Enabling Public Participation in Shaping the Inclusive Energy Transition Through Serious Gaming—Case Studies in India

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Abstract To create holistic plans for equitable access to energy and to create sustainable transition pathways, stakeholder consultation and engagement processes are essential. In India, the planning process for energy has challenges that range from legacy processes, increasing energy demand to fuel growth, pressures arising from competing (as well as new and old) technologies, to varying goals for all the stakeholders. We categorize these factors as institutional structures, geopolitical, environmental, technical, social, and monetary factors. To ensure a vision for a collective future and a coherent plan for energy, it is important that the processes enable participation and allow for co-ordination and interaction to strengthen dialogue. Processes should capture intangibles and include slack for events such as pandemics, which are no longer treated either as externalities or once-in-a-lifetime events. In this chapter, we give two examples of serious games as tools to address these challenges in the context of planning. The first example is of a game created for bureaucrats, decision-makers in the government, and private energy companies to plan collectively and compare results from various plans for energy expenditure in India. In the second case, the game aids transportation planning in urban India, which requires additional effort to ensure a transition to equitable access to energy. Using results from the game sessions, we illustrate how such methods can bridge gaps in energy planning in the diverse and challenging context of India.

Introduction

Energy is and will be the main driver of the world economy. The energy sector however is also a big contributor to global warming. In 2008, the energy sector accounted for more than 80% of anthropogenic greenhouse gas emissions for

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Annex 1[1] countries (Akpan & Akpan, 2012). In the case of India in 2015, nearly 58% of the greenhouse gas emissions were attributed to the energy sector (TNN, 2015). In order to effectively tackle climate change a transition of the energy sector towards renewable sources and adoption of increased energy efficiency is required. Additionally, access to modern energy services is fundamental to fulfilling basic social needs, driving economic growth and fuelling human development (Gaye, 2007). The role of energy planning is hence crucial in providing pathways for the transition.

However, there is a lack of consensus on the exact definition of energy planning (Cajot et al., 2017). Thery and Zarate (2009) define energy planning as "determining the optimal mix of energy sources to satisfy a given energy demand". According to Keirstead et al. (2012), the purpose of energy planning is to balance the spatially localized energy supply and demand of a given area. However this encompasses a variety of processes, energy carriers and technologies that are rarely managed together, as should be, for example, supply, conversion, storage and transportation technologies (Loken, 2007). Also, energy planning is generally not a systematically established institution within administrative departments (Cajot et al., 2017). Energy planning often is spread across multiple stakeholders, each of whom might view the planning and issues differently. The role of energy planning, apart from the technical sphere, needs to include perspectives from social-economic and environmental spheres to align with the sustainable development agenda. The complex interactions in these three spheres, different stakeholders involved in planning, and difficulty in defining it makes it a 'wicked problem' (Cajot et al., 2015,2017; Thollander et al., 2019).

The expression 'wicked problem' was coined in 1973 by Rittel and Webber (1973). According to them *"The kinds of problems that planners deal with—societal problems—are inherently different from the problems that scientists and perhaps some classes of engineers deal with. Planning problems are inherently wicked."* Wicked problems are complex problems, which usually involve multiple stakeholders with their own worldviews, leading to variable definitions of the problem, which can sometimes be contradictory (Cajot et al., 2015; Garcia et al., 2016; Thollander et al., 2019). Such problems show resistance to resolution because of incomplete, contradictory, and changing requirements (Coulton et al., 2014; Thollander et al., 2019). Due to the uncertainty and ambiguity that wicked problems involve, technical analysis is unlikely to provide a final resolution (Thollander et al., 2019). Therefore, we require methods to effectively address the nature of wicked problems. According to Conklin (2018), two things must happen to make progress on wicked problems. The first is for stakeholders to collaboratively gain a shared understanding of a problem, as opposing stakeholders usually do not even agree on what the problem is. The second is for opposing stakeholders to have dialogue and a shared commitment to alleviating the problem.

Games are well-suited to communicating a shared understanding of a problem between different stakeholders because they allow users to experiment with potential

[1] The countries that are included in Annex I of the United Nations Framework Convention on Climate Change as amended on 11 December 1997 by the 12th Plenary meeting of the Third Conference of the Parties in Decision 4/CP.3.

solutions in a safe setting and generate their own mental frames for how it works. Additionally, since the cost of failure in games is low, players may be emotionally more capable of trying out different ideologies (Swain, 2007). According to Garcia et al. (2016), games are a powerful tool for engaging users, letting them explore the complexities of a system, and giving them the opportunity to deal with wicked, ill-defined problems in a safe and fun environment. This has led to games being used in different parts of the world to plan in multiple domains such as city-plans, transport, energy, electricity, resource management and participatory planning. In this chapter, we first explore the complexity and wickedness of the energy policy scenario in India. We then demonstrate, through means of case studies, how serious games can aid in resolving those issues in the Indian context.

Energy Planning Scenario in India

Considering the geographic size of India, its population and its increasingly growing energy needs, energy policy in India is complex in nature as can be explained due to the following factors.

Institutional Structure

There is lack of an integrated energy policy structure across India (Planning Commission, 2006). The Indian Energy Policy sector has multiple key players, both at the centre and the state government levels, with functions distributed as per 7th schedule of the Indian Constitution. At the central level, there are six ministries under the Government of India which are responsible for energy policy design and implementation. Each institution involved has its own mandate and objectives. For instance, DAE's objective is to increase the nuclear power generation capacity and MoP's objective to add coal generation capacity. Each ministry is interested in promoting the generation technologies they are responsible for (Ahn and Graczyk, 2012). Furthermore, there are private sector industries involved in electricity generation and research and development (refer Fig. 1 in TERI Energy Data Directory Institute, 2010). Also, there are other sectors like road transport, shipping, housing, etc., which impact the energy usage in the country each of which are under a different ministry, and are not considered part of energy planning in India. This structure leads to siloed functioning, and can make achieving objectives of energy planning difficult in India.

Geopolitical Factors

Though one of the policy objectives in the energy policy framework is energy security and independence, India is still highly dependent on fuel imports for electricity generation. India imports nearly 75% of its energy need from oil (Babajide, 2018).

Geopolitical factors play a key role in some of the energy choices. For example, increasing natural gas plants capacity would mean increased dependence on imports, which would leave the country vulnerable to international price shocks (Planning Commission, 2006).

Environmental Factors

Though India's greenhouse gas emissions (GHG) are less than the global average, the sustainable development policy direction makes it important to contain emissions (Planning Commission, 2006). Given the relationship between economic growth and sustainable development, there is both internal and international pressure to keep the GHG emissions under a certain level. This increases the pressure to use cleaner fuels and invest in research and development.

Technical Factors

Some legacy technologies have associated technical issues that limit their capacity; such as high variation in grids resulting from intermittent generation from wind and solar power plants (Sharma et al., 2018). To address the issue, additional capacity that can act as balancing load needs to be installed.

Social Factors

One of the primary objectives in energy policy is Universal Energy Access (Ahn & Graczyk, 2016). However, this has been difficult to realise due to capacity shortage and affordability issues. This makes producing electricity at very low costs one of the key constraints. Similarly ensuring availability of modern fuels for cooking and heating at affordable prices in rural areas has been a key challenge. Additionally, some of the generation technologies have high societal costs. For instance, large hydro-electric projects displace millions of people, and affect the surrounding ecosystem as well.

Monetary Factors

India's economy is growing and this needs a matching growth in energy capacity. Government have a limited budget to work with, making it hard to achieve the desired energy targets (Institute & "TERI Energy Data Directory & Yearbook", 2010).

Serious Games—Role in Shaping an Inclusive Energy Transition

As discussed before, games can become an important methodology to address the wickedness of energy planning. They enable dialogue between diverse stakeholders, help in understanding the complexity and capture the intangible needs and preferences of people, which traditional planning methodology neglects. We demonstrate this through case studies of two games we have built. First is the Indian Energy Game, where the players are involved in designing the electricity mix for India across 2 five-year planning cycles. Second is Transport Trilemma, where players play the role of a Bus Transport Corporation for the city of Bangalore, taking planning decisions relating to various aspects of bus transport.

Case Study: Indian Energy Game

The Indian Energy Game was designed as a learning tool to help participants learn about the complexity involved in designing energy policy in India, by allowing them to experience the policy making process (Hoysala et al., 2013). The game was targeted at the public at large, and for people with a working knowledge of the energy sector.

About the game:

The game has three roles modelled after the institutional structure for electricity policy in India:

1. Ministry of Power (MoP)[2]: In the game, MoP controls the decisions about Coal based thermal plants, Hydroelectric Power plants and Natural Gas based thermal plants.
2. Department of Atomic Energy (DAE)[3]: In the game, DAE controls the decisions about Nuclear Energy.
3. Ministry of New and Renewable Energy (MNRE)[4]: In the game, MNRE controls decisions about Solar and Wind Energy.

In the first round, the participants play the 12th Five-Year plan (2012–2017) and in the second round, they play the 13th Five-Year plan (2017–2022).[5] Throughout the course of the game, the participants are provided with messages, which describe

[2]Ministry of Power, https://powermin.nic.in/en/content/about-ministry, last accessed on 28th April 2019.

[3]Department of Atomic Energy, https://dae.nic.in/?q=node/634, last accessed on 28th April 2019.

[4]Ministry of New and Renewable Energy, https://mnre.gov.in/history-background, last accessed on 28th April 2019.

[5]Until the year 2014, from the year 1951, India followed the process of five-year integrated plans at the central, national level, https://niti.gov.in/planningcommission.gov.in/docs/plans/planrel/fiveyr/welcome.html, last accessed on 3rd January 2020.

various constraints that the participants experience. For example, the message "90% of Natural Gas is imported" is provided to the MoP to inform them about that the availability of natural gas is dependent on political calm in the region. The message "Hydro projects will displace people, for which the rehabilitation costs are high" is provided to the MoP to describe the social cost of building large hydroelectric projects. Technical factors such as unstable networks due to wind energy generation are also introduced through messages.

The participants have three objectives they need to satisfy as a group. They need to

- add a capacity of 76,000 MW in the first round,
- maintain the price of generation per kWh at Rs. 3,
- and maintain CO_2 emission levels at 395 Million Tonnes of CO_2.

Each of the ministries has a pre-defined budget to meet these targets. The objectives for the second round are dependent on the players' performance in the first round.

Enabling Participation

The energy game was designed for a wide audience ranging from people with little or no knowledge of the energy sector, to experts working in the sector. This design allows making energy policy more accessible to people. It helps a citizen to better understand the complexity of energy policy making, hence enabling informed participation. We have played the India energy game with widely varying sets of participants. In each game session, we documented the background of the participants, captured interactions between the players throughout the course of the game, their responses to the messages provided to them and the debrief sessions. We have 9 game sessions and 6 play-tests of the Indian Energy Game. These nine sessions had the following mix of participants:

- Session 1 and 7: The participants had little or no knowledge about energy policy design in India.
- Sessions 2 and 3: The team was a mixture of people who had a working knowledge of energy policy design and its complexity in India, people who worked in the energy sector and people who had little or no knowledge about energy policy design. Session 3 had a member from the Planning Commission as a participant.
- Sessions 4, 5 and 6: The participants had a working knowledge of energy policy design and its complexity in India. Furthermore, they had a bias towards clean energy and were staunchly against the use of nuclear power.
- Sessions 8 and 9: The participants had a working knowledge of energy policy design in India and were from the Indian Administrative Services (IAS).

Irrespective of the background of the participants the 9 game sessions had the following common feedback from participants shown in Table 1.

Table 1 Observations common across 9 game sessions (Hoysala et al., 2018)

Participant's learning and experiences	Observation from game play data
High life-cycle cost of solar energy	The teams reduce the amount of solar capacity added over the course of the game
High reliance on coal based energy	The teams begin the game with a mixture that results in a high cost of generation. They gradually reduce the mean cost of generation by relying on coal based energy sources
Non-availability of inexpensive hydroelectricity	The teams begin with an average of 25% hydroelectricity. As constraints about hydroelectricity are introduced in the course of the game, the average share of inexpensive hydroelectricity decreases

Hence games can be used as a medium to make complex policy challenges understandable by people, which has potential to enhance their participation in policy making and have an informed discussion.

Coordination Among Players

In order to successfully win the game, coordination among players is important. As each player is in charge of different technologies assigned to their respective Ministries/Department, there are trade-offs involved. For example, while solar power has near zero GHG emissions, the cost of generation is high; whereas coal power has lower cost of generation but higher GHG emissions. As both coal and solar are under the control of different players, players need to break out from their silos and coordinate with other players for arriving at the electricity mix that helps achieve the objectives in the game. During the game sessions it was found that over time the coordination among different players improved, and the teams reached closer to the objectives in the game. In Fig. 1 and Fig. 2 you can see the average cost of generation and average emissions, respectively, across different time bins. The values are averaged across 9 game sessions. As time progresses you can see the convergence with the objective set in the game both for the cost of generation and emissions.

Enabling Dialogue

In energy planning, as discussed earlier, there are multiple stakeholders, each of them with their own perspectives and objectives. Often, these objectives are contradictory and lead to disjoint planning. To shape an inclusive energy transition, there is a need to increase dialogue among different stakeholders, in order to arrive at a shared understanding of the future and therefore work together towards it. For this

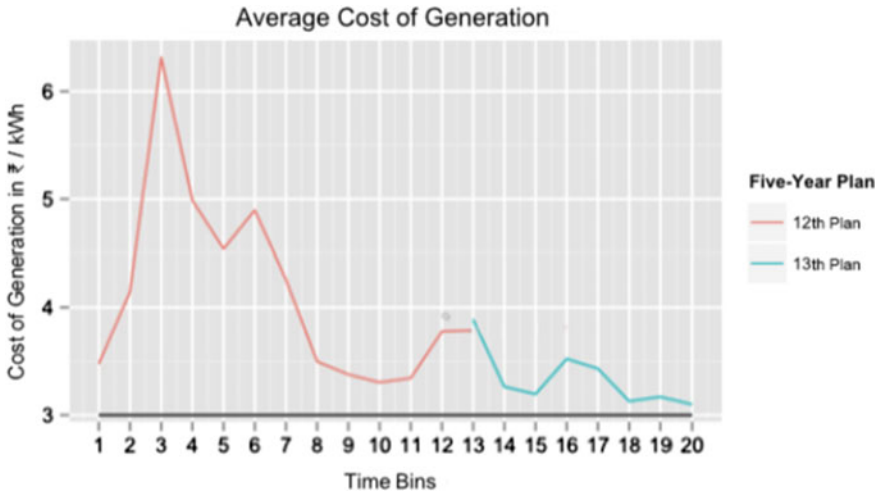

Fig. 1 Average cost of generation (across 9 sessions) (Hoysala et al., 2018)

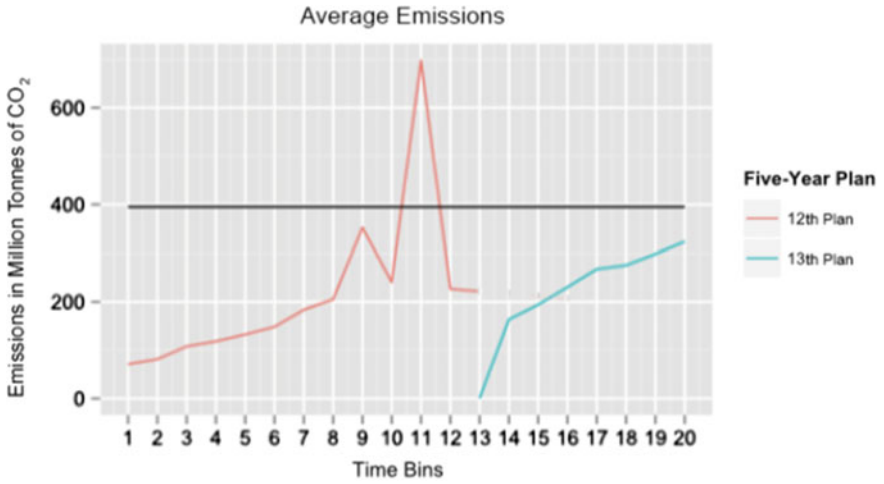

Fig. 2 Average GHG emissions (across 9 sessions) (Hoysala et al., 2018)

to happen, exposure to different perspectives is a starting point. Additionally, due to the different backgrounds and ideologies of the stakeholders, there is an added impact on policy-planning, for example, an anti-nuclear stance will lead to an energy mix devoid of nuclear energy, irrespective of its benefits. Games enable the players to explore the consequences of their choices in a low-cost manner, hence, enabling better engagement of the pros and cons of each policy stance. In the game sessions 4, 5 and 6, the players had a bias towards clean energy and were staunchly against

the use of nuclear energy. Their feedback after the game session and their decisions during the game is discussed in Table 2.

Despite the bias towards clean energy, the game enabled participants to understand the social side of the issue, mainly the affordability of energy. In India, the high reliance on coal based power is due to it being among the cheapest sources of power and also for geo-political reasons, as India has indigenous reserves of coal, whereas it

Table 2 Experience and feedback of participants in game session 4, 5 and 6 (Hoysala et al., 2018)

Game play details	Participants' learning and experiences	Observations from the game play data
Session 4	Tried a strategy of developing an energy mixture without coal Game helped them understand better the consequences of the same	Refer Fig. 3. The team did not use coal based power, and eventually failed to meet the energy requirements of the country in the game
Session 5	The high financial and lifecycle emission consequences of installing solar power became evident during the course of the game	Refer Fig. 4. The team began with a high percentage of solar power, which reduced the available budget due to its cost
Session 6	The game helped understand that the environmental, social, monetary, institutional and technical factors determining energy policy cannot be isolated The game helped them understand the environmental and societal costs of an energy mixture without nuclear energy	Refer Fig. 5. The graphs show that the teams used no nuclear power but generated 75% of the power through coal, thereby potentially increasing emissions and decreasing coal reserves

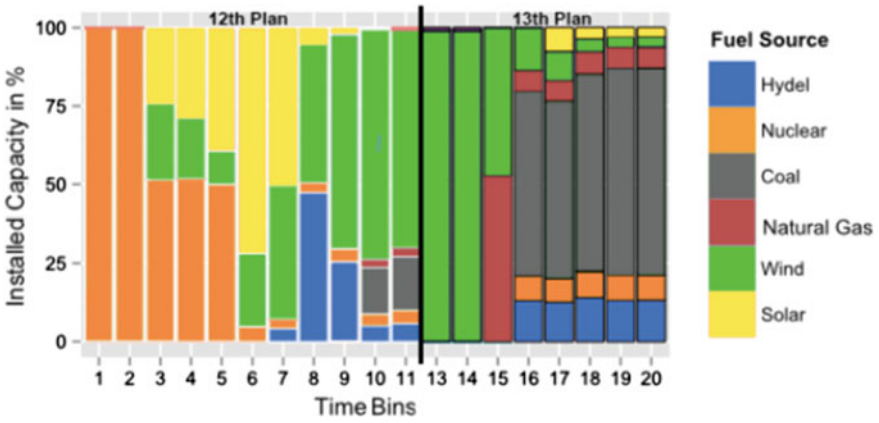

Fig. 3 Electricity mix in session 4 throughout the game (Hoysala et al., 2018)

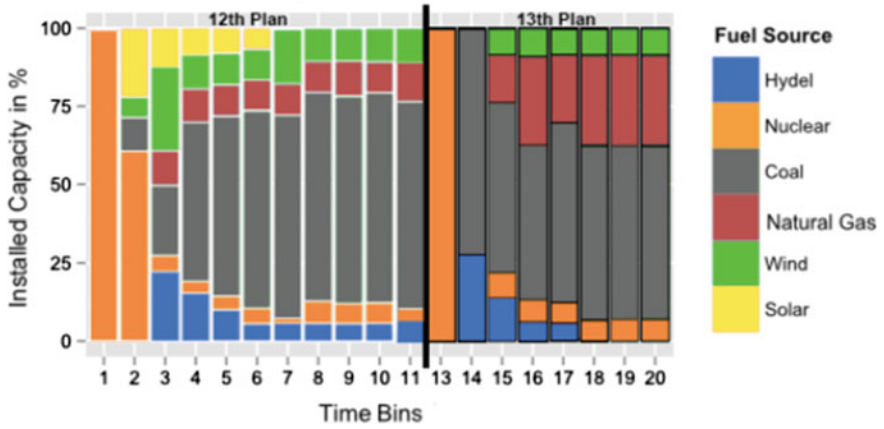

Fig. 4 Electricity mix for session 5 throughout the game (Hoysala et al., 2018)

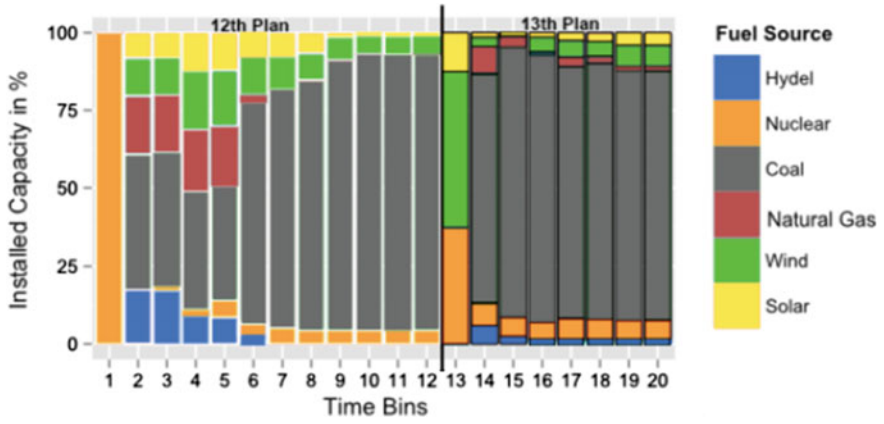

Fig. 5 Electricity mix for session 6 throughout the game (Hoysala et al., 2018)

is reliant on petroleum imports. The game thus becomes a medium to bridge different viewpoints for the same issue, which enables dialogue among different stakeholders.

Case Study: Transport Trilemma

Now let us move away from the electricity sector, to the transportation sector, where we have developed a game called Transport Trilemma. Transport Trilemma is a novel scenario-generation transport planning game designed for the context of public bus transportation in the city of Bangalore. Bangalore Metropolitan Transport Corporation (BMTC), the public bus transport corporation in Bangalore, is considered to

be the "lifeline of Bangalore" (Bangalore Mirror Bureau, 2017). Its buses deliver close to 5 million passenger trips everyday with more than 2000 routes and over 6000 buses (BMTC). Yet, various commuter surveys and feedback suggest that fares are expensive, wait times are long, schedules are unreliable besides numerous other commuting challenges with the existing service. For many people, especially the urban poor, the bus service forms the only means of transport apart from walking, due to unaffordability of other means (Bangalore Mirror Bureau, 2017). Transport Trilemma is a tool built for the planners/policymakers of BMTC with an objective to explore the creation of transport plans that are more inclusive and responsive to the needs of all stakeholders as a part of our Joint Road Forward project.[6]

About the game:

The goal of the game is to provide a participatory, alternative approach to planning and assessment of public bus transportation plans. This gaming simulation is based on a model that incorporates data that conventional methods rely on and also allows planners to 'play with' intangible data such as needs, preferences and priorities that conventional methods fail to capture. The objective is to use the collected results and strategies in the game in an agent-based simulation to understand and consider the different trade-offs while making decisions. This approach also allows planners to experiment with different choices, explore alternative planning scenarios, and consider different trade-offs through this combination of methods which will also provide a low-cost and risk-free environment to test new strategies.

In the game, players assume the role of BMTC and are responsible for ensuring that the operation of buses is profitable while also increasing its ridership in the city by bringing in new commuters from different income segments in Bangalore. Annual plans are created for the period 2018–2020 to achieve the overarching targets set for annual ridership and annual gross revenue using BMTC's operations and maintenance parameters. The historic operational details and parameter values for the years 2005–2017 are provided as information guides for the players to plan and set targets. Throughout the course of the game, constraints are introduced in the form of "messages" as a part of the game experience; constraints that planners encounter in the real world.

Capturing the Intangible

We conducted the game with two different sets of players. In each game session, we documented the background of the participants, captured interactions between the players throughout the course of the game, and their responses and feedback from the debrief sessions.

[6]Details available at last accessed on 28th April 2019 https://fieldsofview.in/projects/joint-road-forward/, last accessed on last accessed on 28th April 2019.

- Session 1: Members from BMTC, the public bus transport corporation in Bangalore
- Session 2: Members from BBPV (Bangalore Bus Prayaanikara Vedike), a commuters' group which conducts public discussions on urban mobility issues covering accessibility and affordability of public transport services.

While the context of the game was the same across both sessions, yet the outcomes of the game are different, due to different needs and priorities of the players. Some of the results of the sessions are briefly discussed in Table 3.

The intangible needs and preference of the stakeholders become visible from their choices in game. From the results of the game sessions, BMTC places a greater priority on ridership and revenue, whereas BBPV places higher priority on accessibility and affordability. These game interactions generate important information that cannot be ignored in planning. Plans need to take cognizance of different stakeholder needs in order to be inclusive and responsive to them. Even when the same context is provided to different stakeholders, we can clearly see how different outcomes are generated. Both the stakeholders considered different factors and goals to guide their decision-making, which results in different planning outcomes. The needs, preferences and priorities differ between stakeholders due to which the plans and their outcomes also change. Transport trilemma helps to sensitise stakeholders to the needs and priorities of other stakeholders involved and makes them aware of the impact of decision-making on each other. Considering that the resources are limited, various trade-offs get introduced into the decision-making, which leads to prioritisation. It becomes necessary for planners to be wary of all the various trade-offs and their impacts before they take any decision and prioritise so that plans can be made more inclusive, participatory and responsive to the needs of different people affected by it. Tools like Transport Trilemma allow for participation of different stakeholders, enable dialogue, explore alternatives and sensitise different stakeholders to each other's needs, priorities and constraints while also making them holistically aware of the system they are operating in.

Table 3 Results from game sessions of Transport Trilemma

Session 1	Session 2
Strategies were based on achieving high ridership and high revenues for BMTC	Strategies were mostly based on increasing accessibility and affordability of BMTC's different services to commuters
Decisions were based on the assumption that an increase in the number of buses on road will result in increased ridership	Preference for routes and schedules over increasing the fleet strength, though the number of buses was also increased
Targets were incrementally increased across the years without any significant change	Ambitious targets were set for all planning years signalling a deviation from historical trend
Was more interested in those routes which were high in revenue for BMTC while others were neglected	Fares were either kept nominally low or even reduced year on year to make BMTC more affordable

Conclusion

While the transition towards clean and renewable sources of energy is inevitable if we want to ensure sustainable development for all, the challenges posed by the wickedness of the energy planning problem makes the existing methodology we use to solve the problem and improve public participation inadequate. Games offer solutions to address the wickedness of the problem. Through the case studies of Indian Energy Game and Transport Trilemma, it was shown how serious games are being used to address the challenges in energy planning in India. Specifically, we have described with case studies in India how games help in:

- Enabling Participation of citizens in policy making, by making policy accessible.
- Improving Coordination among diverse stakeholders, enabling working towards a common goal.
- Enabling Dialogue among different stakeholders, helping to understand the problem in a holistic manner.
- Capturing the intangible needs and preference of stakeholders, to make policy inclusive.

Serious Gaming acts as a complement to the existing approaches. The combination of games with conventional approaches is needed to ensure an inclusive energy transition.

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BMTC, Data on buses-routes, fares, bus stop.

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