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Scenario on Indonesian Coal Governance

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Abstract. Coal as a non-renewable natural resource is still an important source of energy for Indonesia and is projected to continue into the future. The System Dynamics simulation shows that in 2030, Indonesia is predisposed to experiencing market failure, namely a gap between supply and demand, if referencing only to existing reserves and current production capacity that tends to increase from year to year. The governance of Indonesian coal is a multi-faceted governance whereby various policies, norms, and behavioral patterns as interactions between government, business actors, and communities, either individually or together, can influence the governance of Indonesian coal and which therefore necessitates alternative scenarios to take these factors into account. An ideal alternative scenario is a balance between "the gas pedal and brake", as current improvements thus far cannot only be focused on a single aspect or factor. Production capacity must be controlled, whereby level of coal production is prioritized to meet domestic needs first. Next, the allocation of coal for export must be limited. The opportunity to increase export capacity is open when domestic needs have been fulfilled and domestic market capacity has reached a positive point, which is projected to occur after 2040.

Keywords. *governance, scenario, coal, Indonesia*

Introduction

Coal is a non-renewable resources, as are natural resources derived from other fossils such as oil and natural gas. The Indonesian territory that stem from the collision of three large plates, namely the Eurasian plate, the Indo-Australian plate, and the Pacific plate has received extraordinary blessings. As a result of the collision of the three plates, mountain and volcanic pathways were formed which produced metal mineralization and geothermal energy. In addition, the collision of the large plates also formed many sedimentary basins that have the potential to produce oil and gas, as well as coal.

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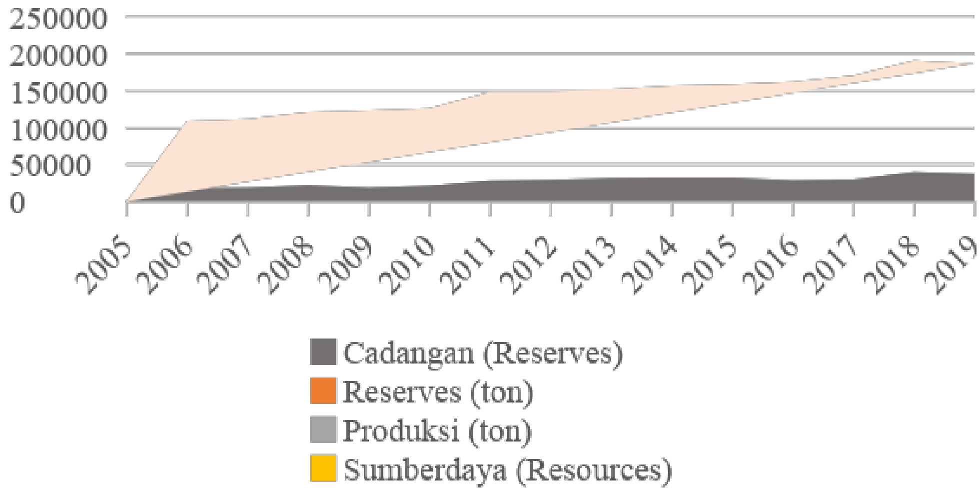
In Indonesia, coal has a high level of availability compared to other sources of energy and therefore plays an important role in meeting domestic energy needs and as a source of state revenue. The contribution to Indonesia's gross domestic product over the last ten years is estimated at 2-2.4 percent. According to data from the Ministry of Energy and Mineral Resources, Indonesia's coal reserves as of December 2019 amounted to 37.6 billion tons with resources reaching 149 billion tons. The largest potential for Indonesian coal reserves is in Kalimantan and Sumatra. The total reserves in the two islands are more than 90 percent of Indonesia's total coal reserves. About 90 percent of Indonesia's total coal reserves consist of low and medium calorie coal, with a calorie content of less than 6,100 calories/gram. The following is data on Indonesia's coal reserves and resources since 2005.

Table 1. Growth of Indonesia's Coal Reserves and Resources



Source: *Handbook of Energy and Economic Statistic of Indonesia 2007-2018*, summary

Indonesian coal production has shown a significant increase since the 1990s, when the coal mining sector was opened to foreign investment. Production, export volume, as well as sales of Indonesian coal for the domestic market have increased significantly since then. The increase in production has been seen to be very significant, especially since 2000. In a period of 15 years, Indonesia's coal production has jumped almost six times. While in 2000 national coal production was still 77,040,185 tons, in 2015 Indonesia's total coal production reached 461,566,080 tons, and even reached 557,772,940 tons in 2018.

The BP Statistical Review of World Energy 2020 also compiled that the average growth of Indonesian coal production during the 2008-2018 period reached 8.8 percent. In 2019, the increase in production had even reached 9.4 percent. The growth in Indonesian coal production is much higher than global coal production, whose growth rate averaged only 1.4 percent in the 2008-2018 period. Among coal producing countries, only Mongolia, with coal production growth of 18.4 percent, had a higher average production increase in the 2008-2018 period than Indonesia.

The utilization of Indonesian coal is primarily intended for the export market and the rest is for domestic needs. Empirical data shows that the growth in Indonesian coal production is much greater than the growth in domestic coal consumption. In the domestic market, coal is mainly allocated to supply electricity generation needs. In fact, in practice, the direction of the largest consumption growth is still limited to the need for electricity.

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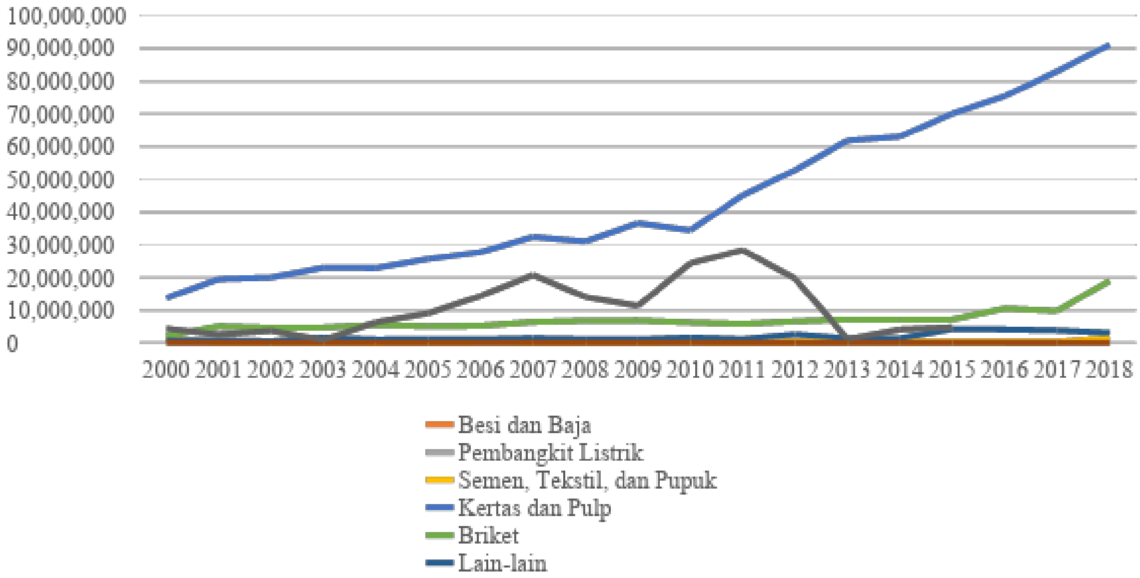
Table 2. Allocation of Indonesian Coal for Local Demand



Source: *Handbook of Energy and Economic Statistic of Indonesia 2007-2018*, summary

According to the National Energy Council in Indonesia 2019 Energy Outlook, the demand for coal for the Indonesian domestic market will continue to increase. This increase is proportional to the growth in energy demand of 5 percent per year, with the composition of coal in the national energy mix remaining at around 30 percent. To obtain domestic supplies, the Ministry of Energy and Mineral Resources of Indonesia requests coal producers to reserve a certain amount of production for domestic consumption. Utilization of domestic coal is intended to ensure the supply of domestic primary energy sources and industrial raw materials as well as the construction of a coal-fired power plant (CFPP).

Around 60-80 percent of Indonesia's total coal production each year is exported to consumers abroad. Indonesia is also the largest coal producer and exporter in the world. It has been recorded that since 2000, Indonesia's total coal exports have never been less than 60 percent of the total national production. Even though there has been a downward trend in exports in the last five years, this percentage is still higher than the target set by the government. The main destination countries for Indonesia's coal exports are China, India, Japan, South Korea, Malaysia and the Philippines. Japan was once the main export destination for Indonesian coal, but shows a downward trend from year to year. On the other hand, China and India continue to be the most important export destinations for Indonesian coal. Exports to China and India in the last eight years have reached more than 30 percent of Indonesia's total coal exports.

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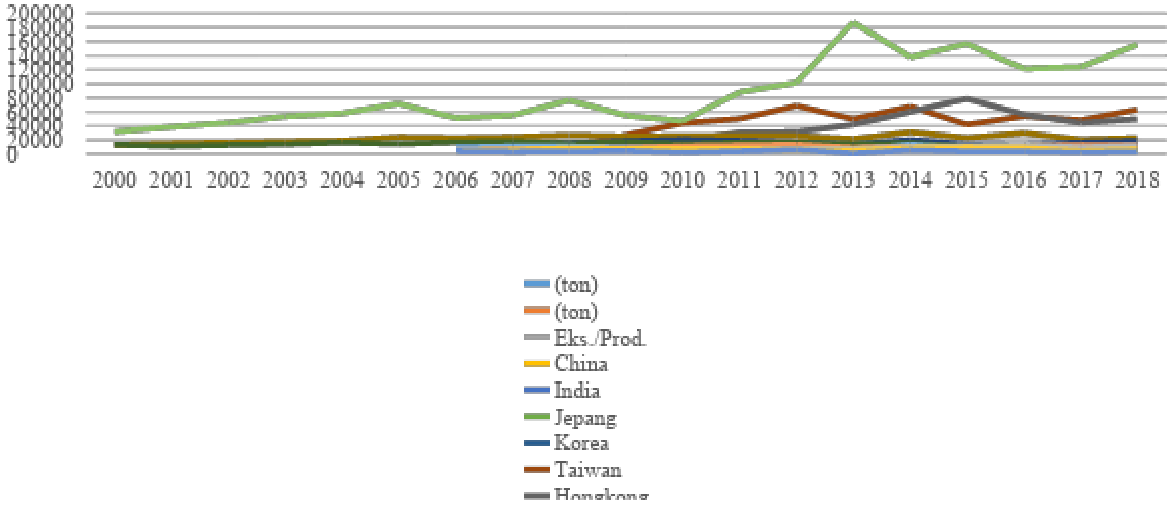
Table 3. Destination Countries for Indonesian Coal Exports



Source: *Handbook of Energy and Economic Statistic of Indonesia 2007-2018,* summary

In general, the coal mining industry in Indonesia faces fluctuating market conditions and commodity prices after a relatively long downward trend. The coal industry is also often faced with accusations of being a source of dirty energy and therefore it is judged to be prohibited or at least deemed inappropriate to be used for the main supply of energy sources. This can be seen in the cases of China, India, and the United States as major coal users in the world. In these countries, large investment is directed towards renewable resources, leaving behind coal and other fossil resources. One of the agreements in the Climate Change Summit (Summit) is to limit the use of fossil-based energy sources. The Paris Agreement, which was the result of a meeting of 196 countries in the world in 2015, came into effect on November 4, 2016. Future trend points to a society that is moving towards a more environmentally-friendly order, with lower carbon emissions and using renewable energy sources.

Article 33 paragraph (3) of the Constitution of the Republic of Indonesia states that "The land, water and natural resources contained therein are controlled by the state and are used maximally for the prosperity of the people." In the context of governance, what needs to be done is to make coal resources in Indonesia a blessing for the people at large (pro-people), continue to grow and provide optimal benefits, and maintain its sustainability. In its derivative products, one of the issues that surfaced during the discussion and discourse on the revision of Law Number 4 of 2009 concerning Mineral and Coal Mining was the optimization of natural resource management in the form of minerals and coal for the greatest prosperity of the people.

Indonesia has a direct interest in meeting energy needs for national development, for the present and for the future. In the current condition, coal has a strategic role in overcoming the threat of the energy crisis and supporting national energy security. The use of coal can be directed as an economic driver which is expected to provide added value and a multiplier effect on economic growth and people's welfare. Coal can be a priority choice of energy sources. This consideration is based on the criteria for the 4A concept stated in Presidential Regulation Number 5 of 2006 concerning National Energy Policy, namely the aspects of availability, accessibility, affordability, and acceptability.

Consistency and coherence regarding the governance of Indonesian coal, including in terms of controlling production and meeting domestic needs, is one of the issues concerning the governance of Indonesian coal. The constitutional mandate that natural resources, including coal, be managed for the greatest prosperity of the people, is often distorted or at least inconsistently spelled out in lower regulations. The availability of non-renewable natural resources is also an important issue in any discussion on the concept of sustainable development.

Natural resource management, in the end, returns to the basic principle of regulating production and consumption behavior, by taking into account, among other things, the objectives to be achieved and also the limitations of natural resources. In the framework of a systems thinking view, such conflicts, both regarding institutions and actors in exercising their influence in the governance system, make the natural resource management scenario, particularly regarding Indonesian coal which is a non-renewable natural resource with limited availability, becomes a matter of which is important to be prepared.

The governance of Indonesian coal in the future is an interesting and important research topic to do. This research is designed by reconstructing governance with a system dynamics concept approach and scenario planning resulting from this research is built with dynamics and responsiveness to continuous changes in the policy environment, both internal and external/global, including in relation to debates on governance which places coal as a mere commodity or as a strategic reserve for national energy security. The main point of this research is the governance of Indonesian coal as a nonrenewable natural resource by modeling the influencing variables using the System Dynamics method and Powersim Program, which is then further developed to the scenario planning stage, whereby the research is conducted by constructing the factors that affect the governance of Indonesian coal.

Literature Review

Governance plays an important role in the structure of the modern economy and society, with the availability of regulations and institutions that would allow for adjustments to changes that occured, including those changes that occured to stakeholders with its varied interests. Good governance promotes equality, participation, pluralism, transparency, accountability and the rule of law, which are carried out in ways that are effective, efficient and sustainable. Referring to Neo and Chen (2007), governance that is implemented is able to support the ability of an organization / country to survive in the face of dynamic and uncertain conditions.

In general, governance can be defined as mechanisms, practices, and procedures to govern and for citizens to manage resources and solve public problems. The term governance has been widely used by contemporary administrative circles, one of which is to show a shift in the role of government that was previously hierarchical, including also relating to which relationships or institutions can be involved in public affairs.

Several definitions of governance that are adopted by organizations focus on the exercise of power and authority, where governance does involve the management of power (exercise of power), decision-making, and implementation. While other experts or organizations emphasize governance in the process and decision making. Other definitions focus more on regulations or laws and institutions. Other experts even say that governance and management are the same thing. Some even define governance with management; although in fact there are fundamental differences between the two. Governance is a strategic matter, while management is concerned with operational matters. Governance involves making and implementing decisions; while management is a tool for implementing decisions (Moore, 2011: 100). This is in line with Heinrich and Lynn's (2000) view that governance functions are at three levels or different levels, namely: (1) institutional or institutional levels that formulates formal and informal stipulations which are carried out in accordance with hierarchies and procedures; (2) organizational or managerial level, which mainly relates to public policy management; and (3) the technical level (Fairholm, 2009: 5).

The diversity in the definitions of governance suggests that there may be difficulties in getting a unanimous consensus on the definition of governance. Abdellatif (2003: 3) notes that governance as a theoretical construct is not only in an embryonic state, but its formulation among researchers also varies depending on their ideological beliefs (Gibson, 2011: 3). On the other hand, the widespread use of the term governance in the study of administration and public policy is also predicted to further expand in the future. Particularly since a dynamic environment (organization/state) turns political, social, economic, and cultural situations into different things according to their respective contexts.

In general, there are three types of governance, namely the type of hierarchy (hierarchical style), market (market style), and network (network style). The hierarchical type is based on the type of bureaucratic organization that is hierarchical with limited opportunities for parties to make decision choices. This type of market allows each party to get options and opportunities without being tied to the other, as occurs in hierarchical type. Meanwhile, the network type places inter-parties with interdependence. Louis Meuleman (2008: 45-50) identifies 36 differences between the three types of governance, which can be grouped into five major groups, namely vision (and strategy), orientation, structure (including systems), people, and results. Some of the fundamental differences between the three types of governance are presented in the following table.

Table 4. Different Types of Governance

Type / Indicator	Hierarchy	Market	Network
Problems	Crises	Routine problems	Unstructured problems
Solutions	Rules, control prosedures	Contract, services	Consent, content agreement
Choice opportunities	Focused on rule-making	Focused on bargaining	Focused on result via dialogue
Actors	Subordinates	Buyers and sellers	Partners

Source: Meuleman (2008: 51)

In principle, the term governance becomes increasingly important when there is a trend towards fundamental changes in the process of making public decisions and the production of public services. The contributing factors are, among others, the encouragement and pressure from the public who have different expectations than before, and information-communication channels which, among others, demand transparency and participation. This makes public agencies no longer able to ignore the presence of other stakeholders in an effort to create better public services and to achieve better policy outcomes (Bovaird, 2009: 240). This is in line with the basic understanding that governance is a form of shift or new meaning of "government" which was previously a formal institution of the state with a monopoly on its coercive power (Stoker, 1998: 17). Governance and its dynamics are traced by following Khan (2015), namely by identifying which aspects must be managed, the functions that work in the governance mechanism, and the governance structure. As stated by (Kuzemko et.al., 2012: 262), natural resource governance in principle follows standards that refer to basic patterns of supply and consumption. Supply will increase the availability of reserves, while consumption will be an outflow which will reduce reserves.

Governance on natural resource is currently important because of the reality of human needs for certain resources and mother nature’s ability to supply them. One of the failures in natural resource management is often related to the failure of environmental governance (Diamond, 2005). Good natural resources governance is a new approach that includes all the principles needed for consolidated democratic management. These principles can be expressed as participation, transparency, accountability, effectiveness, consistency, fairness and legislation. These principles are in line with the principles of good governance, namely consistency (predictability), responsibility, accountability, fairness, transparency, participation (subsidiarity), effectiveness, and compliance with law (Toksöz, 2008). This is in line with the thoughts of Kuzemko et.al. (2012: 262) that natural resource management will in principle follow the standards commonly applied in good governance. Specifically, natural resource management will basically focus more on basic patterns of supply and consumption. Regarding supply, there are different characteristics between renewable natural resources and non-renewable natural resources such as fossil energy sources, including coal.

In essence, the complexity of natural resource governance is influenced and determined by two things, namely the interaction between natural ecosystems and human responsibility. This is in line with what is expressed by some experts, that natural resources governance is seen as a very complex concept of governance, where interactions and feedback occur at various scales and between various components in the socio-ecological system (Folke, Hahn). Olsson & Norberg, 2005; Holling, 2001; Ostrom, 2009). Therefore, the concept of natural resources governance does not only refer to the human order, but also talks about ecology related to the availability of natural resources, which in this study is reflected in resources and reserves. Human activities determine supply, namely by the growth in production carried out, as well as activities to increase the availability of resources. Furthermore, the interaction between resource availability and supply determines the volatile market and commodity prices or the market and fluctuative commodity prices. All the results obtained so far are related to certain conditions under which the availability of resources (stock), production, and preference functions can be known. Associated with non-renewable resources (such as fossil fuels like coal), their use cannot run without depletion. Especially for non-renewable natural resources, there are limitations to the capacity of the availability of resources and / or reserves in nature - this limitation distinguishes it from the management of renewable natural resources.

Research Method

The system dynamics method was first developed at the Massachusetts Institute of Technology in 1956 by Jay W. Forrester. The rationale for the system dynamics methodology is systems thinking, which is a way of thinking in which every problem is seen as a system, namely the entire interaction between the elements of an object within certain environmental boundaries that work to achieve goals. Systems thinking is a general term that describes an approach to understanding and working with complexity in the real world and on a number of key elements, such as the existence of complexity and interrelationships.

System dynamics is a system that is influenced by changes in time, where time is an independent variable. Many authors have contributed to the development of system dynamics, including Coyle (1977, 1996), Randers (1980), Richardson and Pugh (1981), Roberts (1983), Senge (1990), Wolstenholme (1990), Richardson (1991) , Mohapatra (1994), Morecroft and Sterman (1994), Vennix (1996), Richmond and Petersen (1997), and Sterman (2000). Quoting Cavani and Maani (2000), A Methodological Framework for Integrating Systems Thinking and System Dynamics, the most appropriate definition to explain the notion of system dynamics is that of Eric Wolstenholme (1997).

Wolstenholme explained that system dynamics is a sharp way to help think, describe, connect the future evolution of data organization and complex problems from time to time. The reason put forward is because system dynamics aims to find solutions to problems and create robust designs that minimize unwanted impacts.

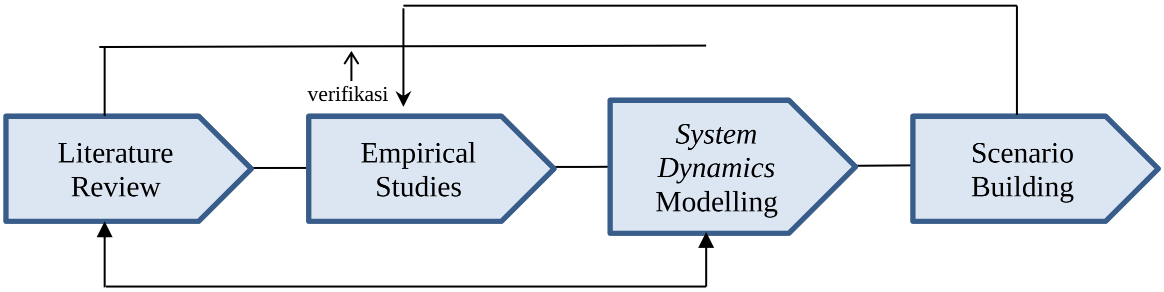
The System Dynamics method is built with five main phases, namely: (1) problem structuring; (2) causal loop modeling; (3) dynamic modeling; (4) scenario planning and modeling; (5) implementation and organizational learning (learning lab). In more detail, Cavani and Maani describe the stages of developing a dynamics system as presented in Table 2.4. Of the five main phases, for this study only four phases were carried out. The fifth phase, namely implementation and organizational learning, was not carried out in this study. In the fifth phase, a number of stages are carried out including preparing reports and presentations to management as well as communicating results and proposing intervention designs to stakeholders.

Scenario planning is considered a relatively recent discipline and there are many variations (models) of development. Quoting Chermack, there has not been much discussion on the theory of scenario planning. Scenario planning has grown more due to the touch of "art" from practitioners and still has not received much attention from academics. Based on the literature review, there are six key domains as the basis for scenario planning theory, namely: (1) dialogue, conversation quality, and engagement; (2) learning; (3) mental models; (4) decision making; (5) leadership; and (6) organization performance and change.

Scenario planning is a method of preparing strategic plans for the future by properly managing the uncertainty of the future. Scenarios are not predictions, but rather tools for constructing perceptions about the future alternative environment in which a decision is likely to occur. Through scenario planning, alternatives to future scenarios can be prepared based on trends that exist from the present to be used as a basis for anticipating the future, in a more useful and legible way to convey, both negative and positive. Within the processes of the series of events, movements that are both positive and neegative will be visible, as well as the impact from uncertainty that will influence the movement of planned activities. Referring to Marra (2009: 22), scenario planning focuses on certain critical uncertainties related to an issue, not on things that are already known and can be predicted. Quoting Ringland (1998: 10), scenarios aim to create a real-life picture of the future, so that they can answer two basic things, namely (1) anticipating the possibility of a future that was not previously predicted, by exploring various obstacles, changes to external environment or the relationship between various related factors; and (2) creating a mental model that allows users to know from the beginning the evidences that are obvious/visible or not.

Just like scenario formulation in a qualitative research method, the usage of a systems thinking, by involving the creation of a system dynamics model in scenario formulation, tends to increase. In the system dynamics community, scenario analysis is used to represent the process of model exploration through sensitivity analysis. To quote Jay Forrest, the concept of scenario analysis should be provided to explore the structure of the model; where system dynamics techniques are used to formulate, simulate, calibrate, and validate. Modeling in system dynamics is carried out to simplify complex real-world phenomena and the interrelationships between various components in the planning process as real-world abstractions. The focus is on the relationship between variables over time (rate of change). Behaviors result from feedback between system components, which can limit the effect or amplify the cycle. Scenario planning in system dynamics is a data-driven process that seeks to explore a lot of future potential to identify and develop future alternatives. Scenario building implies substantial knowledge of trends, problems, certainties and uncertainties. This study uses a post-positivism (post-positivism) approach, which is the use of theory as a research reference that is constructed so that it is connected empirically. Some of the main principles of post-positivism are that reality can never be fully understood because of human limitations; objectivity is ideal and accessible only; as well as giving attention to "understanding" rather than "controlling". The System Dynamics method is used to help represent research problems in a model with a series of interconnected variables. The model that is built as a capture of the real-world is used to simplify complex real-world phenomena and the relationship between various components. System Dynamics is a method commonly used to describe the structure of the process of changing causality or cause-effect relationships. This method can also be used to obtain behavior caused by a complex causality structure.

The stages of the research carried out are illustrated as follows.



Ilustration 1. Research Stages

Finding and Analysis

The concept of resource governance, as generally stated by Meadows (1970), can then be translated into a non-renewable natural resource governance model expressed in a causal loop diagram (CLD) which is an articulation of empirical problems which, by referring to the sequence of the System Dynamics method, the problem is mapped into variables that are interconnected and have an important correlation in the model. The governance model in this study is oriented towards a process sequence, in which relationships and assumptions are made based on what is observed and is believed to be closely interdependent. Modeling is carried out to simplify complex real-world phenomena and the interrelationships between various components into an abstraction. This approach is taken to make it easier to see complex problems, which are elaborated based on the main variables and then reintegrated into a complete model with related variables. The key to success in modeling is maintaining an understanding of the model and what to say about the problem related to its size (Coyle, 1996: 31). Loop Reinforcing (R) is one of the characteristics of system dynamics (system building block) which describes the nature of growth or decay -which arises because of a causal relationship with unidirectional effects between variables. Meanwhile, Balancing (B) is one of the characteristics of goal seeking or towards balance.

The CLD model is described as follows.

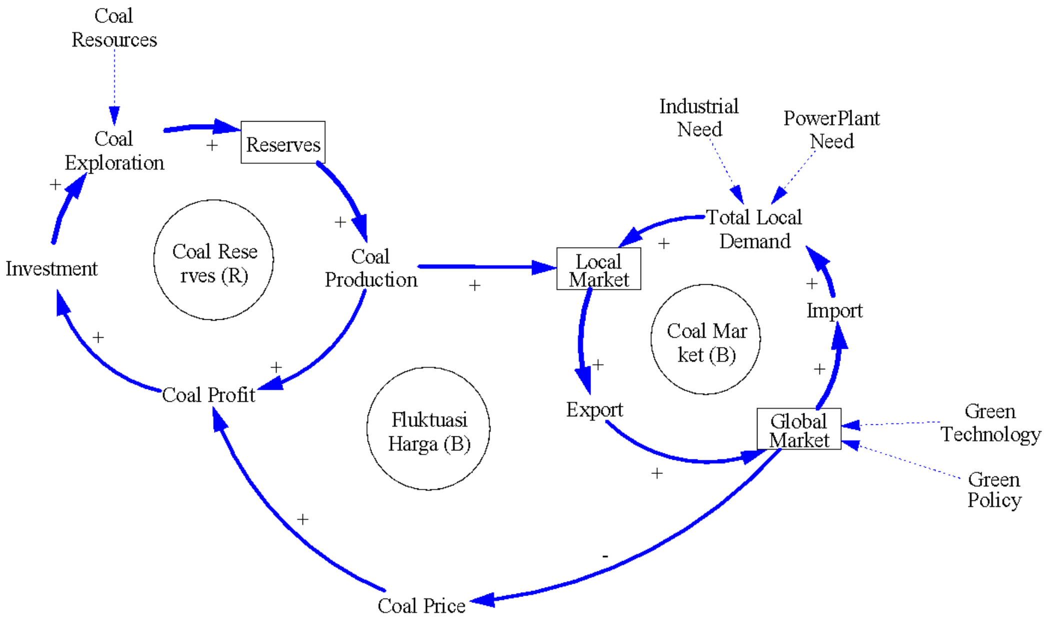


Illustration 2. Causal Loop Diagram Governance on Indonesian Coal
Source: summarized by Researcher

The governance modeling is based on the Causal Loop Diagram which consists of three loops, namely the Reserves loop; Market (supply-demand), and the Price Fluctuation loop. This approach is taken to make it easier to see complex problems, which are described based on the main variables and then reintegrated into a complete model with related variables.

The causal model above provides an overview of the use of coal which is a non-renewable natural resource. The count starts from the resources, some of which are converted into reserves after fulfilling the technical and economic feasibility assessment. The Causal Loop Diagram consists of three loops, namely the Reserves, Market (supply-demand), and the Price Fluctuation loop.

Loop Reserves consists of the Coal Production variable. This production variable will change in line with the increase in investment made by mining business actors, but will be limited by the amount of reserves that will not exceed the total available resources. Believing that the world is finite, this limits the supply of resources and thus affects the maximum level of output that can be sustained. Following economic theory, additional investment will be made if there is an increase in profits or profits from coal production. This loop has a Reinforcing pattern.

The use of resources is largely determined by the market mechanism. Economists have emphasized the role of markets in allocating and adapting to scarce resources, including non-renewable natural resources such as coal. The second loop, namely Loop Market, shows the reality that the allocation of Indonesian coal production is generally divided into two purposes, namely for meeting domestic needs and for export purposes. The amount of coal consumed for the domestic market is determined by the existence of domestic supply-demand conditions. The demand for the domestic market is divided into two major groups, namely the need for electricity generation and other industries. Meanwhile, Indonesia's coal exports are part of the total world production. The global coal market is also experiencing consumption dynamics. World consumption is also starting to be influenced by environmentally friendly policies and technologies that try to find alternative energy that are considered cleaner. This loop has a balancing pattern, just like the behavior of a market. This loop is greatly influenced by supply-demand conditions that occur in the market, both local and global or overseas. In principle, the commodity theory applies, in which the value of a product or service is related to its availability. In general, a product with a lower supply level will be considered to have a higher value than if the product is abundantly available on the market. The basic law of supply and demand also applies, that is, if demand increases and supply remains unchanged, the condition leads to a higher equilibrium price and a higher quantity. If demand decreases and supply remains unchanged, it leads to a lower equilibrium price and a lower quantity. If supply increases and demand remains unchanged, conditions will lead to a lower equilibrium price and a higher quantity. Furthermore, if supply decreases and demand remains unchanged, it will lead to a higher equilibrium price and a lower quantity. So far, prices are determined by the international market. Indonesia recognizes the Coal Price Reference that is determined by the government, nevertheless, the benchmark is more for determining royalty rates and other levies.

Next is the third loop, the Price Fluctuation loop, which contains a portrait of price dynamics that affect the amount of profit, which then affects the amount of investment that can be made by business actors in coal production. This loop has a balancing pattern. The profit calculation is the selling price minus the cost or cost (cost) of production. As long as the selling price is profitable, production and investment in the coal industry will continue. In response to price fluctuations, all entrepreneurs can do is to carry out process management efficiency to reduce cost of production. With coal which is a natural product whose sales are relatively direct without complicated processing and refining procedures (when compared to mineral mining products, for example), the discussion is limited to the supply chain of coal produced from nature to entry into the market.

Based on the CLD that has been mentioned above, a central concept in a dynamic model is built, namely the Stock Flow Diagram (SFD). The SFD model related to Indonesian coal governance as shown in the figure below.

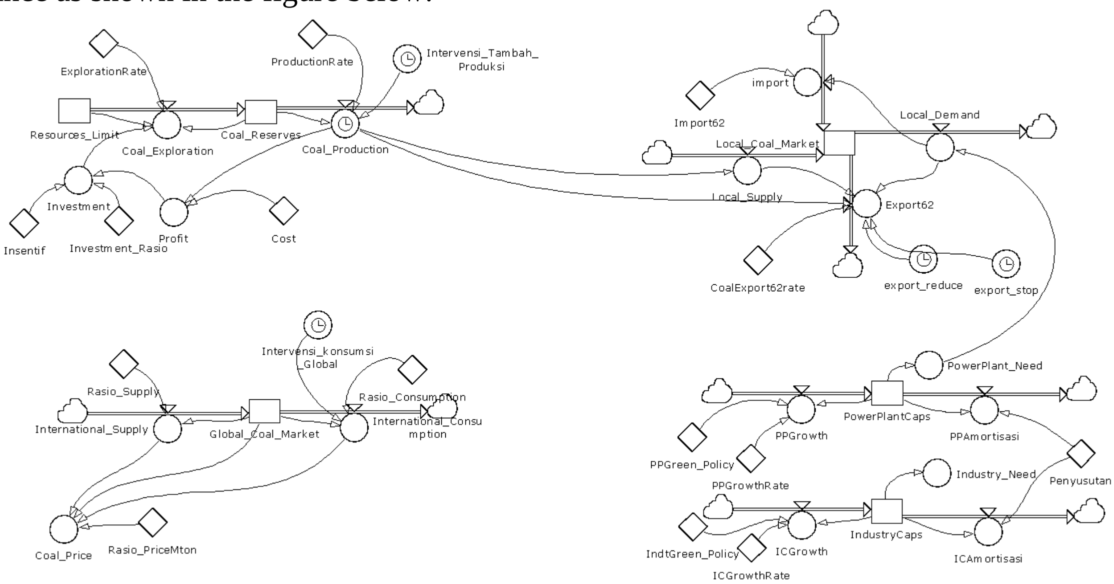


Illustration 3. Stock Flow Diagram – Indonesian Coal Governance

SFD Subsystem on Coal Reserves describes Indonesia's coal reserve supply chain. Reserves are determined by exploration activities to increase resources into coal reserves. Exploration activities will be able to add to the existing coal reserve data. This activity is influenced by the willingness of industry players to allocate budgets to carry out further exploration activities or exploration to find new sources of reserves. Of course, because coal is

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a non-renewable natural resource, there is a limit to the reserves it may get. Meanwhile, Indonesia's coal output is determined by the amount of production and its growth from year to year.

This SFD Market Subsystem describes the allotment of coal, namely for the domestic market and the export market. The domestic coal market is influenced by two main factors, namely the need for electricity generation and industrial needs. The need for electricity generation absorbs the largest proportion of the domestic coal market. Meanwhile, export needs are highly dependent on the growing demand for coal from consumer countries which are the destination for Indonesian coal exports.

The third subsystem of the SFD describes price fluctuations as reflected by the behavior that occurs in the global market which is influenced by supply factors and the needs of countries in the world for coal. Global coal consumption tends to experience a downward trend, especially in connection with the policies of a number of countries to reduce the use of fossil fuels which are considered environmentally unfriendly. In accordance with law of supply and demand, the behavior of coal supply and consumption affects the price of coal.

In summary, a number of factors that influence the governance of Indonesian coal are presented in the following table, with a grouping based on the following subsystems identifying possible interactions among the government (G), the private sector (P), and the community (C).

Table 5. Factors Affecting Indonesian Coal Governance

Subsystem	Factors in Indonesia Coal Governance	Interaction		
		G	P	C
Coal Reserves	Availability of coal in Indonesia			
	Amount of coal reserves and resources			
	Regulating production amount			
	Policy on production, including production permitting and production limitation	√		
	Policy on issuance of production permit	√	√	
	Government policy on continuing operation for permit holders	√		
	Limitation on land and permit	√	√	
	Limitation on supporting infrastructure	√	√	√
	Prevention of illegal coal mining/trade	√	√	√
	Exploration activity to find new reserves	√	√	
	Development exploration activity for adding/updating reserves data	√	√	
	Government policy relating to Reserves Security Funds	√		
Market	Allocation of production and/or market priority	√	√	
	Government policy relating to Domestic Market Obligation (DMO) and export	√		
	Growth of coal needs for coal-fired powerplant	√	√	
	Policies of national and global banks on funding powerplant		√	
	Growth of coal for industries		√	
	Government policy to increase the added-value of coal (downstream)	√		

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	Ratification of global policies to reduce carbon emission and climate change	√		
Price Fluctuation	Growth of global demands/consumption of coal			
	Growth of supply/production from coal-producing countries			
	Energy policies of coal-producing and coal-consuming countries			
	Global policies relating to substituting fossil energy with new and renewable energy			
	Findings of “clean” and economical technology		√	√
	Negative campaign relating to usage of fossil energy			√
	Global economic condition			

As seen in the table above, the identified factors in coal governance do not stand alone, showing that there are a number of interactions between parties, namely between the government, business actors, and also the community, including elements of civil society. There are also a number of factors involving the interaction of global stakeholders, whose scope is no longer in Indonesia alone. These interactions jointly affect the Indonesian coal governance system as modeled in the previous section.

One factual problem on the governance of Indonesia coal that is prominently visible is related to the availability of reserves and limited resources, including the increase in reserves from year to year; coal production and allotment, including details of requirements for the domestic market; as well as the coal market and its dynamics, including fluctuations in commodity prices which are influenced by levels of demand and supply. Indonesia's coal reserves are still relatively large when compared to the production rate. The largest portion of Indonesian coal production is for the needs of the export market. Domestic needs in the form of electricity generation and other industries do not absorb enough Indonesian coal production. As an economic theory with the law of supply and demand, changes in coal prices are determined by the international coal circulation. The amount of world production is still greater than the total world consumption. There is also a significant effect, namely the green policy to reduce carbon emissions supported by the development of environmentally friendly technology (green technology). With such a policy, the assumption is that there will be a limitation or at least a slowdown in coal consumption in the future.

The next stage is a simulation of the model created, which is intended to understand a phenomenon or process, which is then used in the analysis and forecasting of future behavior. Meanwhile, validation is carried out to determine the suitability of the simulation results with the imitated symptoms or processes. Validation is done by comparing the simulation results with real symptoms, field data, or processed calculation data. The model is considered valid if the error or deviation from the simulation results with imitated symptoms or processes is small.

Simulations are carried out to obtain a business as usual model, which portrays the reality that has occurred to date and at the same time predicts future conditions if there is no intervention or change in the variables forming the Indonesian coal governance system. One principle that can be an analogy for this modeling is the principle put forward by James Hutton, known as the Father of Geology, namely "the present is the key to the past". As is known in geology, current conditions can be a description of conditions that occurred in the past. While in system dynamics modeling, conditions that occurred in the past, based on relation patterns and empirical data, will provide an overview of conditions that will occur in the future.

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In this model, the level of production and supply for domestic needs and for the export market follows the current pattern of behavior. This means that no policy intervention has been taken to control and/or limit Indonesian coal production or supply to the export market.

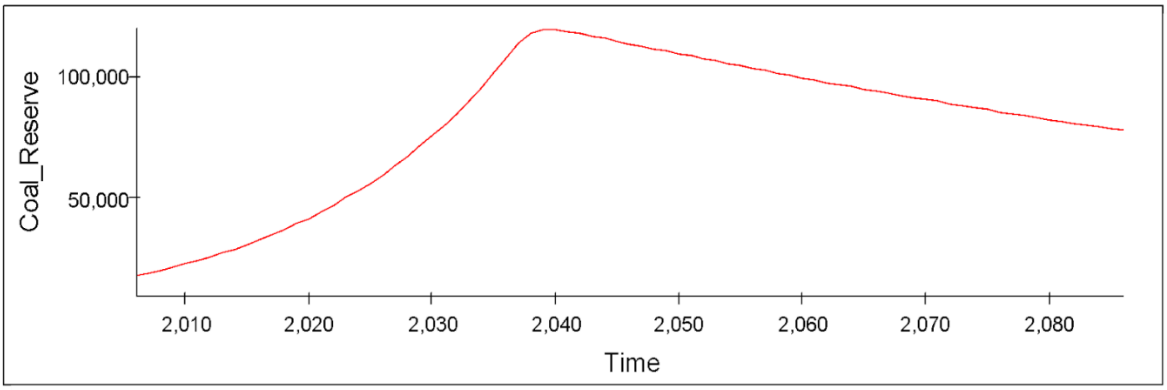

Illustration 4. Simulation on Coal Reserves

The figure above shows that by following the current production pattern, Indonesia's existing coal reserves and resources will be optimally utilized in 2040 as shown by the peak of the Reserves chart. This condition is built with the assumption that the addition of coal reserves from the existing resource potential follows the pattern of growth behavior that has occurred so far. This condition certainly reflects challenges that must be answered by the government as a regulator and coal mining industry players in carrying out further exploration activities.

The aforementioned pattern also creates uncertainty, namely how fast the continued exploration rate and growth of reserve data will be. If the discourse of a slowdown or even a stagnation in exploration activities actually occurs in the future, the growth in coal reserves may be a change that does not reflect the behavior that occurred in previous years. On the other hand, it is possible that the growth of reserves will be faster if the government, with its policy of allocating reserve security funds, can encourage that further development exploration be implemented properly and then mining industry players also respond to further exploration and update the reserve data in the area of their permit or work contract.

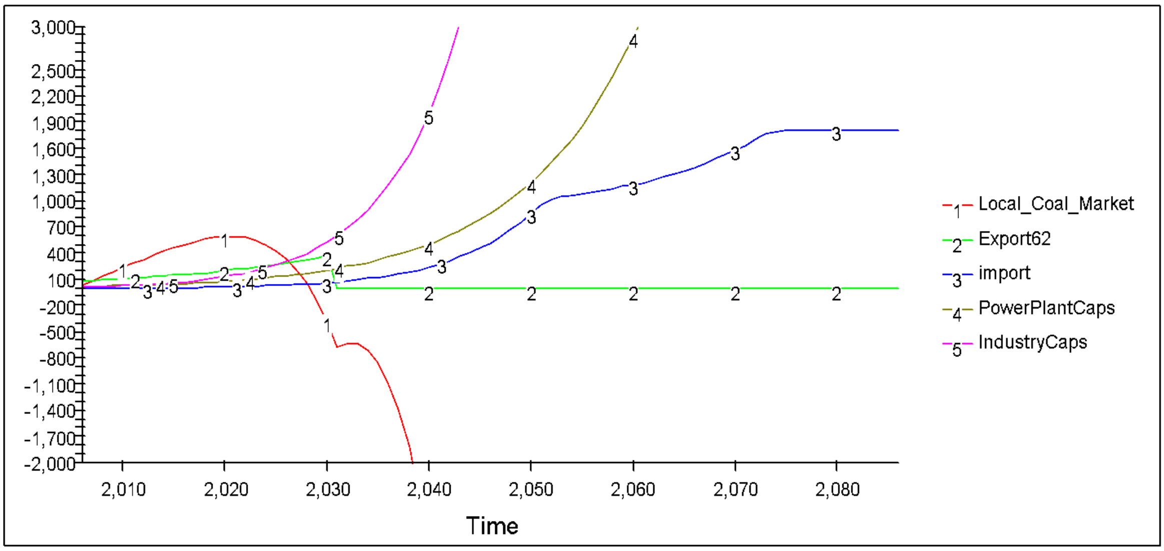

Illustration 5. Simulation on Dynamic Model of Indonesian Coal Governance

Meanwhile, from the Figure above, it can be seen that even though there is a growth in the amount of coal produced, it is estimated that the level of Indonesian coal production will still not able to optimally supply domestic demand. Production growth has not been able to keep up with the increasing demand for domestic power generation and industry; meanwhile, the composition of coal for export still follows the pattern of behavior so far. In 2030, coal availability for domestic market will thinned out, considering the growing demand for power generation and industry.

This condition needs to be addressed with appropriate and necessary anticipation, that coal production cannot meet domestic needs and especially for export purposes. Even though coal reserves and resources in Indonesia are still available in sufficient quantities. However, the rate of production is not easily boosted if the market is unable to provide sufficient profit for efforts to increase production. This condition will occur under the status quo assumption, in which the growth of coal production and the growth of power plants as well as the need for other industries is still at the current rate.

There are two possible alternatives to anticipate, namely intervention at the upstream process with increased production or intervention at the downstream process in the form of reducing consumption in power plants and industries with environmentally friendly policies and technologies. Technically, the determination of the intervention can be simulated with the required intervention scenario. In the real world, these interventions also need to be carried out by considering other macro environmental conditions that can be influenced or influence the model.

To find the leverage factor, analysis of the model is carried out by conducting a sensitivity test, namely by intervening in the parameters contained in the model. As a general rule, interventions are carried out by giving a higher value by 10 percent, which is then followed by an analysis of the impact taking into account changes in the reference value. Main attention is paid to the parameter with the highest sensitivity which is assessed as the most significant parameter affecting system performance. The parameter sensitivity test is carried out using Reserves and Local Market stocks as reference values.

The intervention that significantly affects Reserves is the Coal Exploration variable. Nevertheless, this intervention is no longer effective in the long term. In addition to exploration activities requiring additional investment, restrictions will occur because coal as a non-renewable natural resource will have limitations in its availability in nature - in contrast to renewable natural resources which can be continuously pursued in nature. Another intervention that affects Reserves is the Coal Production variable, where there are many (negative) changes to Indonesia's coal reserves. Meanwhile, interventions on other variables relatively did not show much change to the system.

The main discussion to develop alternative scenarios in the context of Indonesian coal governance that follows the “limit to growth” pattern is to determine the main objective to be achieved, between reaching the maximum point or maintaining availability as long as possible. The framework and assumptions used are the basis for developing alternative scenarios. The simulation as presented in the previous section, namely the business as usual condition that reflects the behavior in the current Indonesian coal governance model, indicates a market failure in 2030, in which there is a gap between supply and demand in the domestic market. It is also projected that conditions will not improve in the following years.

In the model simulation in the system dynamics method, alternative scenarios can be carried out by intervening with the variables in the model, namely by maintaining the basic structure of the model and changing the basic structure of the model. If the basic structure remains, changes are made to certain mechanisms and elements. Meanwhile, if the basic structure changes, changes occur in archetypes which are carried out with changes in the prevailing structure, environmental dynamics, or with alternative structures.

With the functional intervention method on the variables in the model, the simulation that shows the occurrence of market failure in 2030 cannot be improved significantly. Efforts to increase supply by stimulating production volumes will not be able to catch up with the void in the local market, if the desire and behavior to promote exports is not controlled. In practice, it is predicted that a reduction in export allocations will cause problems between the government (which still requires coal as a significant commodity for state revenue) and mining business actors whose current production capacity has not been fully absorbed by the local market. With a variety of simulations, it is ensured that functional interventions on each variable in the model will not provide a significant change from business as usual conditions, which reflect the behavior that has occurred so far in Indonesian coal governance.

This condition shows that changes in coal governance in Indonesia cannot be carried out only with a single intervention, even scenarios that involve linear intervention. Alternative scenarios need to be built based on the intervention of several variables, in line with the view that a strategy is not only dependent on a single policy, but more as an approach with multiple policy interventions. The alternative scenario is like a combination of the ability to "balance the gas pedal and brake." Improving the conditions that have progressed so far cannot only be done by intervening on one side or certain factors, without considering the conditions holistically.

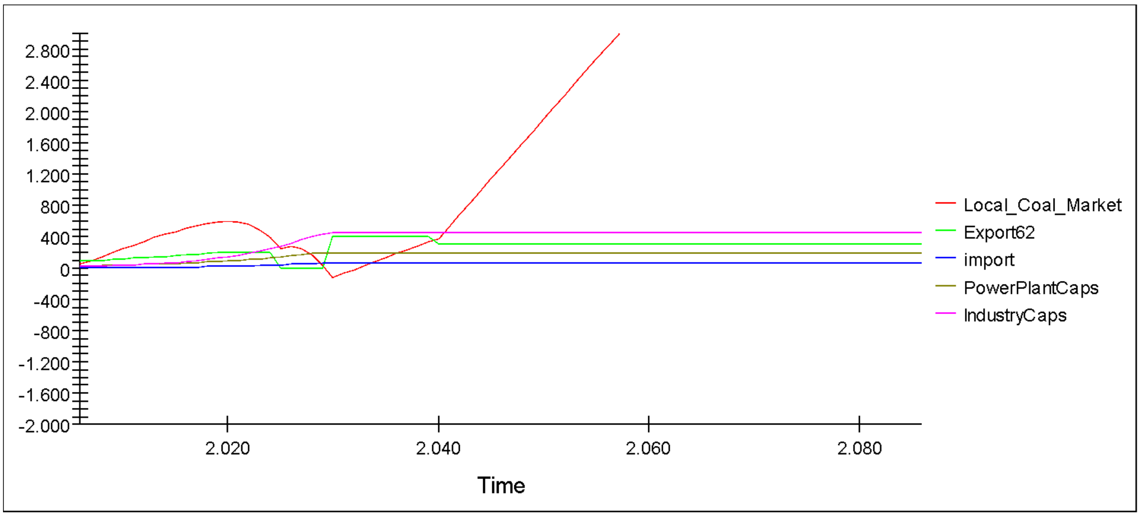

Illustration 6. "Pedal and Brakes" Scenario - Indonesian Coal Governance

Indonesia benefits from the availability and availability of coal, whose current reserves allow it to meet needs for at least the next 50-60 years. The next challenge is how to manage these benefits in order to provide optimal benefits in accordance with the objectives to be achieved. The prioritization of needs must be clearly formulated to determine scenarios for Indonesian coal governance that can be applied in the future. Empirical data shows that the increasing demand for Indonesian coal, especially for electricity generation which takes the largest portion and also for various other types of industry, is something that is likely to occur in line with population growth or economic growth. The work mechanism to suppress the growth of these needs can be implemented if green policy policies and green technology innovations that have competitive economic value and provide great benefits can be implemented properly. On the other hand, production growth must respond to demand growth, in which the need to prevent market failures in local markets must be accompanied by government policies to prioritize meeting domestic needs - in line with placing coal as part of the national energy security strategy. All of these conditions further emphasize that improving the governance of Indonesian coal is a complex issue, which requires the interaction of various parties.

Conclusion

Coal as a non-renewable natural resource is still an important source of energy for Indonesia, both in the past and, it is predicted, in the future. Analysis of various data and information in the research entitled Indonesian Coal Governance Scenario as described in the previous four chapters results in the conclusion that the dynamics of Indonesian coal governance are influenced by a number of factors by modeling in three main subsystems, namely coal reserves, market, and price fluctuations which are a reflection of the supply-demand chain, particularly in the global market. The governance of Indonesian coal is a multi-faceted governance, in which various policies, norms, and behavioral arrangements as an interaction between the government, business actors, and the community society, either individually or simultaneously, can influence the governance of Indonesian coal.

The pattern of relationships between factors, as reflected in behavior so far and based on model simulation, shows the tendency for market failure, namely the gap between supply and domestic demand in 2030. Another intervention that affects Reserves is the Coal Production variable, because intervention in exploration activities will ultimately face the limited availability of non-renewable resources in nature. Meanwhile, the intervention that most quickly affects the Local Market is the Local Supply variable.

Alternative scenarios are built based on the intervention of several variables, in line with the view that a strategy is not only dependent on a single policy, but more as an approach with multiple policy interventions. The alternative scenario that is considered ideal is like a combination of the ability "balance the gas pedal with the brake" because the improvement in conditions that have been running so far cannot only be done by intervening on one side or certain factors only, without considering the conditions holistically and comprehensively. Production capacity is controlled, in which the level of coal production is prioritized to meet domestic needs first, especially for the needs of power plants which have so far absorbed the largest allocation of Indonesian coal production. Next, the allocation of coal for export must also be limited. The opportunity to increase export capacity is open when the domestic fulfillment target has been reached and the domestic market capacity has reached a positive point, which is projected to occur after 2040.

Referring to the framework of thinking that "all models are wrong, but some are useful", there are a number of things that can be identified as key uncertainties that could have a significant influence on Indonesia's coal governance model in the future, such as the presence of new technology or policies that can minimize the use of coal energy. With the basic pattern of limit to growth, the management of non-renewable natural resources is faced with a choice between the desire to achieve the maximum possible benefits or the choice to maintain the availability of resources for a longer time. The common ground of (or at least an understanding from) all parties regarding these goals will sharpen scenarios of the future that can be developed.

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