

Global and Thailand NCZ trends and technologies

Presentation at 2nd TIChE Open Innovation Idea Challenge

Bangkok, 9 January 2023



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**McKinsey
presenter**



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Leads McKinsey's sustainability-related work in Thailand

Introduction to McKinsey Sustainability

We are working to help all industry sectors transform to reach net zero by 2050.

We do this by leveraging our thought leadership, innovative tools and solutions, top talent, and a vibrant ecosystem of industry associations and knowledge platforms focused on innovating to net zero.

>600

Clients served
across ~70
countries

>1,000

colleagues with deep
expertise and diverse
backgrounds

>30

Companies and
government agencies
served across SEA

Topics today

NCZ global context

Thailand NCZ context

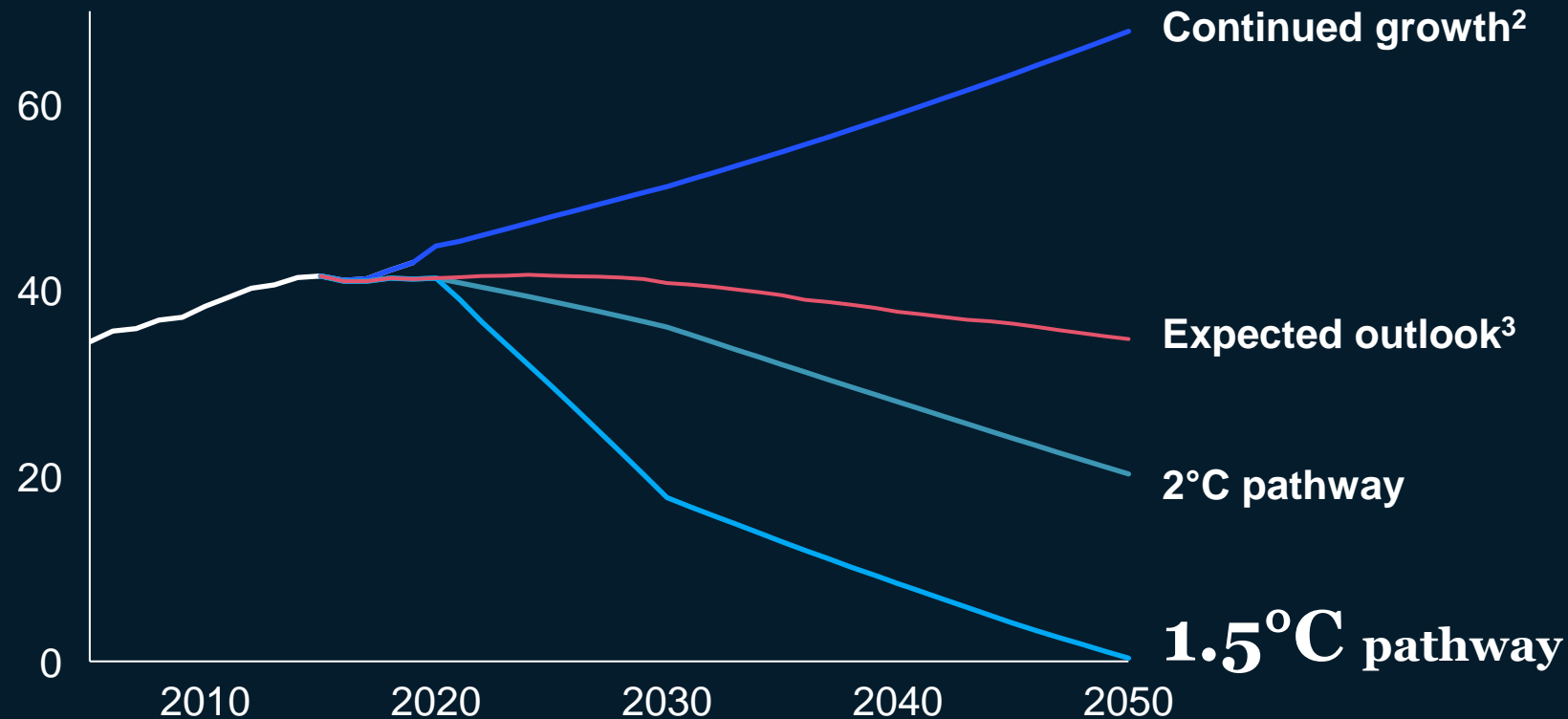
Select technologies as part of the solution for Thailand, and as opportunity

Key messages

The world is currently trying to move towards the '1.5°C pathway'

Pathways of global carbon dioxide emissions¹

Gt CO₂ per year



Continued growth

Historical trends continue, and yearly CO₂ emissions surpass **70 Gt by 2050**, leading to warming of up to **5°C** and severe physical climate impacts

Expected outlook

McKinsey's projection of current global energy trends still leads to warming of **3.5°C**

1.5°C pathway

The significant effort required to reach a 1.5°C pathway would be **challenging, yet feasible**

1.2005-2018 emissions from Global Carbon Budget 2019. Emissions from biotic feedbacks not included (e.g.: permafrost thawing, wildfires).








































2.Average of the IEA WEO 2019 Current Policies Scenario and IPCC RCP8.5 pathway.

3.Reference case used is McKinsey's Global Energy Perspective - Reference Case 2019

NB: Projected warming estimated by 2100

Countries are making Net Zero commitments

Flags not exhaustive

	European, US, Canada	ASEAN	Rest of Asia	Total countries	Additional countries (change since 2019)
Achieved net zero emissions			  Bhutan Cambodia	8	+6
Legislation in place	 Sweden  UK  France  Spain  Canada  Germany  Denmark  Ireland  Hungary		 Japan  South Korea  New Zealand	12	+8
In policy document	 Finland  Austria  Italy  US	 Iceland  Singapore	 China  Sri Lanka	31	+22
Declaration / pledge	 Estonia  Andorra	 Thailand  Vietnam  Malaysia	 Russia  India  Australia	15	
Proposed / Target under discussion	 Slovakia  Belgium  Switzerland  Bulgaria  Cyprus	 Indonesia  Philippines	 Pakistan  Bangladesh	69	

Countries with net-zero targets represent

88%

of global fossil fuel emissions

90%

GDP (PPP)

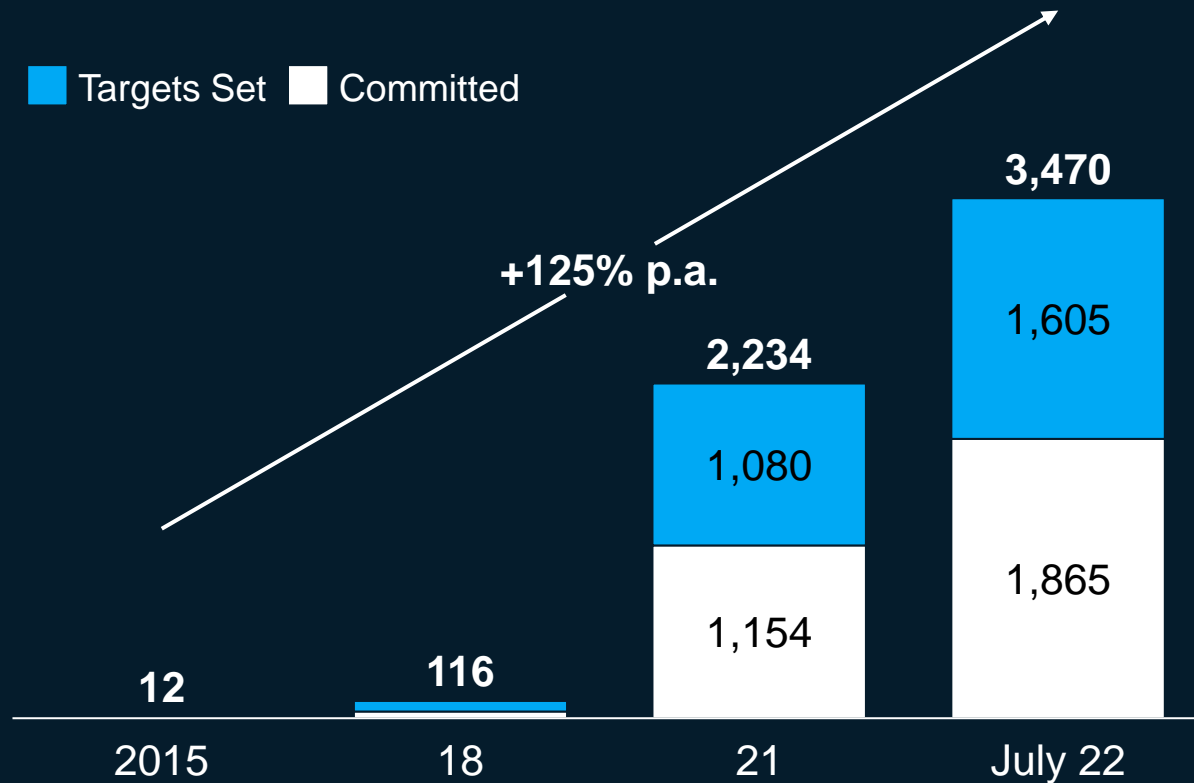
85%

Population

Companies are making bold Net Zero commitments across sectors

A growing number of companies are using Science Based Targets

Count of companies with SBTis¹ Set or Committed²



1. Science Based Targets

2. Companies "Committed" have expressed their intent to set SBTs but no finished the target setting process. Companies with "Targets Set" have developed their reduction targets, presented them to SBTi for official validation, announced the target to their stakeholders and reported company-wide emissions annually. More companies may have committed to or set decarbonization targets but might not have submitted to SBTi.

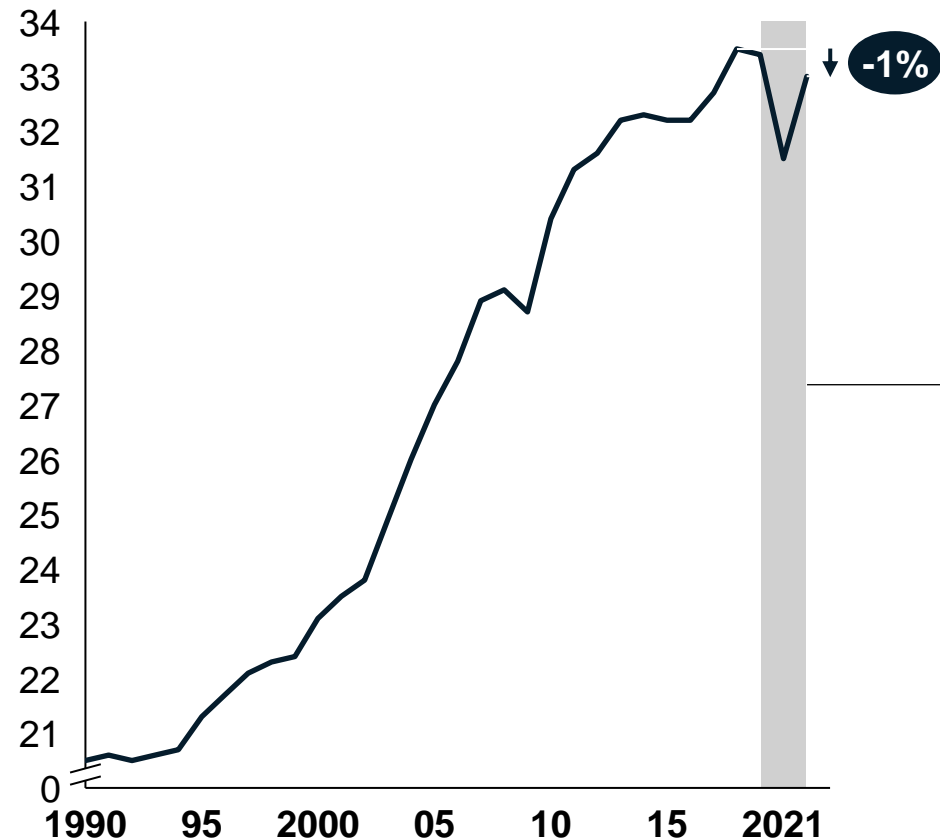
Examples

European personal care company	Reduce Scope 1+2 emissions 30%, and Scope 3 emissions 10% by 2025
European food company	20% reduction in absolute emissions by 2025, 50% by 2030; become net zero by 2050
European retailer	Reduce scope 3 emissions 27.5% by 2030. 78% of its suppliers will have SBTs by 2026
European fast fashion company	Reduce emissions across value chain by 56% by 2030 and reach net zero by 2040

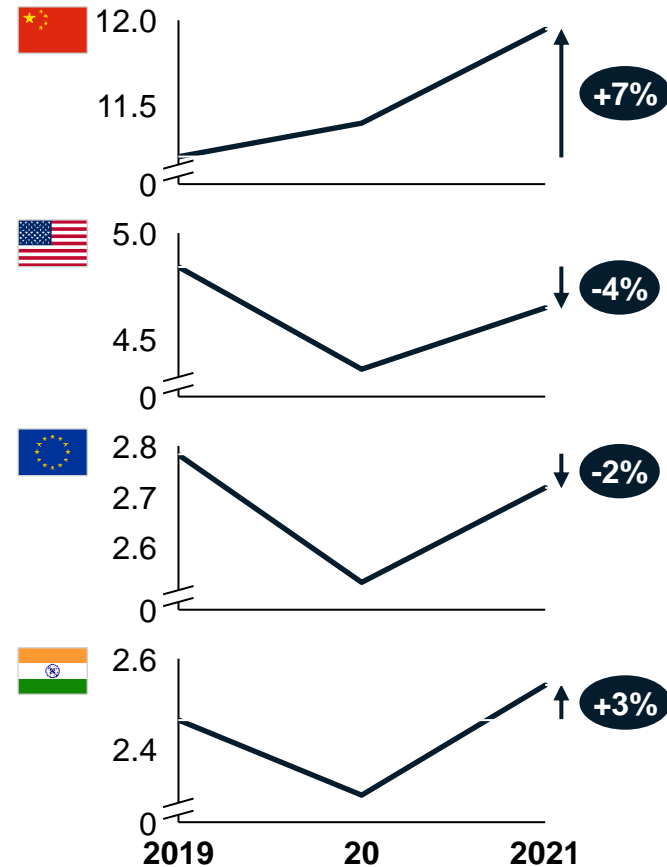
Emissions rebounded to historical trends in 2021 with limited reductions

Historical energy-related emissions, GtCO₂ pa

Global



By country



Emerging markets' emissions growing, to support high GDP growth

Advanced economics remain below 2019 levels due to GDP – energy decoupling and structural shifts (e.g., renewables, electrification)

Topics today

NCZ global context

Thailand NCZ context

Select technologies as part of the solution for Thailand, and as opportunity

Key messages

Thailand contributes ~1 % to total emissions and has pledged Net Zero by 2065

Thailand's starting context, commitments and risks



Thailand's starting point



Thailand's commitments



Economic risks to Thailand

- 360** Mtpa CO₂eq emissions in 2016
- 260** Mtpa CO₂eq NET emissions in 2016
- 0.8%** Of total global emissions in line with share of GDP (0.9%)
- Top-10** Thailand in top 10 countries with most impact from flooding risk (USD 2.6 bn avg loss from flooding¹, >3m people effected by extreme flooding by 2035-44²)

- 2065** Zero emission
- 2050** Net carbon neutral
- 2030** Reduce BAU emissions by 20-40%



Thailand's non-commitments

- Global Methane pledge
- Global coal to clean power transition
- Deforestation protection
- Clear 2030 Baseline

- Export competitiveness risk
- Increasing requirement for Carbon accounting and low carbon intensive products, e.g., need for Western importers to buy RE100 certificates to offset Carbon in production
- Agricultural productivity in tropical countries incl. Thailand particularly vulnerable to temperature rises as result of climate change

1. UNISDR (2014). PreventionWeb: Basic country statistics and indicators. Available at: <https://www.preventionweb.net/countries>

2. Extreme flood is defined as being in the 90th percentile in terms of numbers of people affected

Thailand has started to make some early moves

Moving from commitment to action



Green Hydrogen

World's largest Green Hydrogen project

24 November 2022

ACWA Power signed an MOU with PTT and EGAT to invest in

USD 7 bn green hydrogen complex in Thailand, producing

225 Mtpa green hydrogen

1.2 Mtpa ammonia



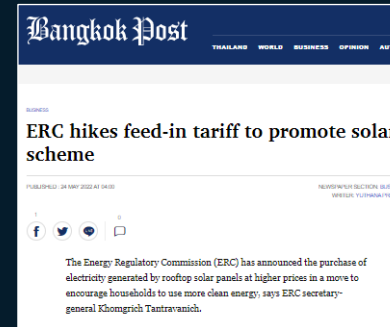
Renewables

Capitalize on Thailand's renewables potential

24 May 2022

By 2030, total planned solar power generation capacity of

4,900 MW (up 60% from 3,049 MW in 2021, and keeping 2nd spot in the region after Vietnam)



Electric vehicles

Push towards gvmnt 30/30 vision for electric vehicles

24 August 2022

THB 2.92bn EV subsidies package approved by cabinet (THB 18k-150k per EV)

29 October 2022

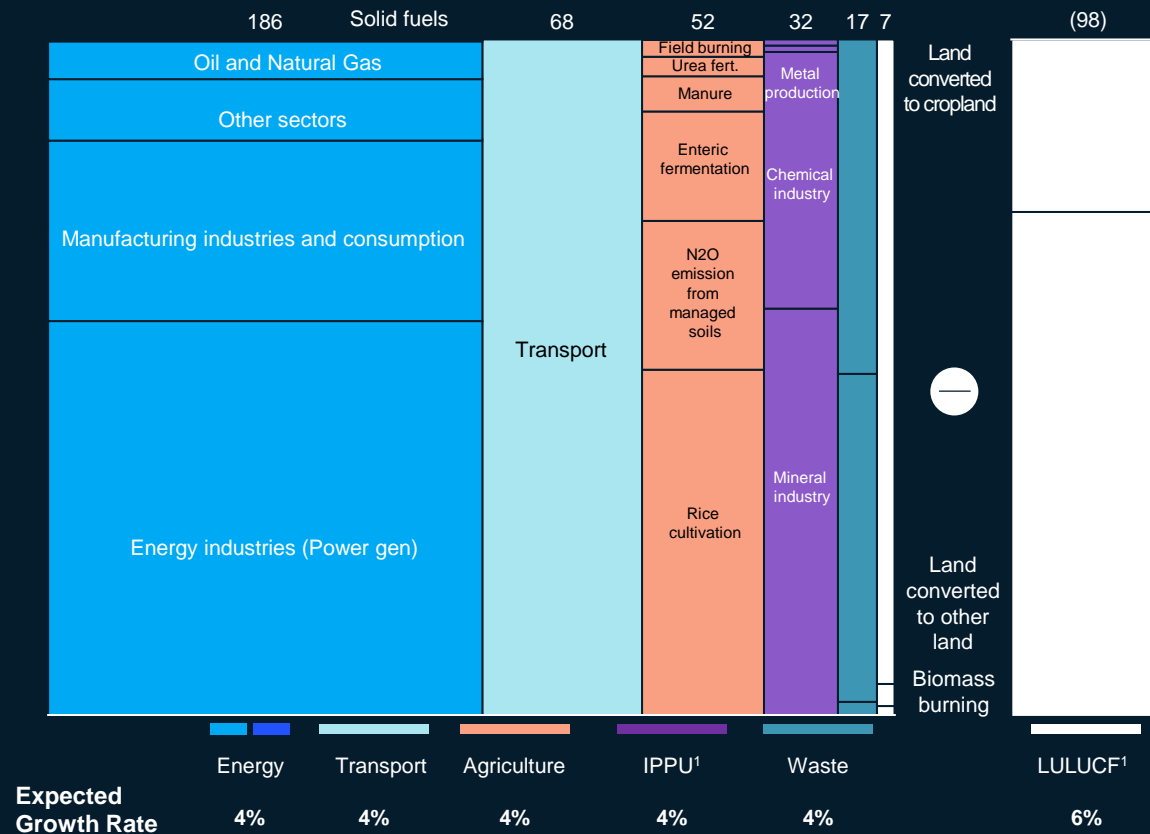
13k+ BEVs registered in 2022 up until September



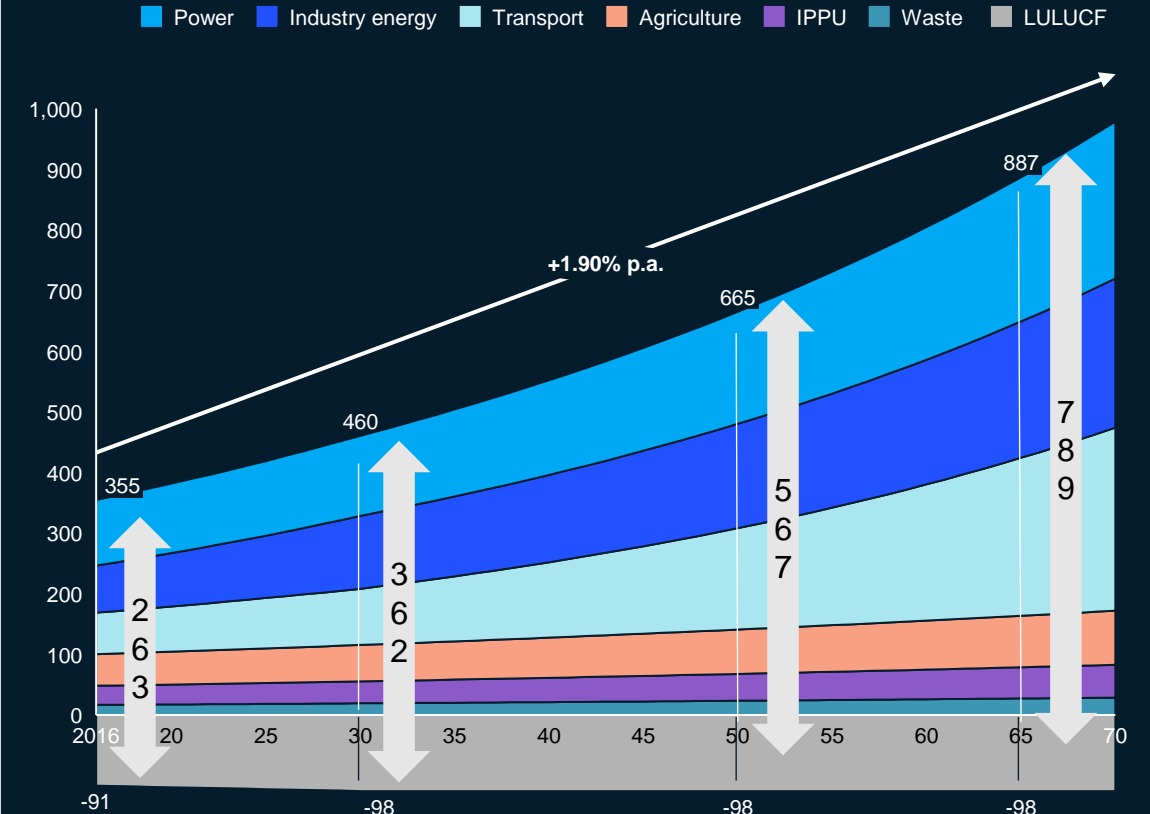
Thailand's emissions have grown 2% p.a. over past 15 years, and are expected to double by 2050 at current rate (BAU scenario)

Thailand greenhouse gas emissions trend , Mpta CO₂eq

Thailand's emission sources by sector (2016)



Emission expected to double in 2050 under BAU scenario



1. Industrial processes and product use (IPPU) sector covers GHG emissions resulting from industrial activities that produce emissions (not directly from energy consumption) and use of man-made GHGs in products (IPCC, 2006)
 2. Some processes under LULUCF (turning forest into croplands and other lands, decomposing peat) emits CO₂, while the forest that remain forest serves as carbon sink

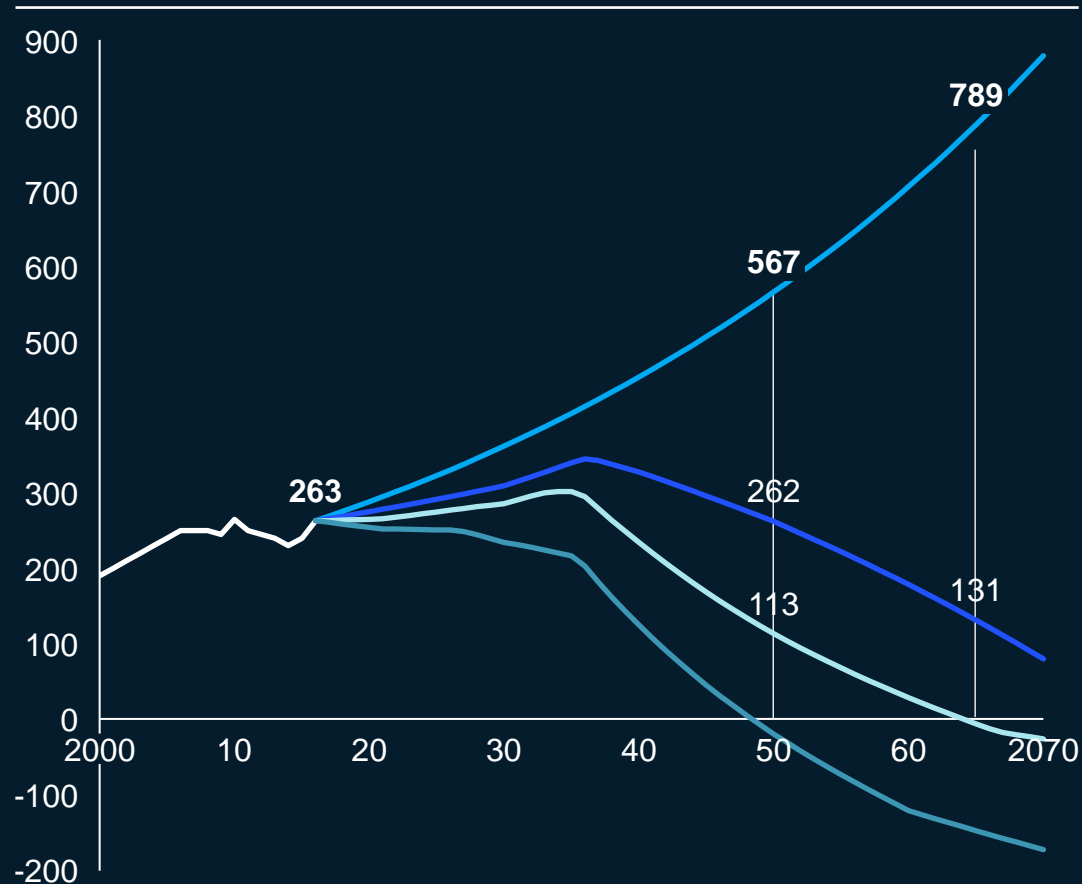
Thailand faces challenges to reach NCZ by 2065

Expected NET emissions, Mtpa CO₂eq in various scenarios

Highly preliminary

— Historical — BAU (NCN: NA) — Current (NCN: 2090) — Green step-up (NCN: 2065) — Stretch (NCN: 2050)

Thailand's NET emissions scenario projections



BAU scenario (NCN: NA)

Trends continue at its current rate with technology adoption remain at the same level to what it is in 2020. **Yearly CO₂ net emissions reaching ~550 GgCO₂e by 2050.** Emissions under BAU can potentially be lower with **increased technological adoption due to improved economics**

Current scenario (NCN: 2090)

Using existing plans and significant efforts to decarbonize by 2050 such as 43% CCS for Gas and Coal power production, renewable penetration of 33%, 34% of biofuels usage, CCS usage in industries, EE measures for residential and commercial (e.g., solar water heating)

Green step-up scenario (NCN: 2065)

Further pushing efforts on energy and transportation to country's maximum potential such as renewables at >50%, 100% BEV and PHEV vehicles by 2050 – 69% by 2035, 30% Energy efficiency improvement by 2037, extensive CCS use

Stretch scenario (NCN: 2050)

Early adoption of next wave of technologies and initiatives (e.g., battery technology, alternative green power sources) will be crucial to help Thailand achieve net zero by 2050

Overall 3 broad areas and 9 key success factors for an orderly transition needed. Focus today on technology

Focus of presentation

A Physical building blocks

- 1 **Proven technology:** Technological innovation
- 2 **Investible projects:** Ability to create at-scale supply chains and support infrastructure
- 3 **Natural resource availability** e.g., space necessary for renewables

B Economic and Financing requirements

- 4 **Market mechanisms:** Effective capital reallocation and financing structures
- 5 **Project economics:** Management of demand shifts and near-term unit cost increases
- 6 **Policy:** Compensating mechanisms to address socioeconomic impacts

C Governance, institutions, and commitment

- 7 **Institutions and governance:** Governing standards, tracking and market mechanisms, and effective institutions
- 8 **Joint public-private effort:** Commitment by, and tracking and market collaboration among, public-, mechanisms, and private-, and social-sector effective institutions leaders globally
- 9 **Awareness and public ambition:** Support from citizens and consumers

Topics today

NCZ global context

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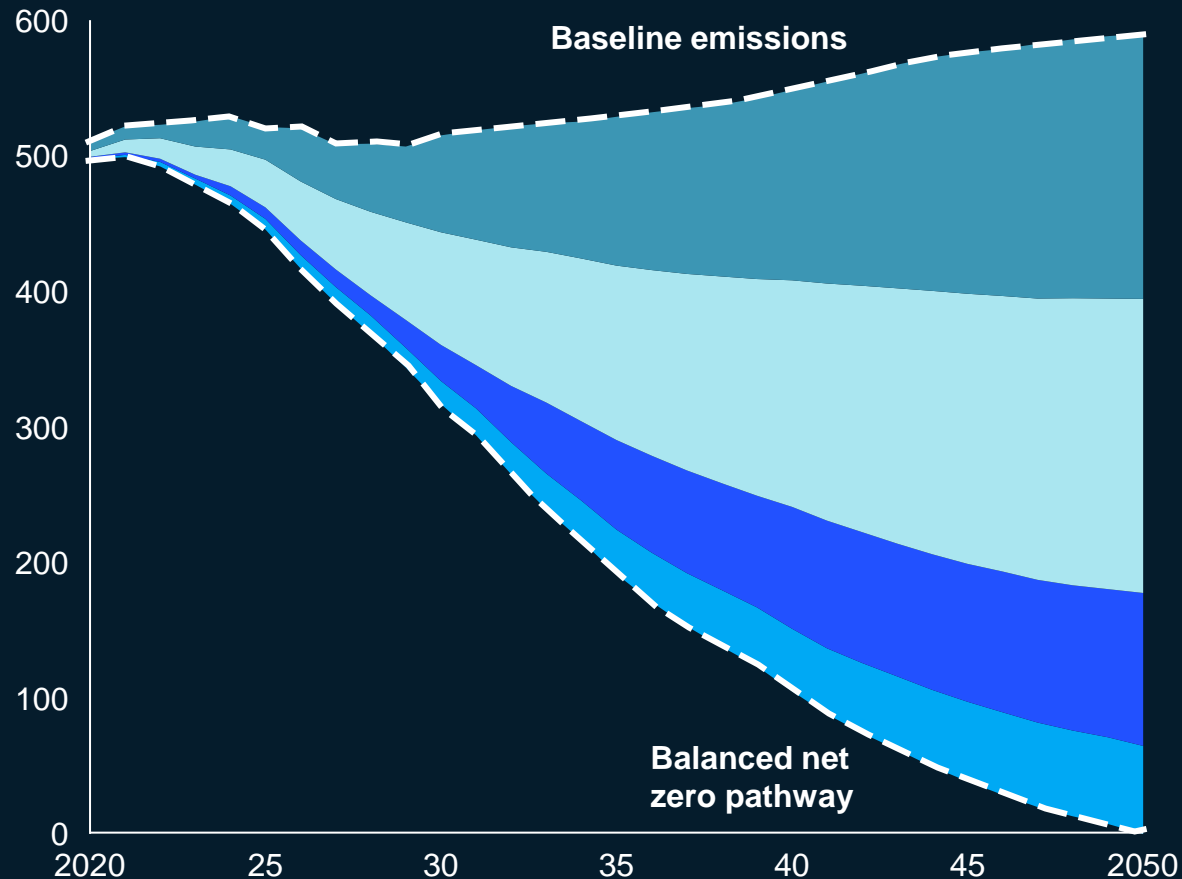
Select technologies as part of the solution for Thailand, and as opportunity

Key messages

It is technologically feasible to achieve NCZ with current technology, but without innovation progress can be slower and more costly

CONCEPTUAL

Abatement impact by current state of development of levers, MtCO₂e



Current state of development

Mature



Definition

Mature market and mature technology

Examples

Renewable power, energy from waste, low carbon new buildings

Early adoption



Mature technology but immature market

Electric cars, LULUCF, switch away from petroleum

Demonstrated



Immature technology and market but technology exists

BECCS, Electrification in manufacturing and construction, CCUS

Research and Design



Technology in the early stages of research and development

Long haul trucking, low carbon shipping, direct air capture

New technologies offer significant, attractive opportunities, with a market potential of USD ~4-5tn in Asia alone

Addressable market size across 11 sectors (USD bn)

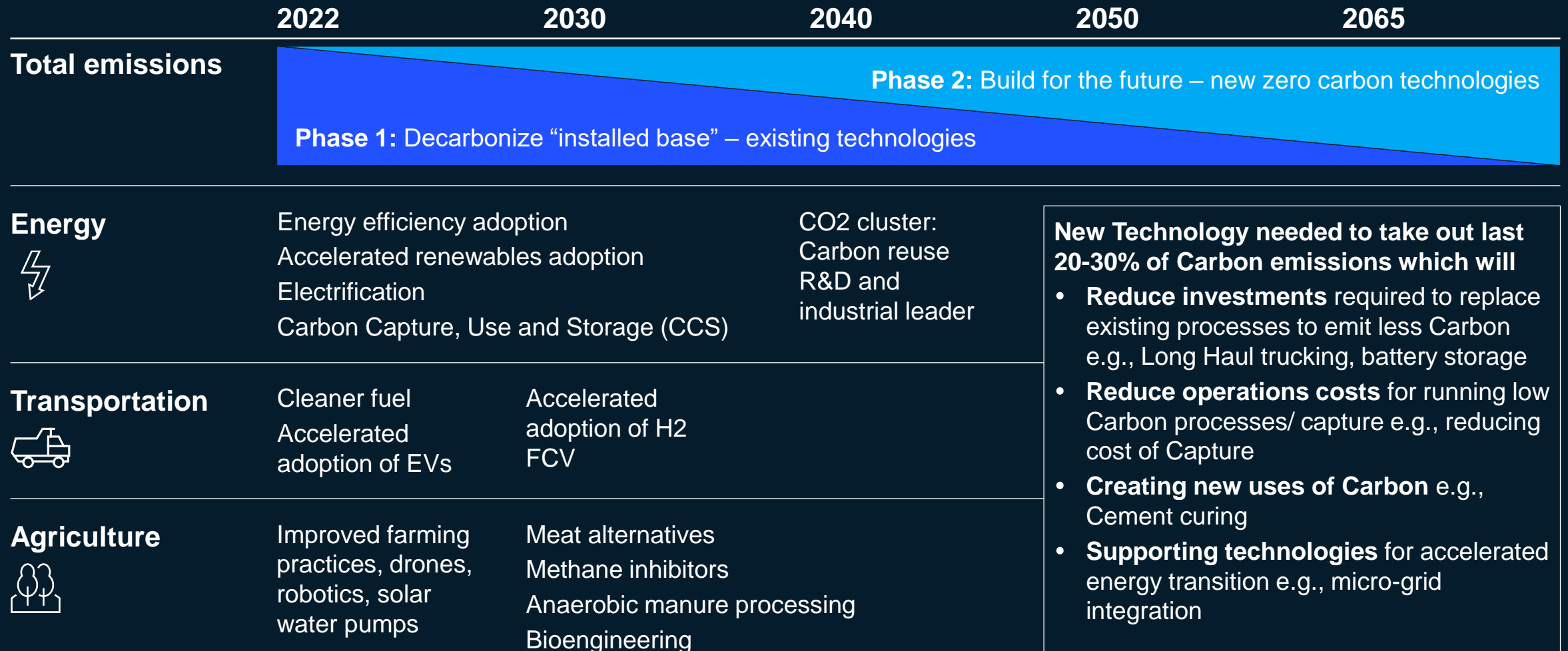
Preliminary

Non exhaustive

Size	USD 900-1,100B	USD 380-570B	USD 500-800B	USD 500B	USD 400B	USD250-350B	USD 160-300B	USD 200-260B	USD 190-240B	USD 140-180B	USD 50-100B	Total Asia Market Size ~4-5 trillion USD
Sectors	Transport	Buildings	Power	Water	Hydrogen	Consumer	Agriculture	Waste	Oil and Gas operations decarbonization	Industrials	Carbon management	
Themes	Electrification Micro-mobility Infrastructure for electric vehicles Biofuels Sustainable aviation	Sustainable design, engineering and construction advisory Green building materials High efficiency building equipment Green building technology and operations	Renewable power generation Grid modernization and resiliency Flexibility and energy storage solutions Power system technology and analytics Decommission and thermal conversion	Municipal water supply Industrial water supply	Production Transmission End use	Consumer electronics Sustainable packaging Sustainable fashion	Land and forest management Agriculture Production Alternative proteins and food waste reduction Sustainable agricultural inputs Sustainable agricultural equipment	Enablers of materials re-use ecosystem Industrial and mature materials processing Nascent and emerging materials processing innovation	Electrification of upstream and downstream Efficiency improvements Fugitive emissions capture	Steel Aluminum Cement Mining Chemicals	CCUS Carbon Offsets Markets	

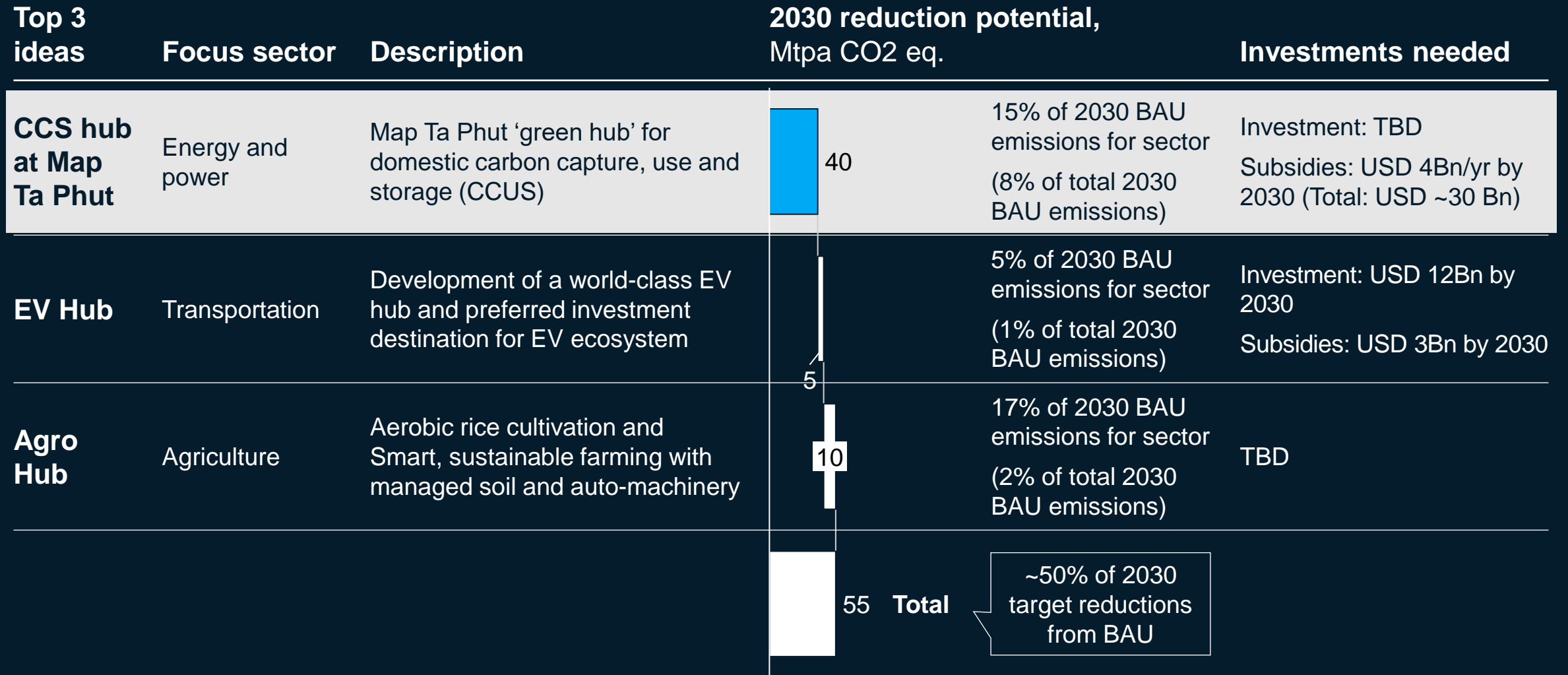


Thailand can combine immediate decarbonization with attracting mature start-ups to develop new carbon technologies

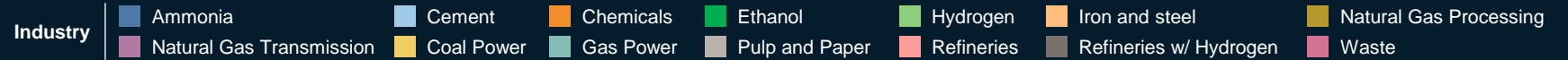


Thailand might consider building 3 hubs which will help achieve 2030 reduction targets leveraging Thailand's strengths

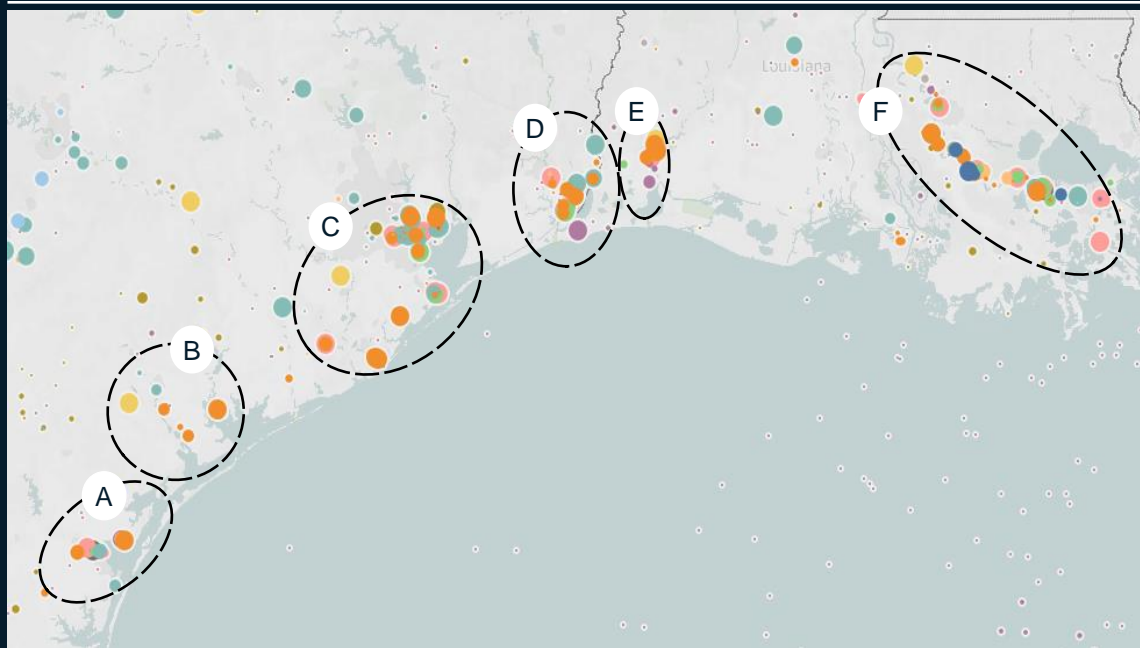
■ Detailed next



Companies in Greater Houston are showcasing effective use of clusters to accelerate carbon capture, use and storage (CCUS)



Point source emissions in Gulf Coast region, 2019 emissions

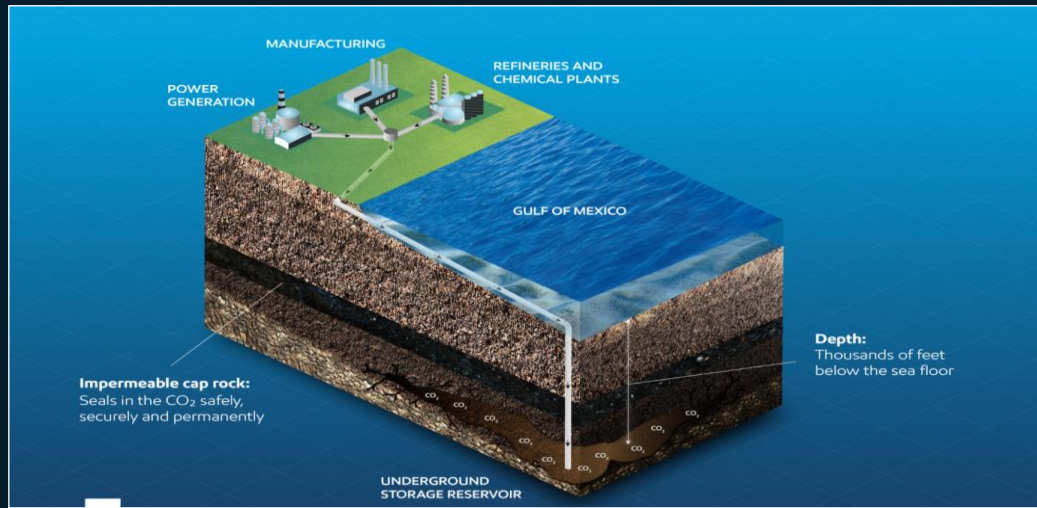


Cluster	Total (Mtpa CO2)
A Corpus Christi	19
B Victoria	11
C Houston	96
D Port Arthur	39
E Lake Charles	20
F Mississippi Delta	80

Greater Houston companies from energy sectors including oil and gas, refinery, generation, chemical, industrial gas, etc.

Recent CCUS hub announcements highlight potential collaborations between industry and government to enable CCUS

Houston CCS Innovation Zone (announced 2021)



ExxonMobil has proposed launching a carbon capture hub in Houston due to its proximity to geologic storage and high-emissions industries like power, chemicals, and refining

- Estimated **USD100B** of investment between industry and government to reach goal
- Target of **50 MTPA** CO₂ sequestered by hub in 2030

1. The "CO₂" is silent

Porthos CCUS hub (announced 2020)

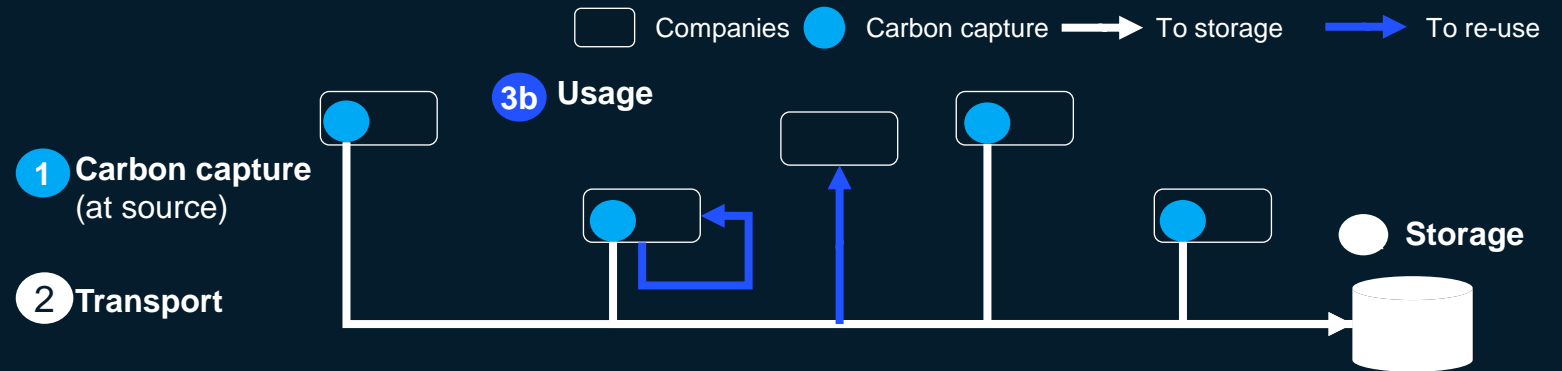
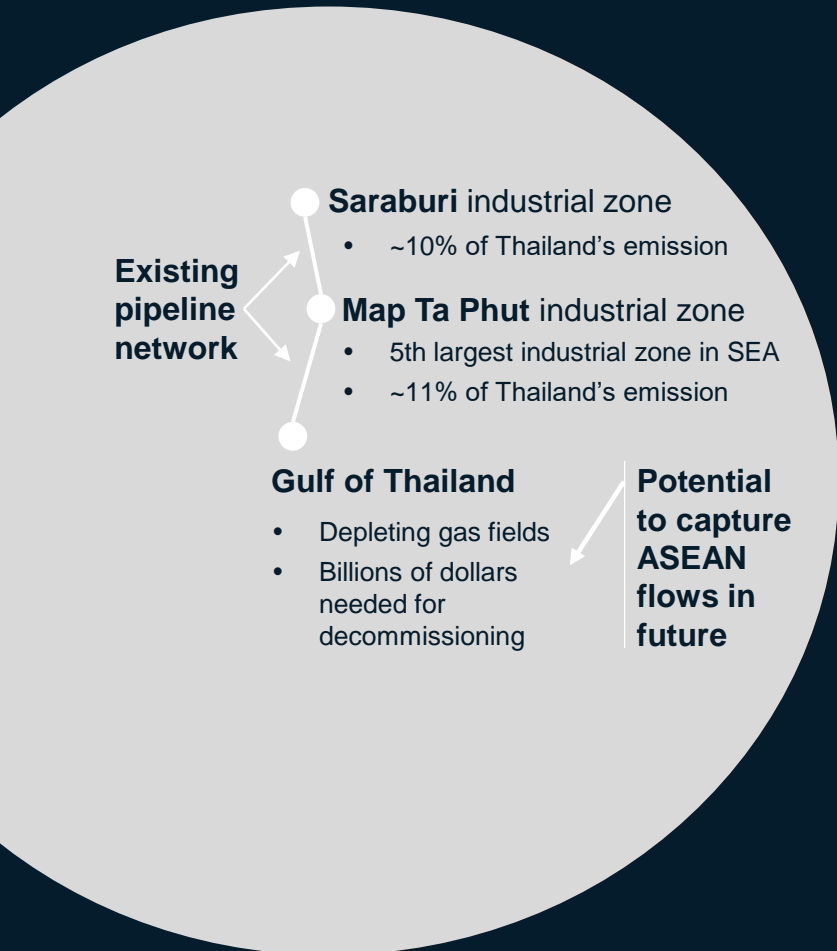


Port of Rotterdam CO₂ Transport Hub and Offshore Storage (**Porthos**¹) aims to capture port emissions for storage in the North Sea via a 50 km pipeline

- Project will take FID in 2022; proposed funding of €102M from European Commission
- Target of 2.5 MTPA CO₂ sequestered by 2024

Map Ta Phut might represent an opportunity to develop a CCUS cluster if right investment and actor collaboration can be accessed

Illustrative



Activities	Description	Opex required	
1 Capture	Capture CO₂ emissions from: <ul style="list-style-type: none"> Existing and new industrial activities in Map Ta Put Regional and international sources 	Source capture infrastructure and operations	USD 2.5-4 Bn/year
2 Transport	Transport captured CO₂ to usage or storage location	New pipeline / expand existing	} USD 0.5-1 Bn/year
3a Storage	Store remaining CO₂ in PTTEP operated reservoirs <ul style="list-style-type: none"> Sequestration infrastructure Access / trade on carbon markets 	Potential to use empty gas fields in GoT	
3b Usage	Reuse captured CO₂ for commercial-scale new industrial processes e.g. <ul style="list-style-type: none"> Construction materials (e.g., CO₂-cured cement) Fuel (e.g., synfuel) 	New use-cases for using stored/ Captured CO ₂	On commercial feasibility basis

Topics today

NCZ global context

Thailand NCZ context

Select technologies as part of the solution for Thailand, and as opportunity

Key messages



Key messages

1 NCZ is a top-agenda items for countries & companies

69 countries have committed or at least proposed NCZ targets

~3,500 companies have set or committed Science Based Targets to achieve NCZ

Still, emissions are not coming down just as yet, to secure the 1.5°C pathway

2 Thailand faces physical and economic risks from climate change; Thailand has set leading NCZ targets, and a path to NCZ exists

Thailand has pledged to achieve NCZ by 2065. Its recent NCZ strategy sets bold aspirations for 2030 already

To actualize this target, Thailand can develop a detailed decarbonization roadmap for each sector. It can use a tested framework addressing A) Physical building blocks, B) Economic and Financing requirements and C) Governance, institutions, and commitment

3 Technology for transition is forming, with significant opportunity to partake in development and new business building

Only ~2/3 of technologies needed for the transition are mature and can be applied and scaled today; it is critical to develop new technologies in the coming ~10 years

On the back of the transition, a USD ~4-5 Tn market opportunity exists for new technologies in Asia alone

For Thailand, 3 ideas (or hubs) could contribute ~50% of 2030 target reductions from BAU: CCS at Map Ta Phut, EV and Agri