Policy and Decision Science. He manages a multidisciplinary, multi-national team of researchers who work on quantitative models of collective decision-making processes (CDMP), geospatial information system applications to energy economics and energy policy, demography and energy, and energy policy studies of countries in the Gulf Cooperation Council (GCC) region. Dr. Efir is co-editor-in-chief of a new journal from Springer Scientific called Energy Transitions. He was previously a senior research fellow at the National Defense University in Washington, D.C.; a consultant on defense and international security matters in Washington; and a consultant applying quantitative models to support corporate, investment banking, and legal negotiations in New York.



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## About the Project

KAPSARC has developed the KAPSARC Toolkit for Behavioral Analysis (KTAB), an open source software platform, to support modeling and analysis of collective decision-making processes (CDMPs). KTAB is intended to be the standard platform for analyzing bargaining problems, generalized voting models and policy decision-making. It is our intent to use KTAB to assemble the building blocks for a broad class of CDMPs. Typical models in KTAB will draw on the insights of subject matter experts regarding decision-makers and influencers in a methodical, consistent manner; and then assist researchers to identify feasible outcomes that are the result of CDMPs.



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