

In this lesson, we discuss the key price determinants in carbon markets.



## Carbon price determinants

- The price of a commodity largely depends on its supply and demand.
- As a unique commodity, carbon allowance also follows this economic law.
- The government establishes a carbon allowance allocation plan that stipulates the annual allowable emission of each emission source, which is well-known by all the market participants in advance.
- Accordingly, the supply of carbon allowance is relatively stable; thus, the quantity demanded is the key factor affecting carbon price.
- Besides its own demand, Carbon price is generally affected by following factors: Energy prices, Economic activities, Institutional decisions and regulations, Weather conditions, Policy Uncertainties, etc.

These include energy prices and in particular electricity prices, economic activity, institutional decisions and regulations, unanticipated weather and temperature changes, economic policy uncertainty that is the view and climate policy uncertainty. In this video, we will discuss the determinants of carbon prices starting with a particular focus on energy prices. The price of any commodity largely depends on its supply and demand. However, carbon remains a unique commodity and it also follows this economic law of supply and demand. In contrast to other commodities, the government establishes a carbon allowance allocation plan and this plan stipulates the annual allowable emission of each emission source like covered installation which is well known by all the market participants in advance.

Accordingly, the supply of carbon allowance is relatively stable because it is pre-planned. Thus, the quantity demanded, that is the carbon demanded is the key factor affecting the carbon price. Now, in addition to its own demand, carbon prices are also affected by the factors related to energy prices, economic activity, institutional design and regulations, weather conditions and policy uncertainties. In this backdrop, energy prices are particularly important.



## Energy prices

- The combustion of fossil energy is the primary source of carbon emissions. Thus, the carbon market has a natural link with energy markets such as crude oil, coal, and natural gas.
- Therefore, price volatilities in the energy markets can be effectively transmitted to the carbon market so as to act on carbon prices.
- The main reason is that energy consumption is related to energy price changes, which can influence the demand for carbon allowance in the market and ultimately carbon prices.

For example, combustion of fossil energy is the primary source of carbon emissions. Thus, the carbon market has a natural organic link with energy markets such as crude oil, coal and natural gas. And therefore, we expect the price volatility in energy markets to be effectively transmitted to carbon market and affect the carbon prices. The main reason here is that energy consumption is related to energy price changes and this is also linked to emission levels which can further influence the demand for carbon allowance in the carbon market and thus ultimately affect carbon prices. In economics, the price effect of goods is often studied by dividing it into income and substitution effects which applies to energy prices as well.

For example, looking at the income effects, fossil energy prices are negatively associated with the carbon quantity demanded. In contrast, fossil energy consumption is positively associated with the quantity of carbon emissions. And therefore, there is an approximately complementary relationship between carbon emission and energy consumption. How? Let's take an example. If there is a rise in energy prices, it will lead to lower energy demand and lower energy consumption.



## Energy prices

- In economics, the price effect of goods is often studied by dividing it into income and substitution effects, which applies to energy prices as well.
- In view of the income effects, fossil energy prices are negatively associated with the quantity demanded, and fossil energy consumption is positively related to carbon emissions.
- Thus, there is an approximately complementary relationship between carbon emissions and energy consumption.
- The rise in energy prices will lead to lower energy demand and consumption, thus reducing the demand for carbon allowance and reducing carbon prices.
- Therefore, income effects can explain the negative impacts of energy prices on carbon allowance prices.

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Thus, lower emissions, and if there are lower emissions, this will reduce the demand for carbon allowances which will ultimately result in lower carbon prices. So, in this fashion, the income effects can explain the negative impact of energy prices on carbon allowance prices. Now, let us look at the substitution effects. Fossil energy plays a very important role in the input mix in the power sector.



## Energy prices

- In view of the substitution effects, fossil energy acts as the mediated role of the power sector.
- The power-generating firms are willing to make choices among fossil energy with different combustion efficiency in order to minimize the production cost.
- At present, the majority of nations use coal and natural gas for electricity production, and a few nations also use crude oil for electricity generation.
- Although natural gas is more efficient than coal in terms of energy conversion efficiency and environmental protection, it is costly at the same time.
- As a result, considering the cost of carbon allowance, power-generating firms must comprehensively consider their choice and substitution effects among fuel inputs.

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The power generating firms are willing to make choices among fossil energy with different combustion efficiency in order to minimize the production cost. So, it plays a very important role in the input mix of power generating firms. At present, the majority of nations use coal and natural gas for electricity production. Few nations also use crude oil for electricity generation. Although natural gas is more efficient than coal in terms of

energy conversion efficiency and environment production, it is costly at the same time.

So, there are different factors affecting the use of different sources of energy in the input mix. And as a result, considering the cost of carbon allowances, power generating firms must comprehensively consider their choice and substitution effects among fuel inputs. That is, they must very carefully design their input mix. Now, with an increase in coal prices, power generating firms may reduce the use of coal and increase the use of natural gas. Natural gas is known to be more efficient and this may result in falling carbon emissions or emission reduction and consequently less demand for carbon allowances which will ultimately reduce the carbon prices.



## Energy prices

- With an increase in coal prices, power-generating firms will reduce the use of coal and increase the use of natural gas.
- As a result, carbon emissions will fall, and consequently, demand for carbon allowances will reduce, lowering carbon prices.
- Similarly, with a rise in natural gas or crude oil prices, electricity-generating firms will switch to coal as input.
- This will lead to a surge in carbon emissions and increase the demand for carbon allowances and their prices.
- Theoretically, the substitution effects of energy prices support a positive impact of natural gas or crude oil prices on carbon prices and a negative effect of coal prices on carbon prices.

Conversely, with a rise in natural gas or crude oil prices, electricity or power generating firms may switch to coal as input. This will lead to an increase in emissions, carbon emissions and therefore an increase in demand for carbon allowances and therefore increase and in turn increase in their prices. Thus, theoretically, this kind of substitution effects of energy mix prices support a positive impact of natural gas and crude oil prices on carbon prices while it suggests a negative effect of coal price increases on carbon prices. To summarize, in this video, we discussed the impact of various sources of energy prices such as crude oil, natural gas and coal on carbon prices. We noted the impact is not uniform and it depends on income and substitution effect.

For example, the increase in crude and natural gas prices that are more efficient may lead to fall in carbon prices while less efficient sources such as coal may lead to rise in carbon prices. In this video, we will discuss the role of electricity prices in determining carbon prices. Being one of the major contributors to carbon emissions, electricity prices significantly affect carbon prices. For example, as one of the most prominent participators

in European Union emission trading system, the power sector or the energy generation sector occupies more than 45 percent of the all carbon emissions in the European Union regions. Nearly 75 percent of carbon allowances in UTSA are located to power or electricity generation sector which contributes significantly to the carbon price.



## Electricity Prices

- Being one of the major contributor to carbon emission sources, electricity price significantly affects carbon prices.
- As one of the most prominent participators of the EU ETS, power sector occupies more than 45% of all the carbon emissions in European Union (EU) regions.
- Nearly 3/4 of carbon allowances in the EU ETS is allocated to the power sectors, which contributes to the significant driving effect of electricity price on carbon price.
- A rise in electricity prices increases the electricity generation capacity and carbon emissions, which leads to an increase in carbon allowance demand and its prices.

And therefore, a rise in electricity prices increases the electricity generation capacity which in turn leads to more carbon emissions and in turn leading to increase in carbon allowance demand and its prices. Moreover, as the electricity prices represent the price that utility firm gets and therefore, it drives the revenue of this utility firm. So, when the electricity demand is higher due to supply demand dynamics, the electricity prices are up and utility firms have an incentive to produce more electricity to help. This leads to an increase in carbon emissions as more fuels are burnt to produce more electricity. Now, the increase in carbon emissions puts upward pressure on the carbon allowances demand and in turn its prices because the firms are more bound to buy further allowances to meet their compliances.



## Electricity Prices

- As the electricity price represents the price that a utility firm can charge, and therefore drives its revenue.
- When electricity demand is higher, it pushes the electricity price up, utility firms have an incentive to produce more electricity to sell; this leads to an increase in carbon emissions, as more fuels are burnt to produce more electricity.
- The increase in carbon emissions puts upwards pressure on the carbon allowances demand and its prices (as firms are bound to buy further allowances to meet the compliances).
- On the other hand, a decrease in electricity prices will result in a decline in carbon prices.

In contrast, a decrease in electricity prices will result in decline in carbon prices in a very simple and converse manner. To summarize, in this video we discussed how rising prices may lead to excess production of electricity and therefore, a higher burning and consumption of fuels and thus a higher demand for carbon allowances thus in turn driving carbon prices and opposite effect that is a decrease in electricity prices will have a opposite or declining impact on carbon prices.



## Economic activity

- As a newly emerging asset with financial features, carbon allowances are similar to stocks, bonds, and other financial assets, which are closely linked to macroeconomic conditions.
- This is because firms and investors tend to adjust their production and investments, respectively, according to economic developments.
- On the one hand, during economic expansion, the aggregate demand in the economy will increase, and the production of goods and services will expand accordingly, which increases the energy demand by the firms and results in massive carbon emissions, thus increasing the demand for carbon allowances and carbon prices.

In this video, we will discuss economic activity and institutional factors as determinants of carbon prices. To begin with, as a newly emerging asset with financial features, carbon

allowances are very similar to stocks and bonds and other financial assets in the sense that they are also affected by macroeconomic conditions. For example, interest rates prevailing in the economy.



## Economic activity

- On the other hand, during an economic recession or crisis, the lower aggregate demand leads to lower production and investments by the firms.
- As a result, the market's demand for carbon allowances and its prices will decrease.
- For example, during the global financial crisis in 2008, the European manufacturing industry was hit hard, which resulted in a massive decline in carbon allowances demand, and the supply of carbon allowances far exceeded its demand in the market. Consequently, carbon prices declined from 25 euros to 3 euros per ton during the beginning of the EU ETS.
- Similar was the case during recent crises, like, Covid-19 pandemic and Russia-Ukraine war.

This is because firms and investors they tend to adjust their production investments respectively according to the macroeconomic and market conditions and economic developments. So, for example, on the one hand during economic expansion booming economy, there is a increase in aggregate demand and the production of goods and services will expand accordingly which increases the energy consumption demand by the firms and results in higher carbon emissions thus resulting in higher demand for carbon allowances and in turn carbon pricing increases. Conversely, on the other hand, during economic recession or crisis periods, the aggregate demand is lower and macroeconomic conditions are weaker which leads to lower production and investment by the firms. As a result, the market's demand for carbon allowances is expected to be lower and the prices of carbon are expected to decline. One example we can take, for example, during global financial crisis in 2008, the European manufacturing industry was hit hard which resulted in massive decline in carbon allowance demand and the supply of carbon allowances far exceeded its demand in the market.

Afterwards, consequently, carbon prices declined from 25 euros to 3 euros per ton during the beginning of the EU-ETS. Similar was the case during the recent crisis like COVID-19 pandemic and Russia, UK war where manufacturing and economy activity went down, and it gave a shock to carbon prices which fell slightly. Next, institutional policies, decisions and regulations will affect the carbon markets as well. For example, decisions such as carbon loans and locations mean institutional information disclosures, clean energy policies are key factors that may affect carbon prices. A major political and economic event

may also drive carbon prices by affecting the future expectations of market participants.

For example, during the Brexit referendum growth, as an important member of EOTS, the declaration of UK had brought significant instability to the current market during the Brexit referendum. Allowance prices were retarded and declined by 17% in the next week. Additionally, a very stringent and strict constraint regarding climate negotiation may strengthen individuals confidence in carbon trading and encourage other participants to join as a result, the carbon prices are expected to increase. In contrast, a weak regulation or something that weakens the resolve to reduce mitigate climate change will lead to pessimism and reduce carbon prices. To summarize, in this video, we discussed two important factors that affect carbon prices that is economic activity and institutional decisions and regulations.



## Institutional decisions and regulations

- Institutional policies, decisions, and regulations, affect the carbon markets as well, e.g., such as carbon allowance allocation schemes, institution information disclosures, clean energy policies, etc.
- A major economic or political event may also drive carbon prices by affecting the future expectations of market participants.
- For example, during the Brexit referendum vote, as an important member of the EU ETS, the declaration of the UK had brought significant instability to the carbon market. During the Brexit referendum EUA price was hit hard and declined by 17% in 4-5 trading days.
- Additionally, a strict constraint regarding climate negotiation will strengthen individuals' confidence in carbon trading and encourage other participants to join, as a result the carbon price will increase. On the other hand, a weak one will lead to pessimism and reduce the carbon price.

We noted that a higher economic activity is expected to lead to higher emissions and thus higher prices. And conversely, lower economic activity leads to lower emissions and therefore, excess supply and lower demand and falling prices. A similar situation was witnessed in 2008 crisis. Similarly, institutional decisions and regulations that show the strength and resolve of the members, parties at EU and other global nations to mitigate climate change will strengthen the carbon prices, improve the expectations of market participants, vice versa. If or those decisions and regulations that are weaker and show weakening resolve of market participants towards climate change mitigation may weaken the carbon price.





## Unanticipated weather and temperature change

- Carbon allowance (as one of the products of climate change) demand and its prices are easily influenced by weather conditions.
- Extreme weather conditions, as well as mild winter and drought, usually result in a sudden increase or decrease of fossil energy demand and accordingly influence the demand for carbon allowance.
- For example, people's demand for heating soars during the cold wave. The consumption of fossil energy and electricity will increase accordingly, thus increasing carbon prices (as power-generating firms will require additional EUAs for further production and forcing the carbon price upwards).

In this video, we will discuss the role of weather and temperature changes as carbon price determines. Carbon allowance as one of the product of climate change itself, its demand and its prices are easily influenced by weather conditions, weather and temperature conditions. For example, extreme weather conditions, winter, drought, heat waves may result in sudden increase or decrease in fossil energy demand and accordingly increase the emissions or decrease the emissions significantly and may influence the demand for carbon allowances and thus affect its prices. For example, people's demand for heating source during cold wave, the consumption of fossil energy electricity will increase in these situations accordingly, thus increasing the carbon prices because power generating firms will require, they will produce more emissions and they will require additional UAS for these productions thus forcing the carbon price upwards. Also, it has been observed if the temperature changes such as cold and hot temperatures are unexpected and unanticipated, then they also lead to significant increases in energy demand for heating and cooling giving rise to more emissions and thus allowance demand and in turn rising prices.



## Unanticipated weather and temperature change

- If the temperatures changes such as cold (hot) are unexpected, then also they may significantly increase the energy demand for heating (cooling) giving rise to allowance demand and rising prices
- Both temperature increases and decreases beyond a certain threshold only may lead to a rise in demand for electricity.
- With respect to seasonal average, warmer summers increase the demand for air conditioning, electricity, and the derived demand for coal
- Colder winters increase the demand for natural gas and heating fuel.

This is in contrast to those situations where rise in hot and cold weathers are anticipated and people have anticipated these changes and accordingly adjusted their demands, then probably energy demand may not increase so significantly. So, it is the unanticipated and unexpected changes that are more sort of impacting the prices. Both temperature increases and decreases beyond a certain threshold which was not expected may lead to a rise in demand for electricity and thus rising demand for allowances and prices, carbon prices. With respect to seasonal average, more than average warmer summers may increase the demand for air conditioning electricity and the derived demand for cold. Similarly, colder winters may increase the demand for natural gas and heating oil.



## Unanticipated weather and temperature change

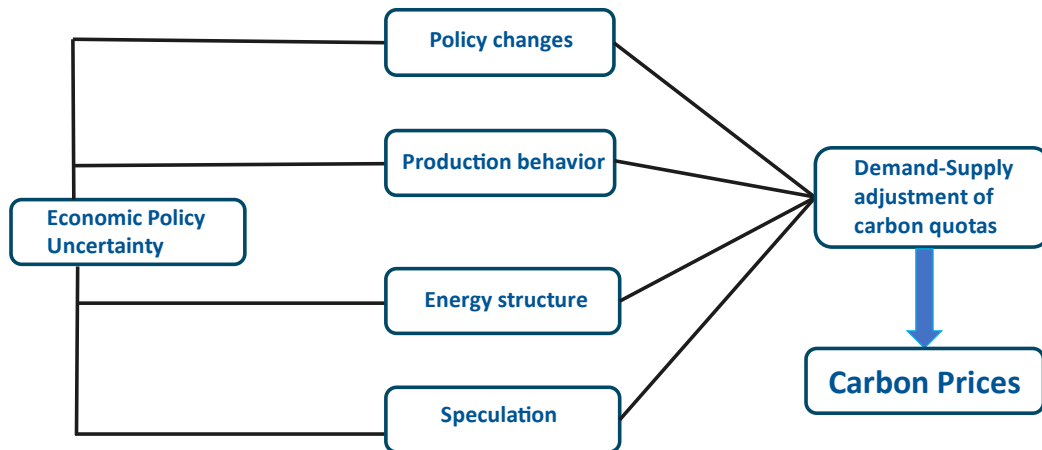
- As a result of increasing (decreasing) their output, power generators will increase (decrease) their CO<sub>2</sub> emissions which should, in turn, increase (decrease) the demand for allowances.
- In addition, environmental factors such as wind speed and rainfall also affect electricity production, which will indirectly affect carbon allowance demand and its prices. Therefore, carbon prices are theoretically affected by weather conditions.

Thus, as a result of these increasing and decreasing temperatures, the power generators

will also increase and decrease their output which will decrease or decrease their CO2 emissions and which should in turn increase decrease the demand for allowances and affects allowance prices. Similarly, in rental factors such as wind speed, rainfall, they also affect electricity production and will indirectly affect carbon levels demanded prices. Therefore, carbon prices are theoretically affected by weather conditions. To summarize, in this video we discuss how unanticipated weather and temperature changes affect the energy demand and therefore the energy production decisions of power and electricity generators affecting their emission levels and thus driving prices higher or lower. In this video, we will discuss economic policy uncertainty as carbon price determinants.



## Economic Policy uncertainty (EPU)



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To begin with, the volatility of carbon prices has proven to be explained by market operation risk, uncertain policy expected change in risk, market mechanism design changes and various significant events such as Brexit. Besides these factors, it might also be influenced by economic policy uncertainty which is defined as a risk in which government policies and regulatory frameworks are defined or less certain and more uncertain for the near future. Generally, EPU affects volatility of carbon prices through the following four channels. These are policy changes, production behavior, energy structure, speculation.



## Economic Policy uncertainty

- The volatility of carbon prices has been proven to be explained by market operation risk, uncertain policy expected risk, mechanism design changes, significant events.
- Besides these factors, it might also be influenced by economic policy uncertainty (EPU), which is defined as a risk in which government policies and regulatory frameworks are undefined for the near future.
- Generally, EPU affects the volatility of carbon prices through the following four channels:
  - A) Policy changes,
  - B) Production behavior,
  - C) Energy structure and
  - D) Speculation.
- Firstly, as the ETS establishes and operates under the government's guidance, government policies could affect the ETS price by adjusting the supply of carbon quotas.

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Let us discuss them one by one. First, as ETS establishes and operates under government guidance, government policies could affect the ETS price by adjusting the supply of carbon quotas. So thus, they may affect the supply demand forces. Next, since the price of ETS quota reflects supply demand relationship between market quotas, the economic policy adjustments might affect the volatility by changing enterprise production behavior and the demand for carbon quotas. Third, EPU also affects the proportion of fossil fuels used by industries. Since carbon emissions are closely related to energy consumption, the change of carbon emissions incurred by the consumption of fuels will also affect the demand for carbon quotas and their prices.



## Economic Policy uncertainty

- Secondly, since the price of ETS quota reflects the supply–demand relationship between market quotas, the economic policy adjustments might affect the volatility by changing enterprises' production behavior and their demand for carbon quotas.
- Thirdly, EPU also affects the proportion of fossil fuels used by industries (Yu et al., 2021). Since carbon emissions are closely related to energy consumption, the change of carbon emissions incurred by the consumption of fuels will affect the demand for carbon quotas and their price. Thus, the volatility in the energy market induced by EPU will be transmitted to the ETS.
- Finally, EPU can also affects investor sentiment and results in speculative behavior (Wei et al., 2017). Some studies have shown that EPU could affect the volatility in financial markets. Since the ETS market has the same speculative attribute as financial markets, the speculative behavior caused by the uncertainty may affect the volatility in the ETS market.

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Thus, volatility in energy market induced by the economic policy uncertainty will also be

transmitted to emission trading system. Lastly, if you can also be affected by investors speculation and sentiments, some studies have shown that if you could affect the volatility in financial markets, since the emission trading system market has the same speculative attributes as financial markets, the speculative behavior caused by the uncertainty may affect the volatility in the emission trading scheme market. So thus, overall, all these four factors or four channels may be deployed by and may affect carbon prices because of economic policy uncertainty. In this video, we will discuss the role of climate policy uncertainty and its impact on carbon prices. This is an illustrative diagram showing the impact of climate policy uncertainty on carbon prices.



## Climate Policy uncertainty

- First channel

CPU hinders investment in low-carbon technologies, as premature investment in carbon reduction projects may lead to sunk costs.

Policymakers cannot ensure that policies remain consistent because optimal policies may change over time. However, enterprises' investment in low-carbon technologies is a long-term process and largely irreversible.

If the government lacks credibility or frequent fluctuations in climate policies, it increases the uncertainty faced by enterprises, thereby delaying or abandoning the investment in low-emission technologies.

In the long run, it will inevitably increase carbon emissions, pushing up carbon prices.

Let us start with the first channel that is technological innovation effect. So, climate policy uncertainty hinders investment in low carbon technologies as premature investment in carbon reduction projects may lead to some cost. In the presence of climate policy uncertainty, if for example, policy makers cannot ensure that policies remain consistent, and they are very uncertain because optimal policies may change your time. However, this is not the case with enterprises because enterprise investment in low carbon technologies is a long-term process which is largely irreversible. This precisely hinders the innovation in low carbon technologies.

For example, if government lacks the credibility and there are frequent fluctuations in climate policy, it increases the uncertainty faced by enterprises and therefore it delays or they may even abandon the investment in low carbon technologies. And in the long run, it will inevitably increase carbon emissions, pushing the carbon prices up. Next, the second channel is investment and output effects. Climate policy uncertainty may also impact high emission enterprises, R&D investment and output. Climate change is essentially due to excessive carbon emissions, climate policy revolves around achieving carbon neutrality

and therefore high emission on the prices will be sensitive to this kind of climate policy uncertainty response.



## Climate Policy uncertainty

- Second channel:

Climate policy uncertainty (CPU) impacts high-emission enterprises' R&D investment and output. Climate change is essentially due to excessive carbon emissions. Climate policy revolves around achieving carbon neutrality. Therefore, high-emission enterprises will be sensitive to CPU response.

When climate policies change, high-emission enterprises will adopt a “wait and see” strategy until more information is available for decision-making. As a result, extreme CPU can deter enterprises from investing in R&D.

Additionally, with widespread awareness of social responsibility, investors pay more attention to green investments. It is worth noting that policy uncertainty makes it harder for enterprises to raise capital. For CPU, it will significantly increase the financing difficulty of high-emission enterprises and force enterprises to shrink their business scale.

In summary, high-emission enterprises reduce carbon emissions during extreme CPU periods.

When climate policies change, high emission enterprises will adopt a great and see strategy until more information is available for decision making. And as a result, extreme climate policy uncertainty can deter enterprises from investing in R&D. Additionally, with widespread awareness of social responsibility, investors may pay more attention to green investments, and it is worth noting that such policy uncertainty makes it harder for enterprises to raise capital. For climate policy uncertainty, it will significantly increase the financing difficulty of high emission enterprises, forcing them to shrink their business scale and reduce the output. In summary, high emission enterprises may reduce their carbon emissions during extreme climate policy uncertainty periods.



## Climate Policy uncertainty

- Third Channel

High CPU affects energy consumption. Climate policies are designed to mitigate climate deterioration, so extreme abnormal weather often accompanies a high CPU.

To cope with climate risks, a significant amount of energy support is required. For example, extremely high temperatures lead to heavy use of air conditioning, creating greater electricity demand.

Similarly, severe cold weather results in more energy and electricity consumption for heating purposes. The low share of clean energy in energy consumption and inconsistent production increases the demand for traditional energy sources, resulting in more CO<sub>2</sub> emissions.

As a result, high CPU may be accompanied by excessive carbon emissions, leading to higher demand for carbon allowances and thus driving up the CTP.

They may delay or hinder their investment or delay their financing decisions, thus reducing their output. So, in particular, those some that are high emitters, it may reduce carbon emissions. The third channel is through energy effect. A high climate policy uncertainty may affect energy consumption of enterprises and individuals. Climate policies are designed to mitigate climate deterioration.

So, extreme abnormal weathers often accompany a high climate policy uncertainty. For example, to cope with the climate risk, a significant amount of energy support is required. For example, during extremely high or low temperatures may lead to heavy use of electricity in the form of air conditioning, creating greater energy and electricity demand. Similarly, cold waves or cold weather produces more energy, requires more energy consumption for heating purposes and the low share of clean energy in energy consumption and inconsistent production increases the demand for traditional energy sources, particularly because clean energy mix is lower as compared to conventional fossil fuel energy sources, which results in more CO<sub>2</sub> emissions, which results in more emissions. And as a result, a high climate policy uncertainty may be accompanied by excessively high carbon emissions, leading to higher demand for carbon prices, carbon emissions, higher demand for carbon allowances, thus driving higher carbon traded prices.



## Climate Policy uncertainty

- In response to increasingly severe climate deterioration, the government has continuously introduced intervention policies.
- The CPU index reflects changes in government policy on climate issues.
- Frequent climate policy adjustments may result in higher CPU. As carbon trading has always been a policy-driven market behaviour, the carbon price is inevitably affected by policy announcements. Similarly, the CPU reflects the lack of clarity about the government's position on tackling climate change, which could significantly affect CO<sub>2</sub> emissions and lead to changes in the carbon prices.
- The CO<sub>2</sub> reduction and related low-carbon transition are preliminary objectives of SDG, which connect CPU and carbon prices.
- The first path is that the CPU is reshaping the macroeconomic environment. Confronted with the high CPU, the public and financial departments will tighten relative credit treatment, imposing tighter financing limitations on production, which reduces the demand for carbon emission, and lowers the carbon prices.

Now, please note in response to increasingly severe climate deterioration, government's World Drive had continuously introduced intervention policies. We have climate policy uncertainty index, which reflects the changes in government policy on climate issues. Frequent climate policy adjustments may result in higher climate policy uncertainty, as carbon trading has always been a policy driven market behavior and therefore the carbon price is inevitably affected by policy announcements. Similarly, climate policy uncertainty reflects the lack of clarity about government's position on tackling climate change, which could significantly affect CO<sub>2</sub> emissions and may lead to changes in carbon prices. Therefore, the carbon or CO<sub>2</sub> reduction and related low carbon transition are primarily objectives of sustainable goals, SDV, sustainable development goals, which connect CPU and carbon prices.

The first part is that the CPU is reshaping the macroeconomic environment. Confronted with the high CPU or climate policy uncertainty, the public and financial departments will tighten the relative credit treatment, imposing tighter financing conditions and limitations on production, which reduces the demand for carbon emission and therefore lower the carbon prices. Next, the second part is that the climate policy uncertainty alters corporations behavior. Corporations act as main participants in the global carbon market and their behaviors and actions have an intangible effect on carbon prices. When the climate policy uncertainty is high, businesses frequently take steps to limit carbon emissions, such as boosting clean energy use and implementing green manufacturing techniques.

These measures change the supply and demand of carbon emission rights, which in turn affect the carbon prices. The fluctuation of carbon prices serves as an indicator of the



government's climate policy adjustment. Carbon market, enterprises and government are important participants of sustainable development goal, SDGs, which have tight relationship around the goal. So the volatility of carbon prices can have a direct impact on the economics of climate policy. If the carbon price is higher, the cost of reducing emissions will increase, which may negatively impact the economic viability of implementing climate policies.



## Climate Policy uncertainty

- A higher carbon price could lead to increased pressure on businesses and industry to raise more questions about the government's emissions reduction targets, adding to CPU.
- In addition, the volatility of carbon prices will also have an impact on industrial restructuring and investment decisions. However, the volatility in carbon prices can lead to unstable investor confidence in the clean energy sector and influence their investment decisions, which in turn increases climate policy uncertainty. In addition, the volatility of carbon market prices can lead to increased political and stakeholder pressure, with implications for climate policy. When carbon prices rise, some stakeholders, such as the energy industry, may increase resistance and put more pressure on governments to reduce emissions. Such conflicts of interest can lead to policy adjustments and increased uncertainty.

Lastly, a higher carbon price could lead to increased pressure on businesses and industry to raise more questions about the government's emission reduction targets adding to climate policy uncertainty. In addition, the volatility of carbon prices will also have an impact on industry restructuring and investment decisions. However, the volatility in carbon prices can lead to unstable investor confidence in the clean energy sector and influence their investment decisions, which in turn may increase the climate policy uncertainty. In addition, the volatility of carbon market prices can lead to increased political and stakeholder pressure with implications for climate policy. When carbon prices rise, some stakeholders, such as energy industry, may increase resistance and put more pressure on governments to reduce emissions.

Such conflicts of interest can lead to policy adjustments and increase uncertainty. To summarize, in this video, we discussed the impact of climate policy uncertainty and the three channels that is technology innovation effect, energy effect and investment and output effects and how they affect carbon emissions and in turn carbon prices. For example, organizations may delay their investments in low carbon technology due to carbon policy uncertainty. This may hinder innovation in low carbon technology, which in turn may result in higher carbon emissions and thus higher carbon prices. Similarly, firms may delay their investment and the output decisions due to climate policy uncertainty.

This may hinder investment in their R&D activities and also reduce their output, thus reducing their emissions, particularly for high energy emitting, high emitting firms, firms covered installations that have high emissions. The third channel is energy effect firms. Their energy consumption decisions may be affected by unexpected changes in weather and temperature conditions, which may further affect their energy demand, particularly an increase in energy demand would lead to increase in carbon emissions and thus higher carbon prices. To summarize, like financial security and commodities, the price of carbon also depends on the dynamics of supply demand forces. First, the energy prices, for example, fossil fuels, are negatively related to carbon prices.

As rising energy prices would result in a decrease in the consumption of energy leading to lower emissions and thus lower demand for carbon allowances and thus lower allowance prices, rise in electricity prices driven by demand for higher electricity leads to more consumption of fuels, for example, coal, natural gas among others, resulting in more emissions and thus higher allowance prices. Similarly, higher economic activity leads to more emissions and thus higher allowance prices and vice versa. Institutional actions, decisions and regulations that reflect sickness towards climate change mitigation targets provide more confidence in the measures taken and thus result in higher prices and vice versa for those actions that appear weak in terms of their resolve for climate change mitigation and may result in lower prices. Unexpected changes in weather and temperature also result in higher energy demands leading to higher carbon prices. Economic policy uncertainty can also contribute to higher carbon price volatility and prices in general through the channels namely policy changes, production behavior of firms, energy consumption structure, speculation.

Lastly, the uncertainty in climate policy can also affect carbon prices through the three channels namely technology and innovation effect, energy effect, investment and output effects among others. For example, uncertainty in climate policy changes may hinder innovation in low carbon technologies leading to higher emissions. Similarly, climate policy uncertainty may also result in energy consumption mix and volumes that are not aligned to climate change mitigation objectives. Also, climate policy uncertainty can affect decision related to investment in R&D, economic activity and other similar affecting the level of emissions and thus carbon allowance demand and in turn carbon prices. Thank you.