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U.S. DEPARTMENT OF ENERGY

Indonesian Industry Decarbonization Policy Roadmap

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Energy Technologies Area

Lawrence Berkeley National Laboratory

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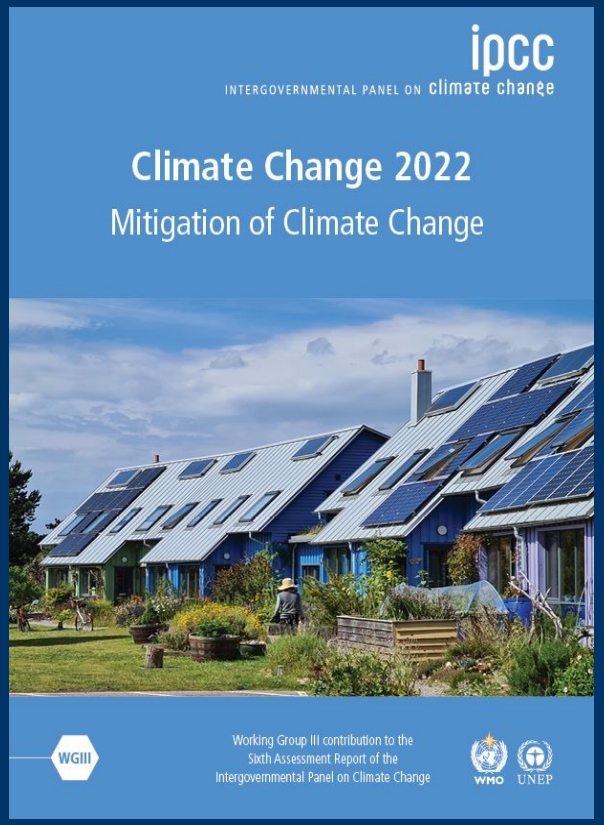
- The IPCC assessment reports provide a **comprehensive summary of scientific knowledge** on climate change, its causes, potential impacts and response options.



- They **provide governments, at all levels, with scientific information needed to develop climate policies**.

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Industry

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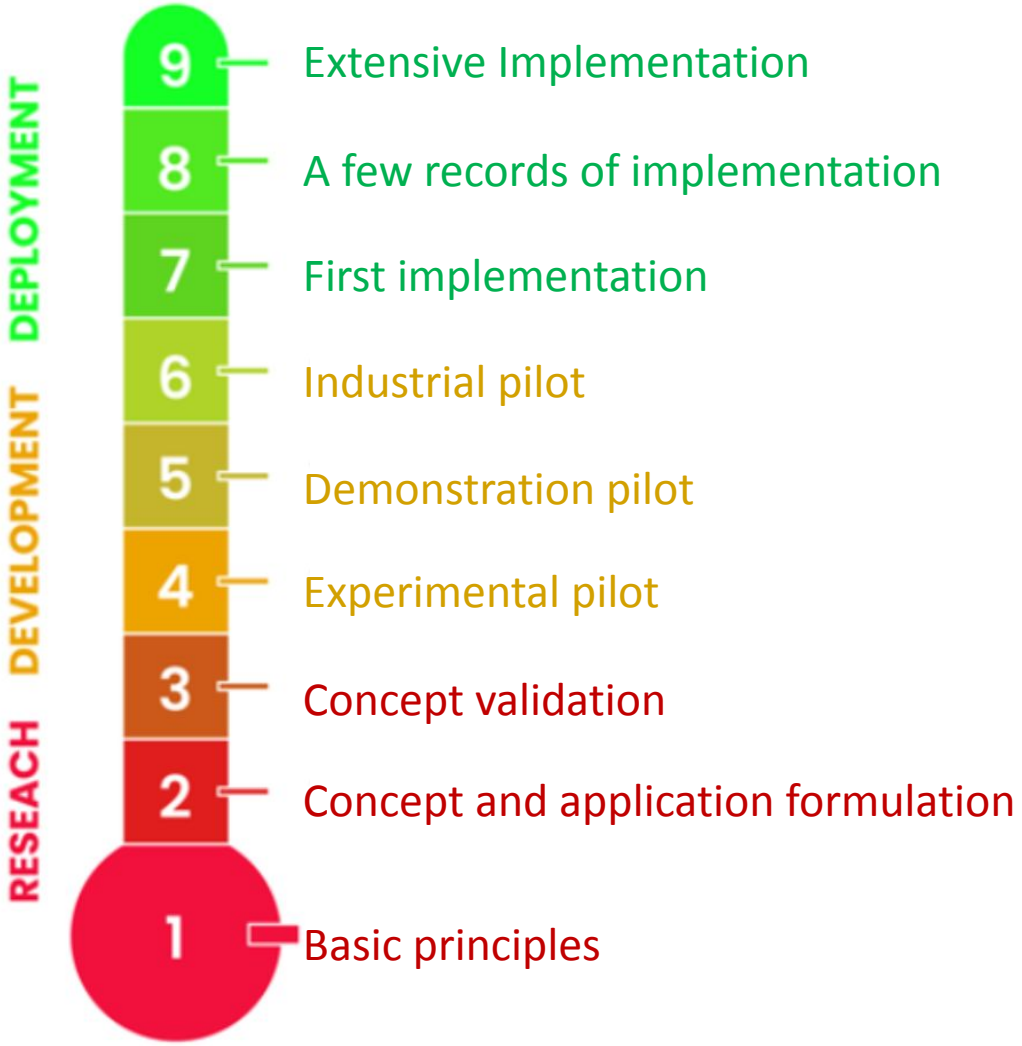
The industry Chapter found that:

- Net-zero emissions from the industrial sector are possible in the mid-century horizon, (high confidence)
- New and Innovative Climate Policy targeting the Industry sector is necessary to accelerate transition (medium confidence).
- Need a combination of Technology push (demonstration, technology roadmap) and Demand pull
-

Barriers to Industry Decarbonization

- **Long lived assets**: 30-40 years
- **High-temperature heat requirements:** Energy intensive sectors require high temperature process heat that cannot be electrified easily.
- **Competitiveness:** Energy intensive sectors are typically low margin businesses with well-established processes that are difficult to change. These industries face intense competition and risk carbon leakage.
- **Workforce:** lack of engineering resources, innovators, risk takers, business angels
- **Just Transition:** Industry is also a sensitive sector that employs a large number of employees (e.g., textile industry) and is an important driver of economic growth (e.g., iron and steel industry).

Technology Readiness Levels and Policy



- Technologies exist for decarbonizing the industry sector but many at an early stage of development and commercialization
  - The IEA estimates that 60% of the technology are not commercially available today, and 35% are at the early adoption phase
- This require a package of programs that address all stages of technological development to improve performance and reduce costs of emerging technologies
- Local and international concertation are key to enable faster technology uptake

Technology Solutions for Industrial Decarbonization

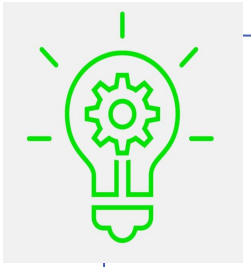




Material Management	Energy Efficiecny	Electrification	Fuel Switching	CCUS
• Higher quality, high performance, and longer life materials/products	• Component and system energy efficiency	• High efficiency electric heating (e.g. arc furnaces, induction furnaces)	• Green Hydrogen as feedstock or fuel	• CO2 capture and storage
• Increase post-consumer scrap recycling and collection rates	• Smart energy management	• Expand electricity applications (e.g. electrify industrial heat processes)	• Biomass for feedstocks and low/high temp heat	• Direct air capture of CO2 coupled with RE H2 to produce synthetic gas
• Lightweight/alternative materials and construction	• Waste heat recovery and use	• On-site or grid power generation using solar PV and wind turbines	• Renewable natural gas derived from biogas sources	• CO2 use to produce calcium carbonate to be sequestered in concrete
• Prefab construction/ additive manufacturing/ 3D printing	• Integrative design/system optimization	• Use renewable electricity for electrolysis for iron making	• low carbon synthetic natural gas	• Bioenergy crops with carbon capture and storage (BECCS)

Policy Package for Industry Decarbonization

Industry GHG Reduction Targets And Planning



Innovation

Electrification and Fuel Switching

Energy Efficiency

Material Efficiency and Circular Economy

Workforce And Local Communities

GHG Reduction Targets and Planning

National Climate Goals needs to be translated into Specific Sectoral and Sub-sectoral targets

Visibility into long-term planning is essential for guiding investment of today

	Government	Companies	Civil Society
GHG Reporting	• Strengthen mandatory GHG reporting • Publish annual reporting with aggregate data • Monitor Progress	• Develop GHG accounting • Set internal targets	• Hold government and industries accountable
Concerted Sub-sectoral Roadmaps	• Collaborate to produce sectoral roadmaps that assess the technical, economic and social opportunities to transition to low- GHG development and can guide investment decision and policy design		
National Impacts	• Assess infrastructure development needs • Assess workforce impact	• Provide inputs • Review documents	

California Global Warming Solutions Act of 2006 (AB 32)

Under California's Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR), **industrial sources, fuel suppliers, and electricity importers must report their annual GHG emissions** to the California Air Resources Board (CARB).

For reporters subject to the California Cap-and-Trade Program, submitted data are verified by a CARB-accredited independent third-party verifier.

Transparent system:
2021 GHG emissions data and prior years' annual data are archived under the Historical Emissions Data section below: *https://ww2.arb.ca.gov/mrr-data*

California Air Resources Board

Annual Summary of GHG Mandatory Reporting
Non-Confidential Data for Calendar Year 2021

CALIFORNIA AIR RESOURCES BOARD

The

See the "Introduction" tab and the "Column Descriptions" tab for important information about the data shown.

		Total Emissions (metric tons CO_2e)		Entity-Reported GHG Data (metric tons CO2e)		
ARB ID	Facility Name	Total CO_2e (combustion, process, vented, and supplier)	AEL	Emitter CO2e from Non-Biogenic Sources and CH4 and N2O from Biogenic Fuels	Emitter CO2 from Biogenic Fuels	Fuel Supplier CO2e f Non-Biogenic Fuels a CH4 and N2O fron Biogenic Fuels
104883	Western Community Energy - RSO	0	No	0	0	
104360	Western Digital Technologies, Inc.	18,503	No	18,503	0	
104075	WG Holdings SPV, LLC - Los Angeles Basin Facility	9,638	No	9,638	0	
104392	Wild Goose Storage LLC	30,731	No	30,731	0	
101343	Wildflower Energy, LP - Indigo Generation, LLC	18,840	No	18,840	0	
100353	Wildflower Energy, LP - Larkspur Energy Facility, LLC	16,377	No	16,377	0	
104359	Windset Farms	34,311	No	34,311	0	
101693	Wm. Bolthouse Farms, Inc.	35,719	No	35,719	0	
101493	Woodland Biomass Power, LLC	47,324	No	1,187	46,136	
104679	WP&A Firebaugh	11,464	No	11,464	0	

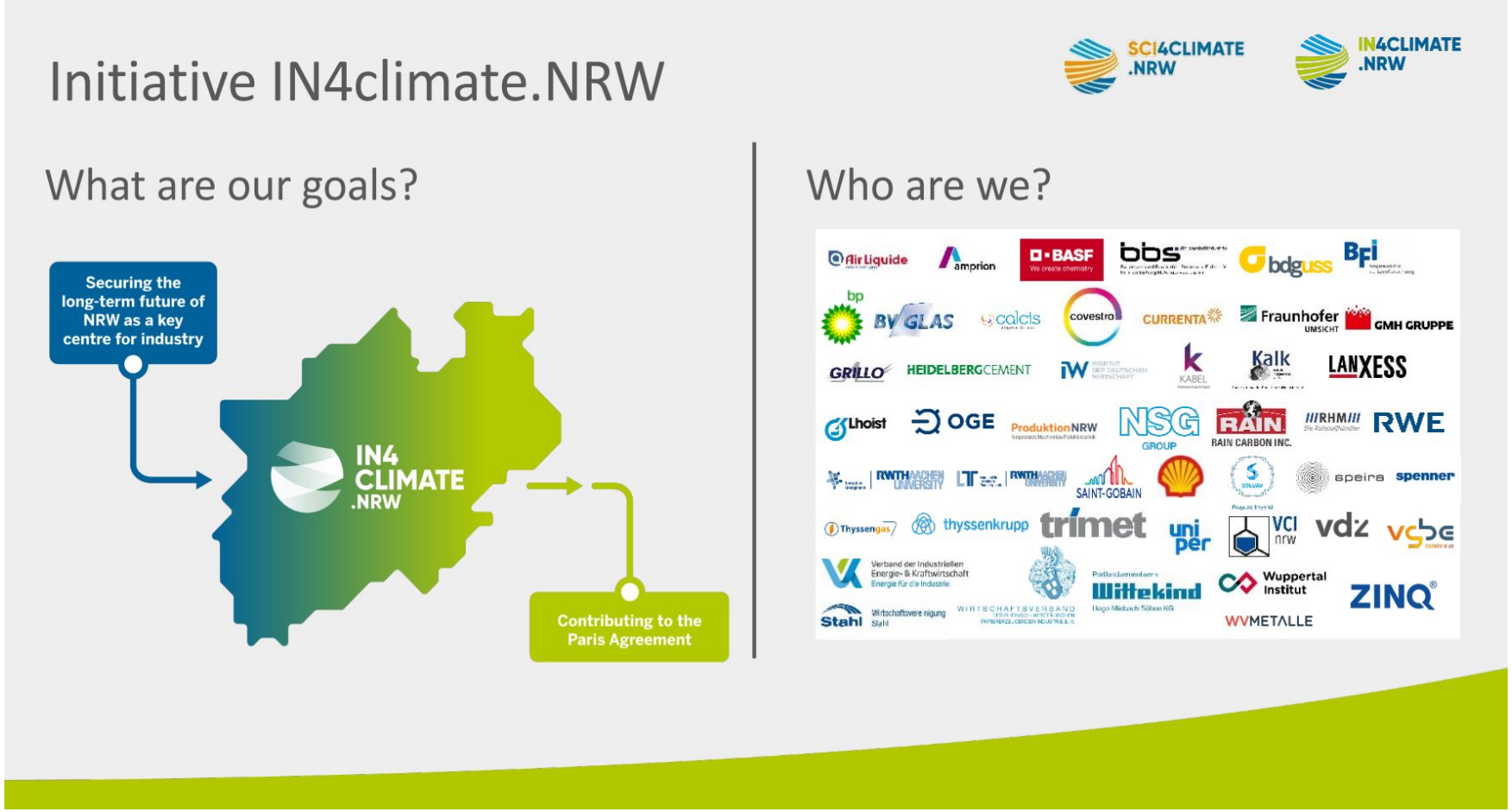
Subsectoral targets through a transparent stakeholder engagement

North Rhine Westphalia (NRW) is Germany's Most Industrialized Region

NRW Aspire to become climate-neutral industrial region as soon as possible

NRW passed a Climate Process Law that resulted in the adoption of a Climate Protection Plan that set subsector targets through a transparent stakeholder engagement process based on scenario development and identification of low-GHG options

The law accelerates planning and permitting procedures



Source: Dr. Sebastian Busch's presentation to ECEEE 2022, https://www.eceee.org/static/media/uploads/site-2/2022_ZeroCarbonIndustry/presentations/busch_mainstreaming-industrial-climate.pdf

Roadmap – GHG Target

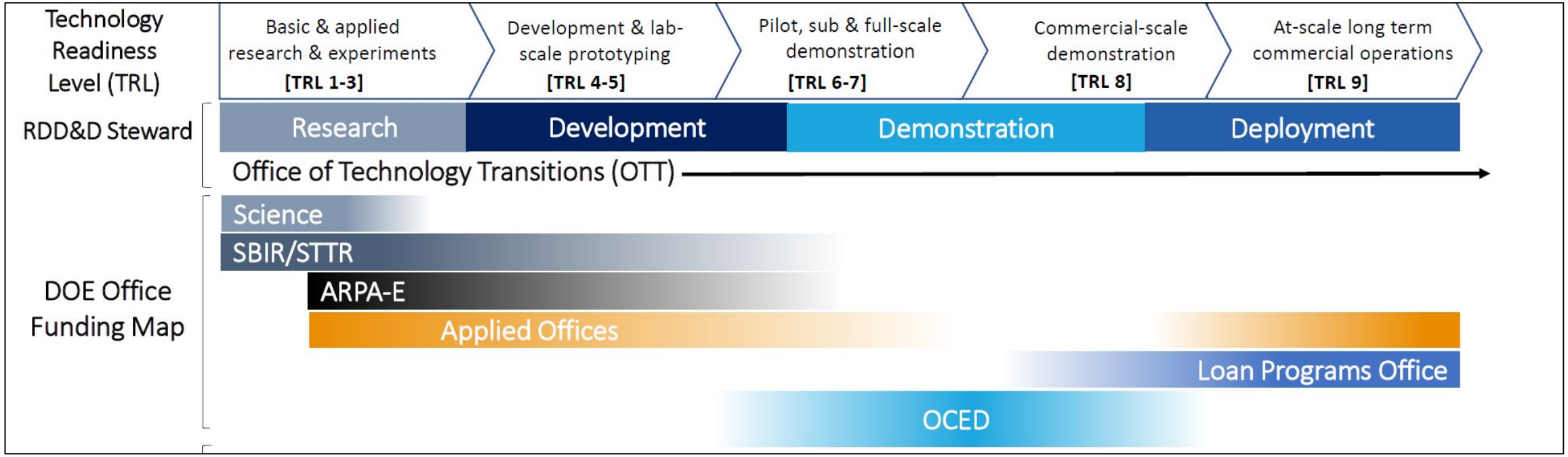
Timing	Actions	Lead Agencies
1-2 years	GHG reporting system developed	MEMR, MOEF
2-4 years	Concerted action plans with specific sectoral target established	MOI
	Infrastructure strategy developed	BAPPENAS, MOI
	Job and community impact assessment	
	Sectoral target included in GHG trading scheme for 2030	MEF
5 years	Monitoring and adjustment as needed	MEMR, MOEF

Innovation is key to foster competitiveness

The industry sector bears the highest proportion of low TRL of decarbonization technologies

	Government	Companies	Civil Society
Research Development and Innovation (RDI)	• Develop a RDI program directed toward low TRL technologies to provide	• Integrate RDI into competitiveness strategies	• Develop educational curriculum • Organize international exchange programs
Demonstration Program	• Support tech-to-market partnerships, that brings together government, industry and research to finance the demonstration of innovative technology such as H2-DRI, CCS projects, industrial heat pumps, lightweight building materials, etc.		
Leadership Program	• Reward risk takers and spread the word on the feasibility of net zero carbon technology applications in the industry sector		

US DOE and Inflation Reduction Act (2022)



Demonstration:

- OCED at DOE is soliciting applications for projects for **USD 6.3 Billion** that will demonstrate the production of low carbon products in the highest emitting industries
- Projects to be considered have to show **a minimum of 50% cost sharing from the private sector** and the **contribution to the goal that 40% of the benefits** goes to disadvantaged communities to drive the creation of accessible good-paying jobs.

Mission Innovation

Mission Innovation is a global initiative to catalyze action and investment in research, development and demonstration

Commitment by all members to seek to **double their clean energy innovation investments over five years** in selected priority areas.

- Mission innovation is organizing the Net-Zero Industries Award 2023 to honor the world's best innovations for industrial decarbonization in three distinct categories:
- Outstanding Projects, Female Innovators and Young Talents.
- A jury of experts will evaluate the applications and the winners in each category will be announced in a ceremony at the United Nations Climate Change Conference (COP28).

Timing	Actions	Lead Agencies
1-2 years	• Adoption of an Industry Decarbonization Innovation Bill to allocate significant budget to co-fund low carbon technology uptake in Indonesia	MOI, MOF and MEMR
2-4 years	• 1st round of solicitation of RDI projects and demonstration projects • Launch of the Indonesia Industry Decarbonization Leadership Program	
5 years	• 2nd round of solicitation of RDI projects and demonstration projects	

Electrification, Fuel Switching and CCUS

Industry electrification with renewable energy is a critical strategy for reducing GHG

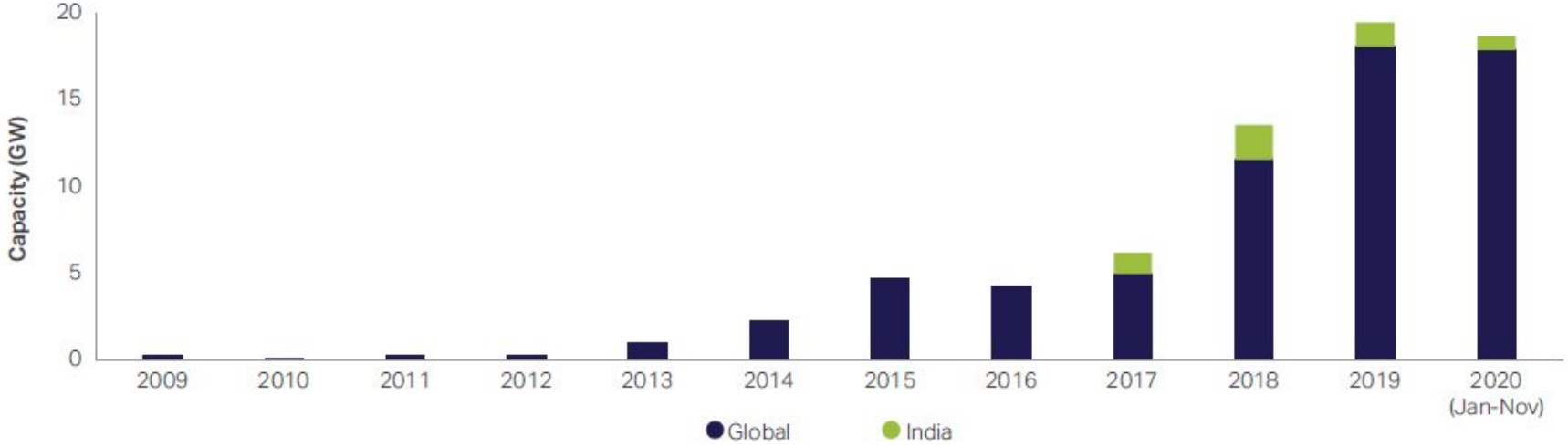
A range of policies and regulations can play a role in creating a favorable enabling environment for industry companies to invest in renewable energy

	Government	Companies
Renewable Energy Self-Generation and Purchase	• Developing an enabling environment to encourage fuel switching (permitting, standardization of agreements, wheeling, etc)	• Direct power purchase agreements (PPA) • Investment in RE captive Power
End use Electrification	• Incentivize the adoption of industrial heat pumps, electric boilers, resistance heating, induction heating, industrial microwaves, electric arcs furnaces, etc. • <u>New plants</u>: Consider setting GHG requirements on new built production capacity in heavy industry, such as iron and steel, and cement industries • <u>Old plants</u>: Develop phase-out agreements and repurposing plans of existing infrastructure	
Hydrogen and CCUS	• regulatory frameworks that will govern the properties, safety, production, storage, transportation, distribution, and associated infrastructure of hydrogen and CO2	

Corporate RE PPAs - India

- Corporate RE PPA uptake is growing rapidly around the world
- India was the second largest growth market after the US in 2019, with an addition of 1.4 GW of capacity.
  - The regulation allows for large consumers to procure electricity from independent producers through direct PPAs or by setting up their own captive generation plants
  - The consumer can use the state's transmission and distribution infrastructure to procure this power

Figure 1: Annual global signed corporate renewable PPA capacity



Source: WBCSD, Corporate Renewable PPAs in India: Market & Policy Update

End Use Electrification – Finland

In 2022, the Ministry of Economic Affairs and Employment of Finland signed the **Act on Electrification Subsidy for Energy-Intensive Industries** to compensate for the indirect costs of carbon trading on the price of electricity.

The Act allows **to set up a fund to subsidize** the uptake of end use electrification

The program has a determined period of 4 years and has for goal to mitigate carbon leakage risk and safeguard the cost competitiveness of energy intensive industry

Electrification

Timing	Actions	Lead Agencies
1-2 years	• Revise permitting process to facilitate RE captive power and Corporate	MEMR, Local Gov
2-4 years	• Incentivize the adoption of industrial heat pumps, electric boilers, resistance heating, induction heating, industrial microwaves, electric arcs furnaces, etc. • Consider setting GHG requirements on new built production capacity in heavy industry, such as iron and steel, and cement industries • Develop phase-out agreements and repurposing plans of existing infrastructure (e.g. blast furnaces) • Develop Hydrogen and CCS development strategies	MEMR, PLN, MOI, MOF
5 years	• Monitor progress and revise incentive programs	MOI, MOF

Energy Efficiency

Improving energy efficiency cut energy demand and provide cost savings to companies

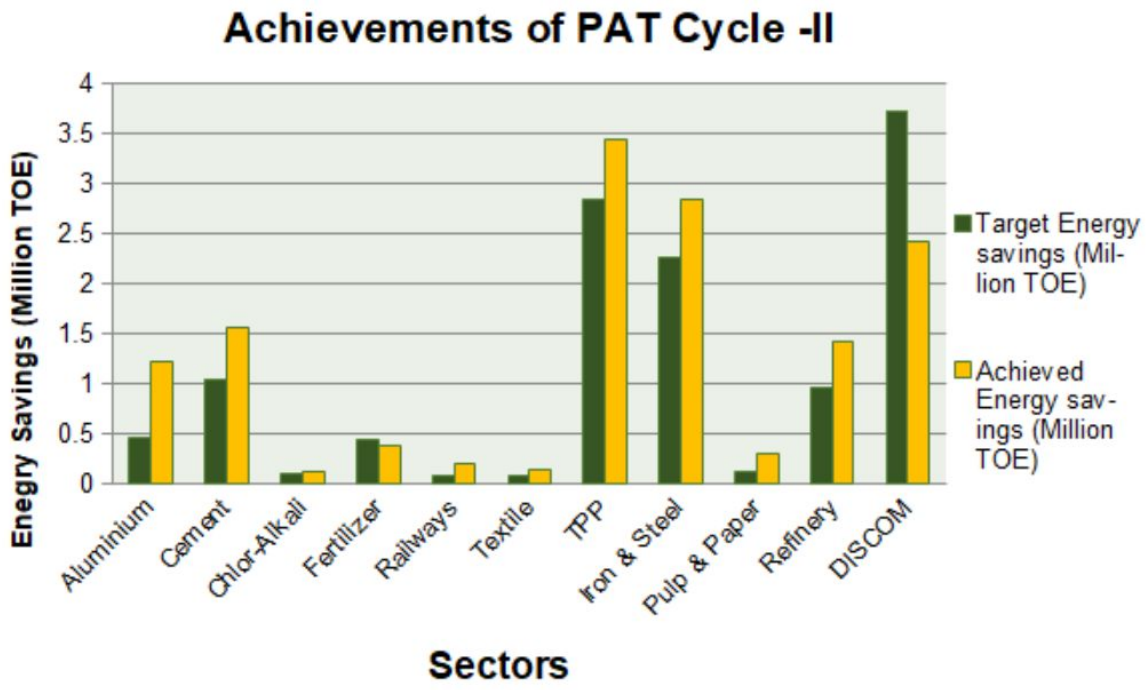
The IEA states that energy efficiency alone could provide more than 40% of the reduction in greenhouse gas emissions required by 2040 to reach the climate goals and be in line with the Paris Agreement

	Government	Companies
Energy Management	• leverage and expand existing EE programs to compel large energy user to achieve greater savings and emissions reduction	• Invest in Energy Audits • Integrate EE in invest to reduce costs
Set Energy Performance Scheme	• Negotiate specific energy consumption (SEC) targets • Consider incentive to achieve these targets (reduce GHG emissions taxes)	• Participate in sectoral industry association assessment • Develop SEC target
Energy Efficiency Standards	• Consider the establishing and revision of energy efficiency standards for specific equipment such as motors, motor system, pumps etc.	• Comply • Adopt voluntary endorsement standards

India Perform, Achieve, and Trade (PAT) program

The Bureau of Energy Efficiency (BEE) of India set individual targets for large energy users to reduce the **Specific Energy Consumption (SEC)** in energy intensive industries, with **an associated market based mechanism** to enhance the cost effectiveness

- Large energy users submit annual energy reports and at the end of three years, they **submit a performance evaluation** audit report and receive **Energy Saving Certificates** (ESCerts) if their SEC exceed their targets.
- These ESCerts can either be traded or keep for next cycle.
- BEE estimates that the first **three PAT cycles** have saved about **8.67, 14.08, and 1.75 Mtoe** respectively in their target years



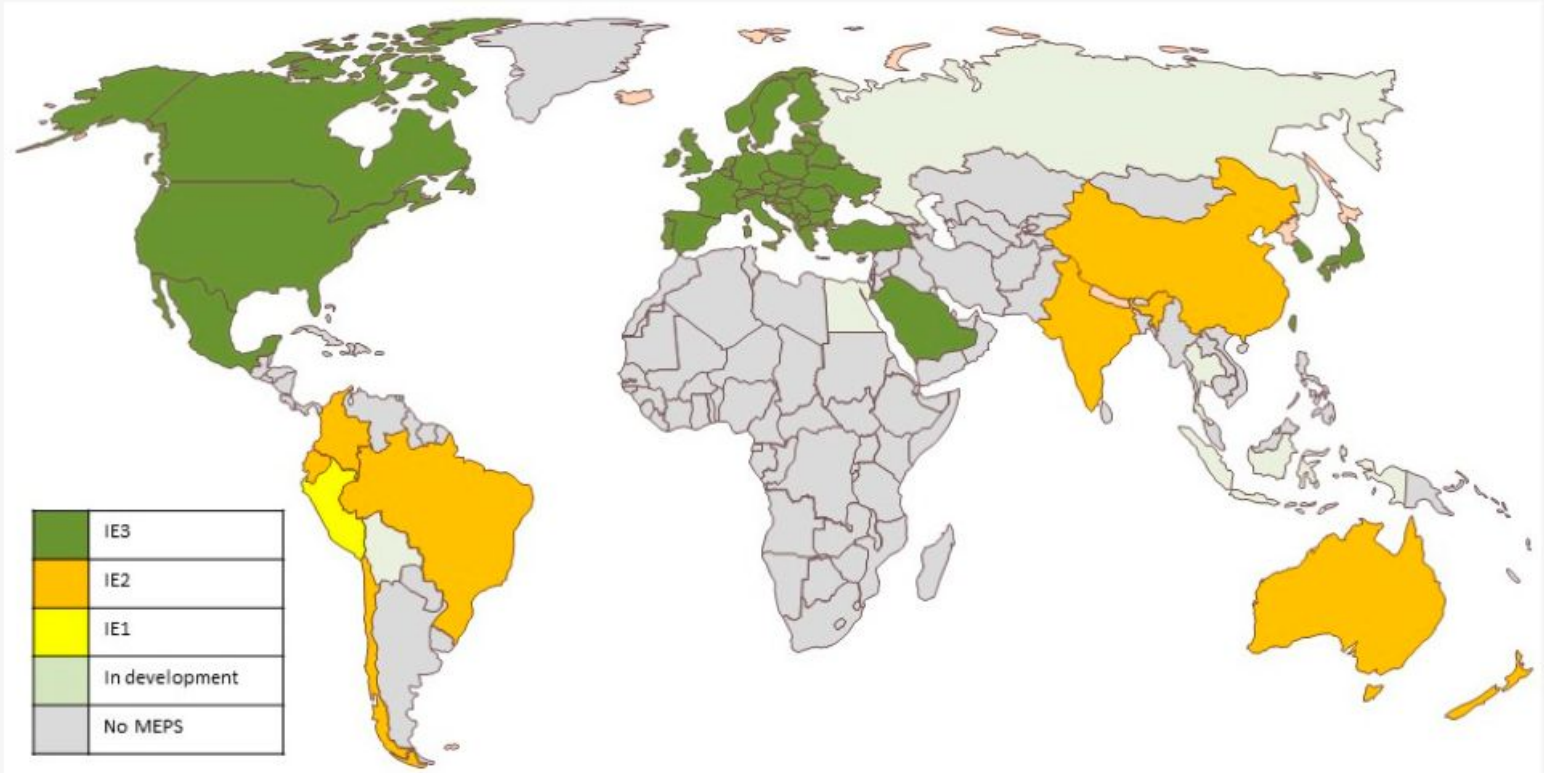
Source: BEE website

IE3 Standards

- The largest potential for reduction in electricity consumption and corresponding emissions results from improving the efficiency of electric motors and end-use devices (e.g., pumps and fans)

- The acknowledgement of this potential major contribution has led to the introduction of regulations imposing minimum energy efficiency levels for new electric motors in all major economies.

Figure 1. Minimum energy performance standards worldwide for electric motors.



Source: Fong et al. 2020. "IEC61800-9 System Standards as a Tool to Boost the Efficiency of Electric Motor Driven Systems Worldwide"

Energy Efficiency

Timing	Actions	Lead Agencies
1-2 years	• Evaluation of current program and remaining potential • Set Energy Efficiency standards for Motors and consider other products	MOI, MEMR, MOEF
2-4 years	• Expand current policies to achieve greater potential • Set an energy performance target scheme for large energy users	MOI, MEMR, MOEF
5 years	• Monitor progress and revise to stringent targets	MOI, MEMR, MOEF

Material Efficiency and Circular Economy

ME and CE promotes the production of low carbon goods and reduce waste

	Government	Companies
Standardization and Certification	• Establishing standards to guide production with less material or alternative material while ensuring product safety, performance and reliability.	• Adopt standards • Develop standards • Participate in national and international discussion on standards
Green Procurement	• Leverage purchasing power to create a market for low carbon products and material	• Develop green procurement for downstream supply chain purchases and production inputs
Circular Economy Strategy	• Build on the work already done by **Bappenas** as described in "The Future is Circular: Concrete Steps for Circular Economic Initiatives in Indonesia". • Implement is **Extended producer responsibility schemes** which require producers to take responsibility for the end life of their outputs • Collect data and develop indicators to quantify the impacts and provide evidence to improve circular economy and materials efficiency policies.	

Green Building Codes - Denmark

An increasing number of jurisdictions worldwide are addressing the carbon footprint associated with building materials and construction processes.

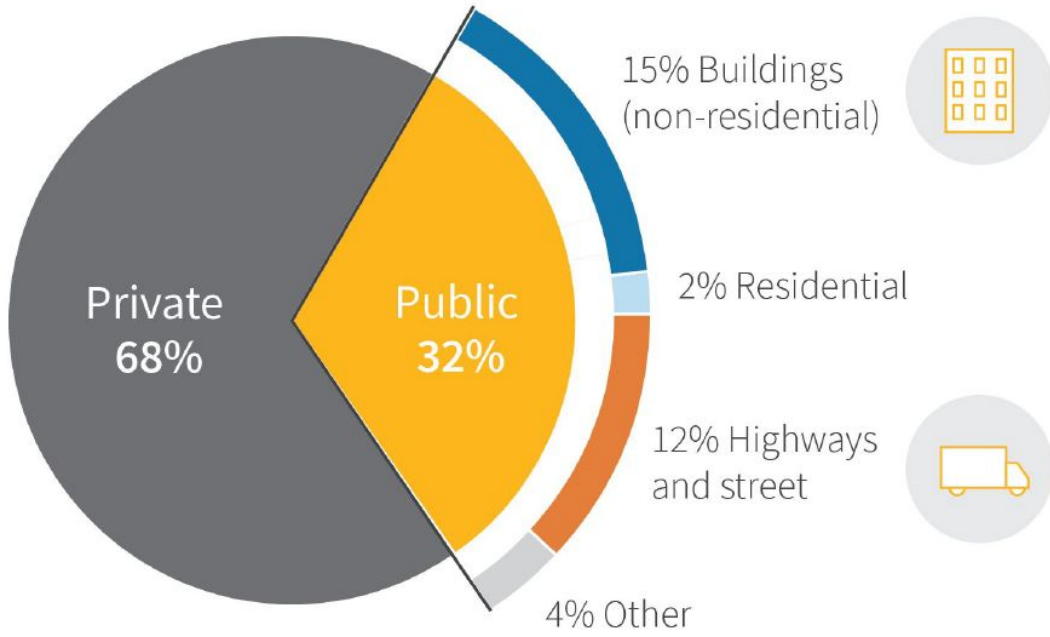
- the Danish government introduced requirement in the **building regulations for whole life carbon** which include both operational and embodied carbon.
- This amendment came into effect in 2023 for all building over 1,000 m^2
- It will be required to meet an initial limit value of **12 kg CO2e/m2/year** with an **endorsement label** for buildings which meet a limit value of **8 kg CO2/m2/year**.
- The goal is **to tighten the limit value every** other year until 2029

U.S. Buy Clean Policies

In 2021, US President Biden released an executive order to use the federal procurement power to help achieve net-zero emissions economy-wide by 2050.

- Buy Clean policies require supply chain emissions disclosure, generally in the form of environmental product declarations (EPDs)
- EPDs are documents that reports the lifecycle assessment of a product based on the international ISO 14025 standard.
- Requiring disclosure encourages manufacturers to produce quality data and to lower their GHG impacts.

Relative Contribution of the US Global Warming Potential from Construction for Private and Public



Source: Carbon Leadership Forum

Material Efficiency and Circular Economy

Timing	Actions	Lead Agencies
1-2 years	• Developing a National Circular Economy Law or Strategy • Develop standards and certifications	**Bappenas** **MOI MOEF**
2-4 years	• Develop green Procurement • Adopting regulations that extend lifetime of product, ban single use products and increase recycling rate • Extended producer responsibility schemes • Foster market opportunities for circular products exchange	**MOF, MOEF, MOI, Bappenas**
5 years	• Monitor and revise strategy, set new goals	**MOF, MOEF, MOI, Bappenas**

Workforce Development

include labor and equity objectives to ensure a just energy transition

Workforce development and technical assistance programs can help ensure that the transition improved health outcomes and long-term job prospects for local communities.

	Government	Companies
Develop Green Industry Training Hubs	• Develop re- skilling centers • Tight their funding allocated to industry to support innovation to requirements on re-skilling programs and worker protection • Develop tools to ensure that benefits and cost of the transition are distributed fairly	• Empower workers to gain knowledge to help transition to low carbon production • Develop plans for workforce development and local community engagement.
Develop an incubator program	• Develop Clean Technology incubator program to support and assist early-stage entrepreneurs in developing their business ideas, products, or services.	

Skill Council for Green (SCGJ) - India

Green Jobs propelling Green Growth

Established by the Government in 2015 as a not-for-profit, autonomous, industry-led society

- **Goals**: to improve skills for green business industries and integrate environmental awareness into job training across skilling programs.
- **Accomplishments**:
  - 44 nationally (NSQC) approved qualifications across various sub domains (e.g. Renewable energy, circular economy, industry, etc.) along with training materials,
  - trained over 504,000 trainees,
  - has a network of over 400 affiliated training institutions / centres along with over 4000 trainers across the country deliver trainings across green business domain.

SCGJ
SKILL COUNCIL FOR GREEN JOBS
ISO 9001 : 2015 CERTIFIED

U.S. Cradle to Commerce program

- In the US, the department of energy worked with its Labs to develop the Cradle to Commerce program which curate compelling climate technologies developed by inventors.
- It is a public-private program
- It helps connect inventors and entrepreneurs by providing coaching for pitch skills, mentoring for business models, and access to pilots, prototyping, and critical resources like state-of-the-art test beds, prototyping facilities, and scientific resources for technology advancement.
- https://c2c.lbl.gov/

Workforce Development

Timing	Actions	Lead Agencies
1-2 years	• Develop Green Industry Training Hubs • Consider designing develop programs that promote a just energy transition	MOI, MEMR, MOEF
2-4 years	• Develop an incubator program • Expand the number of Green Industry Training Hubs	MOI, MEMR, MOEF
5 years	• Assess impacts and develop new programs that ensure that the transition improved health outcomes and long-term job prospects for local communities	MOI, MEMR, MOEF

Policy Roadmap

	1-2 years	2-4 years	5 years
Target Setting	• GHG Reporting System Developed	• Concerted Action plans with specific sectoral target Established • Infrastructure Strategy Developed • Job and Community Impact Assessment • Sectoral target included in GHG trading Scheme for 2030	• Monitoring and adjustment as needed
Innovation	• Adoption of an Industry Decarbonization RDI Bill	• 1st round of solicitation of RDI projects and demonstration projects • Launch of the Indonesia Industry Decarbonization Leadership Program	• 2nd round of solicitation of RDI projects and demonstration projects
Electrification, fuel switching and CCUS	• Revise permitting process to facilitate RE captive power and Corporate	• Incentivize the adoption of industrial heat pumps, electric boilers, resistance heating, induction heating, industrial microwaves, electric arcs furnaces, etc. • Consider setting GHG requirements on new built production capacity in heavy industry, such as iron and steel, and cement industries • Develop phase-out agreements and repurposing plans of existing infrastructure (e.g. blast furnaces) • Develop Hydrogen and CCS development strategies	• Monitor progress and revise incentive programs
Energy Efficiency	• Evaluation of current program and remaining potential	• Expand current policies to achieve greater potential • Set an energy performance target scheme for large energy users	• Monitor progress and revise to stringent targets
Material Efficiency And Circular Economy	• Developing a National Circular Economy Law or Strategy • Develop standards and certifications	• Develop green Procurement • Adopting regulations that extend lifetime of product, ban single use products and increase recycling rate • Extended producer responsibility schemes • Foster market opportunities for circular products exchange	• Monitor and revise strategy, set new goals
Workforce	• Green Industry Training • Develop programs that promote a just energy transition for local communities	• Develop an incubator program • Expand the number of Green Industry Training Hubs	• Assess impacts on health outcomes and long-term job prospects for local communities

ipcc

> **Unless there are immediate and deep emissions reductions across all sectors, 1.5°C is beyond reach.**

The evidence is clear:

The time for action is now

Thank you!

- Comments and Questions?

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