

Supplementary Materials

Table A: Advantages and disadvantages of adopting a Complex Adaptive Systems Theory, Soft Systems Modeling and a Systems Thinking approaches (**extension Table 1**)

Approach	Advantages	Disadvantages
Complex Adaptive Systems (CAS) Theory	<p><i>Adaptability:</i> CAS Theory highlights the adaptability of systems to changing environments, which is relevant for dynamic and uncertain situations.</p> <p><i>Emergent properties:</i> CAS Theory recognizes the fact that complex systems exhibit an emergent behavior, which allows for a deeper understanding of the system.</p> <p><i>Non-linearity:</i> It considers the non-linear relationships and feedback loops within systems, providing insights into how small</p>	<p><i>Complexity:</i> Dealing with complex adaptive systems is challenging, and modeling them accurately may be computationally intensive.</p> <p><i>Lack of prescriptive solutions:</i> CAS Theory often focuses on understanding and describing the system rather than providing clear solutions, which can be a limitation in practical applications.</p> <p><i>Data requirements:</i> It may require extensive data in order to model and analyze complex systems, and obtaining these data is challenging itself.</p>

	<p>changes can lead to large and unpredictable consequences.</p> <p><i>Applicability:</i> CAS Theory is well-suited for analyzing complex, self-organizing systems, such as economies, social networks, and ecosystems.</p>	
<p>Soft Systems Modeling (SSM)</p>	<p><i>Human-centric approach:</i> SSM is particularly useful for addressing problems involving human activity systems. It emphasizes the role of stakeholders and their perceptions.</p> <p><i>Structured Process:</i> SSM provides a structured process for eliciting and modeling different viewpoints, making it a useful tool for addressing unstructured or ill-defined problems.</p>	<p><i>Subjectivity:</i> The subjective nature of stakeholders' perceptions can introduce biases and make the modeling process less objective.</p> <p><i>Limited scope:</i> SSM may not be as effective when dealing with highly technical or deterministic systems, where quantitative analysis is crucial.</p> <p><i>Resource intensive:</i> The process of engaging stakeholders and creating rich pictures can be time-consuming and resource-intensive.</p>

	<p><i>Rich pictures:</i> The technique of creating rich pictures in SSM helps in visualizing and communicating complex problem situations.</p>	
Systems Thinking (ST)	<p><i>Holistic approach:</i> ST takes a holistic approach, considering the interconnections and interdependencies within a system, leading to a more comprehensive understanding.</p> <p><i>Cross-disciplinary:</i> It is applicable across various disciplines and industries, providing a common framework for problem-solving.</p> <p><i>Feedback loops:</i> Emphasis on FLs allows for a better understanding of system dynamics.</p>	<p><i>Abstraction:</i> The abstraction in ST can lead to oversimplification of complex systems, potentially overlooking important details.</p> <p><i>Learning curve:</i> Mastering ST concepts can be challenging, especially for those new to the approach.</p> <p><i>Ambiguity:</i> ST may not often provide clear-cut solutions, as it is more about understanding and influencing complex systems, despite this strongly depends on the applicability.</p>

Table B- Causal Loop Diagram and Forrester diagrams related to the sustainability of the energy sector reported by the literature (Extension of the Table 2)

No.	Title	Aim	General description	Combination with other methods	Hypothesis/ Limitations
01	Hydrogen vehicle-infrastructure	To model the simple relationship between complementary goods in a vehicle-fueling station	This CLD contains a reinforcement feedback loop. With certain interventions, this system can move in a positive direction.	No	Actually this loop is acting in a negative direction because of limited incentives to build new refueling stations when vehicle populations are low. There are limited incentives to produce and purchase vehicles when the refueling infrastructure is lacking.

02	The Bass diffusion model	To model the timing of initial purchase of new products.	<p>When the population of adopters increase, there is more information shared among existing and potential users. Thus, the rate of adoption increases under the influence of reinforcing feedback. Then, at some point, this increasing behavior becomes self-sustaining. This is called the <i>critical mass</i> or the <i>tipping point</i> and refers to a point after which the technology achieves permanent market penetration.</p> <p>The curve ultimately flattens as the technology reaches its market saturation point.</p>	Regression Analysis	The probability of purchase at any time is linearly related to the number of previous buyers.
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03	<p>Hydrogen Vehicle and Infrastructure Simulator for Integrated and Operational Transportation Networks (H₂ VISION)</p>	<p>To simulate the diffusion paradigm related to H₂ FCV and refueling infrastructures.</p>	<p>H₂ VISION explores:</p> <ul style="list-style-type: none"> -the fundamental dynamics of the vehicle-infrastructure. -complementary goods phenomenon. -long-term main stream hydrogen technology diffusion. -consumer preferences regarding FCV. -convenience costs associated with refueling infrastructure. -the potential role that policies aimed at hydrogen technologies may play in market development. -the role of fleet operators, governments and other investors as early adopters of hydrogen technologies. 	<p>Probability theory</p>	<p>H₂ VISION does not consider:</p> <ul style="list-style-type: none"> -home- or residential- refueling options due to the high estimated cost associated with such methods. It explores refueling via refueling stations only. -spillover effects into the transportation sector from hydrogen technology advancements in other industries. -the development of distributed generation fuel cells has not been included. -impact of externalities such as the price of oil.
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04	The CLD of the Australian energy sector	<p>1)To design a conceptual model of the energy sector,</p> <p>2)to analyze the potential consequences of current energy development policies using this model,</p> <p>3)to provide suggestions for improvement of the policy</p>	<p>Sustainability-related issues and challenges of energy systems are manifold and complex involving competing stakeholder expectations.</p> <p>The authors outline crucial limitations of previous efforts and emphasize the importance of using systems thinking in addressing the energy sector’s sustainability challenges.</p> <p>Case study- Australian energy sector.</p> <p>Crucial challenges related to energy supply and use in Australia:</p>	<p>Expert consultation</p> <p>Fixes that Fail Archetype (FFA)- situations where unexpected consequences result from well-planned actions.</p>	-

		towards sustainable energy development.	<p>1)ensure that there are enough accessible energy sources,</p> <p>2)assess the impact of future energy dependency and high oil prices,</p> <p>3)reduce greenhouse gas emissions.</p>		
05	Green Hydrogen industry development model under different subsidy scenarios in China	To simulate the Green Hydrogen industry development in China considering different subsidy scenarios	<p>Green hydrogen subsidy policies can be mainly divided into two categories:</p> <p>1-the investment and operating costs.</p> <p>2-stimulating the utilization of hydrogen energy through subsidies for various applications.</p> <p>The new model considers:</p> <p>-multiple factors that affected the cost and profitability of Green Hydrogen production.</p>	-	

			<p>-the impact of various government subsidy policies on the development of the GH industry.</p> <p>-a new system consisting of Tradable Green Certificate (TGC) market module, power market module and GH production industry module for research.</p>		
06	Coordinated Development Capacity (CDC) of China's hydrogen energy industry chain	To simulate the CDC of hydrogen energy industry chain of China from 2016 to 2030.	<p>This research provides details to promote the coordinated development of China's hydrogen energy industry chain.</p> <p>-The evaluation index system is constructed and evaluated using the entropy method.</p>	<p>-Evolutionary game,</p> <p>-Delphi method,</p> <p>-Regression analysis,</p> <p>-PLS method,</p>	Due to the large number of factors contained in the hydrogen energy industry chain and the limited capacity of the model, only the factors with great influence can be included in the research process, while the factors that indirectly affect the

			<p>-This is the basis for identifying the key factors.</p> <p>-PLS regression method is used to identify the factors that have a strong influence or large variation between the two phases.</p>	<p>-Input-output analysis,</p> <p>-Multiobjective programming,</p> <p>-Integer programming.</p>	<p>CDC of the hydrogen energy industry chain may be missed, which need follow-up studies to refine.</p>
07	Hydrogen energy (Australia and Global)	To model the hydrogen energy system.	<p>This research focuses on:</p> <p>(1) using a systems thinking approach to build a conceptual model for hydrogen energy, with a special focus on the pathways of hydrogen use, to assess the potential consequences that could lead to unintended impacts, and possible interventions;</p>	-	<p>Energy demand growth has been taken as an exogenous variable, although other studies may take it as an endogenous variable.</p>

			(2) using a system dynamics approach to highlight the possible demand growth of hydrogen energy until 2050.		
08	System dynamics model for Green Hydrogen industry development	To study the policy impact under different terminal demand scenarios in China.	This paper studies the policy impact under different terminal demand scenarios based on a system dynamic model in China. Additionally, this study provides an exhaustive calculation method for computing the tension between supply and demand, which is determined by a comparison among the production, the demand and the reserve of GH.	No	It is based on the investment decision theory.

No.	Main variables/ loops	Database	Software	Previous CLD used	Translation to Flow Diagram	Stocks	Flows	Availability of equations
01	-Hydrogen Fuel Cell Vehicles. -Hydrogen Refueling Infrastructure.	-	-	-	-	-	-	-
02	-Potential Adopters -Adoption Rate -Adopters	Annual time series data for eleven different consumer durables.	-	-	Yes	-Potential adopters -Adopters	-Adoption rate	Yes

	-Adoption from advertising -Adoption from Word of Mouth -Total population -Adoption Fraction -Advertising Effectiveness							
03	H ₂ VISION CLD consists of multiple variables and	Data on demographics, consumer preferences,	STELLA	01-Hydrogen vehicle- infrastructure.	Yes	1)The core model captures the FCV and conventional vehicle	Depending on the sub- model	Yes

<p>six loops: four of which are reinforcing and two of which are balancing.</p> <p>The H₂ VISION system dynamics model is separated into three sections:</p> <p>1-the core H₂ VISION Model,</p>	<p>and vehicle and station attributes.</p>		<p>02-The Bass diffusion model.</p>		<p>populations, vehicle aging and demographics</p> <p>2)RSMS-SM captures the hydrogen and fossil fuel refueling station populations, the potential number of new stations.</p> <p>3)VMS-SM captures the market shares of FCV and</p>		
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	2-the refueling station market stores sub-model (RSMS-SM), 3-the vehicle market shares sub-model (VMS-SM).					conventional vehicles.		
04	The CLD includes reinforcing loops and balancing loops.	DISER. Australian Energy Statistics. 2020. Climate Change Performance	-	-	No	-	-	-

<p>There are: -energy production capacity- economic loops. -energy production capacity-social loop. -energy production capacity- emissions loops.</p>	<p>Index 2017 (CCPI).</p>							
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	-energy production capacity- energy policy development loops.							
05	-Electricity supply, -electricity demand, -Government subsidy, -GH production,	China Green Power Certificate Subscription Trading Platform (CGPCSTP), National Energy Administration	Vensim PLE 7.3.5	-	Yes	-RES CIP -GH CIP -FIT -TGC Inventory -TGC vacancy -TGC Market price variation -Electricity demand	-RES EIC -GH EIC -FIT Variation -TGC supply -TGC trading volume	Yes

	- Environmental benefits, -TGC supply.	(NEA), State Taxation Administration (STA), China EV100.					-TGC price variation -Electricity demand growth rate	
06	-Market demand, -employees, -technological innovation, -supply, -total assets	-Database of China hydrogen energy Alliance Research Institute. -Bulletin of listed companies.	Vensim PLE	-	Yes	-Market demand, -employees, -technological innovation, -supply, -total assets	-Change of market demand, -change of employees inflow and outflow, -change of technologic	Yes

		-China HowNet database. -Market analysis report. -China national Government Website, 2022					al innovation, -change of total assets	
07	The model consists of 7 reinforcing loops and 3 balancing loops	“Australian Energy Statistics”— Australian Energy Update report 2019–2020	Silico	-	Yes	-Transport, -Energy-intensive manufacturing, -Mining, -Export, -Electricity supply.	-Transport annual growth, - Manufactur ing annual growth,	No

<p>representing the following: -growth of hydrogen and renewable energy, -emissions mitigation, -supply- demand, -energy insecurity, -economic growth, -risk of adoption</p>						<p>-Mining annual growth, -Export annual growth, -Electricity annual growth.</p>	
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	hydrogen as a combustion fuel							
08	-Cumulative installed capacity, -governance expenditure, -cumulative investment, -hydrogen storage amount.	Data related to the GH production and policies in 2020	-	-	Yes	-Cumulative installed capacity, -governance expenditure, -cumulative investment, -hydrogen storage amount.	-New installed capacity, -New government expenditure, -unit installed cost, -input and output	Yes

							hydrogen flows	
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No.	Key factors	Model output	Conclusions	Future research	Reference
01	-	The relationship between the hydrogen FCV and the hydrogen refueling infrastructure.	Government policies that incentivize hydrogen FCV purchases may stimulate refueling infrastructure development. This would lead to more vehicle purchases.	Integration into other CLDs	Meyer and Winebrake, (2009)

02	During technology diffusion, the early majority will emulate the practices of the early adopters, and this is the key to widespread acceptance of technology.	The model implies exponential growth of initial purchases to a peak and then exponential decay.	<p>-Data for consumer durables are in good agreement with the model.</p> <p>-For planning purposes, the main interest is related to the forecast of the timing and magnitude of the sales peak.</p> <p>-Policies aimed at reaching the early majority need to be designed to ensure that diffusion will reach the critical mass of adopters.</p> <p>-When this critical mass is reached, the technology diffuses to other end-users, and policy incentives become less necessary.</p>	The model may be useful in providing a rationale for long-range forecasting.	Bass, (1969); Sternan, (2000); Meyer and Winebrake, (2009)
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03	<p>Four scenarios were analyzed considering different levels of infrastructure investment, FCV investment and hydrogen market condition.</p> <p>Only scenarios 2 and 3 succeeded.</p> <p>Scenario 2: Inf. Inv- high FCV Inv.-moderate H₂ market-moderate</p> <p>Scenario 3:</p>	<p>1)The core model- total vehicles operating by type (FCV and CV)</p> <p>2)RSMS-SM- essential data regarding total stations operating and the portion of those stations that are hydrogen or</p>	<p>-Focusing on infrastructure leads to faster hydrogen vehicle adoption and station construction (S2).</p> <p>-FCV market conditions will be extremely important for any FCV success.</p> <p>-Investments affecting only one of the complementary good may not be sufficient for FCV diffusion to occur.</p> <p>-Vehicle and fuel-oriented incentives must be accompanied by infrastructure-oriented incentives.</p> <p>-Any incentivization that takes attention to the respective complementary good will yield zero</p>	-	<p>Meyer and Winebrake, (2009)</p>
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	<p>Inf. Inv- very low</p> <p>FCV Inv.-high</p> <p>H₂ market-moderate</p>	<p>fossil fuel</p> <p>stations.</p>	<p>or drastically limited market</p> <p>penetration rates.</p>		
04	-	-	<p>-The sustainability of the energy sector is of paramount importance to ensure economic growth and societal development.</p> <p>-The advantages of system thinking greatly outweigh traditional linear approaches that have been previously used in formulating strategic levels of energy management policies and plans.</p>	<p>The developed CLD can serve as a reliable tool to establish a common understanding of the issues that influence sustainability of the energy sector and to provide opportunities for stakeholders to</p>	<p>Laimon et al., (2022)</p>

				share learning and vision planning.	
05	-	<p>-Government subsidies under different scenarios.</p> <p>-Income tax rate modes under different scenarios.</p> <p>-Electricity price for hydrogen production with different scenarios.</p>	<p>-The government's subsidy policies for investment production, hydrogen production electricity price and preferential income tax rate will promote the development of the GH industry to varying degrees.</p> <p>-There is no fixed subsidy methodology that is applicable in all situations.</p> <p>-Diverse subsidy policies are required to accommodate the technological level.</p>	-	Li et al., (2022)

		<p>-Hydrogen price under different scenarios.</p> <p>-Installation of green hydrogen in different government subsidy modes and the corresponding government expenditure.</p> <p>-Installation of green hydrogen in different</p>			
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		<p>electricity price.</p> <p>-The impact of different tax rates on installation of green hydrogen.</p> <p>-Cumulative capacity of green hydrogen in different learning rate.</p> <p>-Cumulative capacity of green hydrogen</p>			
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		in different hydrogen price.			
06	-Market demand, -employees, -technological innovation, -supply, -total assets	Dynamic behavior of the identified key factors.	-Build a science and technology innovation system. -Improve the policy and institutional guarantee system. -Promote the construction of hydrogen energy infrastructure. -Promote the diversified application of hydrogen energy.	To refine the model	Gao and An, (2022)
07	Using System Archetypes (SAs) for identifying leverage points.	-The potential global demand for hydrogen for four scenarios.	-A system dynamics approach was used to highlight the growth of the possible global demand of hydrogen energy until 2050, and	Implement the model in other countries, as the proposed model can be used in any country.	Yusaf et al., (2022)

		<p>-The potential hydrogen demand in the Australian context compared to the global demand for four scenarios</p>	<p>it has been linked to Australia's potential hydrogen demand in order to leverage global energy opportunities.</p> <p>-Findings indicate that hydrogen global demand is rising and ranges from 73 Mt (pessimistic case) to 568 Mt (optimistic case) by 2050.</p> <p>-For countries seeking to be leaders in hydrogen production like Australia, this is motivating news, as adopting hydrogen for some sectors (heavy and long-distance transport, energy-intensive manufacturing, mining,</p>		
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			<p>and grid electrical supply) and replacing fossil fuel (mainly gas) with hydrogen, for export, means that the Australian hydrogen demand could reach 55 Mt.</p> <p>-This study provides insights and information on the future of hydrogen energy demand and highlights the risks that may affect the sector, which may assist policy decision makers to understand and test their options for the transition to a hydrogen economy, which may enable more effective decisions and/or policy changes to</p>		
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			obtain much better outcomes and avoid undesirable ones.		
08	Appropriate and reasonable policy combination	GH supply under different levels of demand, and government expenditure under different levels of demand.	The results showed that under the circumstance of a 25% income tax, and no installation subsidy, the production capacity of the GH production industry can hardly meet the demand under different demand scenarios. Hence, finding an appropriate and reasonable policy combination is the right way for addressing the development of the GH industry, and to meet the demand for GH.	To use the model for the prediction of the GH industry scale in other places.	Yang et al., (2023)

List of loops corresponding to the integrated CLD

Loop Number 1 of length 3

H2 Sustainable Prod.

Economic Growth

Jobs

Social Acceptance

Loop Number 2 of length 3

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Loop Number 3 of length 4

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Loop Number 4 of length 4

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Energy safety

Loop Number 5 of length 4

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

Loop Number 6 of length 5

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Energy insecurity

Effect. of gov. policies

Loop Number 7 of length 5

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Energy insecurity

Energy safety

Loop Number 8 of length 5

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Investment in RE

Loop Number 9 of length 5

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Inv. Costs

Econ. Profits

Loop Number 10 of length 6

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 11 of length 6

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Loop Number 12 of length 6

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Energy insecurity

Effect. of gov. policies

Investment in RE

Loop Number 13 of length 6

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Demand

Energy insecurity

Energy safety

Loop Number 14 of length 6

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Loop Number 15 of length 6

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Energy prod. capacity

Energy insecurity

Energy safety

Loop Number 16 of length 6

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Investment in RE

Env. Sust.

Loop Number 17 of length 6

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Market price

Value of Prod.

Econ. Profits

Loop Number 18 of length 6

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Demand

Energy insecurity

Effect. of gov. policies

Loop Number 19 of length 7

H2 Sustainable Prod.

Energy prod. capacity

Integration with other RE sources

Supply

Reliability of intermittent RE resources

Energy insecurity

Investment in RE

Energy safety

Demand

Loop Number 21 of length 7

Energy prod. capacity

H2 Sustainable Prod.

Energy insecurity

Integration with other RE sources

Effect. of gov. policies

Reliability of intermittent RE resources

Loop Number 20 of length 7

Investment in RE

H2 Sustainable Prod.

Net CO2 emissions

Integration with other RE sources

Atmospheric GHG conc.

Reliability of intermittent RE resources

Global Warming

Investment in RE

Social Acceptance

Loop Number 22 of length 7

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Loop Number 23 of length 7

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Energy prod. capacity

Supply

Energy insecurity

Effect. of gov. policies

Loop Number 24 of length 7

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Market price

Demand

Energy insecurity

Effect. of gov. policies	Energy prod. capacity
Loop Number 25 of length 7	Supply
H2 Sustainable Prod.	Market price
Integration with other RE sources	Demand
Reliability of intermittent RE resources	Energy insecurity
Investment in RE	Energy safety
Net CO2 emissions	Loop Number 27 of length 7
Atmospheric GHG conc.	H2 Sustainable Prod.
Global Warming	Economic Growth
Env. Sust.	Energy prod. capacity
Loop Number 26 of length 7	Supply
H2 Sustainable Prod.	Energy insecurity
Economic Growth	Effect. of gov. policies

Investment in RE	Economic Growth
Env. Sust.	Energy prod. capacity
Loop Number 28 of length 7	Combustion pathway
H2 Sustainable Prod.	Nitrogen oxides
Economic Growth	Emissions
Energy prod. capacity	Environmental deterioration
Energy insecurity	Env. Sust.
Effect. of gov. policies	Loop Number 30 of length 7
Investment in RE	H2 Sustainable Prod.
Inv. Costs	Integration with other RE sources
Econ. Profits	Reliability of intermittent RE resources
Loop Number 29 of length 7	Investment in RE
H2 Sustainable Prod.	Demand

Energy prod. capacity	H2 Sustainable Prod.
Energy insecurity	Economic Growth
Energy safety	Energy prod. capacity
Loop Number 31 of length 7	Supply
H2 Sustainable Prod.	Market price
Integration with other RE sources	Demand
Reliability of intermittent RE resources	Energy insecurity
Investment in RE	Effect. of gov. policies
Uncertainty in fulfilling demand growth	Investment in RE
Inv Non-RE	Loop Number 33 of length 8
Inv. Costs	H2 Sustainable Prod.
Econ. Profits	Integration with other RE sources
Loop Number 32 of length 8	Reliability of intermittent RE resources

Investment in RE	Environmental deterioration
Energy prod. capacity	Policies encouraging reduction in emissions
New non-RE capacity	Investment in RE
Economic Growth	Loop Number 35 of length 8
Jobs	H2 Sustainable Prod.
Social Acceptance	Integration with other RE sources
Loop Number 34 of length 8	Reliability of intermittent RE resources
H2 Sustainable Prod.	Investment in RE
Economic Growth	Energy prod. capacity
Energy prod. capacity	Supply
Combustion pathway	Market price
Nitrogen oxides	Value of Prod.
Emissions	Econ. Profits

Loop Number 36 of length 8

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Env. Sust.

Loop Number 37 of length 8

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Energy prod. capacity

New RE capacity

Economic Growth

Jobs

Social Acceptance

Loop Number 38 of length 8

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Energy insecurity

Effect. of gov. policies	Effect. of gov. policies
Investment in RE	Loop Number 40 of length 8
Inv. Costs	H2 Sustainable Prod.
Econ. Profits	Economic Growth
Loop Number 39 of length 8	Energy prod. capacity
H2 Sustainable Prod.	Combustion pathway
Economic Growth	Nitrogen oxides
Energy prod. capacity	Emissions
Employment opportunities	Environmental deterioration
Immigration	Policies encouraging reduction in emissions
Population	Effect. of gov. policies
Demand	Loop Number 41 of length 8
Energy insecurity	H2 Sustainable Prod.

Economic Growth	Demand
Energy prod. capacity	Energy prod. capacity
Energy insecurity	Supply
Effect. of gov. policies	Energy insecurity
Supply	Effect. of gov. policies
Market price	Loop Number 43 of length 8
Value of Prod.	H2 Sustainable Prod.
Econ. Profits	Integration with other RE sources
Loop Number 42 of length 8	Reliability of intermittent RE resources
H2 Sustainable Prod.	Investment in RE
Integration with other RE sources	Demand
Reliability of intermittent RE resources	Energy prod. capacity
Investment in RE	Supply

Energy insecurity	H2 Sustainable Prod.
Energy safety	Integration with other RE sources
Loop Number 44 of length 8	Reliability of intermittent RE resources
H2 Sustainable Prod.	Investment in RE
Integration with other RE sources	Energy prod. capacity
Reliability of intermittent RE resources	Supply
Investment in RE	Gas exports
Energy prod. capacity	Energy insecurity
Supply	Energy safety
Gas exports	Loop Number 46 of length 8
Energy insecurity	H2 Sustainable Prod.
Effect. of gov. policies	Economic Growth
Loop Number 45 of length 8	Energy prod. capacity

Employment opportunities	Market price
Immigration	Demand
Population	Energy insecurity
Demand	Energy safety
Energy insecurity	Loop Number 48 of length 9
Energy safety	H2 Sustainable Prod.
Loop Number 47 of length 9	Economic Growth
H2 Sustainable Prod.	Energy prod. capacity
Integration with other RE sources	Supply
Reliability of intermittent RE resources	Market price
Investment in RE	Demand
Energy prod. capacity	Energy insecurity
Supply	Effect. of gov. policies

Investment in RE

Env. Sust.

Loop Number 49 of length 9

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 50 of length 9

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Demand

Energy prod. capacity

Supply

Market price

Value of Prod.

Econ. Profits

Loop Number 51 of length 9

H2 Sustainable Prod.

Integration with other RE sources	Investment in RE
Reliability of intermittent RE resources	Demand
Investment in RE	Energy prod. capacity
Demand	New RE capacity
Energy prod. capacity	Economic Growth
New non-RE capacity	Jobs
Economic Growth	Social Acceptance
Jobs	Loop Number 53 of length 9
Social Acceptance	H2 Sustainable Prod.
Loop Number 52 of length 9	Economic Growth
H2 Sustainable Prod.	Energy prod. capacity
Integration with other RE sources	Energy insecurity
Reliability of intermittent RE resources	Effect. of gov. policies

Investment in RE	Energy insecurity
Net CO2 emissions	Effect. of gov. policies
Atmospheric GHG conc.	Investment in RE
Global Warming	Loop Number 55 of length 9
Social Acceptance	H2 Sustainable Prod.
Loop Number 54 of length 9	Integration with other RE sources
H2 Sustainable Prod.	Reliability of intermittent RE resources
Economic Growth	Investment in RE
Energy prod. capacity	Energy prod. capacity
Employment opportunities	Combustion pathway
Immigration	Nitrogen oxides
Population	Emissions
Demand	Environmental deterioration

Env. Sust.

Loop Number 56 of length 9

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 57 of length 9

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Env. Sust.

Loop Number 58 of length 9

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity	Nitrogen oxides
Supply	Emissions
Gas exports	Environmental deterioration
Energy insecurity	Policies encouraging reduction in emissions
Effect. of gov. policies	Effect. of gov. policies
Investment in RE	Investment in RE
Inv. Costs	Loop Number 60 of length 9
Econ. Profits	H2 Sustainable Prod.
Loop Number 59 of length 9	Integration with other RE sources
H2 Sustainable Prod.	Reliability of intermittent RE resources
Economic Growth	Investment in RE
Energy prod. capacity	Energy prod. capacity
Combustion pathway	Supply

Market price	Energy insecurity
Demand	Effect. of gov. policies
Energy insecurity	Loop Number 62 of length 9
Effect. of gov. policies	H2 Sustainable Prod.
Loop Number 61 of length 9	Economic Growth
H2 Sustainable Prod.	Energy prod. capacity
Integration with other RE sources	Energy insecurity
Reliability of intermittent RE resources	Effect. of gov. policies
Investment in RE	Investment in RE
Demand	Uncertainty in fulfilling demand growth
Energy prod. capacity	Inv Non-RE
Supply	Inv. Costs
Gas exports	Econ. Profits

Loop Number 63 of length 9

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 64 of length 9

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Demand

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 65 of length 10

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE	Nitrogen oxides
Energy prod. capacity	Emissions
Energy insecurity	Environmental deterioration
Effect. of gov. policies	Policies encouraging reduction in emissions
Supply	Investment in RE
Market price	Inv. Costs
Value of Prod.	Econ. Profits
Econ. Profits	Loop Number 67 of length 10
Loop Number 66 of length 10	H2 Sustainable Prod.
H2 Sustainable Prod.	Integration with other RE sources
Economic Growth	Reliability of intermittent RE resources
Energy prod. capacity	Investment in RE
Combustion pathway	Energy prod. capacity

Employment opportunities	Investment in RE
Immigration	Uncertainty in fulfilling demand growth
Population	Inv Non-RE
Demand	Inv. Costs
Energy insecurity	Econ. Profits
Effect. of gov. policies	Loop Number 69 of length 10
Loop Number 68 of length 10	H2 Sustainable Prod.
H2 Sustainable Prod.	Integration with other RE sources
Economic Growth	Reliability of intermittent RE resources
Energy prod. capacity	Investment in RE
Supply	Demand
Energy insecurity	Energy insecurity
Effect. of gov. policies	Effect. of gov. policies

Supply	Effect. of gov. policies
Market price	Investment in RE
Value of Prod.	Env. Sust.
Econ. Profits	Loop Number 71 of length 10
Loop Number 70 of length 10	H2 Sustainable Prod.
H2 Sustainable Prod.	Economic Growth
Economic Growth	Energy prod. capacity
Energy prod. capacity	Supply
Combustion pathway	Energy insecurity
Nitrogen oxides	Effect. of gov. policies
Emissions	Investment in RE
Environmental deterioration	Net CO2 emissions
Policies encouraging reduction in emissions	Atmospheric GHG conc.

Global Warming	Effect. of gov. policies
Social Acceptance	Loop Number 73 of length 10
Loop Number 72 of length 10	H2 Sustainable Prod.
H2 Sustainable Prod.	Economic Growth
Integration with other RE sources	Energy prod. capacity
Reliability of intermittent RE resources	Supply
Investment in RE	Energy insecurity
Env. Sust.	Effect. of gov. policies
Fuel cell pathway	Investment in RE
Zero emission pathway	Net CO2 emissions
Emissions	Atmospheric GHG conc.
Environmental deterioration	Global Warming
Policies encouraging reduction in emissions	Env. Sust.

Loop Number 74 of length 10

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Demand

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Env. Sust.

Loop Number 75 of length 10

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Market price

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Inv. Costs

Econ. Profits

Loop Number 76 of length 10

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Env. Sust.

Loop Number 77 of length 10

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Energy safety

Loop Number 78 of length 10

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE	Net CO2 emissions
Energy prod. capacity	Atmospheric GHG conc.
Combustion pathway	Global Warming
Nitrogen oxides	Imports
Emissions	Concerns
Environmental deterioration	Policies encouraging reduction in CO2 emissions
Policies encouraging reduction in emissions	Effect. of gov. policies
Effect. of gov. policies	Loop Number 80 of length 11
Loop Number 79 of length 10	H2 Sustainable Prod.
H2 Sustainable Prod.	Economic Growth
Integration with other RE sources	Energy prod. capacity
Reliability of intermittent RE resources	Combustion pathway
Investment in RE	Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Demand

Energy insecurity

Effect. of gov. policies

Loop Number 81 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Inv. Costs

Econ. Profits

Loop Number 82 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 83 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Inv. Costs

Econ. Profits

Loop Number 84 of length 11

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

The adoption of H2 as a net zero fuel

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Loop Number 85 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Energy insecurity

Energy safety

Loop Number 86 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Investment in RE

Energy prod. capacity

Uncertainty in fulfilling demand growth

Energy insecurity

Inv Non-RE

Effect. of gov. policies

Net CO2 emissions

Supply

Atmospheric GHG conc.

Market price

Global Warming

Value of Prod.

Social Acceptance

Econ. Profits

Loop Number 87 of length 11

Loop Number 88 of length 11

H2 Sustainable Prod.

H2 Sustainable Prod.

Integration with other RE sources

Integration with other RE sources

Reliability of intermittent RE resources

Reliability of intermittent RE resources

Investment in RE

Investment in RE

Demand

Demand

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Loop Number 89 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Investment in RE

Inv. Costs

Econ. Profits

Loop Number 90 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 91 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 92 of length 11

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Inv Non-RE

Environmental deterioration

Net CO2 emissions

Policies encouraging reduction in emissions

Atmospheric GHG conc.

Investment in RE

Global Warming

Demand

Imports

Energy insecurity

Concerns

Energy safety

Policies encouraging reduction in CO2 emissions

Loop Number 93 of length 12

Effect. of gov. policies

H2 Sustainable Prod.

Loop Number 94 of length 12

Integration with other RE sources

H2 Sustainable Prod.

Reliability of intermittent RE resources

Economic Growth

Investment in RE

Energy prod. capacity

Uncertainty in fulfilling demand growth

Combustion pathway

Nitrogen oxides

Employment opportunities

Emissions

Immigration

Environmental deterioration

Population

Policies encouraging reduction in emissions

Demand

Investment in RE

Energy insecurity

Uncertainty in fulfilling demand growth

Effect. of gov. policies

Inv Non-RE

Supply

Inv. Costs

Market price

Econ. Profits

Value of Prod.

Loop Number 95 of length 12

Econ. Profits

H2 Sustainable Prod.

Loop Number 96 of length 12

Economic Growth

H2 Sustainable Prod.

Energy prod. capacity

Economic Growth

Energy prod. capacity

Supply

Market price

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 97 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Market price

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Inv. Costs

Econ. Profits

Loop Number 98 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 99 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 100 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 101 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 102 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Market price

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 103 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 104 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Investment in RE

Demand

Energy insecurity

Energy safety

Loop Number 105 of length 12

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Emissions

Policies encouraging reduction in emissions

Environmental deterioration

Effect. of gov. policies

Policies encouraging reduction in emissions

Energy dependancy

Effect. of gov. policies

Risk of supply disruption

Supply

Energy insecurity

Market price

Energy safety

Value of Prod.

Loop Number 106 of length 12

Econ. Profits

H2 Sustainable Prod.

Loop Number 107 of length 13

Economic Growth

H2 Sustainable Prod.

Energy prod. capacity

Integration with other RE sources

Combustion pathway

Reliability of intermittent RE resources

Nitrogen oxides

Investment in RE

Energy prod. capacity	Energy prod. capacity
Combustion pathway	Combustion pathway
Nitrogen oxides	Nitrogen oxides
Emissions	Emissions
Environmental deterioration	Environmental deterioration
Policies encouraging reduction in emissions	Policies encouraging reduction in emissions
Effect. of gov. policies	Effect. of gov. policies
Supply	Investment in RE
Energy insecurity	Net CO2 emissions
Energy safety	Atmospheric GHG conc.
Loop Number 108 of length 13	Global Warming
H2 Sustainable Prod.	Social Acceptance
Economic Growth	Loop Number 109 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 110 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 111 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 112 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 113 of length 13

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Energy insecurity

Energy safety

Loop Number 114 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Inv. Costs

Econ. Profits

Loop Number 115 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Inv. Costs

Econ. Profits

Loop Number 116 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Market price

Demand

Energy insecurity

Energy safety

Loop Number 117 of length 13

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Supply

Gas exports

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Loop Number 118 of length 13

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Energy insecurity

Energy safety

Loop Number 119 of length 13

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Energy prod. capacity

Env. Sust.

Combustion pathway

Fuel cell pathway

Nitrogen oxides

Zero emission pathway

Emissions

Emissions

Environmental deterioration

Environmental deterioration

Policies encouraging reduction in emissions

Policies encouraging reduction in emissions

Effect. of gov. policies

Effect. of gov. policies

Supply

Loop Number 120 of length 14

Market price

H2 Sustainable Prod.

Value of Prod.

Integration with other RE sources

Econ. Profits

Reliability of intermittent RE resources

Loop Number 121 of length 14

Investment in RE

H2 Sustainable Prod.

Economic Growth

Social Acceptance

Energy prod. capacity

Loop Number 122 of length 14

Supply

H2 Sustainable Prod.

Market price

Integration with other RE sources

Demand

Reliability of intermittent RE resources

Energy insecurity

Investment in RE

Effect. of gov. policies

Env. Sust.

Investment in RE

The adoption of H2 as a net zero fuel

Uncertainty in fulfilling demand growth

Fuel cell pathway

Inv Non-RE

Zero emission pathway

Net CO2 emissions

Emissions

Atmospheric GHG conc.

Environmental deterioration

Global Warming

Policies encouraging reduction in emissions

Effect. of gov. policies	Investment in RE
Supply	Uncertainty in fulfilling demand growth
Energy insecurity	Inv Non-RE
Energy safety	Net CO2 emissions
Loop Number 123 of length 14	Atmospheric GHG conc.
H2 Sustainable Prod.	Global Warming
Economic Growth	Env. Sust.
Energy prod. capacity	Loop Number 124 of length 14
Supply	H2 Sustainable Prod.
Market price	Integration with other RE sources
Demand	Reliability of intermittent RE resources
Energy insecurity	Investment in RE
Effect. of gov. policies	Energy prod. capacity

Employment opportunities	Energy prod. capacity
Immigration	Combustion pathway
Population	Nitrogen oxides
Demand	Emissions
Energy insecurity	Environmental deterioration
Effect. of gov. policies	Policies encouraging reduction in emissions
Supply	Investment in RE
Market price	Uncertainty in fulfilling demand growth
Value of Prod.	Inv Non-RE
Econ. Profits	Net CO2 emissions
Loop Number 125 of length 14	Atmospheric GHG conc.
H2 Sustainable Prod.	Global Warming
Economic Growth	Env. Sust.

Loop Number 126 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

The adoption of H2 as a net zero fuel

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Loop Number 127 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Energy dependancy

Risk of supply disruption

Energy insecurity

Energy safety

Loop Number 128 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Energy dependancy

Risk of supply disruption

Energy insecurity

Energy safety

Loop Number 129 of length 14

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 130 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 131 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 132 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Demand

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Energy prod. capacity

Emissions

Combustion pathway

Environmental deterioration

Nitrogen oxides

Policies encouraging reduction in emissions

Emissions

Effect. of gov. policies

Environmental deterioration

Supply

Policies encouraging reduction in emissions

Energy insecurity

Effect. of gov. policies

Energy safety

Supply

Loop Number 133 of length 14

Gas exports

H2 Sustainable Prod.

Energy insecurity

Integration with other RE sources

Energy safety

Reliability of intermittent RE resources

Loop Number 134 of length 14

Investment in RE

H2 Sustainable Prod.

Integration with other RE sources

Econ. Profits

Reliability of intermittent RE resources

Loop Number 135 of length 14

Investment in RE

H2 Sustainable Prod.

Env. Sust.

Integration with other RE sources

Fuel cell pathway

Reliability of intermittent RE resources

Zero emission pathway

Investment in RE

Emissions

Net CO2 emissions

Environmental deterioration

Atmospheric GHG conc.

Policies encouraging reduction in emissions

Global Warming

Effect. of gov. policies

Imports

Supply

Concerns

Market price

Policies encouraging reduction in CO2 emissions

Value of Prod.

Effect. of gov. policies

Energy dependancy

Risk of supply disruption

Energy insecurity

Energy safety

Loop Number 136 of length 14

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Market price

Value of Prod.

Econ. Profits

Loop Number 137 of length 15

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

The adoption of H2 as a net zero fuel	Economic Growth
Fuel cell pathway	Energy prod. capacity
Zero emission pathway	Combustion pathway
Emissions	Nitrogen oxides
Environmental deterioration	Emissions
Policies encouraging reduction in emissions	Environmental deterioration
Effect. of gov. policies	Policies encouraging reduction in emissions
Energy dependancy	Effect. of gov. policies
Risk of supply disruption	Investment in RE
Energy insecurity	Uncertainty infulfilling demand growth
Energy safety	Inv Non-RE
Loop Number 138 of length 15	Net CO2 emissions
H2 Sustainable Prod.	Atmospheric GHG conc.

Global Warming	Policies encouraging reduction in emissions
Env. Sust.	Effect. of gov. policies
Loop Number 139 of length 15	Energy dependancy
H2 Sustainable Prod.	Risk of supply disruption
Integration with other RE sources	Energy insecurity
Reliability of intermittent RE resources	Energy safety
Investment in RE	Loop Number 140 of length 15
Demand	H2 Sustainable Prod.
Energy prod. capacity	Integration with other RE sources
Combustion pathway	Reliability of intermittent RE resources
Nitrogen oxides	Investment in RE
Emissions	Demand
Environmental deterioration	Energy prod. capacity

Combustion pathway	Reliability of intermittent RE resources
Nitrogen oxides	Investment in RE
Emissions	Energy prod. capacity
Environmental deterioration	Combustion pathway
Policies encouraging reduction in emissions	Nitrogen oxides
Effect. of gov. policies	Emissions
Supply	Environmental deterioration
Market price	Policies encouraging reduction in emissions
Value of Prod.	Effect. of gov. policies
Econ. Profits	Supply
Loop Number 141 of length 15	Market price
H2 Sustainable Prod.	Demand
Integration with other RE sources	Energy insecurity

Energy safety
Loop Number 142 of length 15
H2 Sustainable Prod.
Economic Growth
Energy prod. capacity
Employment opportunities
Immigration
Population
Demand
Energy insecurity
Effect. of gov. policies
Investment in RE
Uncertainty in fulfilling demand growth

Inv Non-RE
Net CO2 emissions
Atmospheric GHG conc.
Global Warming
Env. Sust.
Loop Number 143 of length 15
H2 Sustainable Prod.
Economic Growth
Energy prod. capacity
Combustion pathway
Nitrogen oxides
Emissions
Environmental deterioration

Policies encouraging reduction in emissions	Combustion pathway
Investment in RE	Nitrogen oxides
Net CO2 emissions	Emissions
Atmospheric GHG conc.	Environmental deterioration
Global Warming	Policies encouraging reduction in emissions
Imports	Effect. of gov. policies
Concerns	Investment in RE
Policies encouraging reduction in CO2 emissions	Uncertainty in fulfilling demand growth
Effect. of gov. policies	Inv Non-RE
Loop Number 144 of length 15	Net CO2 emissions
H2 Sustainable Prod.	Atmospheric GHG conc.
Economic Growth	Global Warming
Energy prod. capacity	Social Acceptance

Loop Number 145 of length 15

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

The adoption of H2 as a net zero fuel

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 146 of length 15

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Market price

Demand

Energy insecurity

Energy safety

Loop Number 147 of length 15

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Employment opportunities

Immigration

Population

Demand

Energy insecurity

Effect. of gov. policies

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Social Acceptance

Loop Number 148 of length 15

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Loop Number 149 of length 15

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Demand	Fuel cell pathway
Energy insecurity	Zero emission pathway
Effect. of gov. policies	Emissions
Supply	Environmental deterioration
Market price	Policies encouraging reduction in emissions
Value of Prod.	Effect. of gov. policies
Econ. Profits	Supply
Loop Number 150 of length 15	Market price
H2 Sustainable Prod.	Demand
Integration with other RE sources	Energy insecurity
Reliability of intermittent RE resources	Energy safety
Investment in RE	Loop Number 151 of length 15
Env. Sust.	H2 Sustainable Prod.

Integration with other RE sources

Energy insecurity

Reliability of intermittent RE resources

Energy safety

Investment in RE

Loop Number 152 of length 15

Demand

H2 Sustainable Prod.

Energy prod. capacity

Integration with other RE sources

Combustion pathway

Reliability of intermittent RE resources

Nitrogen oxides

Investment in RE

Emissions

Uncertainty in fulfilling demand growth

Environmental deterioration

Inv Non-RE

Policies encouraging reduction in emissions

Net CO2 emissions

Effect. of gov. policies

Atmospheric GHG conc.

Supply

Global Warming

Gas exports

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Energy insecurity

Energy safety

Loop Number 153 of length 15

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

The adoption of H2 as a net zero fuel

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Market price

Value of Prod.

Econ. Profits

Loop Number 154 of length 16

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Energy insecurity

Investment in RE

Energy safety

Net CO2 emissions

Loop Number 155 of length 16

Atmospheric GHG conc.

H2 Sustainable Prod.

Global Warming

Integration with other RE sources

Env. Sust.

Reliability of intermittent RE resources

Fuel cell pathway

Investment in RE

Zero emission pathway

Uncertainty in fulfilling demand growth

Emissions

Inv Non-RE

Environmental deterioration

Net CO2 emissions

Policies encouraging reduction in emissions

Atmospheric GHG conc.

Effect. of gov. policies

Global Warming

Supply

Imports

Concerns	Inv Non-RE
Policies encouraging reduction in CO2 emissions	Net CO2 emissions
Effect. of gov. policies	Atmospheric GHG conc.
Energy dependancy	Global Warming
Risk of supply disruption	Imports
Energy insecurity	Concerns
Energy safety	Policies encouraging reduction in CO2 emissions
Loop Number 156 of length 16	Effect. of gov. policies
H2 Sustainable Prod.	Supply
Integration with other RE sources	Market price
Reliability of intermittent RE resources	Value of Prod.
Investment in RE	Econ. Profits
Uncertainty infulfilling demand growth	Loop Number 157 of length 16

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 158 of length 16

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Market price

Demand

Energy prod. capacity

Energy insecurity

Energy safety

Loop Number 159 of length 16

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Market price

Demand

Energy prod. capacity

Energy insecurity

Energy safety	Effect. of gov. policies
Loop Number 160 of length 16	Supply
H2 Sustainable Prod.	Market price
Integration with other RE sources	Demand
Reliability of intermittent RE resources	Energy insecurity
Investment in RE	Energy safety
Env. Sust.	Loop Number 161 of length 16
The adoption of H2 as a net zero fuel	H2 Sustainable Prod.
Fuel cell pathway	Integration with other RE sources
Zero emission pathway	Reliability of intermittent RE resources
Emissions	Investment in RE
Environmental deterioration	Uncertainty in fulfilling demand growth
Policies encouraging reduction in emissions	Inv Non-RE

Net CO2 emissions	Integration with other RE sources
Atmospheric GHG conc.	Reliability of intermittent RE resources
Global Warming	Investment in RE
Env. Sust.	Net CO2 emissions
The adoption of H2 as a net zero fuel	Atmospheric GHG conc.
Fuel cell pathway	Global Warming
Zero emission pathway	Env. Sust.
Emissions	The adoption of H2 as a net zero fuel
Environmental deterioration	Fuel cell pathway
Policies encouraging reduction in emissions	Zero emission pathway
Effect. of gov. policies	Emissions
Loop Number 162 of length 17	Environmental deterioration
H2 Sustainable Prod.	Policies encouraging reduction in emissions

Effect. of gov. policies	Investment in RE
Supply	Uncertainty in fulfilling demand growth
Energy insecurity	Inv Non-RE
Energy safety	Net CO2 emissions
Loop Number 163 of length 17	Atmospheric GHG conc.
H2 Sustainable Prod.	Global Warming
Economic Growth	Imports
Energy prod. capacity	Concerns
Combustion pathway	Policies encouraging reduction in CO2 emissions
Nitrogen oxides	Effect. of gov. policies
Emissions	Loop Number 164 of length 17
Environmental deterioration	H2 Sustainable Prod.
Policies encouraging reduction in emissions	Integration with other RE sources

Reliability of intermittent RE resources

Energy prod. capacity

Investment in RE

Energy insecurity

Env. Sust.

Energy safety

The adoption of H2 as a net zero fuel

Loop Number 165 of length 17

Fuel cell pathway

H2 Sustainable Prod.

Zero emission pathway

Integration with other RE sources

Emissions

Reliability of intermittent RE resources

Environmental deterioration

Investment in RE

Policies encouraging reduction in emissions

Net CO2 emissions

Effect. of gov. policies

Atmospheric GHG conc.

Supply

Global Warming

Market price

Env. Sust.

Demand

Fuel cell pathway

Zero emission pathway	Investment in RE
Emissions	Net CO2 emissions
Environmental deterioration	Atmospheric GHG conc.
Policies encouraging reduction in emissions	Global Warming
Effect. of gov. policies	Env. Sust.
Supply	Fuel cell pathway
Market price	Zero emission pathway
Value of Prod.	Emissions
Econ. Profits	Environmental deterioration
Loop Number 166 of length 17	Policies encouraging reduction in emissions
H2 Sustainable Prod.	Effect. of gov. policies
Integration with other RE sources	Supply
Reliability of intermittent RE resources	Gas exports

Energy insecurity	Concerns
Energy safety	Policies encouraging reduction in CO2 emissions
Loop Number 167 of length 17	Effect. of gov. policies
H2 Sustainable Prod.	Supply
Integration with other RE sources	Market price
Reliability of intermittent RE resources	Demand
Investment in RE	Energy insecurity
Uncertainty in fulfilling demand growth	Energy safety
Inv Non-RE	Loop Number 168 of length 17
Net CO2 emissions	H2 Sustainable Prod.
Atmospheric GHG conc.	Integration with other RE sources
Global Warming	Reliability of intermittent RE resources
Imports	Investment in RE

Net CO2 emissions

Energy safety

Atmospheric GHG conc.

Loop Number 169 of length 18

Global Warming

H2 Sustainable Prod.

Env. Sust.

Economic Growth

Fuel cell pathway

Energy prod. capacity

Zero emission pathway

Combustion pathway

Emissions

Nitrogen oxides

Environmental deterioration

Emissions

Policies encouraging reduction in emissions

Environmental deterioration

Effect. of gov. policies

Policies encouraging reduction in emissions

Energy dependancy

Investment in RE

Risk of supply disruption

Net CO2 emissions

Energy insecurity

Atmospheric GHG conc.

Global Warming	Net CO2 emissions
Imports	Atmospheric GHG conc.
Concerns	Global Warming
Policies encouraging reduction in CO2 emissions	Env. Sust.
Effect. of gov. policies	The adoption of H2 as a net zero fuel
Supply	Fuel cell pathway
Energy insecurity	Zero emission pathway
Energy safety	Emissions
Loop Number 170 of length 18	Environmental deterioration
H2 Sustainable Prod.	Policies encouraging reduction in emissions
Integration with other RE sources	Effect. of gov. policies
Reliability of intermittent RE resources	Supply
Investment in RE	Market price

Value of Prod.	Effect. of gov. policies
Econ. Profits	Supply
Loop Number 171 of length 18	Market price
H2 Sustainable Prod.	Demand
Integration with other RE sources	Energy prod. capacity
Reliability of intermittent RE resources	New RE capacity
Investment in RE	Economic Growth
Env. Sust.	Jobs
Fuel cell pathway	Social Acceptance
Zero emission pathway	Loop Number 172 of length 18
Emissions	H2 Sustainable Prod.
Environmental deterioration	Integration with other RE sources
Policies encouraging reduction in emissions	Reliability of intermittent RE resources

Investment in RE

Economic Growth

Net CO2 emissions

Jobs

Atmospheric GHG conc.

Social Acceptance

Global Warming

Loop Number 173 of length 18

Imports

H2 Sustainable Prod.

Concerns

Integration with other RE sources

Policies encouraging reduction in CO2 emissions

Reliability of intermittent RE resources

Effect. of gov. policies

Investment in RE

Supply

Net CO2 emissions

Market price

Atmospheric GHG conc.

Demand

Global Warming

Energy prod. capacity

Env. Sust.

New non-RE capacity

Fuel cell pathway

Zero emission pathway	Reliability of intermittent RE resources
Emissions	Investment in RE
Environmental deterioration	Uncertainty in fulfilling demand growth
Policies encouraging reduction in emissions	Inv Non-RE
Effect. of gov. policies	Net CO2 emissions
Supply	Atmospheric GHG conc.
Market price	Global Warming
Demand	Env. Sust.
Energy insecurity	Fuel cell pathway
Energy safety	Zero emission pathway
Loop Number 174 of length 18	Emissions
H2 Sustainable Prod.	Environmental deterioration
Integration with other RE sources	Policies encouraging reduction in emissions

Effect. of gov. policies	Concerns
Supply	Policies encouraging reduction in CO2 emissions
Energy insecurity	Effect. of gov. policies
Energy safety	Supply
Loop Number 175 of length 18	Market price
H2 Sustainable Prod.	Demand
Integration with other RE sources	Energy prod. capacity
Reliability of intermittent RE resources	New RE capacity
Investment in RE	Economic Growth
Net CO2 emissions	Jobs
Atmospheric GHG conc.	Social Acceptance
Global Warming	Loop Number 176 of length 18
Imports	H2 Sustainable Prod.

Integration with other RE sources

Energy prod. capacity

Reliability of intermittent RE resources

New non-RE capacity

Investment in RE

Economic Growth

Env. Sust.

Jobs

Fuel cell pathway

Social Acceptance

Zero emission pathway

Loop Number 177 of length 18

Emissions

H2 Sustainable Prod.

Environmental deterioration

Integration with other RE sources

Policies encouraging reduction in emissions

Reliability of intermittent RE resources

Effect. of gov. policies

Investment in RE

Supply

Uncertainty in fulfilling demand growth

Market price

Inv Non-RE

Demand

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Market price

Demand

Energy prod. capacity

Energy insecurity

Energy safety

Loop Number 178 of length 18

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

The adoption of H2 as a net zero fuel

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions	Global Warming
Effect. of gov. policies	Env. Sust.
Supply	The adoption of H2 as a net zero fuel
Gas exports	Fuel cell pathway
Energy insecurity	Zero emission pathway
Energy safety	Emissions
Loop Number 179 of length 18	Environmental deterioration
H2 Sustainable Prod.	Policies encouraging reduction in emissions
Integration with other RE sources	Effect. of gov. policies
Reliability of intermittent RE resources	Energy dependancy
Investment in RE	Risk of supply disruption
Net CO2 emissions	Energy insecurity
Atmospheric GHG conc.	Energy safety

Loop Number 180 of length 19

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 181 of length 19

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Net CO2 emissions

Demand

Atmospheric GHG conc.

Energy insecurity

Global Warming

Energy safety

Env. Sust.

Loop Number 182 of length 19

The adoption of H2 as a net zero fuel

H2 Sustainable Prod.

Fuel cell pathway

Economic Growth

Zero emission pathway

Energy prod. capacity

Emissions

Combustion pathway

Environmental deterioration

Nitrogen oxides

Policies encouraging reduction in emissions

Emissions

Effect. of gov. policies

Environmental deterioration

Supply

Policies encouraging reduction in emissions

Market price

Investment in RE

Net CO2 emissions	Integration with other RE sources
Atmospheric GHG conc.	Reliability of intermittent RE resources
Global Warming	Investment in RE
Imports	Uncertainty in fulfilling demand growth
Concerns	Inv Non-RE
Policies encouraging reduction in CO2 emissions	Net CO2 emissions
Effect. of gov. policies	Atmospheric GHG conc.
Supply	Global Warming
Gas exports	Env. Sust.
Energy insecurity	The adoption of H2 as a net zero fuel
Energy safety	Fuel cell pathway
Loop Number 183 of length 19	Zero emission pathway
H2 Sustainable Prod.	Emissions

Environmental deterioration	Environmental deterioration
Policies encouraging reduction in emissions	Policies encouraging reduction in emissions
Effect. of gov. policies	Investment in RE
Supply	Net CO2 emissions
Energy insecurity	Atmospheric GHG conc.
Energy safety	Global Warming
Loop Number 184 of length 19	Imports
H2 Sustainable Prod.	Concerns
Economic Growth	Policies encouraging reduction in CO2 emissions
Energy prod. capacity	Effect. of gov. policies
Combustion pathway	Energy dependancy
Nitrogen oxides	Risk of supply disruption
Emissions	Energy insecurity

Energy safety	Global Warming
Loop Number 185 of length 19	Imports
H2 Sustainable Prod.	Concerns
Economic Growth	Policies encouraging reduction in CO2 emissions
Energy prod. capacity	Effect. of gov. policies
Combustion pathway	Supply
Nitrogen oxides	Market price
Emissions	Value of Prod.
Environmental deterioration	Econ. Profits
Policies encouraging reduction in emissions	Loop Number 186 of length 19
Investment in RE	H2 Sustainable Prod.
Net CO2 emissions	Integration with other RE sources
Atmospheric GHG conc.	Reliability of intermittent RE resources

Investment in RE

Energy dependancy

Uncertainty in fulfilling demand growth

Risk of supply disruption

Inv Non-RE

Energy insecurity

Net CO2 emissions

Energy safety

Atmospheric GHG conc.

Loop Number 187 of length 19

Global Warming

H2 Sustainable Prod.

Env. Sust.

Integration with other RE sources

Fuel cell pathway

Reliability of intermittent RE resources

Zero emission pathway

Investment in RE

Emissions

Env. Sust.

Environmental deterioration

The adoption of H2 as a net zero fuel

Policies encouraging reduction in emissions

Fuel cell pathway

Effect. of gov. policies

Zero emission pathway

Emissions

H2 Sustainable Prod.

Environmental deterioration

Integration with other RE sources

Policies encouraging reduction in emissions

Reliability of intermittent RE resources

Effect. of gov. policies

Investment in RE

Supply

Env. Sust.

Market price

The adoption of H2 as a net zero fuel

Demand

Fuel cell pathway

Energy prod. capacity

Zero emission pathway

New non-RE capacity

Emissions

Economic Growth

Environmental deterioration

Jobs

Policies encouraging reduction in emissions

Social Acceptance

Effect. of gov. policies

Loop Number 188 of length 19

Supply

Market price	Inv Non-RE
Demand	Net CO2 emissions
Energy prod. capacity	Atmospheric GHG conc.
New RE capacity	Global Warming
Economic Growth	Env. Sust.
Jobs	Fuel cell pathway
Social Acceptance	Zero emission pathway
Loop Number 189 of length 19	Emissions
H2 Sustainable Prod.	Environmental deterioration
Integration with other RE sources	Policies encouraging reduction in emissions
Reliability of intermittent RE resources	Effect. of gov. policies
Investment in RE	Supply
Uncertainty in fulfilling demand growth	Market price

Value of Prod.	Emissions
Econ. Profits	Environmental deterioration
Loop Number 190 of length 19	Policies encouraging reduction in emissions
H2 Sustainable Prod.	Effect. of gov. policies
Integration with other RE sources	Supply
Reliability of intermittent RE resources	Market price
Investment in RE	Demand
Net CO2 emissions	Energy prod. capacity
Atmospheric GHG conc.	Energy insecurity
Global Warming	Energy safety
Env. Sust.	Loop Number 191 of length 19
Fuel cell pathway	H2 Sustainable Prod.
Zero emission pathway	Integration with other RE sources

Reliability of intermittent RE resources

Combustion pathway

Investment in RE

Nitrogen oxides

Net CO2 emissions

Emissions

Atmospheric GHG conc.

Environmental deterioration

Global Warming

Env. Sust.

Imports

Loop Number 192 of length 20

Concerns

H2 Sustainable Prod.

Policies encouraging reduction in CO2 emissions

Integration with other RE sources

Effect. of gov. policies

Reliability of intermittent RE resources

Supply

Investment in RE

Market price

Uncertainty in fulfilling demand growth

Demand

Inv Non-RE

Energy prod. capacity

Net CO2 emissions

Atmospheric GHG conc.

Social Acceptance

Global Warming

Loop Number 193 of length 20

Imports

H2 Sustainable Prod.

Concerns

Economic Growth

Policies encouraging reduction in CO2 emissions

Energy prod. capacity

Effect. of gov. policies

Combustion pathway

Supply

Nitrogen oxides

Market price

Emissions

Demand

Environmental deterioration

Energy prod. capacity

Policies encouraging reduction in emissions

New RE capacity

Investment in RE

Economic Growth

Net CO2 emissions

Jobs

Atmospheric GHG conc.

Global Warming	Reliability of intermittent RE resources
Imports	Investment in RE
Concerns	Uncertainty in fulfilling demand growth
Policies encouraging reduction in CO2 emissions	Inv Non-RE
Effect. of gov. policies	Net CO2 emissions
Supply	Atmospheric GHG conc.
Market price	Global Warming
Demand	Env. Sust.
Energy insecurity	The adoption of H2 as a net zero fuel
Energy safety	Fuel cell pathway
Loop Number 194 of length 20	Zero emission pathway
H2 Sustainable Prod.	Emissions
Integration with other RE sources	Environmental deterioration

Policies encouraging reduction in emissions	Net CO2 emissions
Effect. of gov. policies	Atmospheric GHG conc.
Energy dependancy	Global Warming
Risk of supply disruption	Env. Sust.
Energy insecurity	The adoption of H2 as a net zero fuel
Energy safety	Fuel cell pathway
Loop Number 195 of length 20	Zero emission pathway
H2 Sustainable Prod.	Emissions
Integration with other RE sources	Environmental deterioration
Reliability of intermittent RE resources	Policies encouraging reduction in emissions
Investment in RE	Effect. of gov. policies
Uncertainty infulfilling demand growth	Supply
Inv Non-RE	Market price

Value of Prod.	Fuel cell pathway
Econ. Profits	Zero emission pathway
Loop Number 196 of length 20	Emissions
H2 Sustainable Prod.	Environmental deterioration
Integration with other RE sources	Policies encouraging reduction in emissions
Reliability of intermittent RE resources	Effect. of gov. policies
Investment in RE	Supply
Uncertainty in fulfilling demand growth	Market price
Inv Non-RE	Demand
Net CO2 emissions	Energy insecurity
Atmospheric GHG conc.	Energy safety
Global Warming	Loop Number 197 of length 20
Env. Sust.	H2 Sustainable Prod.

Integration with other RE sources

Environmental deterioration

Reliability of intermittent RE resources

Policies encouraging reduction in emissions

Investment in RE

Effect. of gov. policies

Uncertainty in fulfilling demand growth

Supply

Inv Non-RE

Gas exports

Net CO2 emissions

Energy insecurity

Atmospheric GHG conc.

Energy safety

Global Warming

Loop Number 198 of length 20

Env. Sust.

H2 Sustainable Prod.

The adoption of H2 as a net zero fuel

Integration with other RE sources

Fuel cell pathway

Reliability of intermittent RE resources

Zero emission pathway

Investment in RE

Emissions

Uncertainty in fulfilling demand growth

Inv Non-RE

Economic Growth

Net CO2 emissions

Jobs

Atmospheric GHG conc.

Social Acceptance

Global Warming

Loop Number 199 of length 20

Imports

H2 Sustainable Prod.

Concerns

Integration with other RE sources

Policies encouraging reduction in CO2 emissions

Reliability of intermittent RE resources

Effect. of gov. policies

Investment in RE

Supply

Net CO2 emissions

Market price

Atmospheric GHG conc.

Demand

Global Warming

Energy prod. capacity

Env. Sust.

New non-RE capacity

The adoption of H2 as a net zero fuel

Fuel cell pathway	H2 Sustainable Prod.
Zero emission pathway	Economic Growth
Emissions	Energy prod. capacity
Environmental deterioration	Combustion pathway
Policies encouraging reduction in emissions	Nitrogen oxides
Effect. of gov. policies	Emissions
Supply	Environmental deterioration
Market price	Policies encouraging reduction in emissions
Demand	Investment in RE
Energy prod. capacity	Uncertainty in fulfilling demand growth
Energy insecurity	Inv Non-RE
Energy safety	Net CO2 emissions
Loop Number 200 of length 20	Atmospheric GHG conc.

Global Warming	Uncertainty in fulfilling demand growth
Imports	Inv Non-RE
Concerns	Net CO2 emissions
Policies encouraging reduction in CO2 emissions	Atmospheric GHG conc.
Effect. of gov. policies	Global Warming
Supply	Env. Sust.
Energy insecurity	The adoption of H2 as a net zero fuel
Energy safety	Fuel cell pathway
Loop Number 201 of length 21	Zero emission pathway
H2 Sustainable Prod.	Emissions
Integration with other RE sources	Environmental deterioration
Reliability of intermittent RE resources	Policies encouraging reduction in emissions
Investment in RE	Effect. of gov. policies

Supply	Atmospheric GHG conc.
Market price	Global Warming
Demand	Imports
Energy insecurity	Concerns
Energy safety	Policies encouraging reduction in CO2 emissions
Loop Number 202 of length 21	Effect. of gov. policies
H2 Sustainable Prod.	Supply
Integration with other RE sources	Market price
Reliability of intermittent RE resources	Demand
Investment in RE	Energy prod. capacity
Uncertainty in fulfilling demand growth	Combustion pathway
Inv Non-RE	Nitrogen oxides
Net CO2 emissions	Emissions

Environmental deterioration	Emissions
Env. Sust.	Environmental deterioration
Loop Number 203 of length 21	Policies encouraging reduction in emissions
H2 Sustainable Prod.	Effect. of gov. policies
Integration with other RE sources	Supply
Reliability of intermittent RE resources	Market price
Investment in RE	Demand
Net CO2 emissions	Energy prod. capacity
Atmospheric GHG conc.	New non-RE capacity
Global Warming	Economic Growth
Env. Sust.	Jobs
Fuel cell pathway	Social Acceptance
Zero emission pathway	Loop Number 204 of length 21

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway

Nitrogen oxides

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Market price

Value of Prod.

Econ. Profits

Loop Number 205 of length 21

H2 Sustainable Prod.

Economic Growth

Energy prod. capacity

Combustion pathway	Policies encouraging reduction in CO2 emissions
Nitrogen oxides	Effect. of gov. policies
Emissions	Energy dependancy
Environmental deterioration	Risk of supply disruption
Policies encouraging reduction in emissions	Energy insecurity
Investment in RE	Energy safety
Uncertainty in fulfilling demand growth	Loop Number 206 of length 21
Inv Non-RE	H2 Sustainable Prod.
Net CO2 emissions	Integration with other RE sources
Atmospheric GHG conc.	Reliability of intermittent RE resources
Global Warming	Investment in RE
Imports	Net CO2 emissions
Concerns	Atmospheric GHG conc.

Global Warming

Economic Growth

Env. Sust.

Jobs

Fuel cell pathway

Social Acceptance

Zero emission pathway

Loop Number 207 of length 21

Emissions

H2 Sustainable Prod.

Environmental deterioration

Economic Growth

Policies encouraging reduction in emissions

Energy prod. capacity

Effect. of gov. policies

Combustion pathway

Supply

Nitrogen oxides

Market price

Emissions

Demand

Environmental deterioration

Energy prod. capacity

Policies encouraging reduction in emissions

New RE capacity

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Imports

Concerns

Policies encouraging reduction in CO2 emissions

Effect. of gov. policies

Supply

Gas exports

Energy insecurity

Energy safety

Loop Number 208 of length 21

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions	Reliability of intermittent RE resources
Environmental deterioration	Investment in RE
Policies encouraging reduction in emissions	Net CO2 emissions
Effect. of gov. policies	Atmospheric GHG conc.
Supply	Global Warming
Market price	Env. Sust.
Demand	The adoption of H2 as a net zero fuel
Energy prod. capacity	Fuel cell pathway
Energy insecurity	Zero emission pathway
Energy safety	Emissions
Loop Number 209 of length 22	Environmental deterioration
H2 Sustainable Prod.	Policies encouraging reduction in emissions
Integration with other RE sources	Effect. of gov. policies

Supply	Net CO2 emissions
Market price	Atmospheric GHG conc.
Demand	Global Warming
Energy prod. capacity	Env. Sust.
New non-RE capacity	The adoption of H2 as a net zero fuel
Economic Growth	Fuel cell pathway
Jobs	Zero emission pathway
Social Acceptance	Emissions
Loop Number 210 of length 22	Environmental deterioration
H2 Sustainable Prod.	Policies encouraging reduction in emissions
Integration with other RE sources	Effect. of gov. policies
Reliability of intermittent RE resources	Supply
Investment in RE	Market price

Demand	Net CO2 emissions
Energy prod. capacity	Atmospheric GHG conc.
New RE capacity	Global Warming
Economic Growth	Env. Sust.
Jobs	The adoption of H2 as a net zero fuel
Social Acceptance	Fuel cell pathway
Loop Number 211 of length 22	Zero emission pathway
H2 Sustainable Prod.	Emissions
Integration with other RE sources	Environmental deterioration
Reliability of intermittent RE resources	Policies encouraging reduction in emissions
Investment in RE	Effect. of gov. policies
Uncertainty in fulfilling demand growth	Supply
Inv Non-RE	Market price

Demand	Investment in RE
Energy prod. capacity	Uncertainty in fulfilling demand growth
Energy insecurity	Inv Non-RE
Energy safety	Net CO2 emissions
Loop Number 212 of length 22	Atmospheric GHG conc.
H2 Sustainable Prod.	Global Warming
Economic Growth	Imports
Energy prod. capacity	Concerns
Combustion pathway	Policies encouraging reduction in CO2 emissions
Nitrogen oxides	Effect. of gov. policies
Emissions	Supply
Environmental deterioration	Market price
Policies encouraging reduction in emissions	Demand

Energy insecurity

Energy safety

Loop Number 213 of length 23

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

Effect. of gov. policies

Supply

Market price

Demand

Energy prod. capacity

New RE capacity

Economic Growth

Jobs

Social Acceptance	Zero emission pathway
Loop Number 214 of length 23	Emissions
H2 Sustainable Prod.	Environmental deterioration
Integration with other RE sources	Policies encouraging reduction in emissions
Reliability of intermittent RE resources	Effect. of gov. policies
Investment in RE	Supply
Uncertainty in fulfilling demand growth	Market price
Inv Non-RE	Demand
Net CO2 emissions	Energy prod. capacity
Atmospheric GHG conc.	New non-RE capacity
Global Warming	Economic Growth
Env. Sust.	Jobs
Fuel cell pathway	Social Acceptance

Loop Number 215 of length 24

H2 Sustainable Prod.

Integration with other RE sources

Reliability of intermittent RE resources

Investment in RE

Uncertainty in fulfilling demand growth

Inv Non-RE

Net CO2 emissions

Atmospheric GHG conc.

Global Warming

Env. Sust.

The adoption of H2 as a net zero fuel

Fuel cell pathway

Zero emission pathway

Emissions

Environmental deterioration

Policies encouraging reduction in emissions

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Supply

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