

Lecture 13

Energy Pricing



<http://sesp.ui.ac.id/>

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Research Cluster

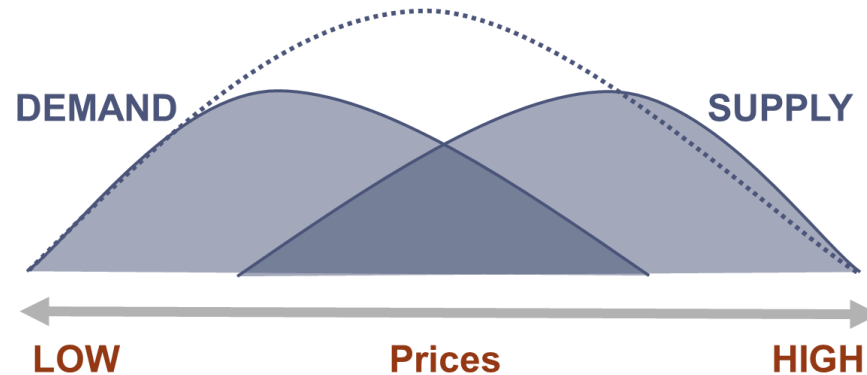
Master Program in Energi Systems Engineering
Chemical Engineering Department
Universitas Indonesia

Outline

- What is Energy Market and Pricing
- How to design energy pricing
- What is carbon pricing
- How to design carbon pricing

What Energy Market and Pricing?

Gas pricing design mechanism



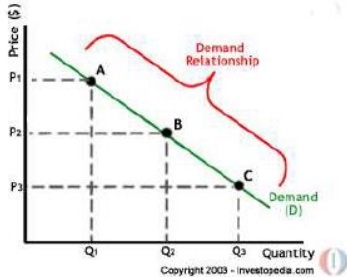
Economy efficiency, Social equity, Financial viability

- Efficient gas allocation* → *Estimate economic value of gas in different sectors (consumer sector -WTP, production sectors-MVP)*
- *Max gas value chain for domestic*
- *Efficient use of gas - Macroeconomic impact*

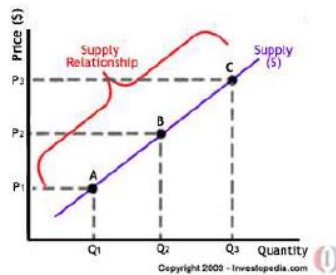
Wholesale price formula or responsive price adjustment

Energy Markets and Energy Pricing

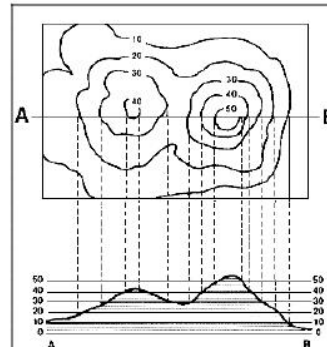
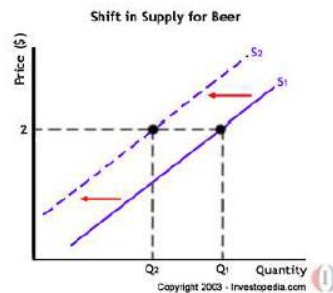
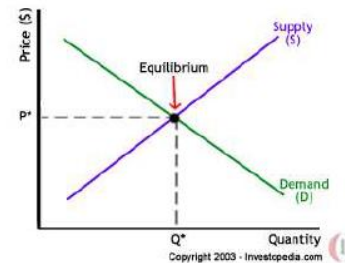
Basic Competitive Market: the theoretical world of perfect competition: consumers maximize their utility subject to their budget constraints and producers maximize their profits subject to the constraints of production possibilities.



The reduction price will increase demand quantity at certain line



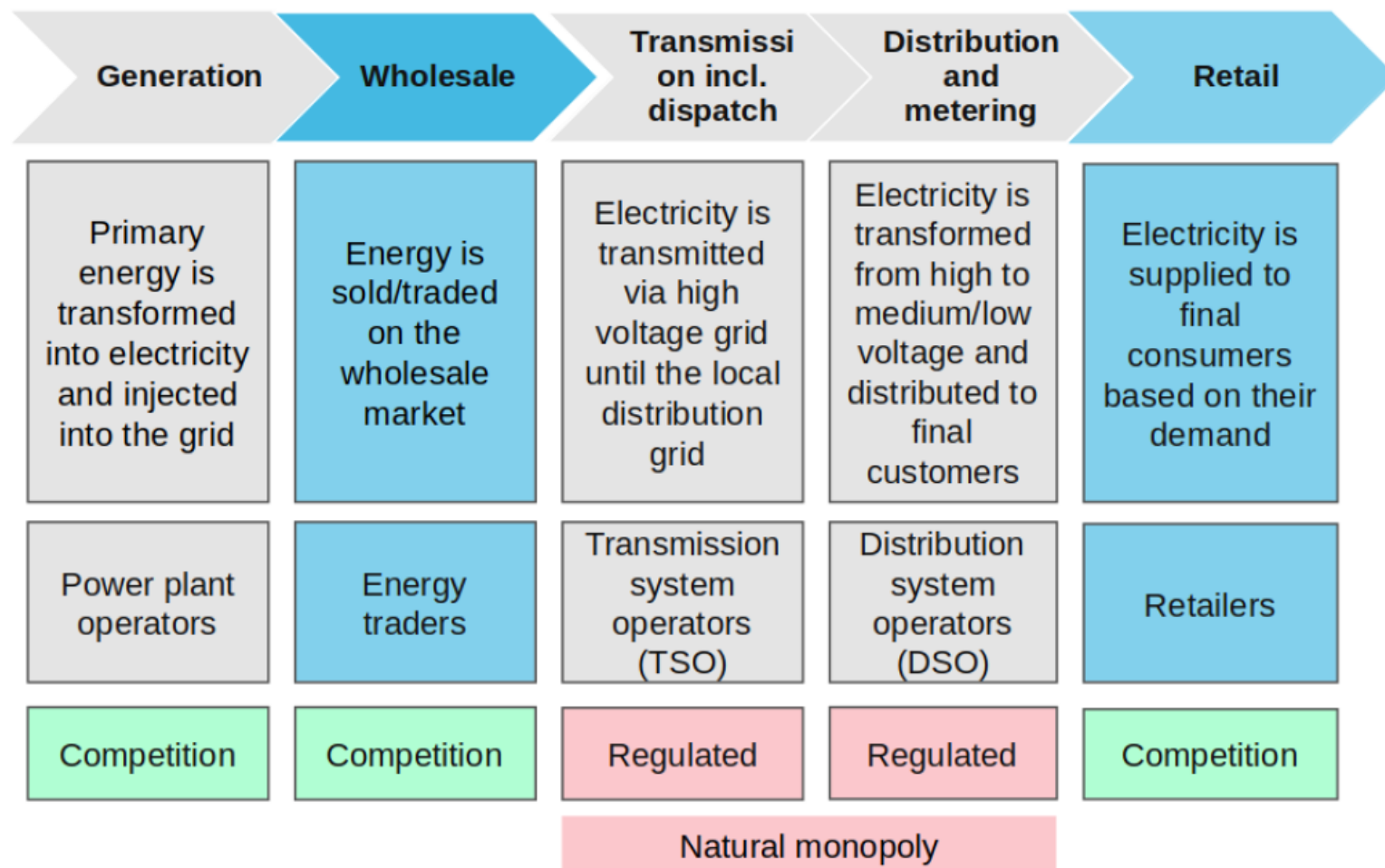
The increased of price will increase the supply quantity



When shifting, try to imagine that the curve shifts is like a hill that has different height

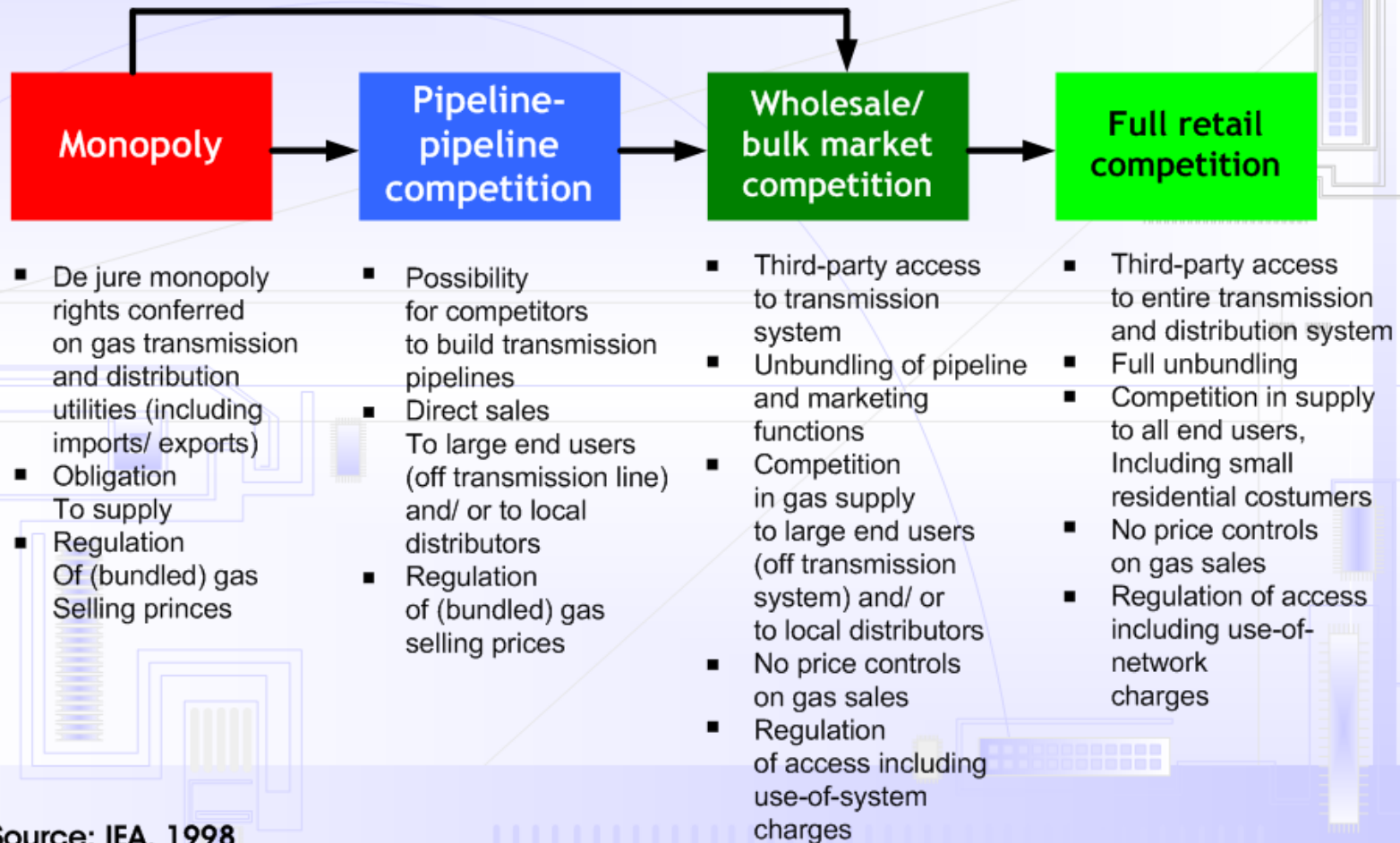


Electricity markets: main actors



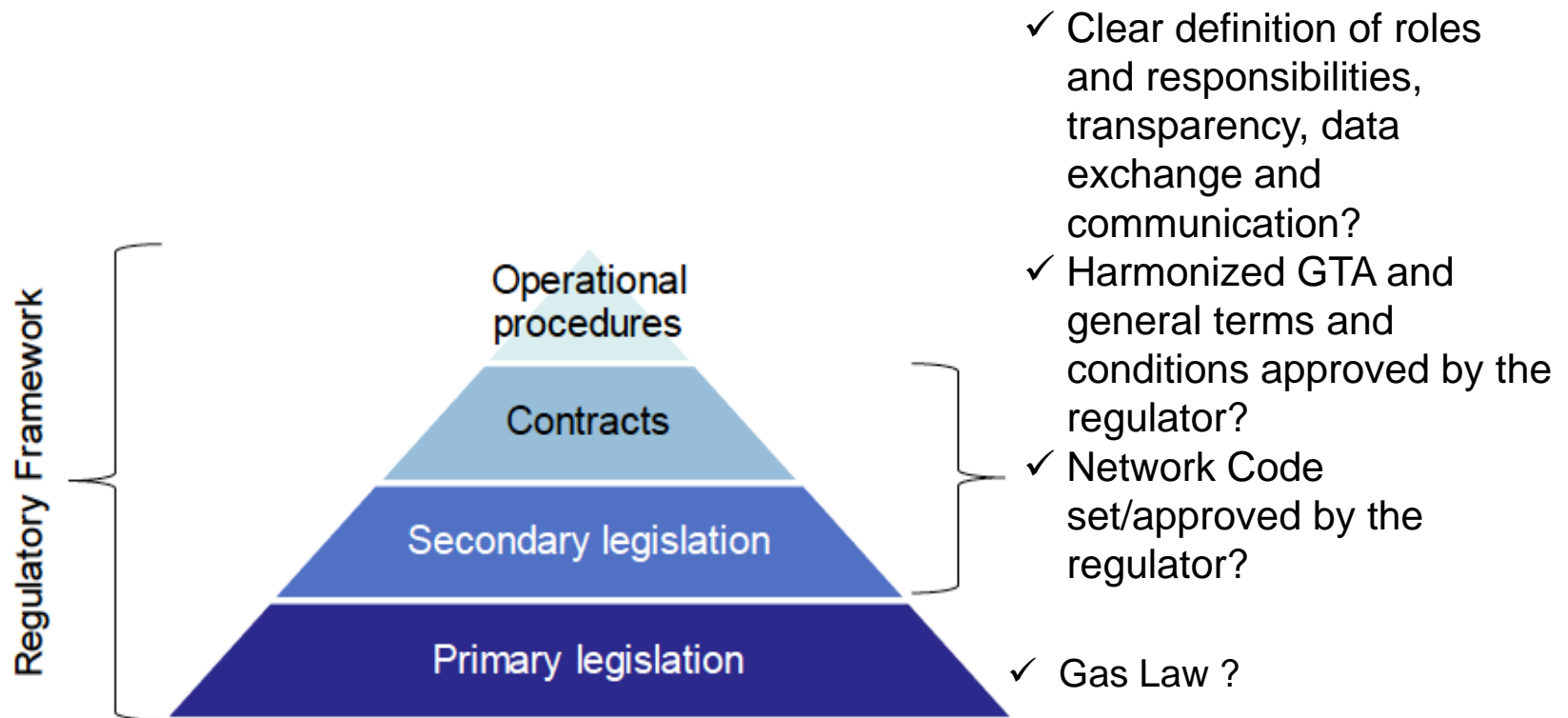
Source: TU Berlin

Stages of Development of Gas-to-Gas Competition



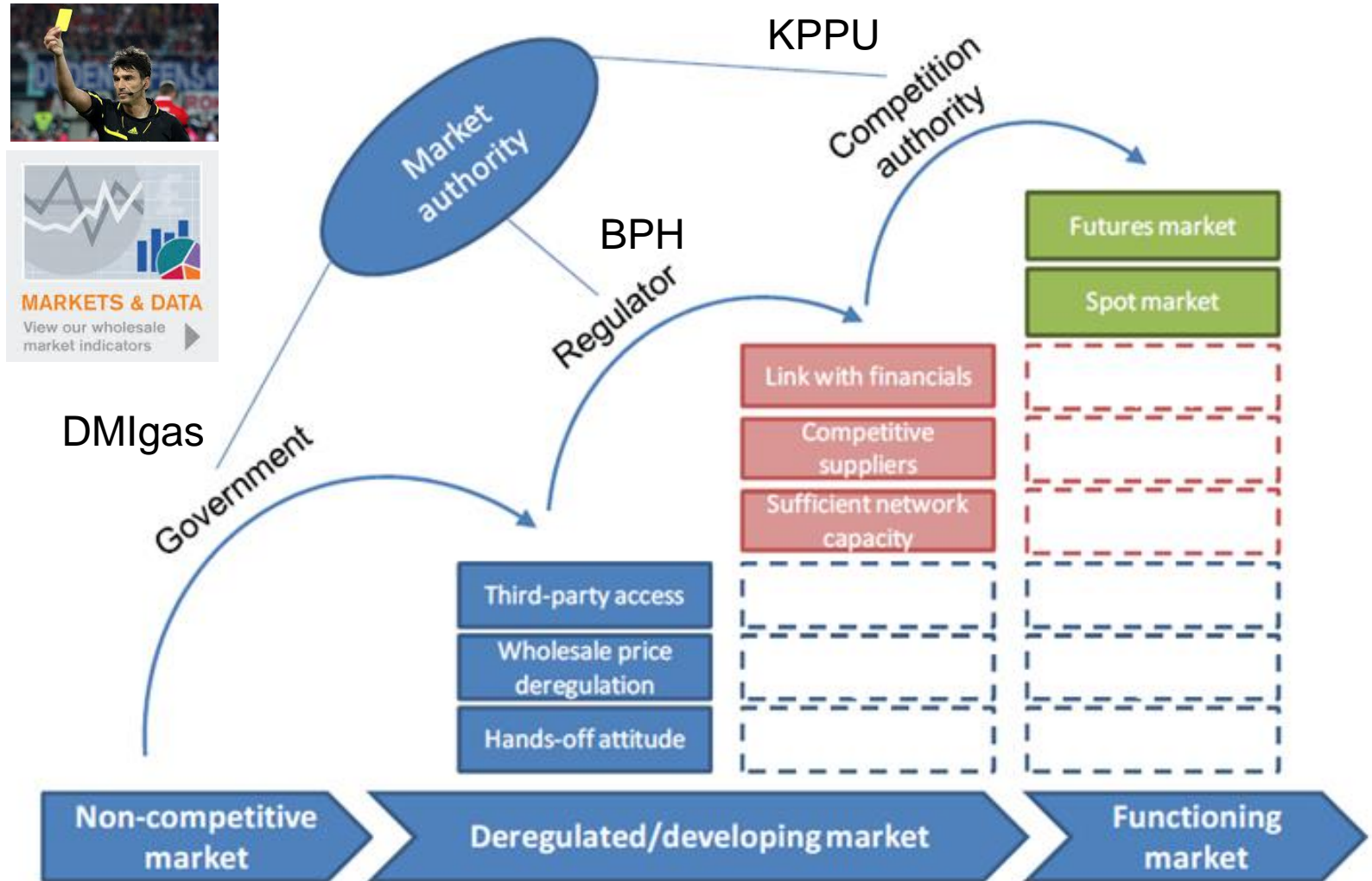
Source: IEA, 1998

Regulatory framework for gas market development

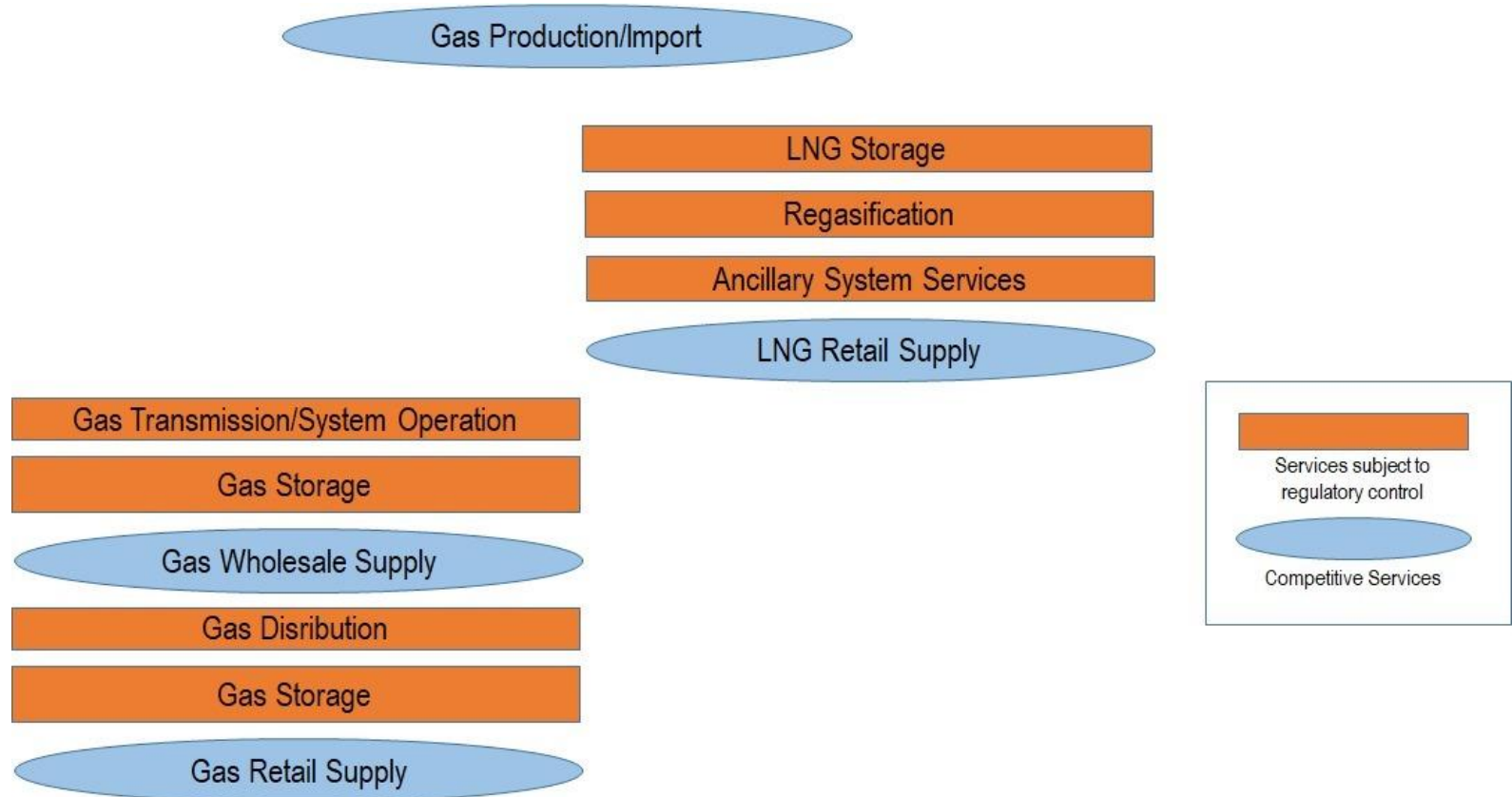


Source: E-Control

Role of Market authority



Area of gas regulation

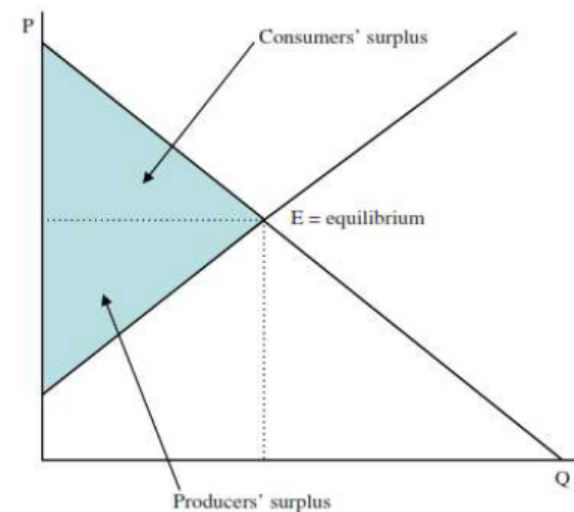


Competitive Equilibrium

- **Basic Competitive Market**

- Competition forces sellers to charge no more than their rivals.
- If one seller charges more than the market clearing price, consumers will go to others offering the same good at a lower price. If someone charges less than the market price, the demand will outweigh the supply, forcing a return to the market price.
- Individual buyers and sellers cannot affect the price. Buyers and sellers react to changes in the market price. At lower prices, some sellers will leave the market while more consumers enter it. Similarly, at higher prices more sellers are willing to offer their goods while there will be fewer consumers. The participation in the market is voluntarily and consumers or sellers are free to enter or leave the market in a perfectly competitive case. Price is equal to the marginal cost of the last supplier.
- However, certain basic conditions have to be satisfied to obtain such efficiency outcomes: existence of freely competitive markets, perfect and costless flow of information and knowledge, smooth transferability of resources and absence of externalities.
- Clearly, most of these requirements are not satisfied by the today's energy market. In addition, the energy sector is marked by certain specific characteristics such as indivisibility of capital, tradability of some products and depletion of some resources.

Fig. 12.3 Competitive equilibrium



Effects of marginal cost pricing in a natural monopoly

Fig. 12.12 Effects of marginal cost pricing in a natural monopoly

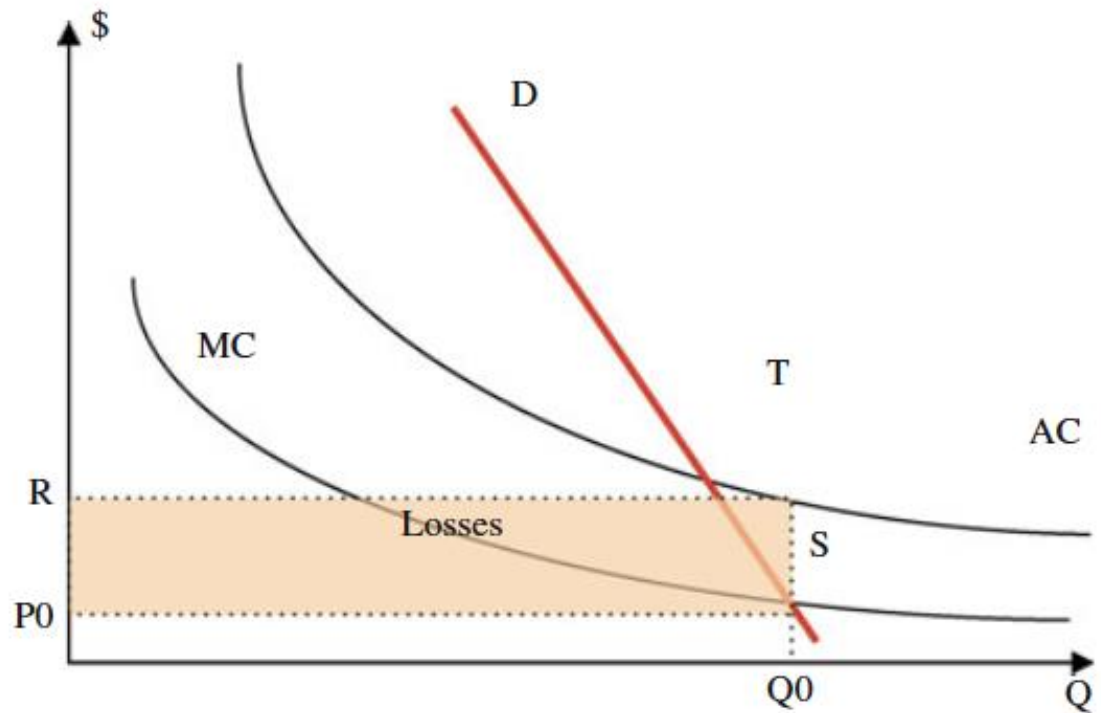


Fig. 13.2 Pricing in an energy self-sufficient country

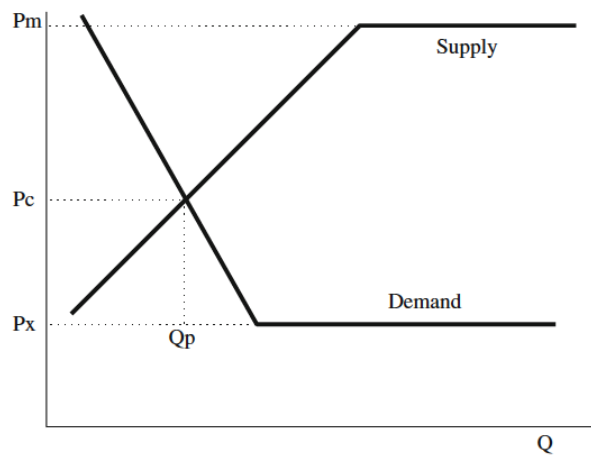


Fig. 13.3 Pricing of energy in an importing country

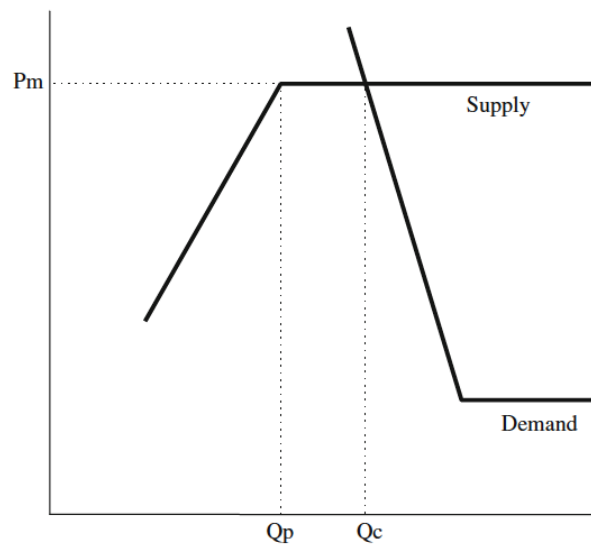
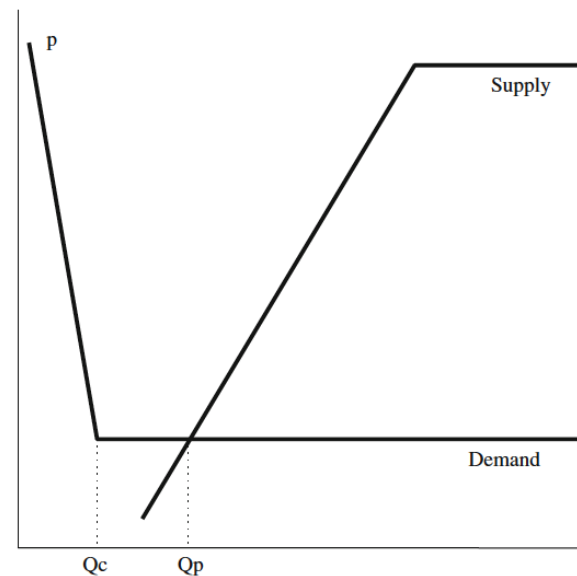
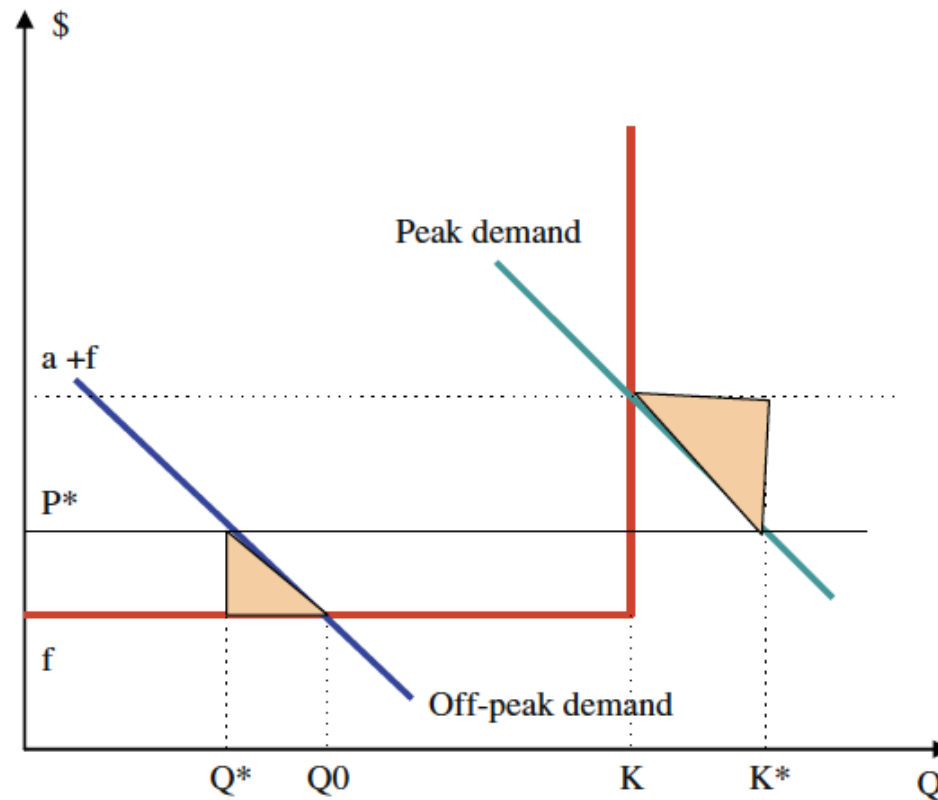


Fig. 13.4 Efficient pricing for an exporting country



Peak and off-peak pricing

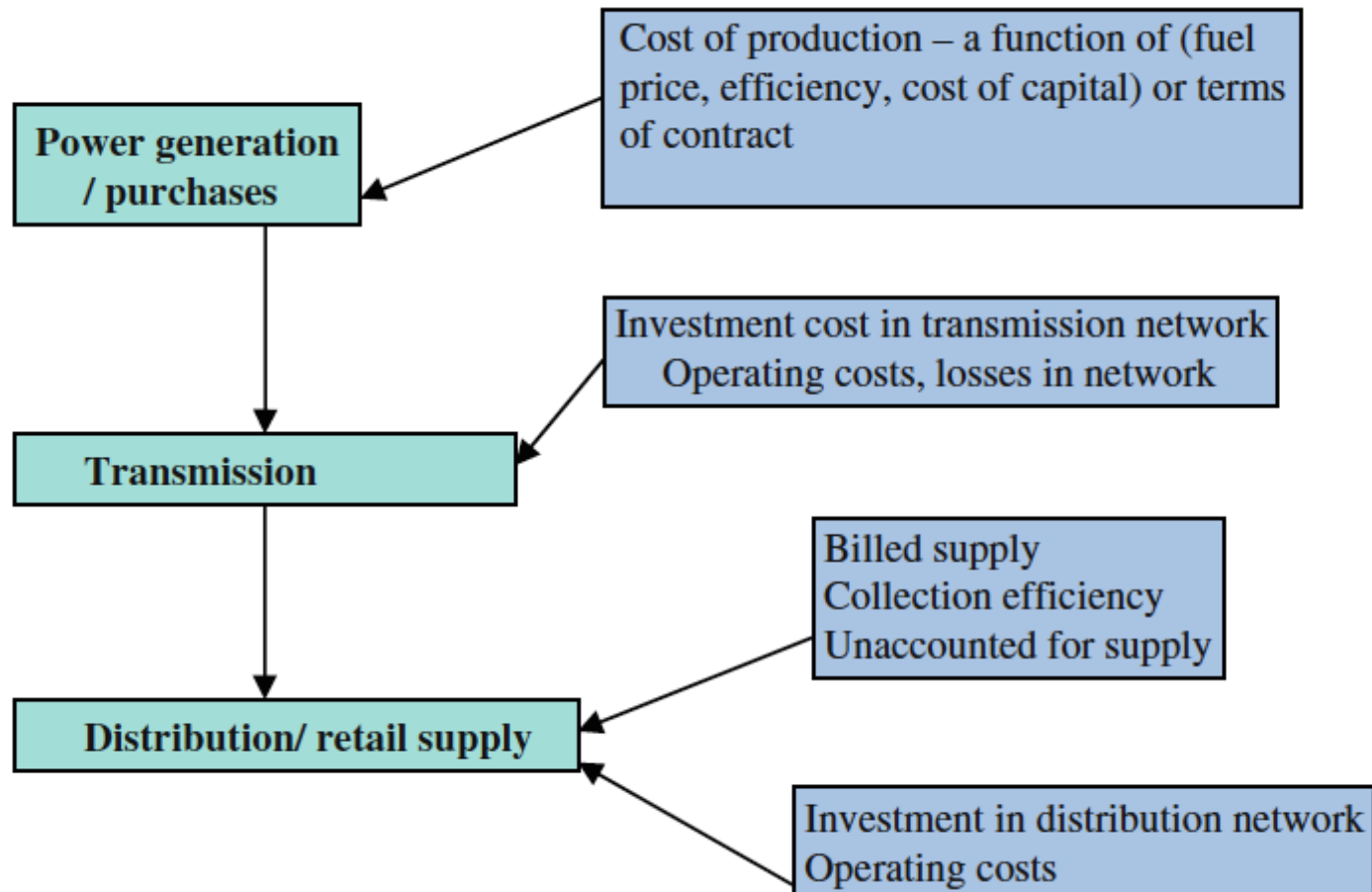
Fig. 13.8 Loss due to non-peak pricing. *Source* Viscusi et al. (2005)



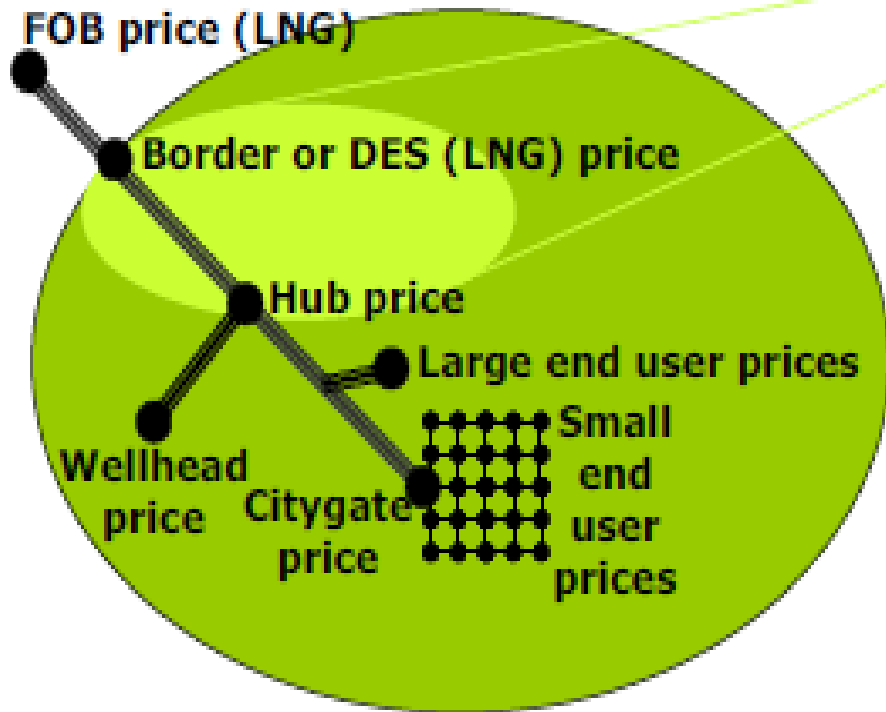
Pricing Approaches Under Different Market Structures

	Monopolistic		Competitive	
<i>Market structure</i>	Pure monopoly	A. Pipeline-to-pipeline competition only	B. Mandatory third-party access (TPA)	
			1. Competitive wholesale market (TPA to high-pressure system)	2. Full retail competition (TPA to entire system)
<i>Pricing approach</i>	Price discrimination between customers. Netback market value, cost-plus or mix of both	Restricted form of discriminatory netback market value (depending on extent of competition)	Interfuel competition and/or gas-to-gas competition (depending on gas supply curve)	Same as for competitive wholesale market
<i>Example</i>	France, Belgium, Netherlands, Spain, Italy	Germany	United States, Canada	Britain

Electricity supply value chain and cost determinants

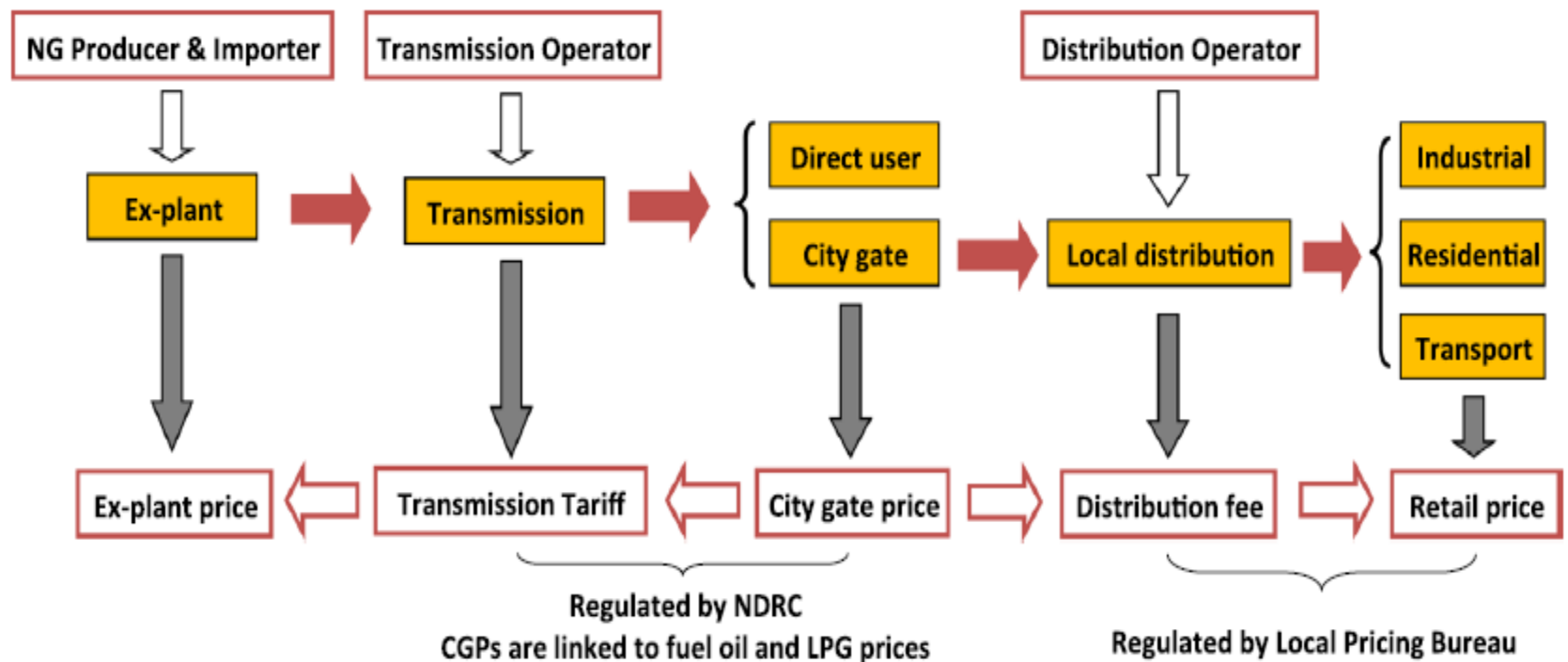


Gas price types



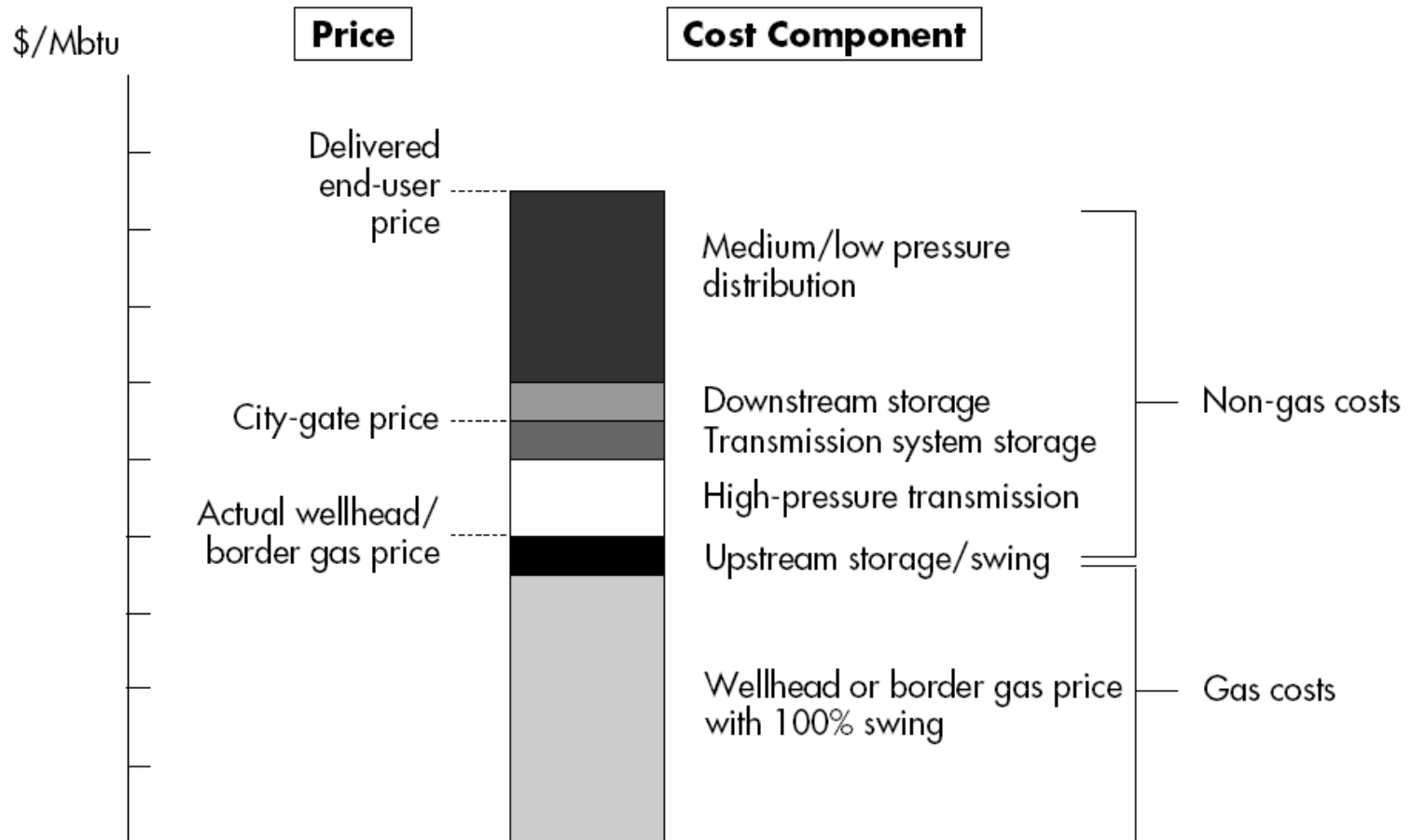
- Study object is wholesale – border or hub – price formation
- Wellhead prices may be unrepresentative for pricing conditions further down the chain
- End user prices reflect, in addition to wholesale prices, taxes, downstream margins and local factors – noise in the big picture
- Also, border/hub prices are better documented

Gas pricing in China



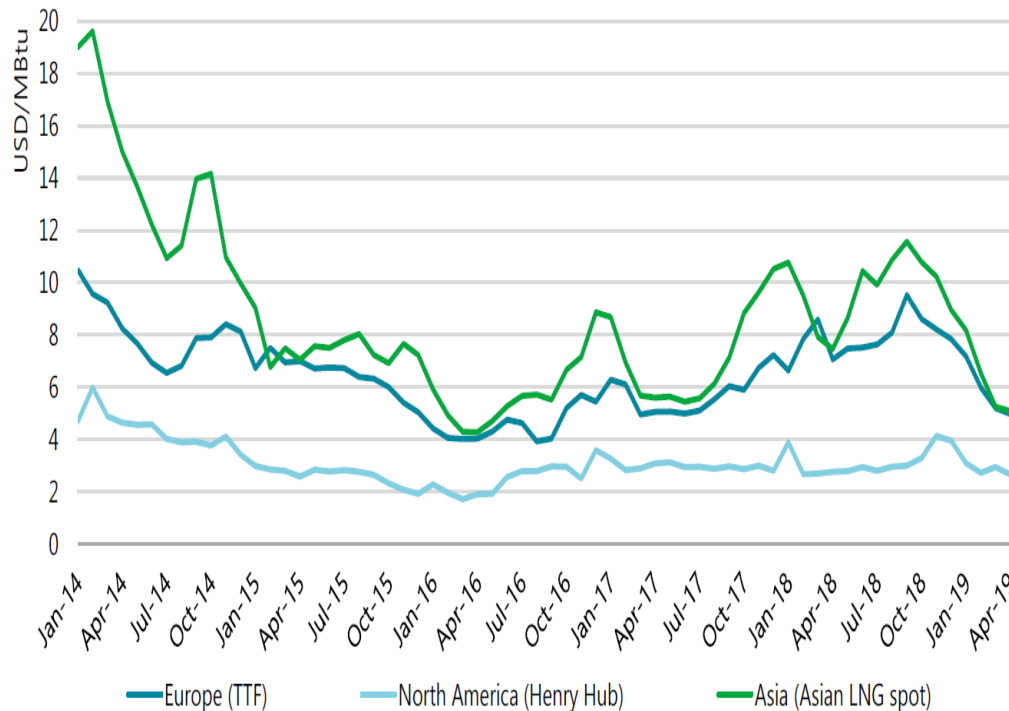
Source: Paltsev & Zhang, 2015

Cost component of pipeline gas

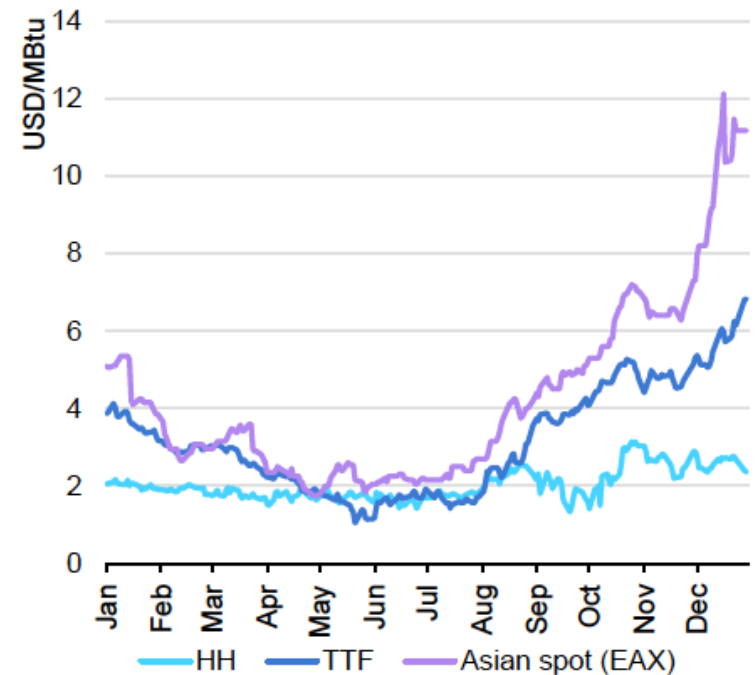


Global convergence of natural gas prices

Evolution of natural gas spot market prices, 2014-19

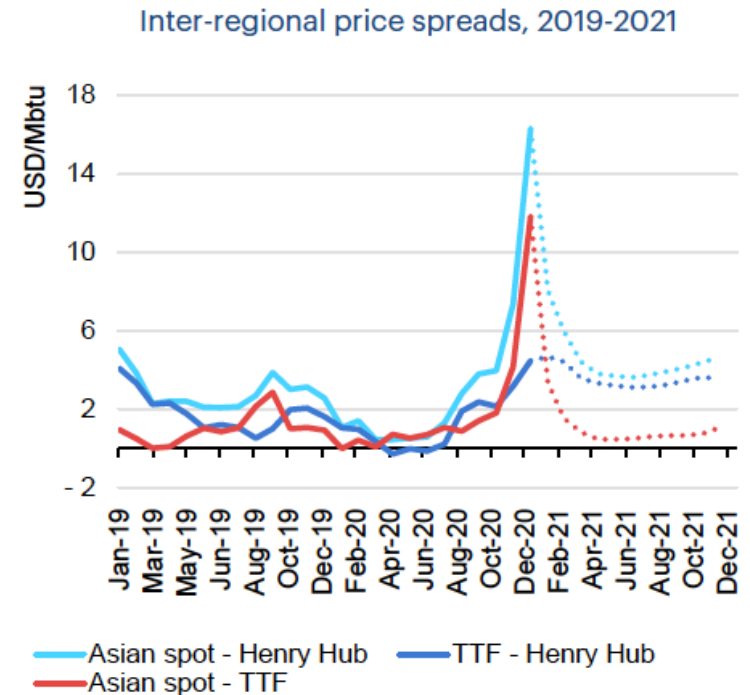
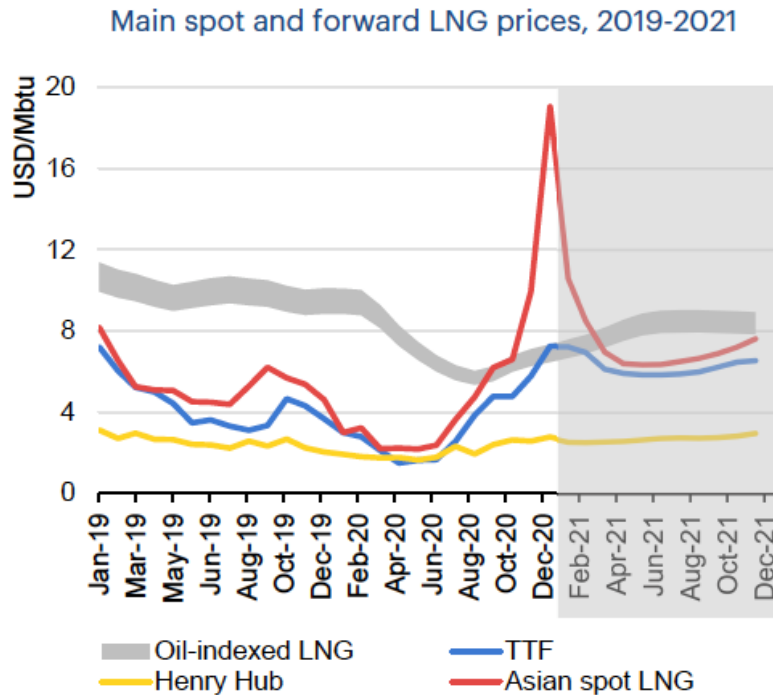


Natural gas spot prices, 2020



Source: IEA, 2019, 2020

Price spreads with Henry Hub



Source: IEA, 2021

Electricity prices



Tarif Listrik 6 Negara ASEAN

Per 1 Juli 2022, tarif listrik untuk masyarakat mampu dengan daya 3.500 ke atas dan kategori pemerintah resmi naik.

Bagaimana perbandingan besaran tarif listrik di Indonesia dan di negara-negara ASEAN lainnya ?



Tarif Listrik Negara-negara ASEAN

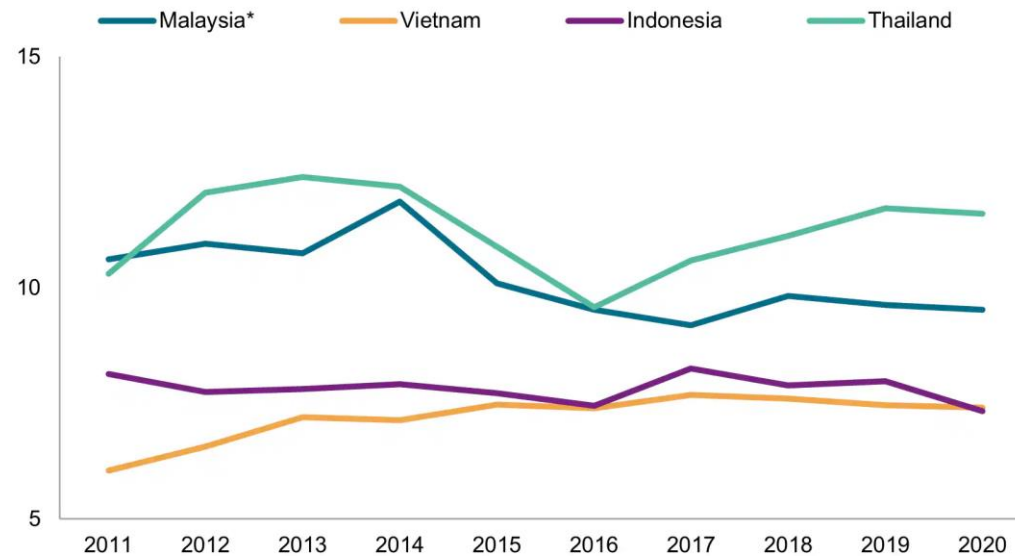
a. Golongan Rumah Tangga



*Keterangan:
Tarif listrik berdasarkan periode Mei 2022

21-06-2022
Kementerian ESDM

Average power retail tariffs (US cents per kWh)



Data compiled Nov. 12, 2022.

*Average power selling prices for Tenaga Nasional Berhad (TNB).

Source: S&P Global Commodity Insights.

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What is carbon pricing?

Carbon pricing as part of a climate policy package

Governments have numerous climate policy instruments at their disposal for achieving their NDCs – carbon pricing is just one of them

Developing a climate policy package requires countries to balance numerous policy objectives as they transition to a low-carbon economy, e.g.:

- Reducing emissions
- Driving innovation and economic development
- Ensuring inclusive growth
- Build economic resilience and adapt to the impacts of climate change

Carbon pricing can play a key role in a wider policy package that addresses these different policy objectives.

Box 2

New Opportunities under Article 6

Article 6 of the Paris Agreement establishes a framework for international cooperation in carbon markets.

Article 6.2 allows purchased mitigation units, called internationally transferred mitigation outcomes (ITMOs), to apply toward nationally determined commitments and their sale to secure funding. Countries can link their emission trading system (ETS) with another country under the Article 6.2 mechanism.

Article 6.4 provides rules for a global trading system under the Paris Agreement and encourages countries to cancel ITMOs for overall mitigation in global emissions.

Countries should consider the Article 6 mechanism as they design an ETS. The regulatory and accounting systems of an ETS can address the accounting requirements for trading ITMOs, which can fund climate action.

Source: Asian Development Bank.

Source: ADB, 2023

What is carbon pricing?

- Restricting the pollution that causes climate change makes sense. The more someone pollutes, the more they ought to pay. A carbon price makes polluting more expensive and solutions like clean energy and electric vehicles more affordable.
- Economists believe that carbon pricing is the most effective way to reduce the carbon pollution that is changing our climate. Several national and subnational governments have introduced a price on carbon pollution

Carbon tax vs ETS

Carbon Tax

- Levy paid by polluters

Emission Trading System (or Scheme) (ETS)

- Cap on pollution
- Sale of allowances, or *pollution permits*

Fossil fuel subsidy reforms

- *Reduce incentives for fossil fuel production and consumption*

- **How does an ETS work?**

An ETS works by setting a cap on emissions and requiring emitters to hold a permit for each tonne of CO₂ that they emit. The level of the cap determines the number of permits available. If emitters don't already hold a permit, they must either cut back on their emissions or buy a permit from another emitter, who must then cut back. This means that a cost is imposed on emissions, equal to the price of buying or selling a permit. But importantly it's not actually the price that causes the overall cuts in emissions. The cap determines the level of emissions, and the required cuts in emissions cause the price. That is, permits have a value because they allow you to avoid making cuts in emissions.

- **How does this differ from a carbon tax?**

A carbon tax is sort of the opposite. A cost is added to all emissions, equal to the level of the tax, and this causes people to cut back. There is no cap on emissions in a tax-based system. People are free to emit as much or as little as they like, but if they do emit, they must pay the tax. Unlike an ETS, under a carbon tax it is the price that determines the level of emissions.

Carbon offset projects can be grouped into two categories:

Avoidance / Reduction Projects



Renewable Energy



Methane Capture

Removal / Sequestration Projects



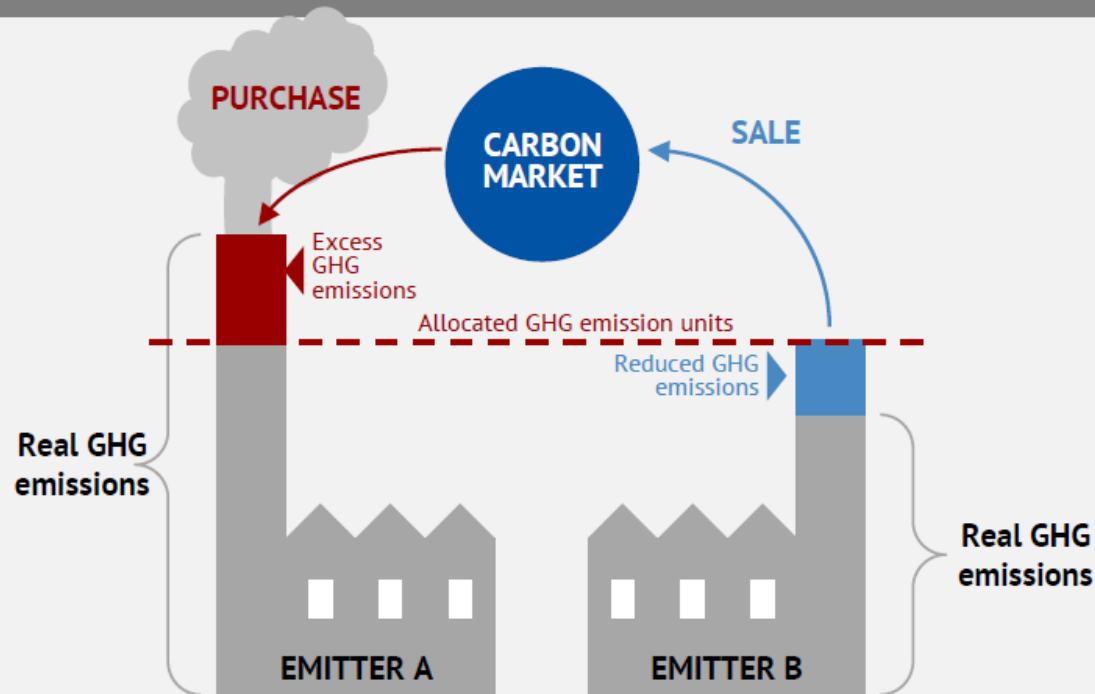
Reforestation



Direct Carbon Capture

Source: Carbon Credit

How an emission trading system works



- Allowances are either freely allocated or auctioned, and then may be traded.
- The supply and demand for these allowances establishes a market price.
- Emitters can also choose to “bank” allowances and hold them for use in future years.
- Emitters with an insufficient amount of allowances required for their industry at the end of the reporting period incur penalties.

Types of carbon pricing

Direct methods

- Cap-and-trade (emissions trading systems)
 - Cap on the total emissions
 - Cap on the emissions intensity
- Carbon tax
 - Tax on the carbon emissions
 - Tax on the carbon content of fuels
 - Tax on the amount of fuel extracted or imported
- Hybrid approaches
 - Combination of carbon tax and ETS with or without sectoral overlaps
 - ETS with a “price collar”
 - Jurisdiction with a Carbon tax linked to another jurisdiction with an ETS

Indirect methods

- Regulatory approaches
- Voluntary shadow pricing by firms

Source: Climate Policy Lab

Design features

Cap-and-Trade

EU, Switzerland, Regional Greenhouse Gas Initiative (RGGI), California, Québec, New Zealand, Republic of Korea, and China's seven provinces - Beijing, Shanghai, Tianjin, Chongqing, Shenzhen, Guangdong, Hubei

Design features compared

- Emissions cap
- Allowance allocation and distribution
- Liquidity and price control mechanisms
- Leakage and gaming of the markets
- International linkage
- Revenue management
- Stakeholder engagement
- Ambition

Carbon Tax and Hybrid Systems

British Columbia, Mexico, Chile, Japan, India, Norway, and Ireland.

Design features compared

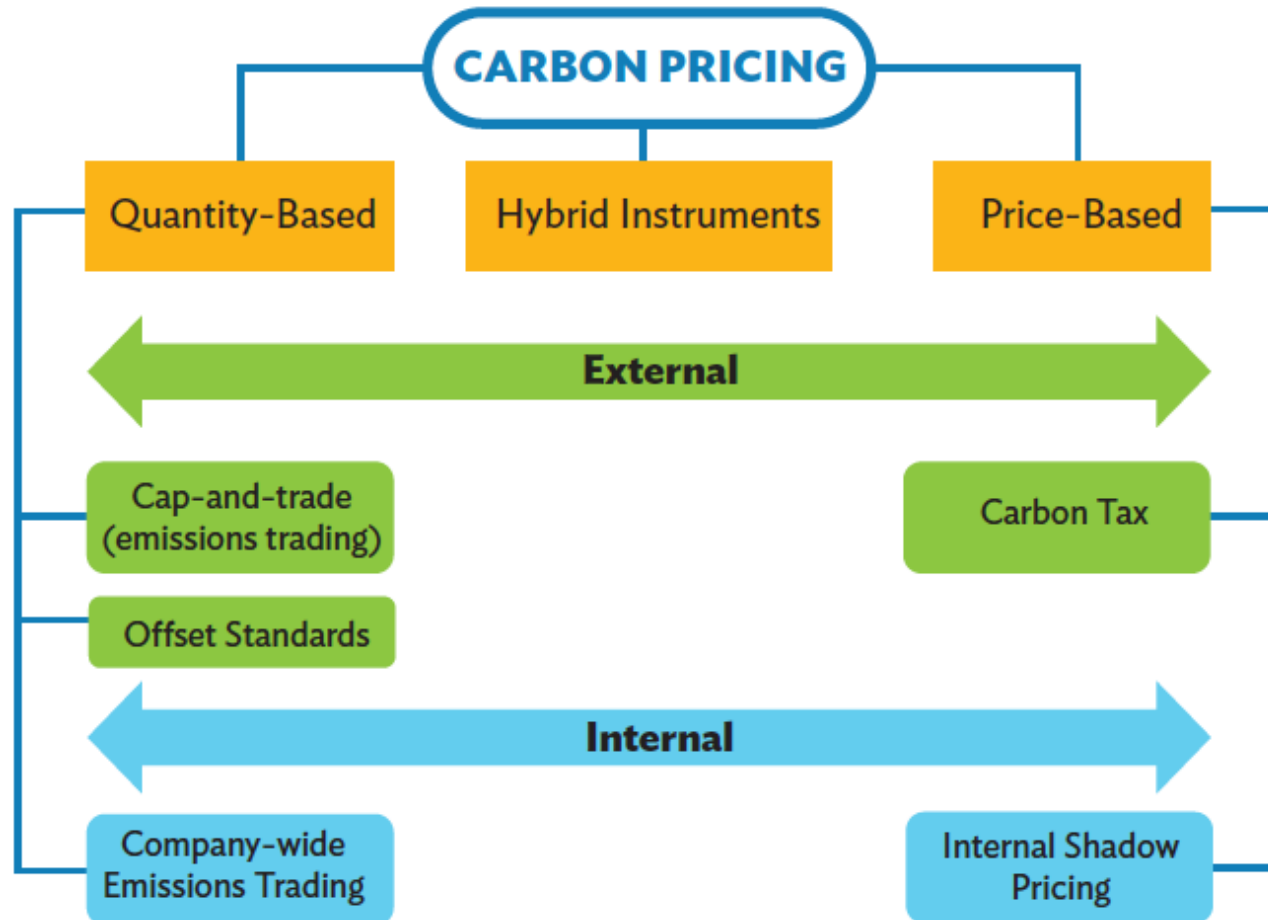
- Price setting
- Emissions coverage
- EITE sector exemptions
- Ambition
- Revenue management

Source: Climate Policy Lab

Tabel 2.1 Perbedaan Kebijakan Instrumen Pasar Karbon

	Sistem Perdagangan Emisi	Pajak Karbon	Mekanisme Kredit
Penentuan harga	Harga ditentukan oleh kuota emisi, nilai batasan (<i>cap</i>) relatif terhadap permintaan pasar.	Tingkat pajak atas emisi karbon ditentukan oleh pemerintah. Umumnya, kenaikan pajak ditentukan sebelumnya untuk menyesuaikan tarif pajak yang berlaku.	Harga kredit ditentukan oleh pasar, mekanisme nilainya memerlukan sumber permintaan eksternal.
Tingkat penurunan emisi	Lebih pasti, tingkat secara maksimal ditetapkan oleh pengaturan batasan emisi.	Kurang pasti, tergantung pada respon pasar terhadap perubahan/elastisitas harga.	Kurang pasti, tergantung pada jumlah proyek dan integritas terukur dalam pengurangan emisi.
Kepatuhan	Penerapan kuota dan partisipasi langsung melalui alokasi atau pasar sekunder.	Berdasarkan pelaporan emisi atau parameter tertentu seperti kandungan karbon pada bahan bakar.	Biasanya penerapan untuk melengkapi nilai dari pajak karbon atau sistem perdagangan emisi (sebagai pengganti pembayaran pajak atau penyerahan kuota).
Peran pasar	Mekanisme lelang kuota dan pengawasan pasar sekunder.	Umumnya tidak ada peran pasar dalam pengaturan.	Mekanisme untuk pengaturan kredit dan pengawasan pasar sekunder.
Pertimbangan kondisi untuk pelaksanaan instrumen	Perekonomian dengan kapasitas tinggi atau liberal, terdapat hambatan politis terhadap reformasi perpajakan, atau mencari peluang untuk kesempatan <i>international linking</i> .	Perekonomian dengan kapasitas rendah, kebijakan pemerintah yang terbangun dengan kerangka pajak yang transparan.	Terdapat tantangan dalam penerapan kedua instrumen lainnya atau ketika ingin membangun kapasitas dan membuka peluang terhadap pasar karbon internasional.

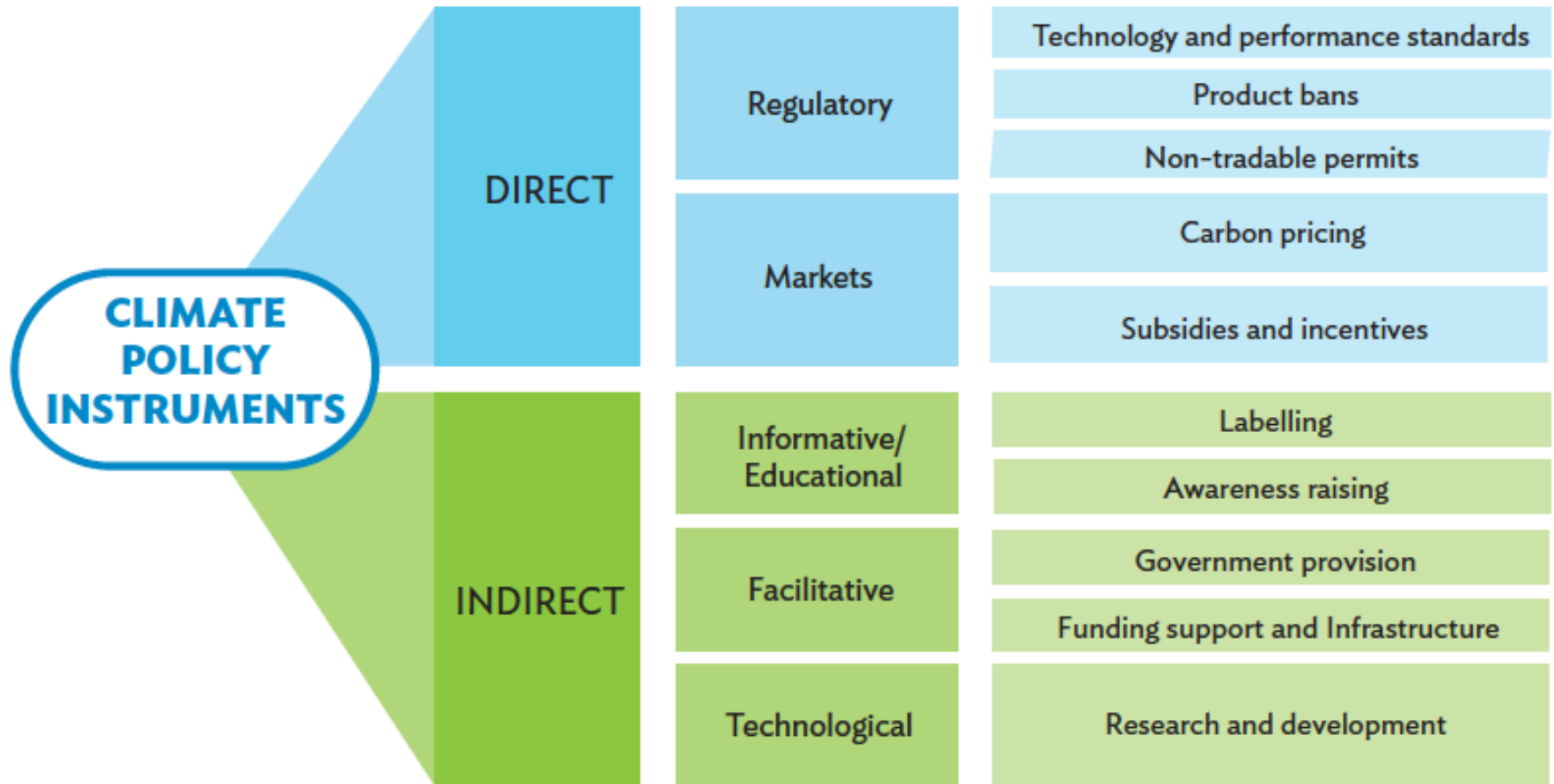
Landscape of Direct Carbon-Pricing Instruments



Source: Asian Development Bank.

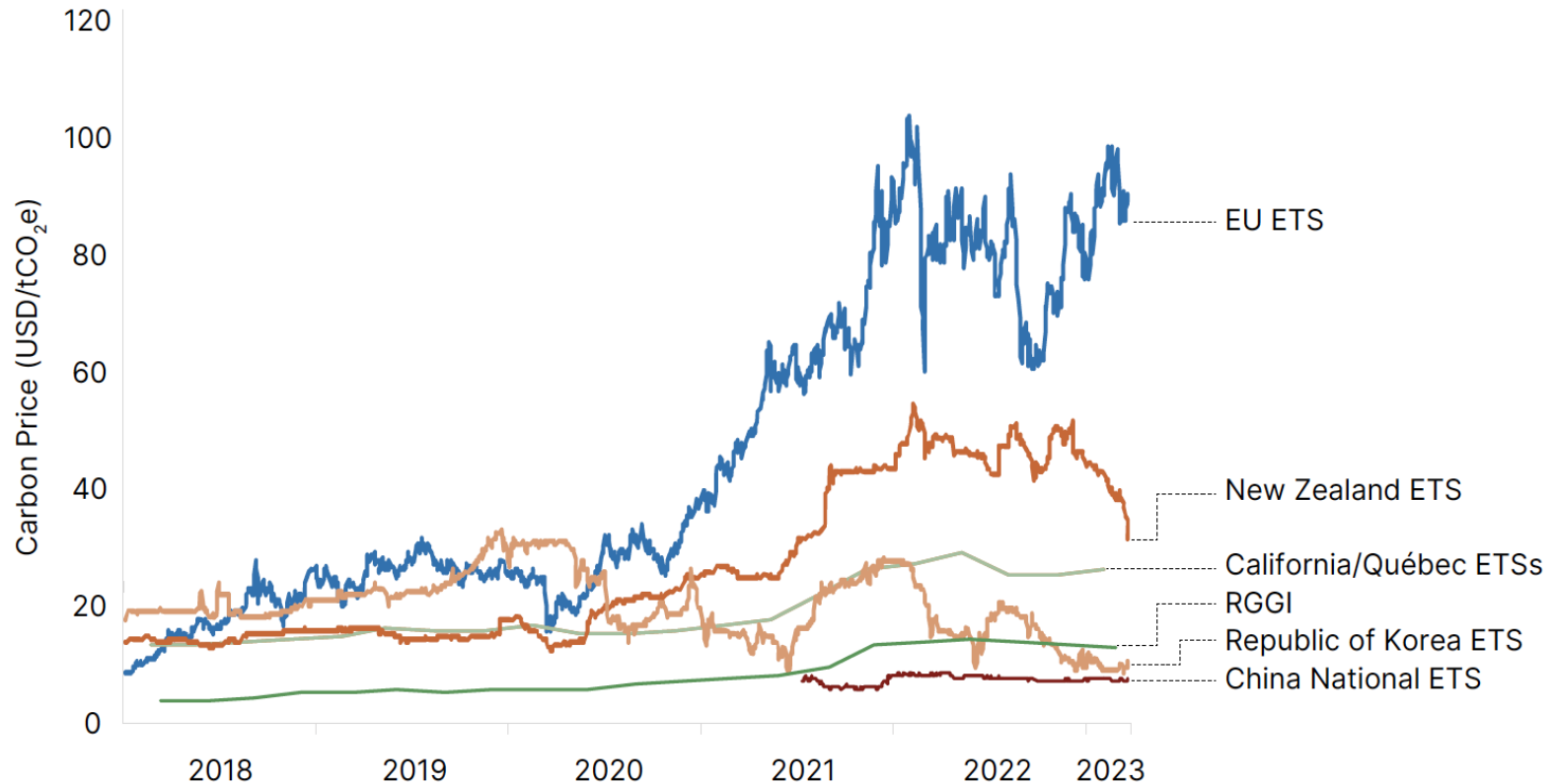
Source: ABD

Carbon Pricing in the Overall Climate Policy Architecture



Source: ABD

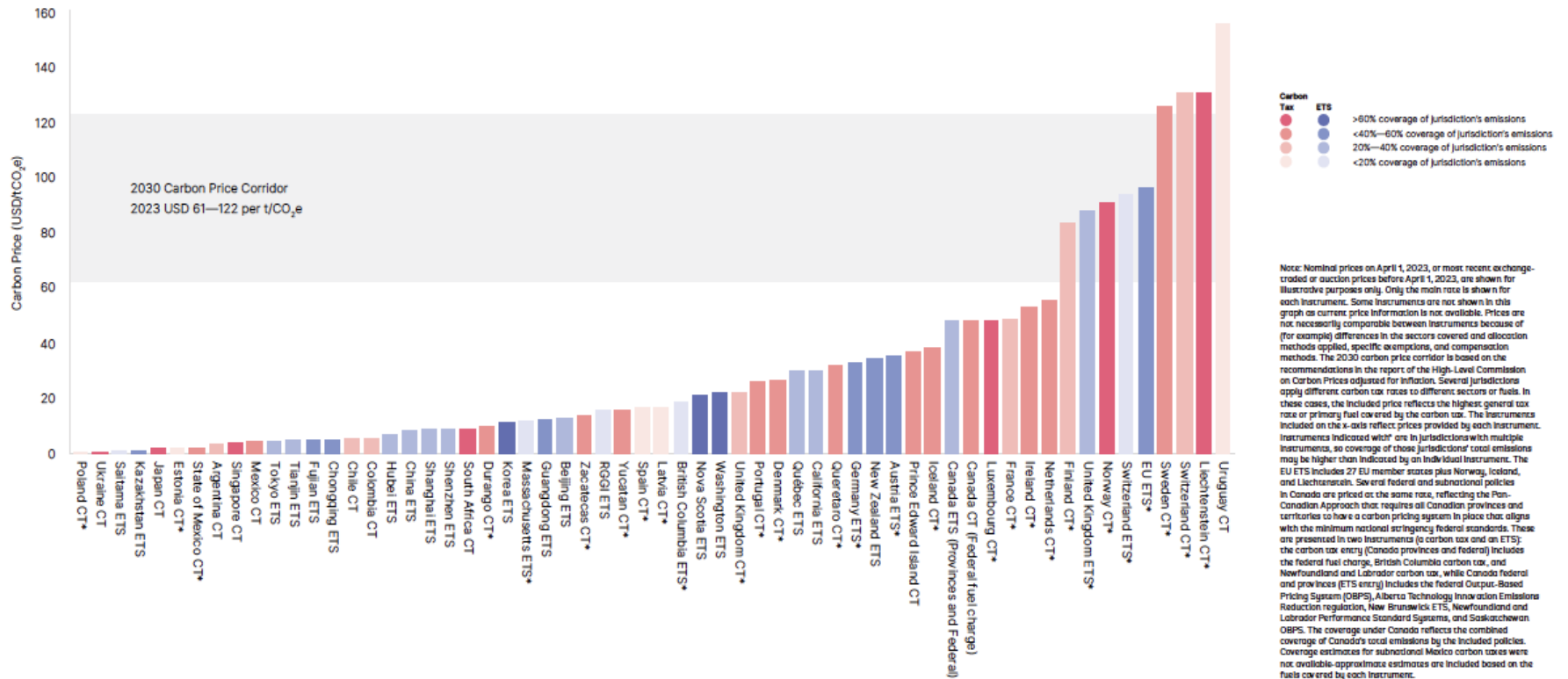
Price evolution in selected ETS from 2018-2023



Note: Based on data from ICAP Allowance Price Explorer. Prices for the RGGI initiative and for California and Québec CaT, come from the primary market, whereas for the other systems the prices reflect the secondary market

Source: WB, 2023

Prices and coverage across ITSs and carbon taxes



Source: WB, 2023

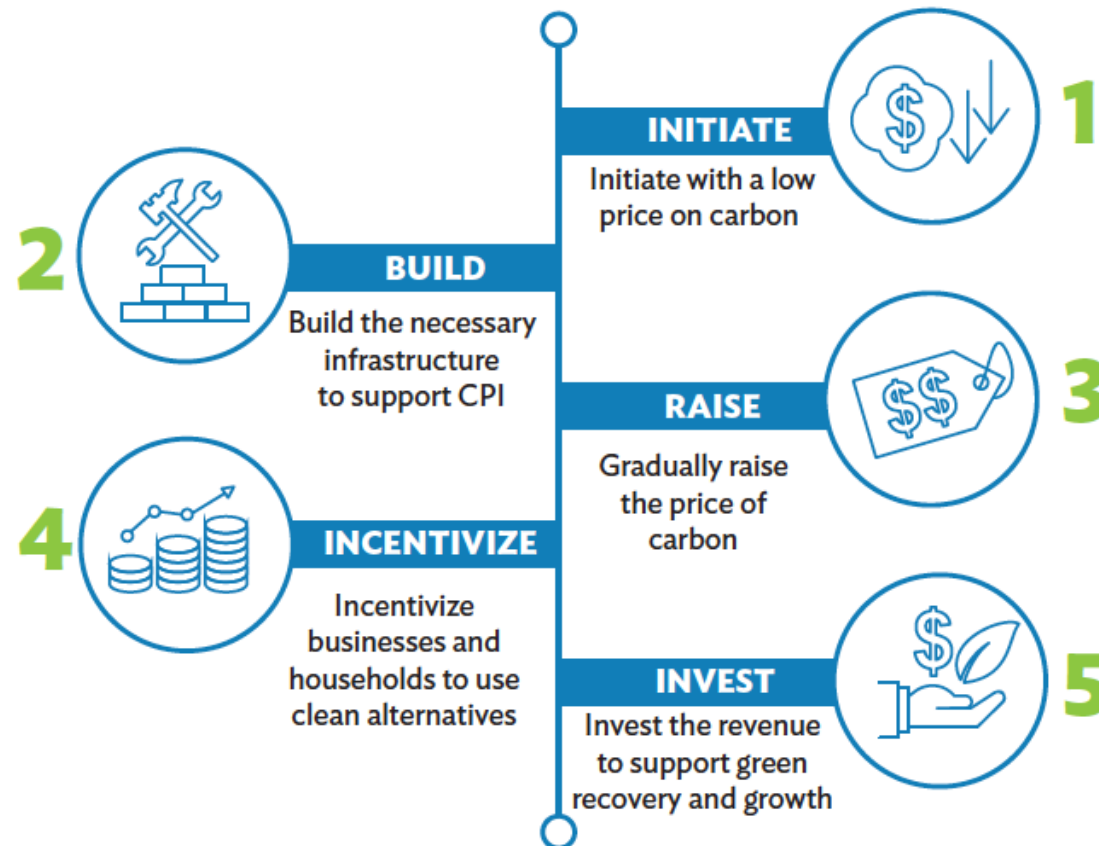
How to design carbon pricing?

Designing Carbon Pricing

1. **Urgently.** Policies should be designed to mobilize resources in time to support the post-COVID-19 economic recovery. This needs to consider the time it takes to collect and re-deploy revenues generated through carbon pricing and the establishment of financing arrangements.
2. **Smoothly.** Carbon-pricing schemes should be simple to implement and administer. Carbon-pricing instruments, especially ETS, are complex and usually require extensive monitoring, reporting, and verification systems, as well as access to trading platforms and legislative frameworks for trading allowances. The institutional capacity needed to operate such schemes can take years to develop. Therefore, for carbon-pricing policies to support economic recovery may require using or building upon existing national policy instruments, such as product taxation, and their systems for collecting and reporting data, as well using existing trading platforms and registries for environmental commodities.
3. **Sensibly.** Design features can determine whether pricing instruments stimulate or constrain economic activity and growth. Stimulating economies is a primary aim of recovery strategies. Carbon pricing can help to make those strategies green. Designing carbon-pricing instruments must also take into account distributive effects and transition costs.

Source: ABD, 2021

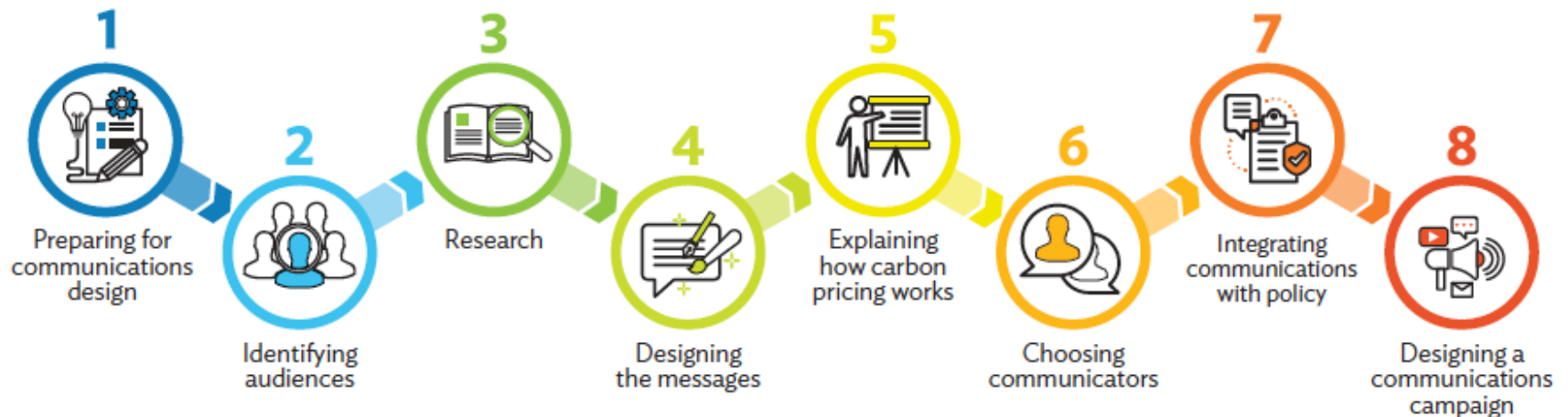
Carbon Pricing Support in Green Recovery and Growth



CPI = carbon-pricing instrument.
Source: Asian Development Bank.

Source: ABD, 2021

Figure 6: Developing a Carbon Pricing Communications Campaign



Source: Partnership for Market Readiness. 2018.

Source: ABD, 2021

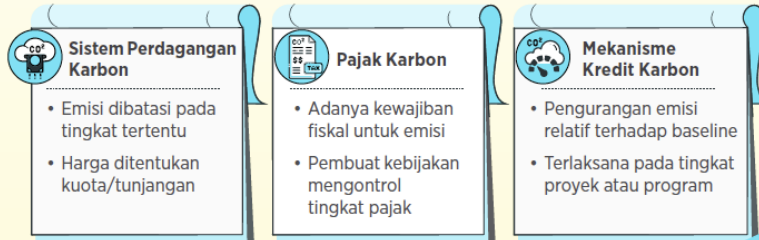
INSTRUMEN PASAR KARBON MERESPONS KRISIS IKLIM

Pilihan mekanisme dalam pasar karbon dinilai mampu mengurangi emisi karbon dengan model pembiayaan yang lebih rendah.

DASAR PEMBENTUKAN PASAR KARBON

Pasar Karbon	Ciri	Contoh
Sukarela	<ul style="list-style-type: none"> Proyek berbasis alam Umumnya diinisiasi swasta Terbentuk atas keinginan sendiri 	VCS (per Juni 2022) • 1.806 proyek • 962 juta VCU
Wajib	<ul style="list-style-type: none"> Terbentuk karena regulasi Volume bergantung pada lingkup kebijakan Relatif mudah direncanakan jangka panjang 	CDM oleh PBB (Juni 2022) • 7.845 proyek • 2,2 miliar CER

TIGA SKEMA PELAKSANAAN



MANFAAT BAGI PENGURANGAN EMISI KARBON



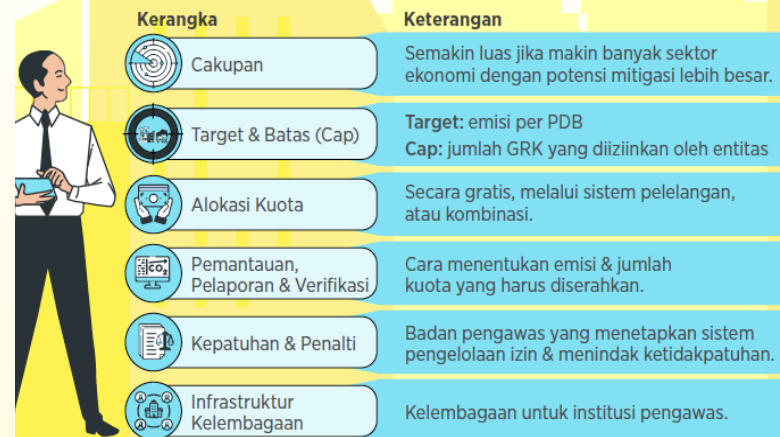
Keterangan:
 CDM: Clean Development Mechanism
 CER: Certified Emission Reduction
 VCS: Verified Carbon Standard
 VCU: Verified Carbon Units

SUMBER: KATADATA INSIGHT CENTER
 NASKAH: RISANTI DELPHIA
 DESAIN: ARIS L. SETIAWAN

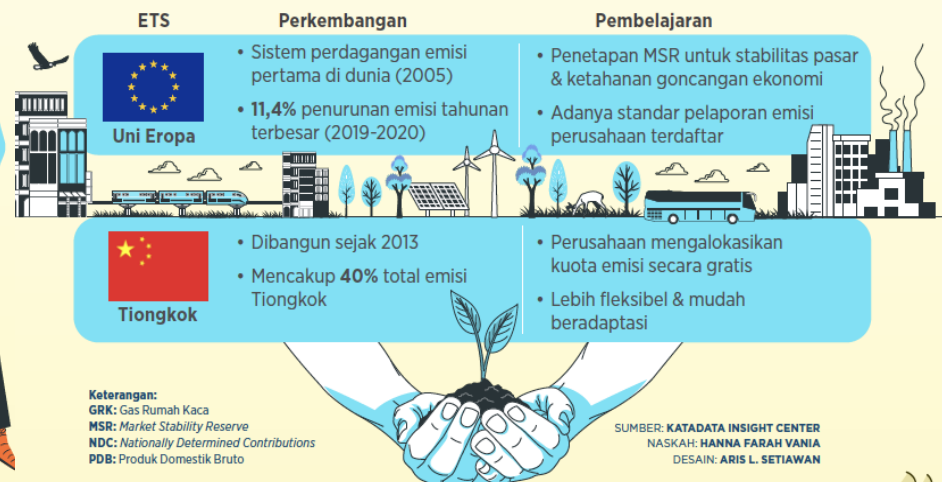
ETS SEBAGAI MEKANISME PERDAGANGAN KARBON

Emission Trading System (ETS) merupakan salah satu mekanisme perdagangan karbon yang ditentukan oleh kuota emisi dan diadopsi sejumlah negara untuk mencapai target NDC.

DASAR PEMBENTUKAN ETS



PERKEMBANGAN ETS DI DUNIA

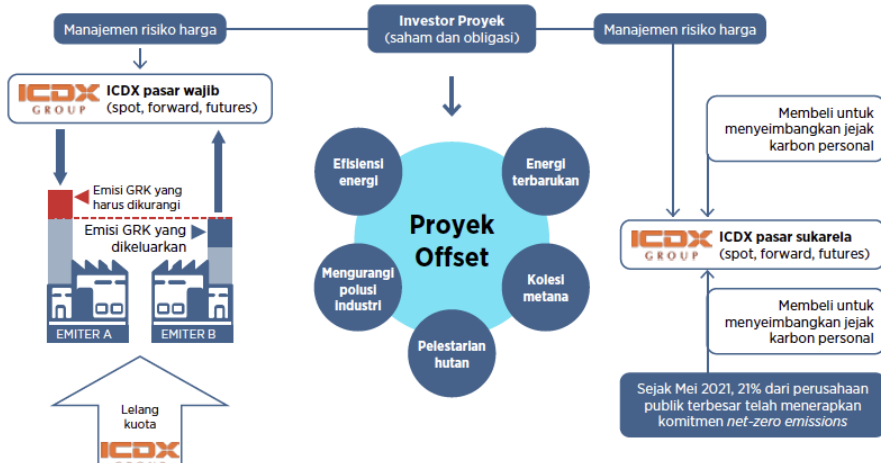


Keterangan:
 GRK: Gas Rumah Kaca
 MSR: Market Stability Reserve
 NDC: Nationally Determined Contributions
 PDB: Produk Domestik Bruto

SUMBER: KATADATA INSIGHT CENTER
 NASKAH: HANNA FARAH VANIA
 DESAIN: ARIS L. SETIAWAN

Source: Katadata, 2022

Gambar 4.2 Skema Perdagangan Karbon ICDX



Tabel 2.2 Peta Sektor dan Aktivitas Terkait

No	Sektor	Kegiatan terkait
1	Pertanian	Kegiatan pertanian dan pengelolaan lahan, termasuk juga aktivitas peternakan
2	CCS/CCU	Kegiatan penangkapan, penyimpanan, dan penggunaan karbon
3	Efisiensi energi	Kegiatan yang mengurangi emisi melalui pengurangan konsumsi energi. Termasuk limbah panas/pemulihan gas dan listrik dari bahan bakar fosil melalui proses yang lebih efisien
4	Kehutanan	Kegiatan perhutanan seperti penghijauan, peningkatan pengelolaan kehutanan dan pengurangan emisi dari degradasi dan deforestasi
5	Penggunaan bahan bakar	Aktivitas yang dasarnya adalah penggunaan bahan bakar fosil untuk listrik atau panas, termasuk beralih ke bahan bakar intensif karbon yang lebih sedikit (misalnya batu bara menjadi gas tetapi tidak termasuk energi terbarukan)
6	Fugitive emission	Kegiatan yang menangani emisi metana industri seperti mencegah kebocoran metana di area pertambangan, tidak termasuk aktivitas peternakan dan pertanian (misalnya sawah)
7	Gas industri	Aktivitas yang menghasilkan gas berfluorinasi—hidrofluorokarbon (HFC), perfluorokarbon (PFC), bahan perusak ozon
8	Manufaktur	Aktivitas yang terkait dengan pembuatan material yang tidak terlalu intensif emisi (bahan konstruksi, semen, logam)
9	Tata guna lahan lainnya	Kegiatan pengelolaan tata guna lahan kecuali kehutanan dan pertanian, misalnya lahan basah
10	Energi terbarukan	Kegiatan energi terbarukan termasuk biomassa yang berkelanjutan
11	Transportasi	Kegiatan untuk mengurangi emisi yang berhubungan dengan transportasi dan mobilitas
12	Limbah	Kegiatan yang terkait penanganan dan pengolahan limbah, termasuk gas dan air limbah yang bersumber dari tempat pembuangan akhir (TPA)

SUMBER: STATE AND TRENDS OF CARBON PRICING 2020

POTENSI PERDAGANGAN KARBON INDONESIA

Luasnya hutan Indonesia didukung dengan instrumen kebijakan pemerintah mendorong berjalannya skema perdagangan karbon dalam upaya pencapaian *net-zero emissions*.



PERKEMBANGAN PERDAGANGAN KARBON



Keterangan:

CDM: Clean Development Mechanism

JCM: Joint Crediting Mechanism

MRV: Monitoring, Reporting, and Verification

REDD+: Reducing Emissions from Deforestation and Forest Degradation

VCS: Verified Carbon Standard

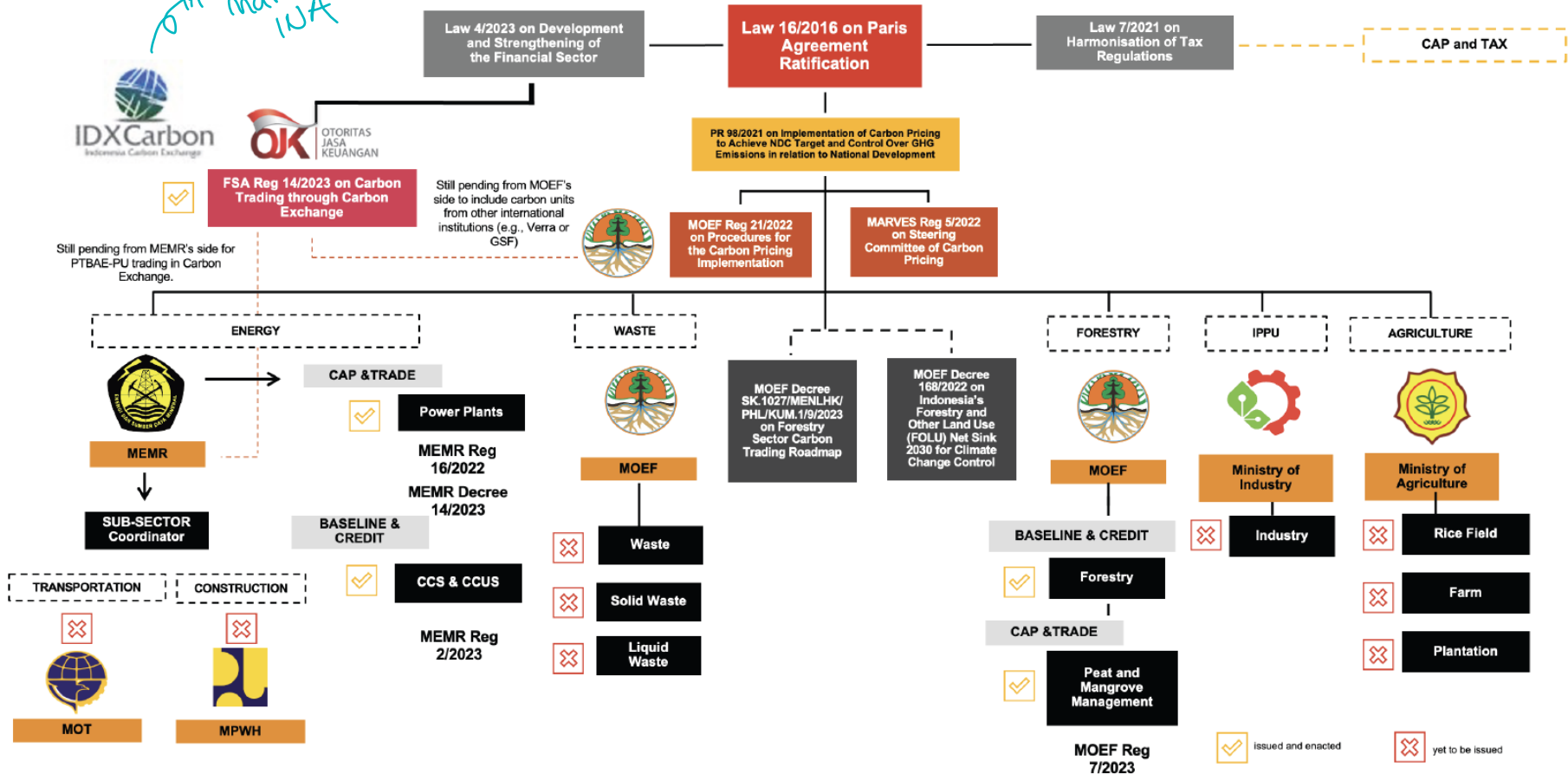
SUMBER: KATADATA INSIGHT CENTER

NASKAH: RISANTI DELPHIA

DESAIN: ANDREY.R.T

Source: Katadata, 2022

*pengelola
market karbon
IWA*



Source: pwc

Thank You

