The Third Way to Global Carbon Neutrality

The New Carbon Emission Liability Mechanism and Global Carbon Neutrality Solutions

同济大学中和研究院
TONGJI COWIN INSTITUTE

November 2023

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Cowin Institute of Tongji University

Cowin Institute of Tongji University (referred to as "Cowin") is a research institute under School of Economics and Management, Tongji University. The main research scope of Cowin includes climate change economics, global carbon neutrality solutions, power market reform and institutional economics, etc. It extensively carries out academic research, dissemination of ideas, and promotion of solutions, as well as provides intellectual support to theoretical innovation and public policy.

Vision: Use Chinese wisdom to deal with the climate change crisis and protect the earth & human beings

Mission: Innovate theories, seek the best global carbon neutral solution, and cope with the problem of climate change

Values: Academic-oriented, Pragmatic for Society, and Concordant with Community

Positioning: A leading research team in the economics of climate change

Dr. Yang Baoming

- Director of Tongji University
- Dean of Cowin Institute of Tongji University
- Founder of Luban Software
- Vice President of Shanghai Zhejiang Chamber of Commerce
- Proposer of the New Carbon Emission Liability Mechanism (CELM) and the New Public Goods Principle (PPG)
- Author of books: *"The New Principle for Public Goods and Solutions for Global Carbon Neutralization", "Breakthrough"* and *"BIM Changes the Construction Industry"*

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Introduction

Under the coordination of the United Nations, the international community has been responding to the challenge of climate change for more than 30 years, however, the progress is still unsatisfactory. Recently, the UN Secretary-General Antonio Guterres declared that the era of global warming had ended, whereas replaced by a new era of global boiling. Humanity is facing a climate crisis! Climate change will pose an existential threat to humanity more than pandemics and wars. Leading the project team with a long-term arduous and comprehensive research of law, sociology, economics, digitalization and sci-tech on global climate issues, Dr. Yang Baoming creatively proposed a brand new carbon emission liability mechanism (Carbon Emission Liability Mechanism, CELM) and the third way for global carbon neutrality—the "1+1" Global Carbon Neutrality Solutions based on CELM, i.e., the constructing of "the Global Decarbonization System + The Global Green Energy Supply System", so as to provide the international community with a more efficient, fairer, and lower-cost new path to global carbon neutrality, and furthermore bring hopes for mankind to solve the climate problem completely.

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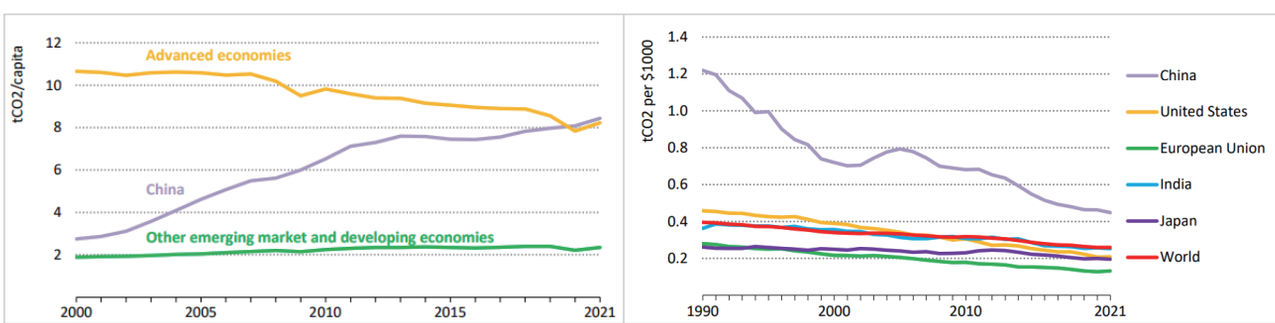
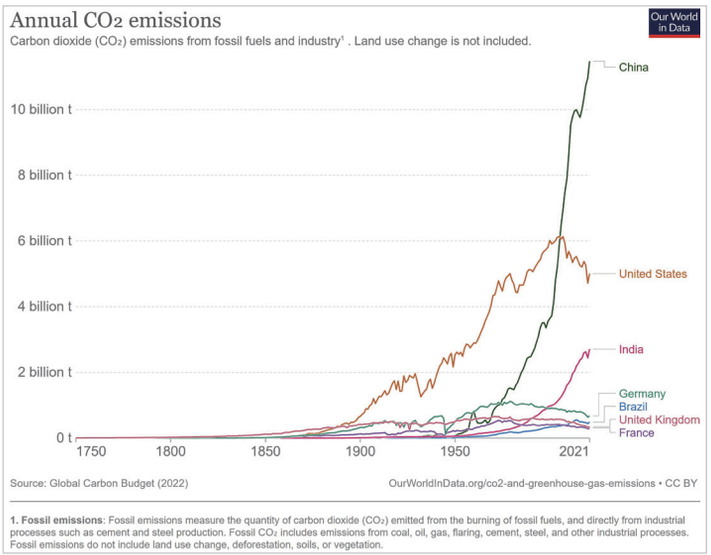
Global Climate Issues and China's Challenge

In March 2023, the Intergovernmental Panel on Climate Change (IPCC) released the Sixth Assessment Report (AR6) *"Climate Change 2023"* , which showed that the global surface temperature in 2011-2020 was 1.1℃ higher than that in 1850-1900; anthropogenic climate change has affected every region of the world ubiquitously; according to the current decarbonization progress committed by governments, the global temperature rising in the 21st century will definitely exceed 1.5°C, and it will be difficult to control it within 2°C; There is still a large gap between the current progress and goals of global agreement. In order to control the global warming within 1.5°C, human society must take much more aggressive and rapid actions.

In 2022, global carbon emissions had increased by 0.9% to 36.8 Gt, of which China emitted about 12 Gt. To achieve the 3060 dual-carbon goals, China's current effort focuses on the allocation and trading of carbon permits in key energy industries. The China ETS market covered 2,162 thermal power plants in the first compliance cycle, with an annual coverage of about 4.5 Gt of CO_2 emissions, making it the largest carbon market in the world in terms of emission coverage. As of Jul 16, 2023, the two-year cumulative transaction volume of carbon emission allocation in China was 240 Mt, with a turnover of 11.03 billion yuan and an average transaction price of 45.96 yuan/ton.

China's current decarbonization system faces many challenges, such as how to establish a complete, accurate and real-time carbon footprint database, how to choose fairer and more effective carbon pricing mechanisms, how to reform and upgrade the carbon market, how to efficiently raise green transformation funds, as well as how to cut back carbon negative effects of decarbonization on macroeconomics and social welfare, etc.





- The total global CO_2 emission reached **36.8 Gt** in 2022, while the amount in China is **12 Gt**, accounting for almost **1/3** of the global emission.
- CO_2 emission per capita in China is **8.4 tons** in 2021, above the level of advanced economies.
- The emission intensity of GDP declined in China, falling to **0.45 tons of CO_2 per USD 1000** of GDP, but still ranking the highest emissions intensity of GDP among major economies.

The Essence of the Climate Issue and the Seven Consensus

The economic essence of the global climate issue is a puzzle of cross-time-and-space externalities and large-scale complex public goods. There are many levels and huge volumes of entities in the interest game of climate issues, including various organizations and individuals from the international community. Under such circumstance, it is very difficult to find a fair and efficient equilibrium solution. At present, the Carbon Tax and the ETS-Emission Trading System as two carbon pricing instruments are generally adopted by various countries, however, their practice cannot bear the heavy duty to realize the temperature control goal of 1.5℃ proposed by the *Paris Agreement* from the perspective of theoretical and empirical results. Both the global climate crisis in 2022 and the sixth assessment report of the IPCC indicate that it is urgent to find a third more effective pathway.

To cope with the climate issue veritably and achieve temperature control goals substantially, the international community must reach the following seven consensus points.

Consumers are Liable for Emissions

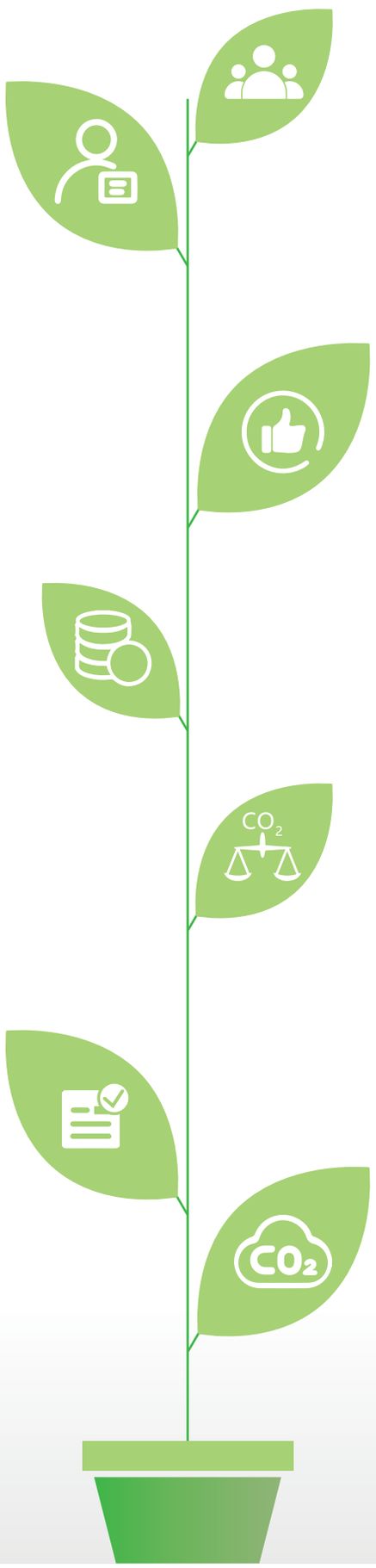
Production activity and carbon emissions come only when there is consumption demand, therefore, consumers should bear the cost of carbon emission in the whole process of product production and circulation.

Fully Leverage the Market Mechanism

The boundary between the government and the market shall be set as efficient and fair during their interaction so as to fully empower the market mechanism.

Right to Know and Right to Choose

Credible carbon footprints of the whole society shall be clarified through digital technology to avoid failure of trade information and price signal so as to ensure market efficiency.



A Community with the Shared Future for Mankind

Human beings share one single common earth; All countries and all people need to work together to face climate change.

Developed Countries and People with High Carbon Emission Should be Held Accountable

Developed countries should take responsibility for historical carbon emissions, whilst high-carbon emitters should pay an adequately high price.

Carbon Equality

Carbon emission rights are equal to everyone, and cannot be used to limit the development of some people nor some countries. Every tonnage of carbon emission should be paid by a reasonable cost.

Real Negative Carbon is a Standard Commodity

One ton of "Real Negative Carbon" means removing or absorbing one ton of carbon dioxide from the air. It is a standard commodity and can be trade freely around the world.

New Carbon Liability Mechanism

Given the goal constraints set out in the Paris Agreement (to achieve global net-zero carbon emissions by 2050), this report proposes a Carbon Emission Liability Mechanism (CELM) and an integrated carbon pricing scheme through comprehensive interdisciplinary research based on the seven major consensuses on global climate issues and the starting point of one community of shared future for mankind, and furthermore designs out the third global carbon neutrality pathway to address climate change: CELM-based "global decarbonization system + global green energy supply system" , i.e., 1+1 global carbon neutrality solutions to achieve the optimal path to global carbon neutrality.

▶ Two assumptions

Assumption 1	Governments of all countries must achieve the carbon neutrality goals committed to the international community.
Assumption 2	Governments of all countries are committed to establishing a fair and efficient decarbonization policy system.

▶ Three basic principles

Based on the following three principles, a relatively consistent decarbonization governance system can be established across the international community.

Principle 1: Consumers bear the cost of carbon emissions, while the back-end of industrial chain is responsible for the total amount of upstream carbon emissions.

Final-end consumers shall pay for the **carbon emission liability(CEL)** embodied within products. Any organization within the industry chain is responsible for the total carbon emissions of its own products, i.e., it is responsible for the selection of its suppliers.

Principle 2: All organizations should balance the input and output of carbon flow tickets, and be responsible for offsetting any CEL stock.

A carbon ticket management system (CTMS, Carbon Ticket Management System) can be established to record the circulation of the carbon liability of every commodity traded in the whole society. For any organization, the carbon ticket issued by the supplier is called an output ticket, while the carbon ticket received by the purchaser is called an input ticket.

Therefore, the big data on the carbon footprint of all goods and services in society can be generated. Each organization shall conduct its final carbon ticket settlement of purchase and sale items on a quarterly basis. Legislation may be needed to define:

The amount of carbon emission liability stock by one organization = total amount of carbon ticket input – total amount of carbon ticket output

Any organization with negative CEL stock can sell negative carbon in carbon trading market to obtain some income. An organization with a positive CEL stock should purchase corresponding amount of negative carbon so as to offset the liability of emission. In this way, organizations with carbon emission intensity higher than the average industrial level have to increase their corresponding carbon emission costs, and those with lower carbon emission intensity will immediately receive low-carbon emission rewards, thereby all organizations in the industrial chain will be driven dramatically to decarbonization in two directions.

Principle 3: "Negative carbon", as emission offset products, will be transacted in the carbon trading market, while the price of "negative carbon" is determined by the market equilibrium.

Negative Carbon Supplier: Produced by forestry, other commercial organizations and CCUS carbon sink organizations, real negative carbon will be supplied to the carbon market through verification by the state-authorized institutions. As the Controller of the carbon source, the state government will input an equal amount of owing negative carbon to the carbon market. Organizations with negative CEL stock can also sell negative stock in the carbon market.

Negative Carbon Demand Side: Different types of negative cabon products can be purchased from the carbon market to meet various needs of business, production, export and investment needs raised from various organizations: e.g., entities to offset their CEL stocks, advanced organization's willing to achieve carbon neutrality inadvance, export enterprises to deal with carbon tariffs, as well as carbon asset investment institutions and individuals.

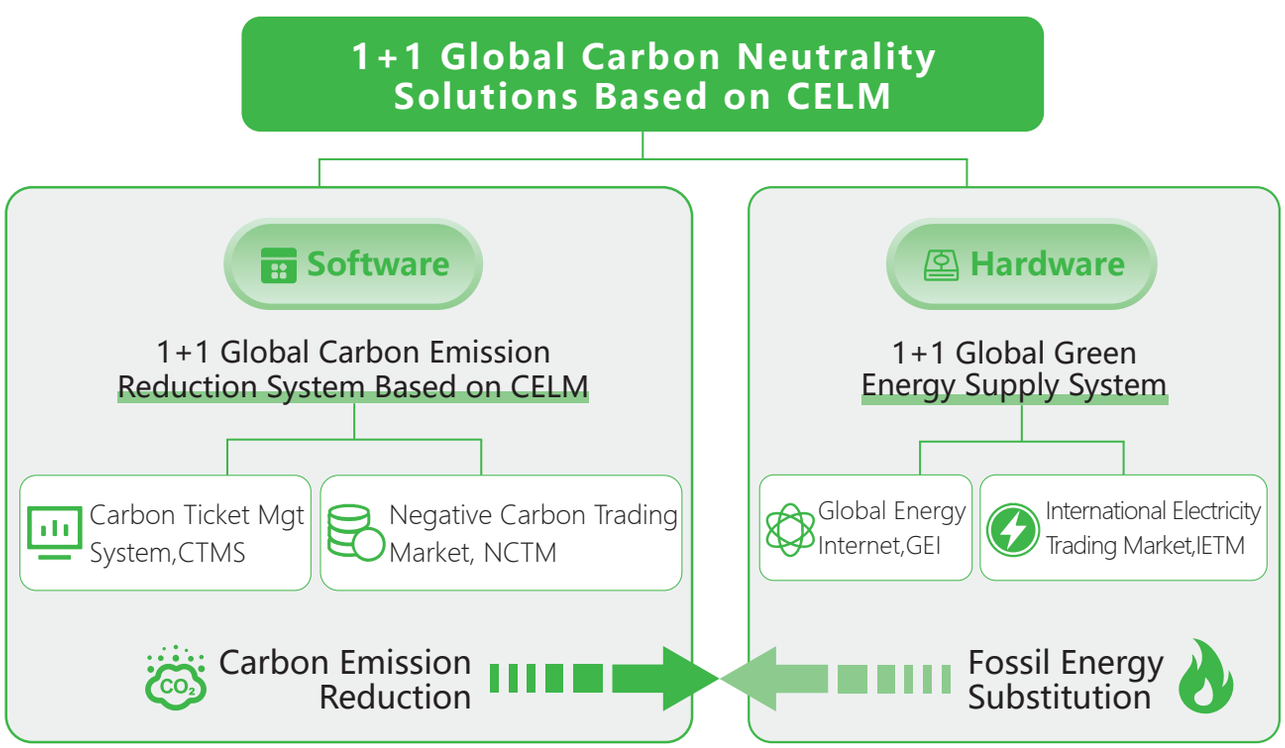
Global Carbon Neutrality Solution Based on CELM

▶ Global Carbon Neutrality Solutions

Due to the shortage of appropriate guidance from basic economic theory, the international community has been exploring the two paths of ETS and carbon taxes for decades, nevertheless, the progress is obtuse with the huge gap against 1.5-degree control target. Neutrality solutions still lack support by an effective roadmap. Global decarbonization faces respective challenges such as multi-level emission rights allocation schemes, carbon leakage and tariffs, neutral investment funding sources, and the inability to unify multiple decarbonization policies.

CELM can provide a solid basis of economic theory and a feasible third pathway to achieve the global carbon neutrality.

This report proposes a CELM-based "1+1" global Neutrality solution: "a global decarbonization system + a global green energy supply system". The "1+1" system will become the key guarantee to achieve global carbon neutrality.



CELM-based global neutrality solutions consist of two major systems and four sub systems.

The two major systems are: the global decarbonization system and the global green energy supply system.

The Global Decarbonization System comprises of two subsystems: **Carbon Ticket Management System (CTMS) and Negative Carbon Trading Market (NCTM).** Among them, the Carbon Ticket Management System provides credible carbon footprint data for each organization and each product in the whole society, and verifies the emission liability of each organization; the Negative Carbon Market furnishes organizations with carbon liability offsets; The government can obtain carbon neutral funds, meanwhile carbon sink organizations and lower-emission organizations can get a profit. Thus, the real negative carbon as standard commodity provide a basis for the development of decarbonization, green energy and transition bills.

The Global Green Energy Supply System also includes two subsystems: **Global Energy Internet (GEI) and International Electricity Trading Market (IETM).** Among them, the Global Energy Internet transports the green power from the green energy bases to the world via the UHV transmission lines with extremely low loss through the intelligent configuration of the global smart grid, hence reduces energy storage cost and improves the efficiency of green power all aroundthe world; The International Power Trading Market is a free open bidding transaction venue for pure green power all aroundthe world and it is market-oriented, efficient in allocation of resources which can expands the scale gradually. The two major systems that constitute CELM's global carbon neutrality solution, same as the two aspects of carbon neutrality, one is designed to accelerate the decarbonization of the whole society through the "pure soft" mechanism; the other is to act as the "hard bone" infrastructure related to the energy internet, accelerating the efficient supply of green energy on a global scale, and also the substitution of fossil energy.

Compared with other carbon pricing instruments in the world, CELM-based global neutrality solutions make full use of market-oriented mechanisms and digital intelligence to operate fairly and efficiently. The overall social cost is lower, furthermore, the requirements for the government's governance level and operating cost are also modest. It is a fairer and more efficient global neutrality solution.

▶ Global Decarbonization System

• Implementation Plan of the Global Decarbonization System

Overall Implementation Plan

1) Legislation based on the CELM

Relevant laws, regulations and operating mechanisms shall be promulgated to clarify the carbon emission liability system and ensure its operation.

2) The "1+1" decarbonization system based on CELM to be established: Carbon Ticket Management System + Negative Carbon Trading Market

Carbon Ticket Management System. In order to facilitate the recording and decomposition of emission liabilities of all organizations and consumers in the whole society, a certificate for registering the emission liability amount of each product and service is designed - **"Carbon Liability Ticket"**, referred to as **"Carbon Ticket"**, also known as "Red Ticket", which records in detail the circulation value (carbon footprint) of the emission liability amount for each market transaction. At the same time, a national-level carbon ticket management system will be established, which can also be called as a national **"Golden Carbon Program"**, and fully realize digital management of carbon footprints. The transfer of carbon emission liabilities of every transaction in the whole society will be recorded through input tickets and sales tickets within this system.

Negative Carbon Trading Market. Government, carbon sink organizations and individuals who hold "Negative Carbon" can provide any amount of "Negative Carbon" products into the carbon market. The government mainly provides certain amount of "Owing Negative Carbon" , whereas carbon sink organizations mainly provide "Real Negative Carbon" . Organizations with negative carbon stocks can sell negative carbon in the market to obtain income, and organizations with emission liability stocks shall purchase negative carbon from the market to offset their emission stocks.

3) Endorsed Carbon Source Quantity

The competent government department approves carbon emission indicators per unit and total products output to carbon source organizations (coal mines, oil fields, natural gas companies, etc.), and issues the total amount as a carbon source output ticket to these organizations and then inputs it into the CTMS system. Carbon source coverage will be gradually selected from fossil industries to other industries.

4) Self-operation of the Carbon Ticket System

All organizations in the whole society shall follow the principle of free trade, while the amount of emission liability will be freely circulated through the purchase and sale of carbon tickets according to the actual trade situation. The carbon ticket system will operate smoothly by itself with no needs for governmental interference and supervision at every transaction link.

5) Terminal Sales Organizations May Collect the Carbon Fee on Behalf of Their Customers

Organizations that sell products to final consumers may collect carbon fees on their behalf. The carbon fee received by these organization is used to purchase negative carbon in the carbon market to offset the emission liability stock.

6) All Social Organizations Shall Conduct Quarterly Settlement and Payment of Carbon Emission Liability Stocks

Organizations with carbon emission liability stocks must purchase negative carbon from the market for offsetting. For each organization, keeping balance of the total amount of purchase and sales items demonstrates that its emission intensity is basically consistent with the average level of the entire industry, and there is usually not directly to bear the cost of carbon emission. The total amount of output bills is greater than that of input bills means that the emission intensity is lower than the industry average level. Negative carbon can be sold in the carbon market to obtain income (low carbon emission reward).

Organizations can reduce decarbonization costs through carbon assets management: buying negative carbon assets for preservation when the price is favorable, or offsetting them in advance.

7) Establishing Household Carbon Accounts with Price in-Tier so as to Promote Policy Progressivity

Household carbon accounts can be established through connecting CTMS with

systems of census and payment. The government can allocate low-price carbon allowances according to the members of households, and define the carbon price in different levels. The more resources and energy consumed, the higher the carbon price, hence to promote decarbonization in the whole society, excite a new consumption concept, and improve the mechanism of the carbon fee progressivity as well as frame an important redistribution mechanism.

8) Response to Export Carbon Tariffs

Domestic export companies shall purchase "International Negative Carbon" in the domestic carbon market for carbon offsets so as to realize zero-carbon products to export and also emission costs assumed yet to be recognized internationally. At the same time, credible carbon footprint data can be provided through the CTMS system. This will avoid carbon tariffs imposed by the EU CBAM or the US carbon border adjustment mechanism.

This program can be further promoted to all countries so as to achieve global carbon neutrality more efficiently.

Carbon Source Organizations and Carbon Source Management

As long as the government manages the carbon source organization and its quantity well, the CTMS system will ensure carbon footprint data of all products in the whole society are accurate, real-time and complete, thus a digital carbon footprint of the whole society can be established simultaneously. After the accurate carbon source value is recorded in the carbon ticket system, the subsequent carbon footprint of the whole society can enable its automatic operation and management.

The amount of carbon sales that the government assigned to carbon source organizations is: total carbon source equals energy output times carbon content per unit of energy. The self-reported amount of primary energy output can be checked with the value-added tax system, which is easier to verify accurately. The carbon content of a unit energy product is relatively constant and can be tested and determined by a government-certified testing agencies. Carbon emissions from the energy industry account for more than 80% of the country's total. Other carbon source verification methods can be promulgated for other carbon source sectors, such as cement, steel, transportation, petrochemical etc., according to their respective characteristics.

Carbon Sink Organizations and Carbon Sink Management

An international advanced carbon sink (negative carbon) certification system shall be built to encourage directly carbon sink organizations get a profit through the negative carbon market, and stimulate the R&D and application of decarbonization technologies.

It is recommended that the ETS and Voluntary Carbon Market(VCM) can be integrated into a unified negative carbon market, while negative carbon is the standard commodity and turbocharge the carbon market. After the cost of carbon emissions is fully internalized, and based on fair competition and policy costs, the certified decarbonizations of low-carbon projects should not be the targets of direct incentives.

The products of carbon sink enterprises are "real negative carbon" and should be verified comprehensively, accurately and in a timely manner. The core of carbon sink management is "real negative carbon" certification, and it should be oriented towards all stock assets. At the same time, carbon sink verification must adhere to the following two principles:

The Principle of Additionality: Some natural resources, such as the carbon sequestration by oceans and the loess plateau, should not be certified as carbon sinks if they do not require additional investment in overseeing and maintenance. These carbon sinks belong to the country's income but not to any organization. Sellable carbon sinks must correspond to input and output efforts in order to improve the efficiency of policies.

Incremental Principle: Only the amount of new carbon sinks added each year is verified. The existing carbon sequestration stock in the natural ecosystem is a national resource and is no longer owned by an economic organization. The CELM-based carbon sink certification system is simpler and easier than the carbon credits, with less difficulty in certification and a high degree of objectivity and standardization.

An internationally recognized "real negative carbon" carbon sink certification system shall be established as soon as possible, while certified "real negative carbon" products can be sold to the international market.

• National Carbon Ticket Management System (CTMS)

The CTMS records the amount of CEL transmitted during every transactions. A large carbon footprint database of the whole society can be established through CTMS with high efficiency and low cost, meanwhile the end-to-end carbon footprint data of each organization and each product can be recorded completely. The carbon footprint database that collects fineness to specific materials, products, and services can form a highly-precise emission factor bank for various industries. The captured data, which is accurate, real-time and complete, can be used for exact formulation and implementation of various policy, decarbonization management tools as well as potent digital support for diverse industries. The CTMS platform covering the whole society is a national-level system, which can be called as "Golden Carbon Program", similar to China's "Golden Tax Project", and could become one of the most important infrastructures in the carbon neutralization process of all countries.

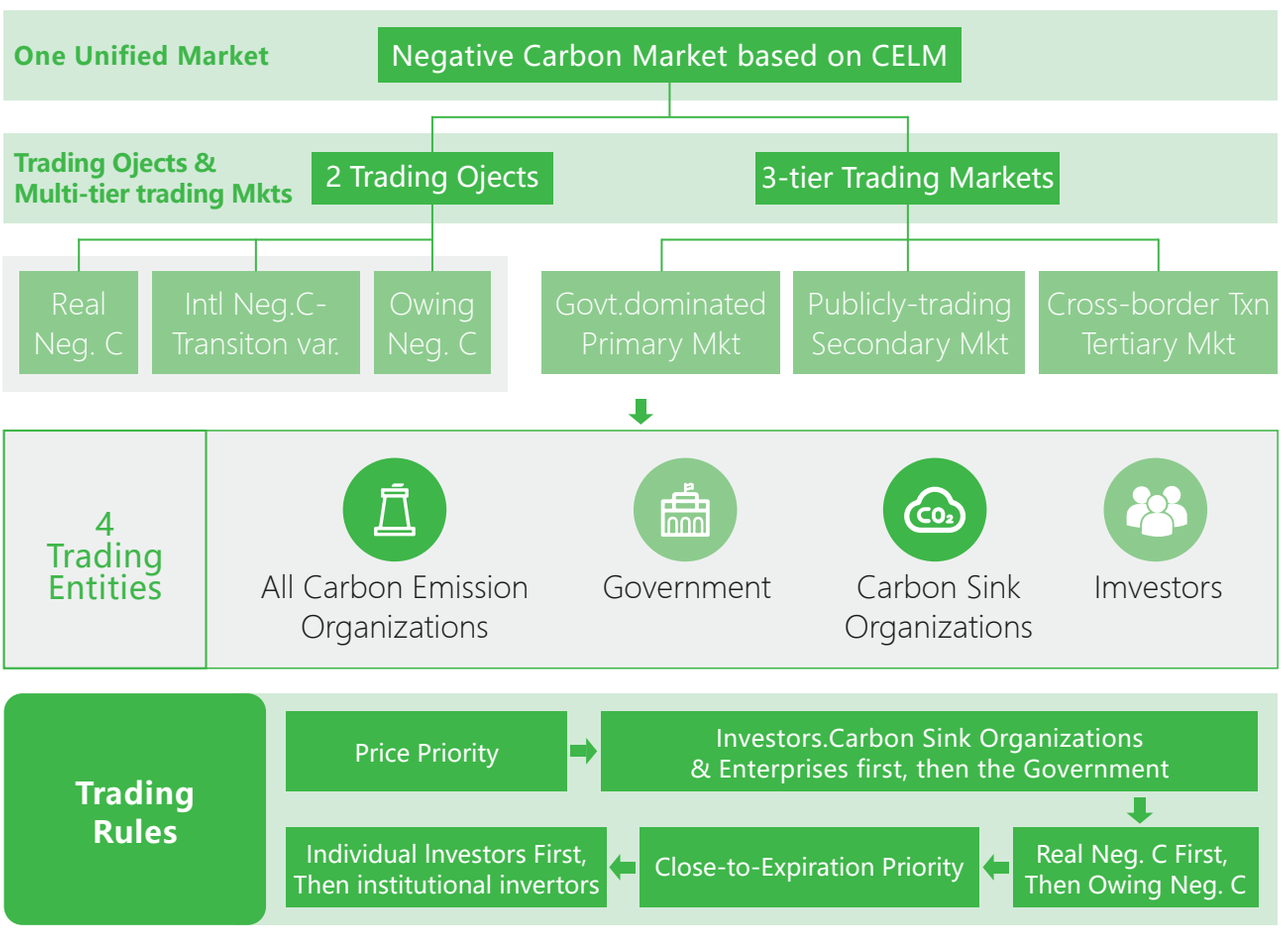
The functions of the CTMS system include: organizations can process the record circulation of carbon ticket purchase and sale items, carry out final quarterly carbon stock settlement and payment, carbon sink management, carbon asset management, etc. The government can monitor purchase and sales carbon bill of any account, process carbon source data input and summary analysis, check and analysis final settlement, form emission factor databases for various industries, as well as practice anti-carbon bill fraud and AI decision support as governmental decarbonization command center with paperless operation.

• Negative Carbon Market

Top-Level Design

Core functions of the carbon market based on CELM are: first, to provide all organizations with emission liability stock offset products - "Negative carbon", to help social organizations with emission liability stock to complete their final settlement; second, to bridge "Carbon Emission " over with "Carbon Sink", emission organizations purchase negative carbon to offset emission liability stocks, carbon sink organizations and organizations with negative carbon stock could sell negative carbon to obtain income, hence two-way incentives will be realized; the third is to help green and transformational finance development, providing source channels for up to tens of billions green investment.

The trading objects of the CELM carbon market is "negative carbon", not those emission permits or carbon credits shown in the current prevailing carbon market. Absorbing one ton of carbon dioxide from the air in any corner of the earth can be valued equally in uniform standard, and it also can be adopted as a sustainable asset. "Negative carbon" points to the ultimate goal of carbon neutrality, and it is easy to form a unified domestic carbon market and expanded into an international carbon market, driving decarbonization more directly and effectively.



One Unified Market

A national-level unified negative carbon market shall be established and developed towards into an international carbon market. The pilot carbon market for emission permits in various provinces and cities should be cancelled, while there are no needs to establish independently VCMs. Compliance Carbon Market and VCMs should be integrated as one unified carbon market.

Two Objects

Real Negative Carbon (Real Negative CO_2): Real negative carbon is the CO_2 equivalent actually absorbed from the air with cost paid by the carbon sink organization and can be sold in the carbon market. Organizations and households with leading social responsibilities and willingness to achieve carbon neutrality in advance are demanders of real negative carbon.

Owing Negative CO_2: It is the "negative carbon" that the government directly inputs into the carbon market to meet the needs from whole society for CEL offsets, without actually absorbing CO_2 from the air. The price is lower than that of real negative carbon, but assumed bore certain carbon emission liabilities and costs. The legal basis for the government to sell owing carbon to the carbon market is that the government is the frontmost issuer of carbon source with a negative CEL stock, the most important organizer of social decarbonization, and the carrier of the national liability for emission pollution mitigation. The owing negative carbon price gradually approaches the real negative carbon price from low to high, and finally merges into one, at which point carbon neutrality is achieved. The owing negative carbon is input into the carbon market by the government, and the income is instilled into the government's "National Carbon Neutrality Fund". The amount of "owing negative carbon" that the government enters into the carbon market every year is equal to the total amount of carbon sources minus the total amount of "real negative carbon" exported by carbon sink organizations. When a large amount of investment funds enters the carbon market, the government can increase the input of "owing negative carbon" to meet investment needs, obtain more decarbonization funds, and expand the "National Carbon Neutral Fund".

International Negative Carbon (International Negative CO_2): In order to deal with the issue of international carbon tariffs, there will also be a transitional variant - "International Negative Carbon", that is, a phased carbon price mutually recognized by countries in trade, whose price is lower than the real negative carbon and higher than the owing negative carbon. The international negative carbon phased price is determined through a multilateral coordination mechanism among countries. Export products can be offset by purchasing "international negative carbon" in-country to avoid carbon tariffs.

Owing Negative Carbon

It is "negative carbon" that is directly inputs into the carbon market by the government to meet the whole society demands for carbon offsets without actually absorbing CO_2 from the air.

Its price is controlled by the government in stages, which is lower than the real negative carbon, but bears a certain liability for carbon emissions.

Real Negative Carbon

It is CO_2 equivalent absorbed from the air. It is provided to the carbon market by the carbon sink organization who already paid the actual processing cost.

Prices are combined costs of CCUS.

International Negative Carbon

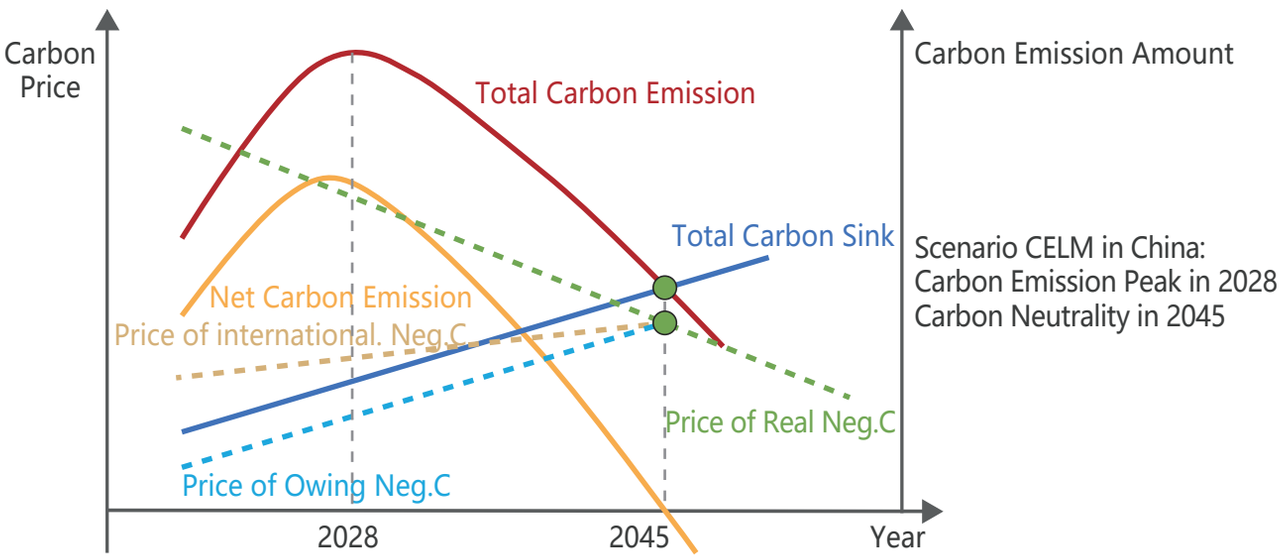
A variant of the transitional product in response to the international carbon tariff issue. That is a negative carbon product with a phased carbon price mutually recognized by trade between countries.

The price is determined through negotiation between countries, which is lower than that of real negative carbon and higher than owing negative carbon.

Principle and Pricing Mechanism of Owing-Negative Carbon

At the initial stage, price of the "Owing-Negative Carbon " is much lower than that of the "real negative carbon". In the trial operation period there would even be priced at zero in certain countries, and later the price would increase year by year until it reaches the price of real negative carbon.

The function of the negative carbon is that the government gradually imports the cost of carbon emissions into the economic system: firstly, the emission liability is imported into the overall economy and the whole society, and finally passed through manufacture and trade down to consumers. Secondly, funds for decarbonization can be obtained, which can be invested into decarbonization projects, technology innovation and upgrading.



Trends of Three Negative Carbon Price

With the development of the carbon sink industry, the price of real negative carbon has gradually decreased.

When the negative carbon market is first launched, the price of real negative carbon will be too high, far exceeding the carbon cost bearing capacity of one country. The government can export negative carbon, and gear the price from a lower point. In order to accelerate the process of carbon neutrality, the price of owing negative carbon can be raised gradually.

The international negative carbon price will be set between those of the real negative carbon and the owing negative carbon, determinedby outcome of negotiations between countries.

With the increase of the owing negative carbon price and the gradual decline of the real negative carbon price, the three negative carbon prices will get closer and gradually converge together. At that time, only the real negative carbon trading products are left. That is, carbon neutrality will be achieved.

Three Tiers of Market

The primary market is mainly an oligopoly market dominated by the government.

The government inputs "Owing-Negative Carbon" and "International Negative Carbon" into the carbon market through legislation, while carbon sink organizations input "Real Negative Carbon" into the market, and a primary market can be formed.

The secondary market is a large publicly traded market.

All investors, negative carbon suppliers and organizations with an unbalanced CEL stock enter the market, will trade according to the rules. As the largest product provider, the government holds substantial pricing power, and can effectively control market prices. Carbon assets could become an important type of asset for investment institutions and ordinary people.

The tertiary market is the international trading carbon market.

Negative carbon is a standard commodity, thus there is great potential in the development of international carbon market.

Four Trading Entities

Because of its huge volume, standardized trading product and governable fluctuations, the CELM carbon market can be opened to government departments, all emission organizations, carbon sink organizations and investors in the early stage of operation, and all institutional and individual investors can engage in.

Main Trading Rules

The first trading order is price priority.

The second order is investors, carbon sink organizations and enterprises first, then the government. The government is inferior.

The government is the ultimate owner of carbon sources and the responsible organizer for carbon neutrality. It is also the absolute largest exporter of "owing carbon" to the carbon market. Mechanisms shall be effectuated to motivate all organizations and individuals to reduce emissions, and all investors prostrate to invest in decarbonization.

The third order is "Real Negative Carbon" first and then "Owing-Negative Carbon".

Real negative carbon funds flow to carbon sink organizations, while owing negative carbon funds flow to the government. Real negative carbon yields actual effects for decarbonization and should be given priority.

The fourth order is the one with the shortest effective period first, and then the long-term effective one.

As a measure to protect investors' interests, this approach can enhance their enthusiasm.

The fifth order is individual investors first, followed by institutional investors.

Giving priority to the interests of individual investors and encouraging them, the policy will enable to raise the awareness of decarbonization among the whole people and activate the carbon market.

▶ Global Green Energy Supply System

While establishing a decarbonization system, it is necessary to accelerate the development of zero-carbon green energy and substitution of fossil energy. Like the two sides of carbon neutrality, if both move towards each other, then the global carbon neutrality will be realized more quickly.

The construction of the global green energy supply system mainly relies on three major energy strategies: breaking through the bottleneck of zero-carbon green energy development, building a global intelligent and efficient low-loss T&D power network, establishing a global electricity trading system to achieve optimal configurations in the range. This will help us establish two major green energy infrastructure of **"Global Energy internet + International Power Trading Market"**, effectively build a green energy supply system on a global scale and accelerate the substitution of fossil energy.

• Global Energy Internet

The global energy internet is the second most important internet on earth after the world wide web.

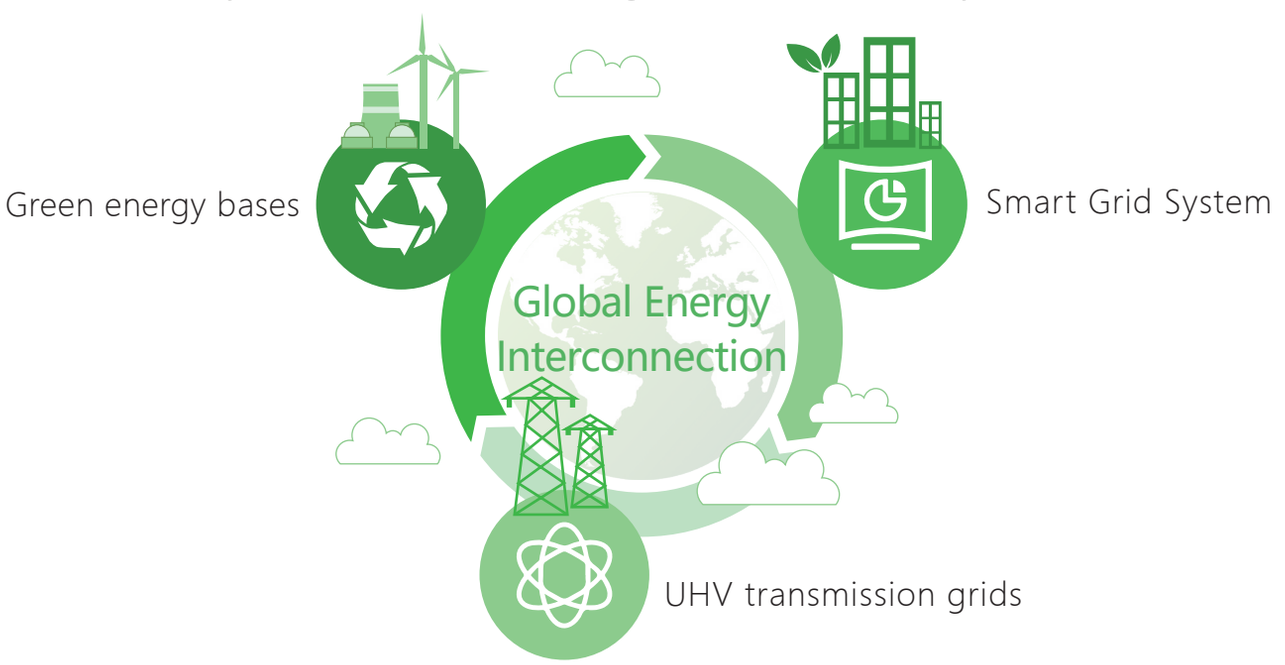
GEI is the key hardware infrastructure for global carbon neutrality with an essence as the huge global power interconnection system of **"Smart Grid + UHV Transmission + Clean Energy"**, which includes three parts:

Part I: rational distribution of green energy (photovoltaic, wind power, etc.) bases around the world. The world can be divided into three or four small 8-6 hours small time zone areas, which has enough photovoltaic and wind power production capacity to supply global electricity demand at the same time.

Part II: globally interconnected UHV transmission grid. It will transmit the electricity from green power plants to every corner of the world, leaving no blind spot on a global scale. This requires the establishment of international technical standards and huge investments. However, compared to the huge spending in energy storage industry, it is still very cost-effective.

Part III: Smart Grid System. Combined with the global UHV power grid, according to the transaction results of the international power trading market, the global automatic and intelligent distribution of power is carried out around the world.

These three physical hardware systems constitute the world energy network and become the key infrastructure to achieve global carbon neutrality.



• International electricity trading market

"Negative Carbon Market + International Power Trading Market" will furnish a strong source of funds for the construction of an immense green power system, among which the international power trading market is a continuous source of funds particularly.

The international power trading market is composed of supply, demand, investment and regulatory parties. The smart market system intelligently and efficiently matches

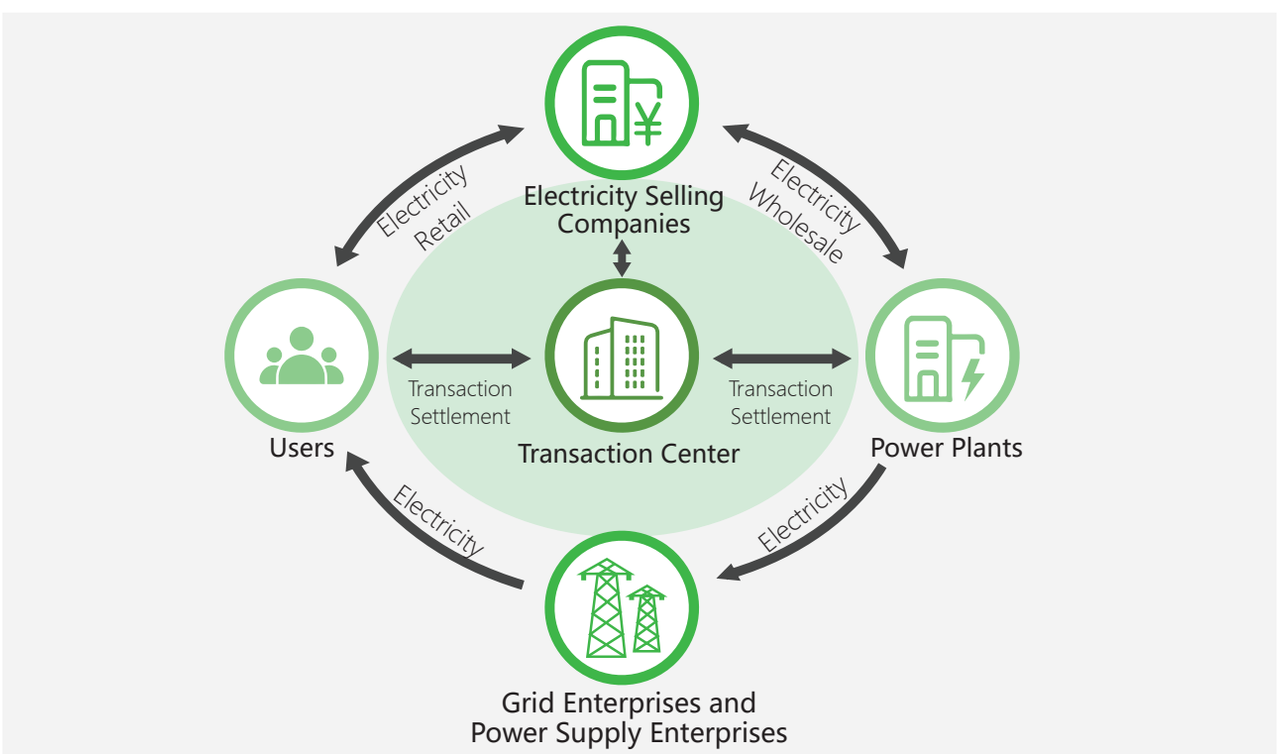
the power demand and supply at each point in time to realize spot and forward product transactions. Under the support of the Global Energy Interconnection system, international power energy transactions have a very large room for growth. It not only supports the growth of green energy, but also provides sufficient power for the development of backward areas.

The electricity that enters the market is "zero-carbon" one that has been offset by "international negative carbon", so that the electricity bidding in various countries is at a relatively uniform and fair level.

An advanced international power trading market can bring market makers to trade, adjust the power futures market, increase capital supply, reduce gap between real-time supply and demand, maintain asset value as well as avoid risks.

A market system that braces the zero-carbon green energy supply is crucial, which can provide huge construction funds, converge long-term investment, gather global green energy consumption and investment demand, furthermore establish a large and efficient global green energy production, scheduling, consumption, investment and operation system finally.

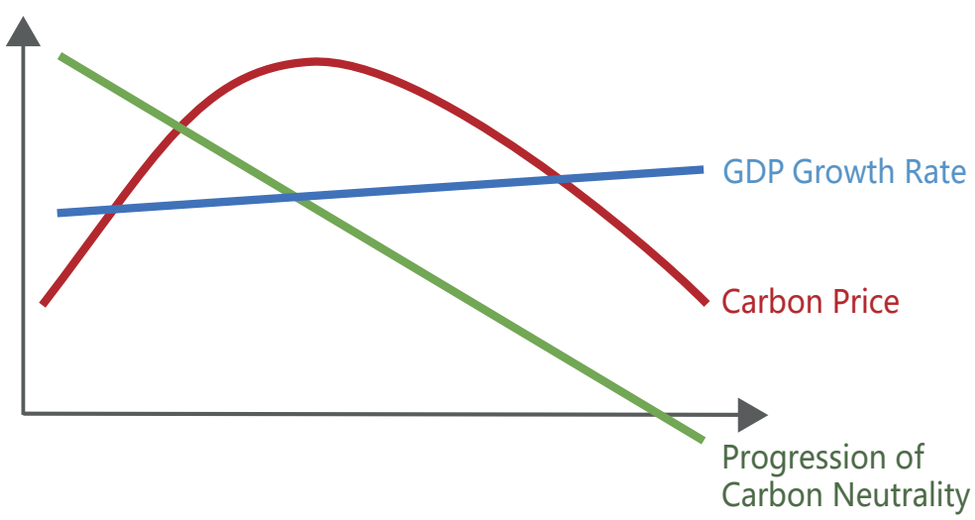
A series of unified technical standards, transaction standards and operational management regulations with legal enforcement across the international community shall be established to build a global green energy supply system.



▶ Integrated Carbon Pricing: A Carbon Pricing Strategy Integrated with both Neutrality Progress and Macroeconomic Effects

The carbon pricing scheme based on CELM integrates the advantages of carbon tax and carbon emission allocation trading market (ETS), whereas avoids the defects of both.

Based on the carbon price and historical macro-operation data, the government can substantiate the dynamic synergy of demands between the macroeconomic development and the carbon neutral process through the "negative carbon" price regulation, and actualize the carbon neutral process goal and the optimal allocation of market resources. CELM's integrated carbon pricing scheme is highly unified, efficient and low-cost. The government holds complete overall control, similar to the adjustment mechanism of national currency interest rate.



Real-time Carbon Pricing Adjustment Mechanism

The owing negative carbon carbon price is capped at the cost of CCUS, and is adjusted appropriately by the government according to the speed of decarbonization and green energy substitution respectively.

If the GDP declines significantly, the carbon price can be appropriately lowered; on the contrary, if the GDP growth is ideal but the emission control progress is not in a satisfactory manner, the carbon price can be properly raised.

Comparisons of three carbon pricing instruments

Carbon Pricing Instruments		Carbon Tax	ETS	Negative Carbon Market
Peculiarity		Mandatory policy instrument, relying on the existing tax system, governments get revenue	A quantitative-oriented policy instrument, an application of tradable pollution permit	A market-oriented, self-driven, neutrality targeted policy instrument
Effect of Decarbon	**Total emission**	Uncertain	More certain	Certain
	Carbon price	Certain, hard to price, lack of flexibility	Uncertain, Insufficient market	More certain, easy to adjust
	Speed of decarbon	Slower	Slower	Faster
	Awareness of society	Weak	Weak	Strong
	promoting Innovation	Weak	Weak	Strong
Scope of Engagement		Part	About 3000 enterprises in China	All organizations and individuals
Globalization		Low	Low	High
International trade Conflict		Unable to solve	Unable to solve	Easy to solve
Trading Cost	**MRV**	High	Very High	Very low
Utilization of public revenue	**Proportional constraint**	Low	High	High
	Directions of use	Promote equity	Improve efficiency of decarbonization	Fairness as well as efficiency
Market influence	**Unified standard**	Hard to unify	Hard to unify	Highly standar dization
	Revenue scale	Hard to predict	Small	Large
	Entities involved	Carbon emission institutions	Few carbon emission institutions	All organizations and individuals

Analysis of Macro Effects of CELM System Implementation

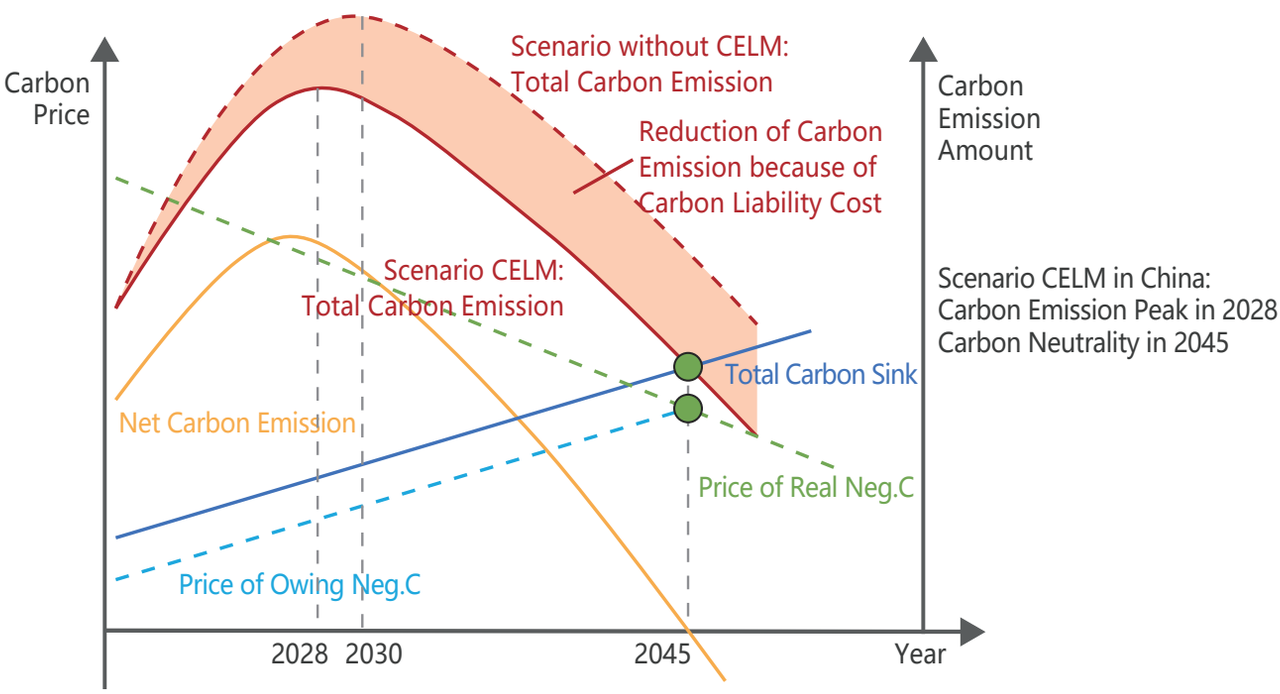
The global carbon neutral pathway based on CELM is by far the best. It can not only achieve carbon neutrality faster, but also minimize the negative effects on the macro economy, enhance the positive impact of low-carbon transformation, as well as finally achieve a larger positive effect on the whole, which will contribute to global carbon neutrality and bring about a fundamental change.

1) Identified the Greatest Common Ground of Converging Interests and the Best Path for The International Community to Achieve Global Carbon Neutrality.

On the climate issue, the international community will move from a game of interests onto a road of win-win cooperation.

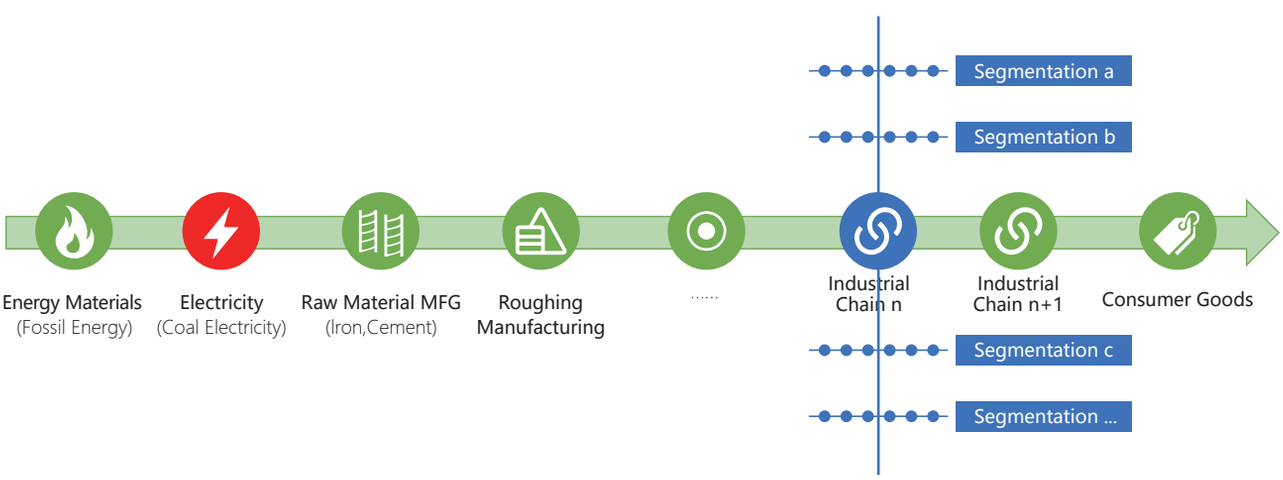
2) Opportunity in Horizon to Achieve Carbon Neutrality 15 Years in Advance with the Correct Guidance to Design Decarbonization Mechanisms by CELM, the New Basic Theory of Climate Economy.

The current governance system of decarbonization policy is very complicated and inefficient, with too many repetitions, missing laps, contradictions, and high administrative costs. The three major rules of CELM theory greatly simplify the framework of the entire decarbonization policy system, greatly reduce regulatory costs, and improve fairness and efficiency.



3) Mitigating Impacts on the Macro Economy and Less Losses of Social Welfare Whereas Increasing Positive Effects on the Macro Economy.

The decarbonization system based on CELM cleverly disperses the overall emission cost to the whole industry chain where all organizations and consumers take responsibility together, which mitigates the macroeconomic pressure and drives the whole society to cut emission unitedly. Low-carbon enterprises and carbon sink enterprises can obtain positive incentives from the negative carbon market in real time. Income from owing negative carbon by the government to invest in green economic transformation will increase both employment and environmental benefits. Meanwhile, adjustments of the household carbon account mechanism can enhance the progressiveness of policies and improve social redistribution.



Under the current decarbonization system, the pressure of decarbonization is concentrated in the thermal power industry, which has a huge negative impact on the macroeconomic industry chain; under the CELM system, the pressure of decarbonization is subdivided into sub-categories of certain types of products, while with high carbon emission intensity production capacity will gradually eliminated and replaced by enterprises with low emission intensity and higher efficiency, therefore, it will improve the production chain and become an important measurement for high-quality development.

4) Solved Well the Conflicts of Carbon Border Adjustment Mechanism in International Trade

Credible carbon footprint data can be furnished through the carbon ticket management system (CTMS), while carbon emissions in products can be offset through "international negative carbon". Therefore, disputes over carbon tariffs in international trade can be avoided.

5) Collecting Green Transition Funds of the International Community, Especially for Those Developing Countries

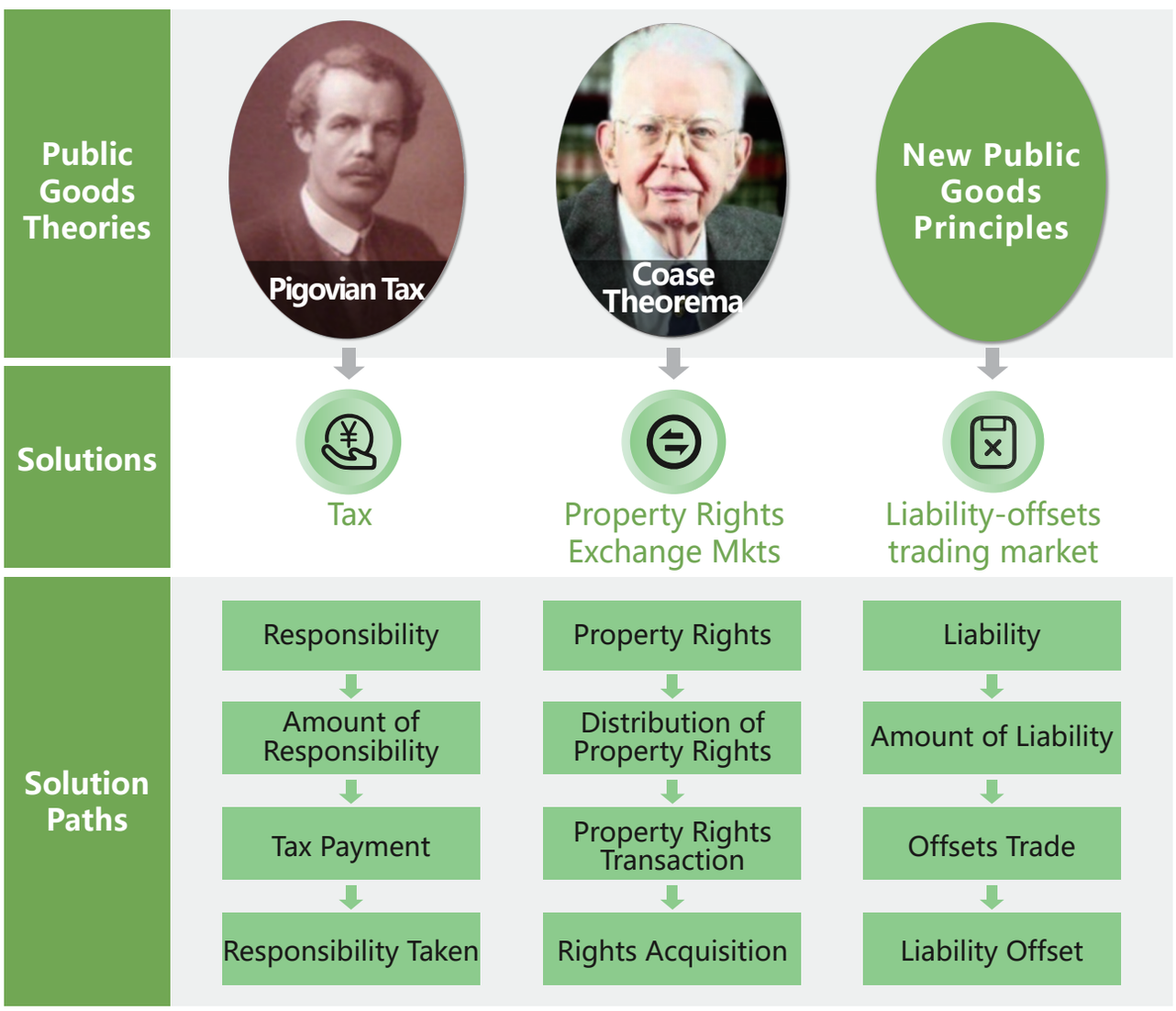
The CELM program internalizes the cost of carbon emissions within products, while the government's ability to raise funds for green transformation has been significantly improved through the negative carbon market. Furthermore, via the consumer liability mechanism, high-consumption countries and groups will pay a greater cost of carbon emissions, which significantly improves the fairness among countries to reduce emissions, and also enable developing countries to obtain more resources. At the same time, green investment and low-carbon emissions can both gain benefits from the carbon market, which creates a source of capital for green transformation.

6) Improving International Security and Relations Dramatically

The climate issue has been the biggest game of the international community in the past 30 years, and it is still trapped in the quagmire of zero-sum or negative-sum games. Once CELM theory and solutions are recognized and implemented by the international community, it will promote global solidarity and cooperation more rapidly. The formation of its system will allow the international community to capture the win-win fruits of cooperation and minimize the threat of division and war.

New Principles of Public Goods

New Principles for Public Goods (PPG): If the external liabilities of public goods can be clarified and its amount can be measured through certain methods or confirmed through transaction negotiations, and meanwhile there are corresponding offsets, then a certain liability mechanism can be designed and a liability-offsets trading market can be constructed, in order to improve the efficiency of social resource allocation and thus achieve Pareto improvement.



Protect The Earth，Save The Human Beings

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