

# System Dynamics & Climate Change

*¿How does System Dynamics help with Climate Change ?*

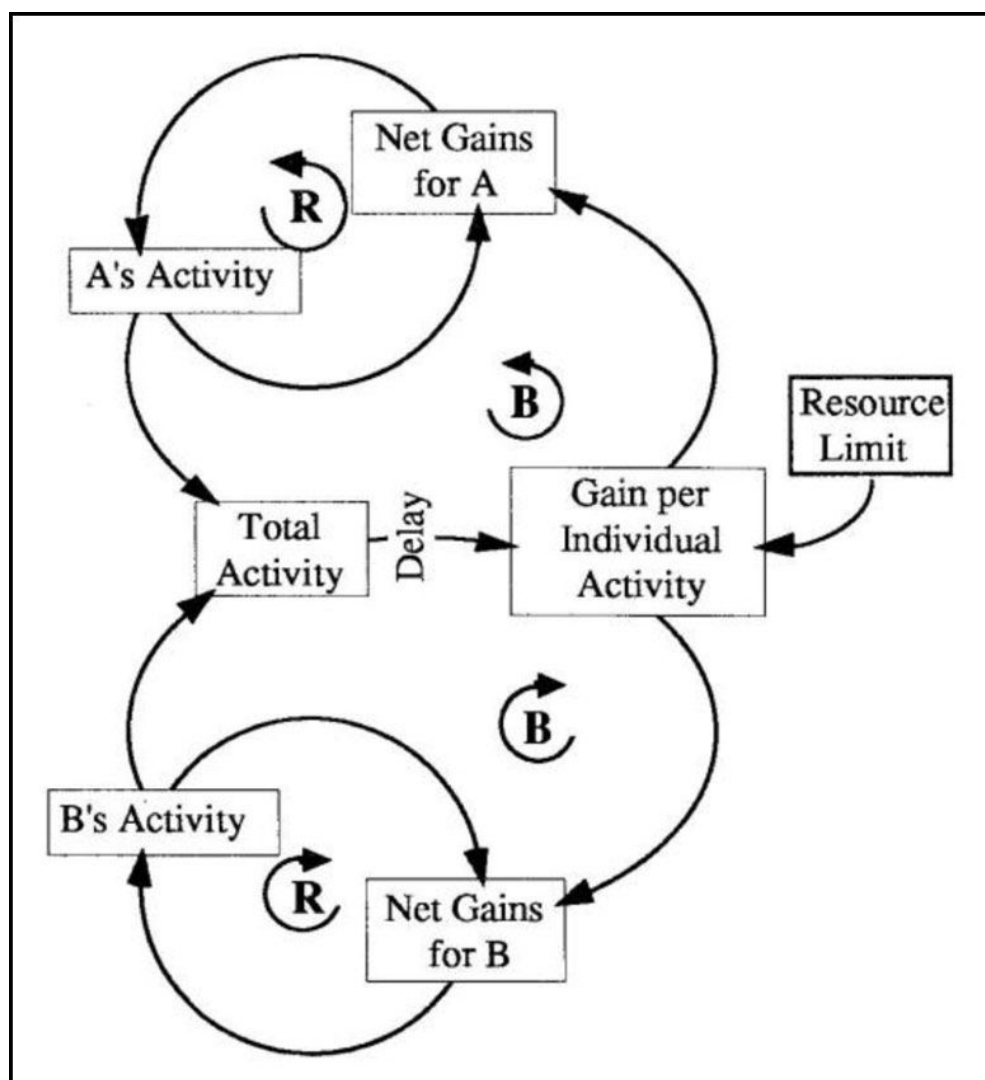
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*¿Which is the underlying SD archetype underlying Climate Change?*



# Some possible interventions.

- **Educating people** (this can eliminate the delay in feedback between the resource depletion and the actors being aware of their behaviors causing this to occur)
- Enforcing **laws** limiting use of a resource
- **Privatizing the resource** so that each participant must pay for the the direct impact of his/her actions



# ¿How is Climate Change Communicated?: “*IPCC Special Report on Global Warming of 1.5 °C*”

“Global mean temperatures in 2017 were about 1.1 °C above pre-industrial levels. Unfortunately we are already well on the way to the 1.5°C limit and the sustained warming trend shows no sign of relenting.

The past two decades included 18 of the warmest years since records began in 1850,” said WMO Deputy-Secretary-General Elena Manaenkova.

“This year is, yet again, expected to be one of the warmest years. We have witnessed **extreme weather** ranging from record heat in northern Europe and historic flooding in *Japan, India, southeast Asia and the southeastern United States*. The consequences were devastating, but advance predictions helped save many lives,” she told the opening session.

“Long-term climate change indicators highlight the need for **urgent climate action**. The rate of sea level rise is accelerating and much of the thick multi-year ice in the Arctic has melted. Carbon dioxide concentrations are record-high,” said Ms Manaenkova.

Es Noticia: ▶ Huracán Florence ▶ Crisis en Venezuela ▶ Guardia Nacional en la frontera

INICIO // MUNDO // URGEN A SALVAR EL PLANETA ANTE CAMBIO CLIMATICO

# Urgen a salvar el planeta ante cambio climático

● Informe de expertos llama a acciones rápidas; buscan calentamiento debajo de 1.5 grados



Mantente al día con el boletín de El Universal

EL UNIVERSAL VIDEO



NACIÓN

AMLO se reúne con el gobernador de Yucatán

## *Major Climate Report Describes a Strong Risk of Crisis as Early as 2040*





Environment &gt; Climate change Wildlife Energy Pollution

## Climate change

## IPCC climate change report calls for urgent action to phase out fossil fuels - as it happened

Updated 5d ago

UN's Intergovernmental Panel on Climate Change says coal-fired electricity must end by 2050 if we are to limit global warming rises to 1.5C

- [Full report: We have 12 years to limit climate change catastrophe, warns UN](#)
- [Overwhelmed by climate change? Here's what you can do](#)

Matthew Taylor, Matthew Weaver and Helen Davidson

Mon 8 Oct 2018 12:16 BST



32,672 3,156

6d ago

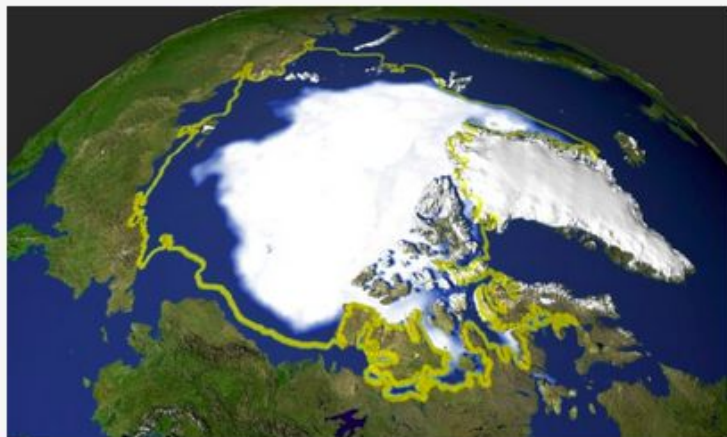
Still a future for coal, coal association says

6d ago

Every emissions reduction option must be used: IPCC panel

6d ago

Current promises aren't enough



▲ A Nasa satellite photo showing the extent of sea ice in the Arctic. The latest IPCC climate change report says unprecedented action is needed to keep global temperature rises to 1.5C. Photograph: HO/AFP/Getty Images

*Al Gore:*

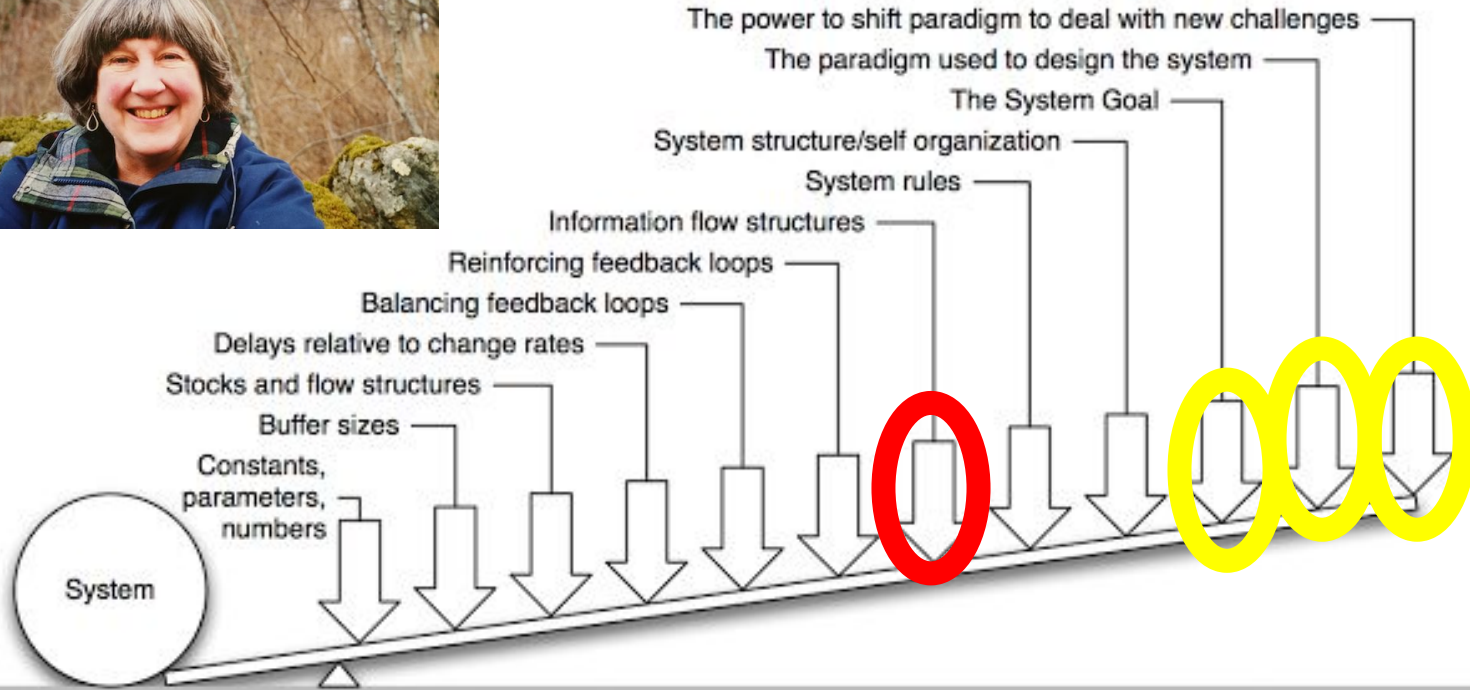
*“An Inconvenient truth” 2007*

<https://vimeo.com/188648827>

*“An inconvenient sequel, truth  
to power” 2017*

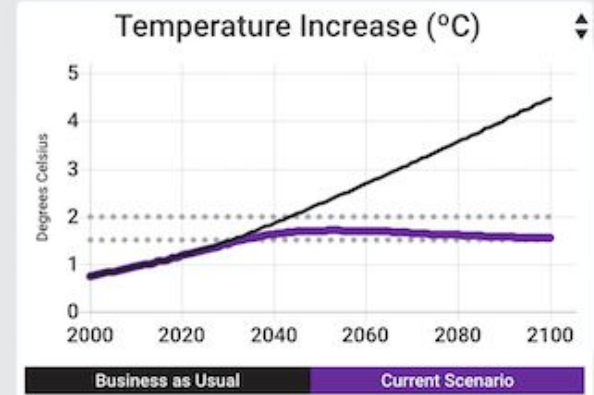
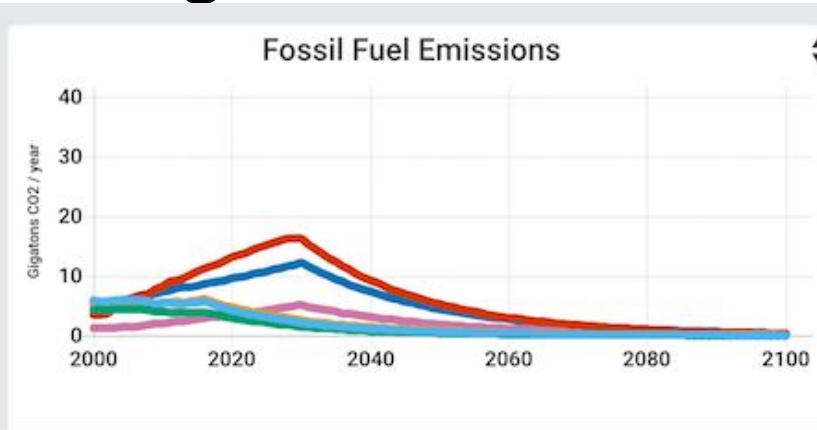
<https://vimeo.com/229203802>

# ¿Which interventions have more leverage?



# ¿How do we apply the three high leverage interventions?

<https://croadsworldclimate.climateinteractive.org/>



	Emissions Peak Year	Reductions Begin Year	Annual Reduction Rate	Prevent Deforestation	Promote Afforestation
US	2016	2016	6.7%	50%	50%
EU	2016	2016	6.7%	100%	60%
Other Developed	2016	2016	6.1%	60%	70%
China	2028	2030	5.6%	70%	100%
India	2030	2030	5%	50%	70%
Other Developing	2030	2030	5%	60%	75%

**+1.5°C**

Temperature Increase by 2100



In 2013 C-ROADS was awarded the System Dynamics Society Award for the best “Real World” Application of System Dynamics.





System  
Dynamics  
Society

## APPLICATIONS AWARD

Presented to

ANDREW JONES

Given for the Best "Real World" Application of System Dynamics.

*Climate Interactive: The C-ROADS Climate Policy Model*

by

John Sterman, Thomas Fiddaman, Travis Franck, Andrew Jones,  
Stephanie McCauley, Philip Rice, Elizabeth Sawin and Lori Regel

*31st International Conference of the System Dynamics Society*

*July 21 - 25, 2013*

*Cambridge, Massachusetts USA*

**C-ROADS is being used at top government, corporate, and NGO levels, and by individuals participating in or monitoring the UNFCCC negotiations. [Read comments](#) by some of our users at the US State Department and European Environment Agency.**

*“The C-ROADS model from Climate Interactive was used by me and other members of President Obama’s climate-change team for gaining rapid insights into the consequences of alternative greenhouse-gas-emissions trajectories for the United States and the rest of the world.”*

**-Dr. John Holdren, White House Science Advisor, 2008-2016**

# Climate Interactive Named Top US Energy and Environment Think Tank



## Climate Interactive

Best US energy and environment think tank

Think Tank Awards 2017

#TTA2017

Prospect





# C ROADS based simulations around the world!

[https://app.mapline.com/map/map\\_6aec799a/Az8UPz9eP3UUDUoUP2BWP2MUP0wUPz9eEz8EZQ4UPz87Gz82Jj](https://app.mapline.com/map/map_6aec799a/Az8UPz9eP3UUDUoUP2BWP2MUP0wUPz9eEz8EZQ4UPz87Gz82Jj)



# IS THE KEY TO SPARKING CLIMATE ACTION A GAME? NEW RESEARCH SUGGESTS IT IS, EVEN ACROSS THE POLITICAL DIVIDE?

81% OF PARTICIPANTS IN A ROLE PLAY SIMULATION INCREASED MOTIVATION TO COMBAT CLIMATE CHANGE, REGARDLESS OF POLITICAL ORIENTATION



<http://mitsloan.mit.edu/newsroom/press-releases/is-the-key-to-sparking-climate-action-a-game/>

# ¿What happened at the X CLADS in Buenos Aires?



**XCLADS 2012**  
X CONGRESO LATINOAMERICANO DE DINÁMICA DE SISTEMAS

I CONGRESO ARGENTINO DE DINÁMICA DE SISTEMAS  
III CONGRESO BRASILEÑO DE DINÁMICA DE SISTEMAS

**21 - 22 - 23 DE NOVIEMBRE**  
BUENOS AIRES - ARGENTINA

**Dinámica de Sistemas:**  
Abordaje a la complejidad,  
Sinergia de Intuición  
y Razón. *Powering Decisions*

**TEMAS A TRATAR:**

- Aplicaciones industriales
- Ecología y ambiente
- Economía y sociedad
- Educación
- Energía
- Gestión y Política Pública
- Innovaciones tecnológicas
- Logística y productividad
- Micromundos de aprendizaje
- Planeación
- Otras temáticas de interés

UADE Sede Monserrat, Lima 775, Ciudad de Buenos Aires.  
Para más información: [www.xcongresolatamds.com](http://www.xcongresolatamds.com) // [info@xcongresolatamds.com](mailto:info@xcongresolatamds.com)



**XIII CONGRESO LATINOAMERICANO DE DINÁMICA DE SISTEMAS Y XIII ENCUENTRO COLOMBIANO DE DINÁMICA DE SISTEMAS**


Cartagena de Indias, Colombia, Octubre 21 al 23 de 2015

Sedes

Organiza

<http://www.utadeo.edu.co/es/micrositio/13e-encuentro-latinoamericano-de-dinamica-de-sistemas>





XII CONGRESO LATINOAMERICANO  
DE DINÁMICA DE SISTEMAS



# XIV CLADS en San Pablo - Brasil

XIV CLADS  
Congresso Latino Americano de  
Dinâmica de Sistemas

De 19 a 21 de outubro  
Centro Universitário FEI



# XV CLADS, Santiago de Chile



# ¿Who participate in the World Climate Project?





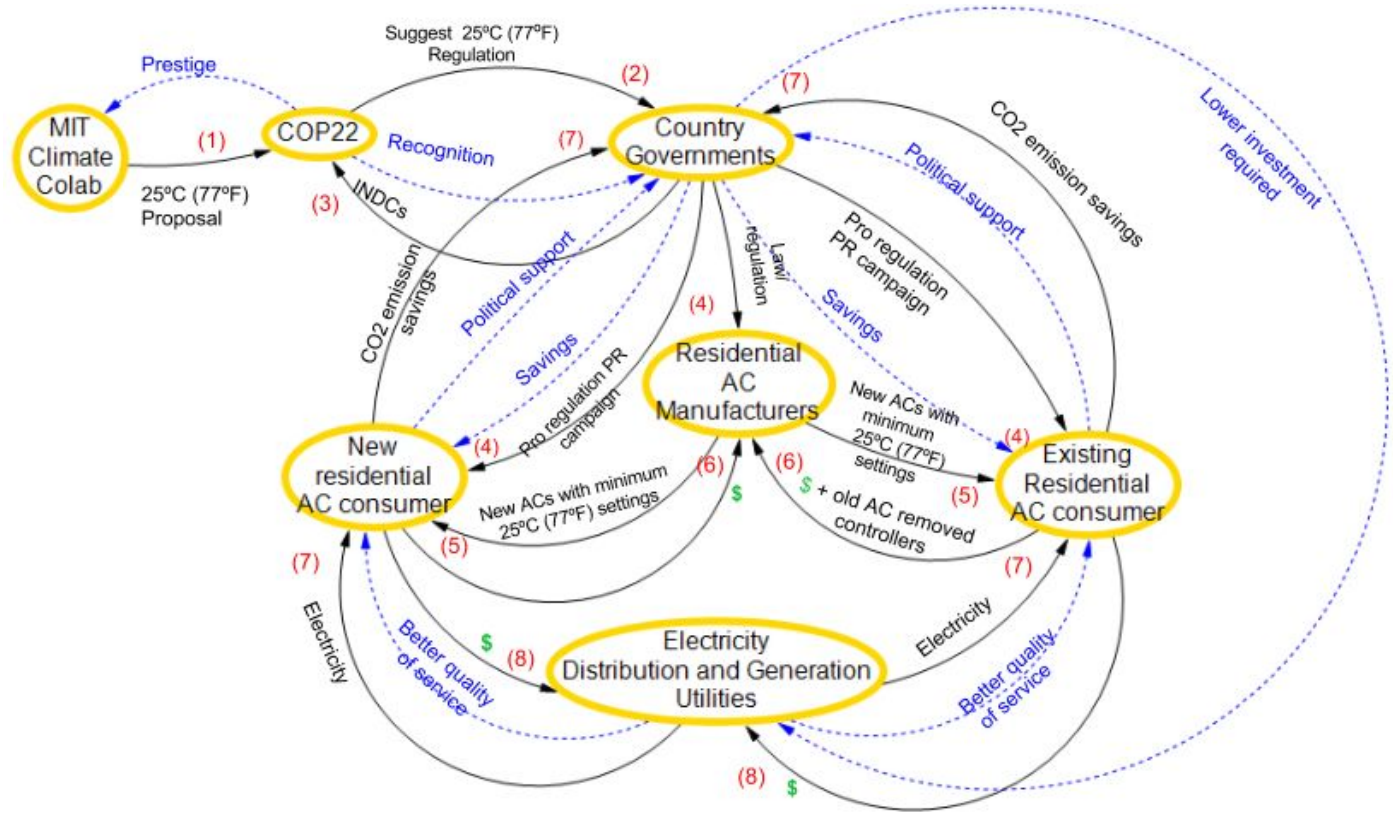
# What is the purpose of the international MIT Climate Colab competitions?

<https://www.climatecolab.org/contests/2016/industry/c/proposal/1329804>





# ¿How does the 25°C work?



# The Kiri Team with the Argentine president.

<https://www.facebook.com/KiriTeam/videos/1237586459585051/>



# World Climate is very engaging!

<https://www.facebook.com/KiriTeam/videos/1870510529625971/>

<https://www.facebook.com/KiriTeam/videos/327751114450783/>

<https://www.facebook.com/KiriTeam/videos/1695428407134185/>

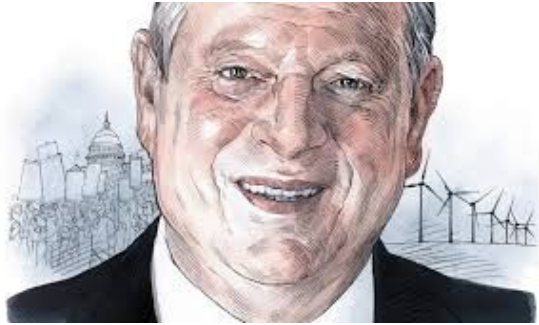
<https://www.facebook.com/KiriTeam/videos/1166317543378610/>

<https://www.facebook.com/KiriTeam/videos/327751114450783/>

# ¿Does climate change generate new Business Opportunities?

<https://www.nibusinessinfo.co.uk/content/take-advantage-climate-change-business-opportunities>

Al Gore <https://www.youtube.com/watch?v=onZYMTwxJ6M>



## Growth & Innovation: A Climate of Opportunity

**54%** of business leaders see opportunities for growth and innovation in addressing the climate challenge

**57%** believe that investment in climate solutions is essential to competitive advantage

Of leaders from the world's largest companies\*:

**70%** see opportunities for growth and innovation

**67%** report a clear business case for action

**69%** see investment in climate solutions as essential to competitive advantage

**48%** report a clear business case for action on climate



\*annual revenues in excess of US\$1bn



# LCOE

[https://www.eia.gov/outlooks/aeo/pdf/electricity\\_generation.pdf](https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf)

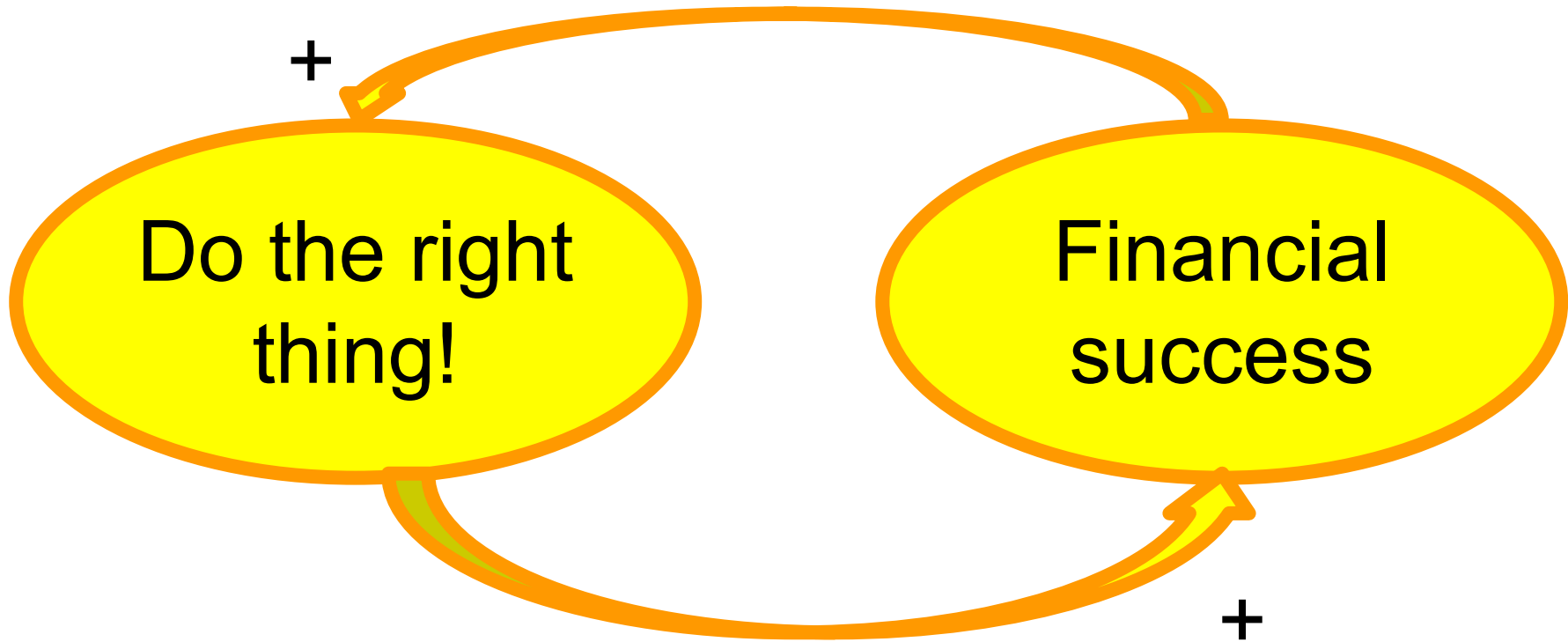
**Table 1a. Estimated levelized cost of electricity (capacity-weighted average<sup>1</sup>) for new generation resources entering service in 2022 (2017 \$/MWh)**

Plant type	Capacity factor (%)	Levelized capital cost	Levelized fixed O&M	Levelized variable O&M	Levelized transmission cost	Total system LCOE	Levelized tax credit <sup>2</sup>	Total LCOE including tax credit
<b>Dispatchable technologies</b>								
Coal with 30% CCS <sup>3</sup>	NB	NB	NB	NB	NB	NB	NA	NB
Coal with 90% CCS <sup>3</sup>	NB	NB	NB	NB	NB	NB	NA	NB
Conventional CC	87	13.0	1.5	32.8	1.0	48.3	NA	48.3
Advanced CC	87	15.5	1.3	30.3	1.1	48.1	NA	48.1
Advanced CC with CCS	NB	NB	NB	NB	NB	NB	NA	NB
Conventional CT	NB	NB	NB	NB	NB	NB	NA	NB
Advanced CT	30	22.7	2.6	51.3	2.9	79.5	NA	79.5
Advanced nuclear	90	67.0	12.9	9.3	0.9	90.1	NA	90.1
Geothermal	91	28.3	13.5	0.0	1.3	43.1	-2.8	40.3
Biomass	83	40.3	15.4	45.0	1.5	102.2	NA	102.2
<b>Non-dispatchable technologies</b>								
Wind, onshore	43	33.0	12.7	0.0	2.4	48.0	-11.1	37.0
Wind, offshore	45	102.6	20.0	0.0	2.0	124.6	-18.5	106.2
Solar PV <sup>4</sup>	33	48.2	7.5	0.0	3.3	59.1	-12.5	46.5
Solar thermal	NB	NB	NB	NB	NB	NB	NA	NB
Hydroelectric <sup>5</sup>	65	56.7	14.0	1.3	1.8	73.9	NA	73.9

<sup>1</sup>The capacity-weighted average is the average levelized cost per technology, weighted by the new capacity coming online in each region. The capacity additions for each region are based on additions in 2020–2022. Technologies for which capacity additions are not expected do not have a capacity-weighted average and are marked as *NB* or not built.

<sup>2</sup>The tax credit component is based on targeted federal tax credits such as the PTC or ITC available for some technologies. It reflects tax credits available only for plants entering service in 2022 and the substantial phase out of both the PTC and ITC as scheduled under current law. Technologies not eligible for PTC or ITC are indicated as *NA* or not available. The results are based on a regional model, and state or local incentives are not included in LCOE calculations. See text box on page 2 for details on how the tax credits are represented in the model.

<sup>3</sup>Because Section 111(b) of the Clean Air Act requires conventional coal plants to be built with CCS to meet specific CO<sub>2</sub> emission standards, two levels of CCS removal are modeled: 30%, which meets the NSPS, and 90%, which exceeds the NSPS but may be seen as a build option in some scenarios. The coal plant with 30% CCS is assumed to incur a 3 percentage-point



**Do the right  
thing!**

**Financial  
success**



# Anexos

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<https://www.youtube.com/watch?v=onZYMTwxJ6M>

<https://www.inc.com/maureen-kline/climate-change-a-26-trillion-growth-opportunity.html>

<https://www.sciencedirect.com/science/article/pii/S0959652618311405>

<https://www.morganstanley.com/access/risks-and-opportunities-of-climate-change>

La palanca en la “Tragedia de los Comunes” pasa por **reconciliar los intereses de largo plazo con los de corto plazo.**

*Ejemplo: la eficiencia energética puede ahorrar energía en el corto y en el largo plazo.*

Evaluar el **sistema de recompensas** puede generar alternativas para proponer soluciones.

Dado que el horizonte temporal para el colapso del sistema es mayor que el de corto plazo de beneficio de los actores, las soluciones para ser viables deben alinear las recompensas del corto plazo con las del largo plazo.

# C ROADS Structure

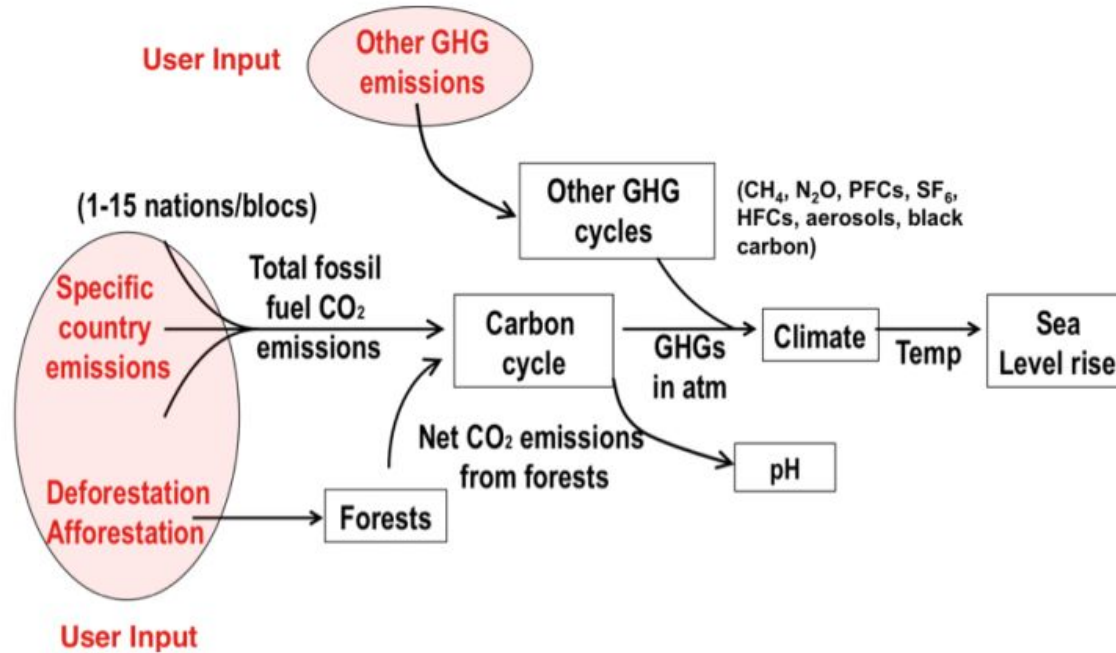


Figure 1. C-ROADS Structure

