

Meeting California's Carbon Neutrality Goals: Approaches for the Industrial Sector

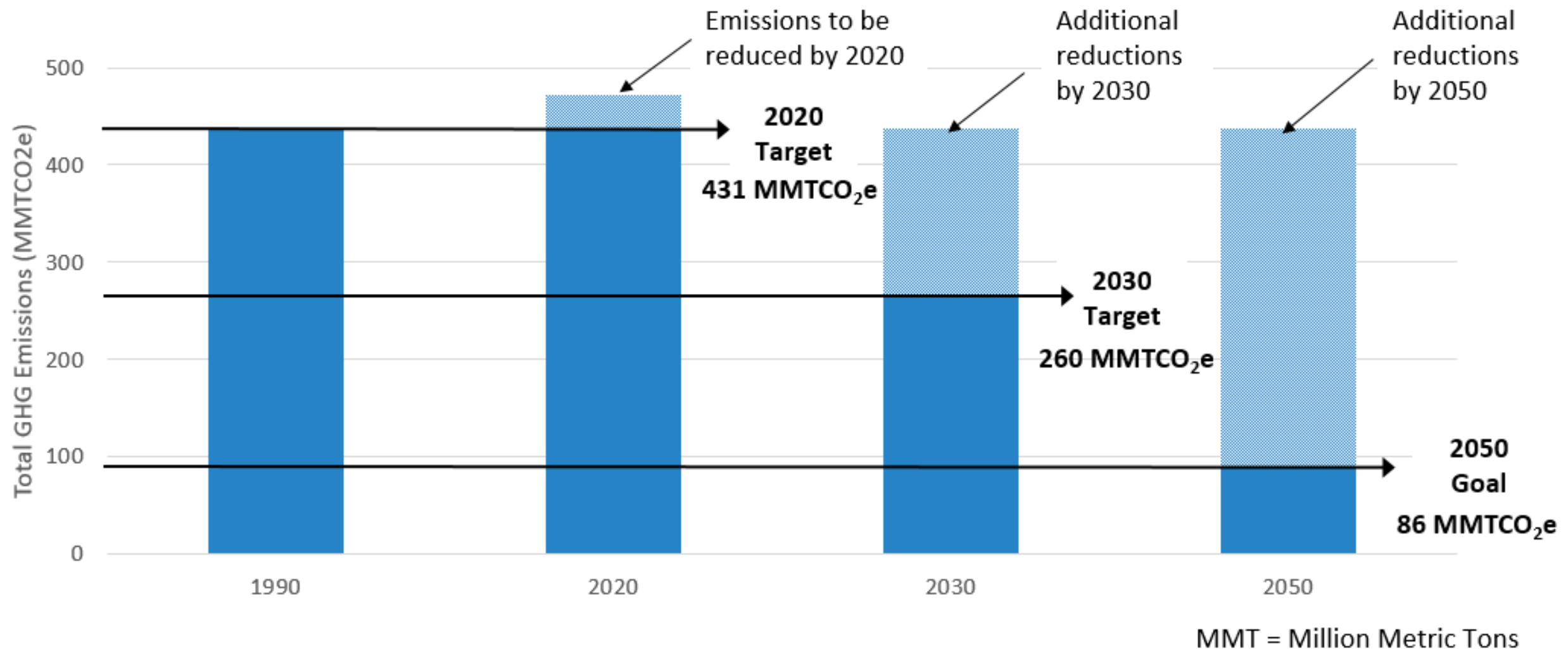


FEBRUARY 20, 2020

Webinar Logistics

- Presentation and link to submit and view informal comments:
 - <https://ww3.arb.ca.gov/cc/scopingplan/meetings/meetings.htm>
 - Comment period from Thursday, February 20 to Friday, March 6
- Webcast at <https://video.calepa.ca.gov/>
- Video will be uploaded to the Scoping Plan meetings web page

California's GHG Emissions Reduction Targets



Source: CARB, 2018

Framing the Path Forward

IPCC Report – Carbon neutrality by 2045 may hold global warming to 1.5°C



Some regions are net emitters;
others are sinks



Carbon Neutrality by 2045



Reduce fossil energy and NWL
emissions; evaluate potential sinks

California Carbon Neutrality (CO₂e)

Today



AB 32 GHG Inventory



Conversion

Natural & Working
Lands Inventory

Minimize emissions

Increase sequestration

Mid-century



Both categories emit GHGs

No net GHG emissions

Carbon Neutrality Meeting Series

- January 2019 – Carbon Neutrality in the California Context
- July 2019 – Public Workshop to Discuss the Role of the Industrial Sector in Meeting California's Carbon Neutrality Goals
- August 2019 – Public Workshop to Discuss Carbon Neutrality: Scenarios for Deep Decarbonization
- August 2019 – Public Workshop to Discuss Carbon Neutrality: Social Cost of Carbon and Affordability
- December 2019 – Public Workshop to Discuss the Role of Carbon Capture, Sequestration, and Options for Utilization
- Carbon Neutrality Meetings at <https://ww3.arb.ca.gov/cc/scopingplan/meetings/meetings.htm>

Carbon Neutrality – Role of Industrial Sector

- July 8, 2019 Workshop
- Two sets of panelists presented on:
 - Economic Considerations of Industrial Emission Reductions
 - Development and Implementation of Technologies to Decarbonize Industry
- Key Takeaways for California
 - Current technologies may not result in sufficient emission reductions
 - Prices of renewable fuels and electricity need to decrease
 - Must take an all-of-the-above approach to target GHG-reducing opportunities
 - Strong policies needed to drive deep decarbonization in industry
 - Policies must minimize leakage and recognize the importance of industry to jobs and the economy

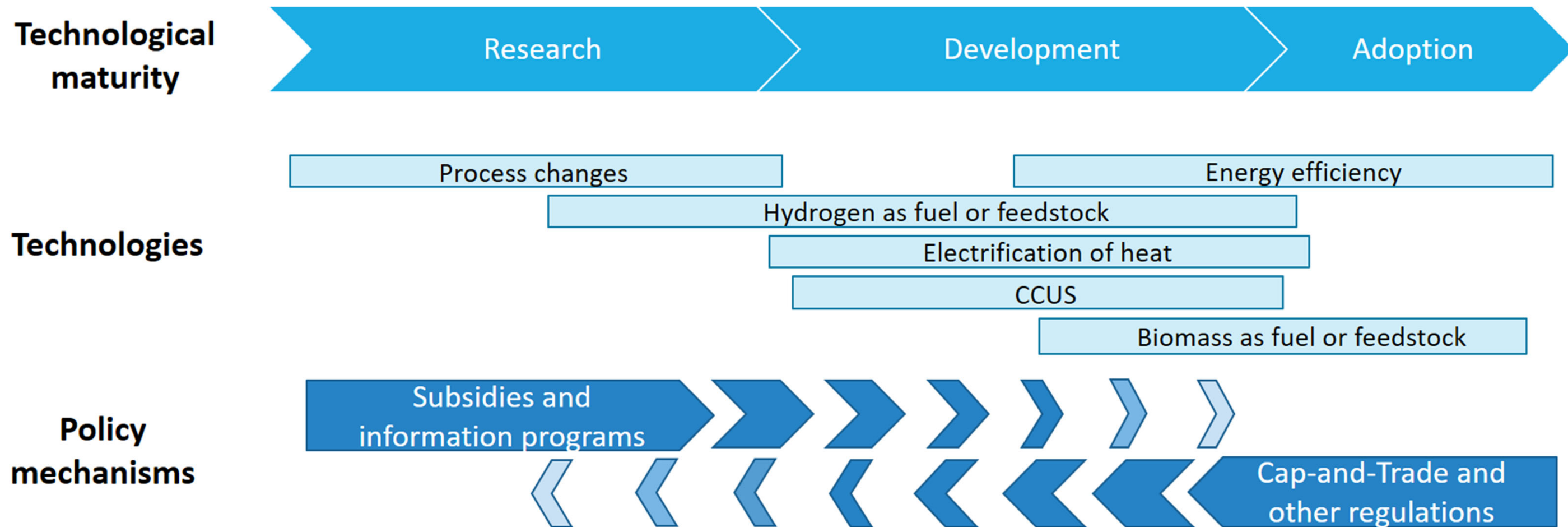
Today's Workshop

- Review technology and policy options considered by researchers, industrial groups, and others on industrial decarbonization
- Discuss the current industrial sector regulatory context in California
- Overview of policies and incentives being implemented in other jurisdictions to drive GHG reductions in the industrial sector
- Solicit feedback on potential regulatory and policy approaches
- Please submit written comments by 5:00 p.m. on Friday, March 6 at https://www.arb.ca.gov/lispub/comm2/bcsubform.php?listname=cn-industry-web-ws&comm_period=1

Overview of Technology Options for Decarbonizing Industry

- Process changes and efficiency gains
 - Membrane technology
- New sources of process heat
 - Electric boilers
 - Solar thermal
- Renewable fuels
 - Renewable natural gas
 - Green hydrogen
 - Biomass
- Carbon capture, sequestration, and options for utilization
 - See CARB workshop held December 11, 2019

Innovation to Ensure a Range of Decarbonization Options



McKinsey & Company (2018). Decarbonization of industrial sector: the next frontier

Tools for Decarbonizing Industry

1. Funded research and development
2. Government procurement
 - Buy Clean California
3. Fiscal subsidies
 - Tax incentives, grants, loans
4. Infrastructure development
 - Renewable gas infrastructure, electricity transmission
5. Carbon pricing
6. Carbon tariffs
 - Border carbon adjustment
7. Mandates
 - Direct regulations
8. Voluntary industrial association
 - ISO 50001
9. Clean energy ministerial (Global forums and information sharing)

Innovation for a Cool Earth Forum, 2019. Industrial Heat Decarbonization Roadmap

CARB Industrial Sector Regulations

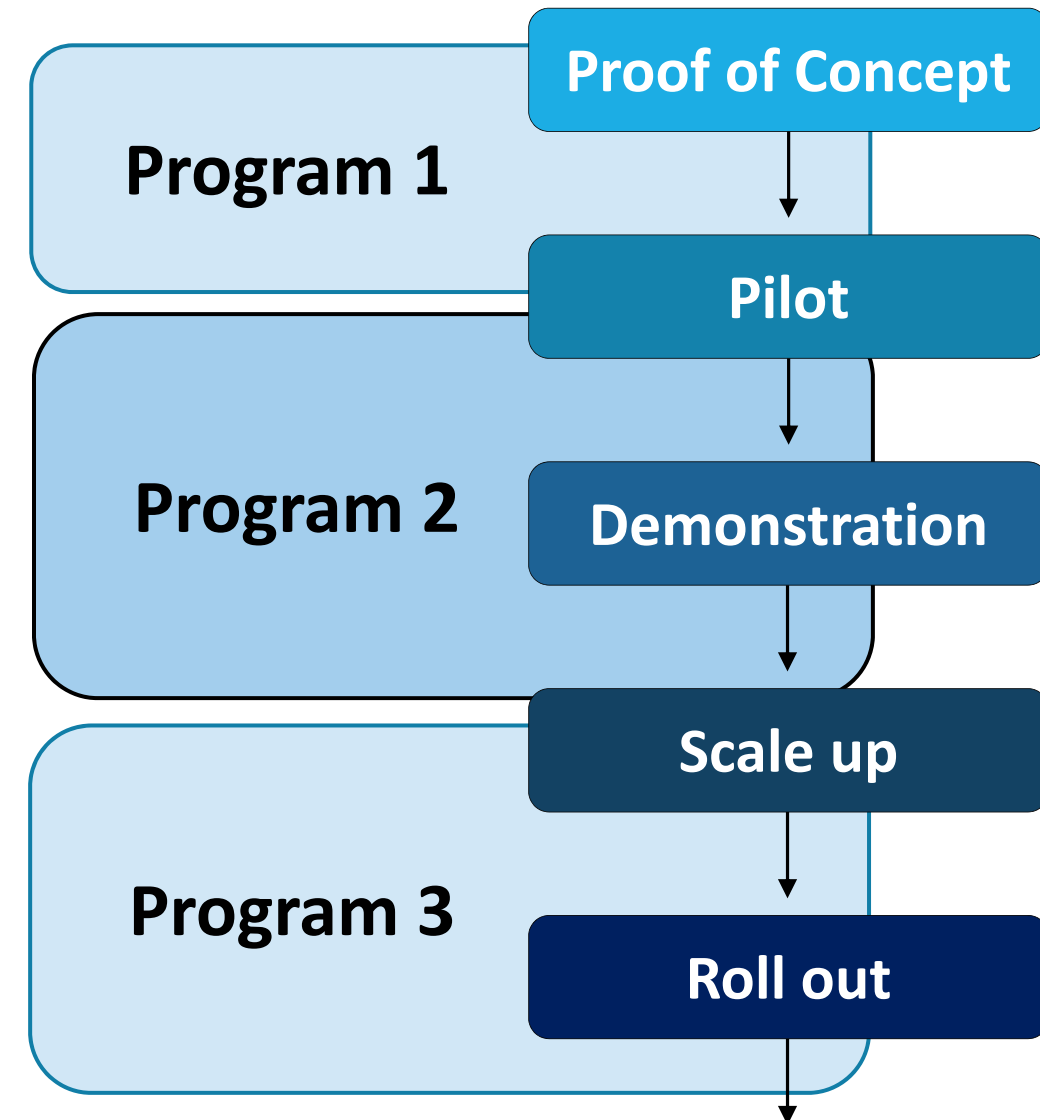
- Cap-and-Trade Regulation
 - Economy-wide carbon pricing
 - Incentivizes covered entities to reduce emissions through a steadily increasing price signal
- Low Carbon Fuel Standard Regulation
 - Reduce carbon intensity of transportation fuel pool
 - Incentivizes efficiency in the production of traditional fuels
- Oil and Gas Regulation
 - Reduces methane emissions from oil and gas production, processing, storage, and transmission
 - Requires regulated entities to limit intentional (vented) and unintentional (leaked or fugitive) emissions
- Regulation for Energy Efficiency and Co-Benefits Assessment of Large Industrial Facilities

California Incentive Mechanisms

- Cap-and-Trade Program industrial allowance allocation incentivizes more efficient production
- California Climate Investments (CCI)
 - Food Processor Investment Program
- Utility programs to reduce industrial GHG emissions
- Refinery Investment Credit Program within Low Carbon Fuel Standard (LCFS)
 - Provides LCFS credits for GHG reductions at refineries that lower carbon intensities of CARBOB and diesel

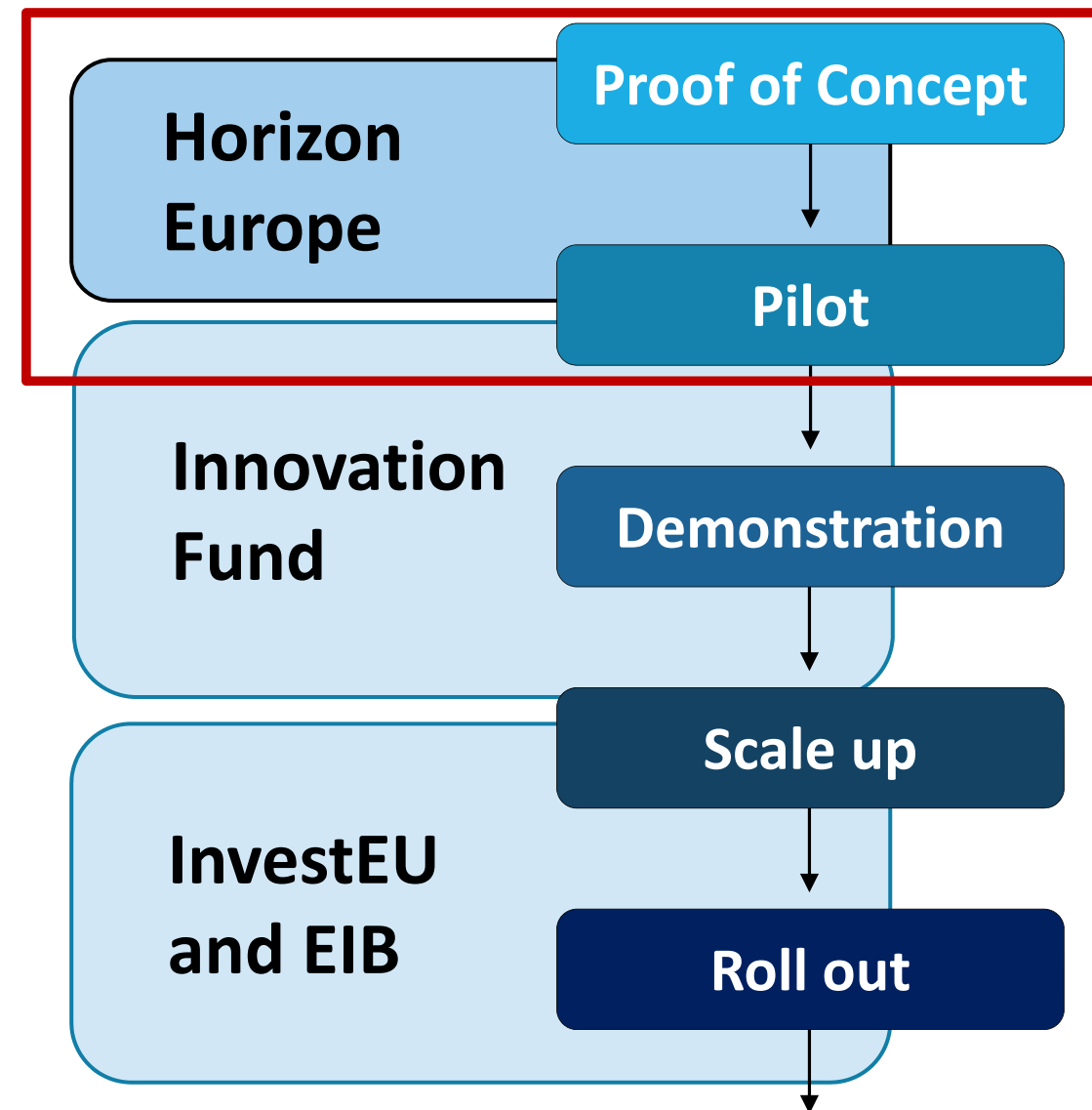
Other Programs Incentivizing Industrial Sector GHG Reduction

- European Union
- Canada
- New Zealand
- Australia
- Tokyo



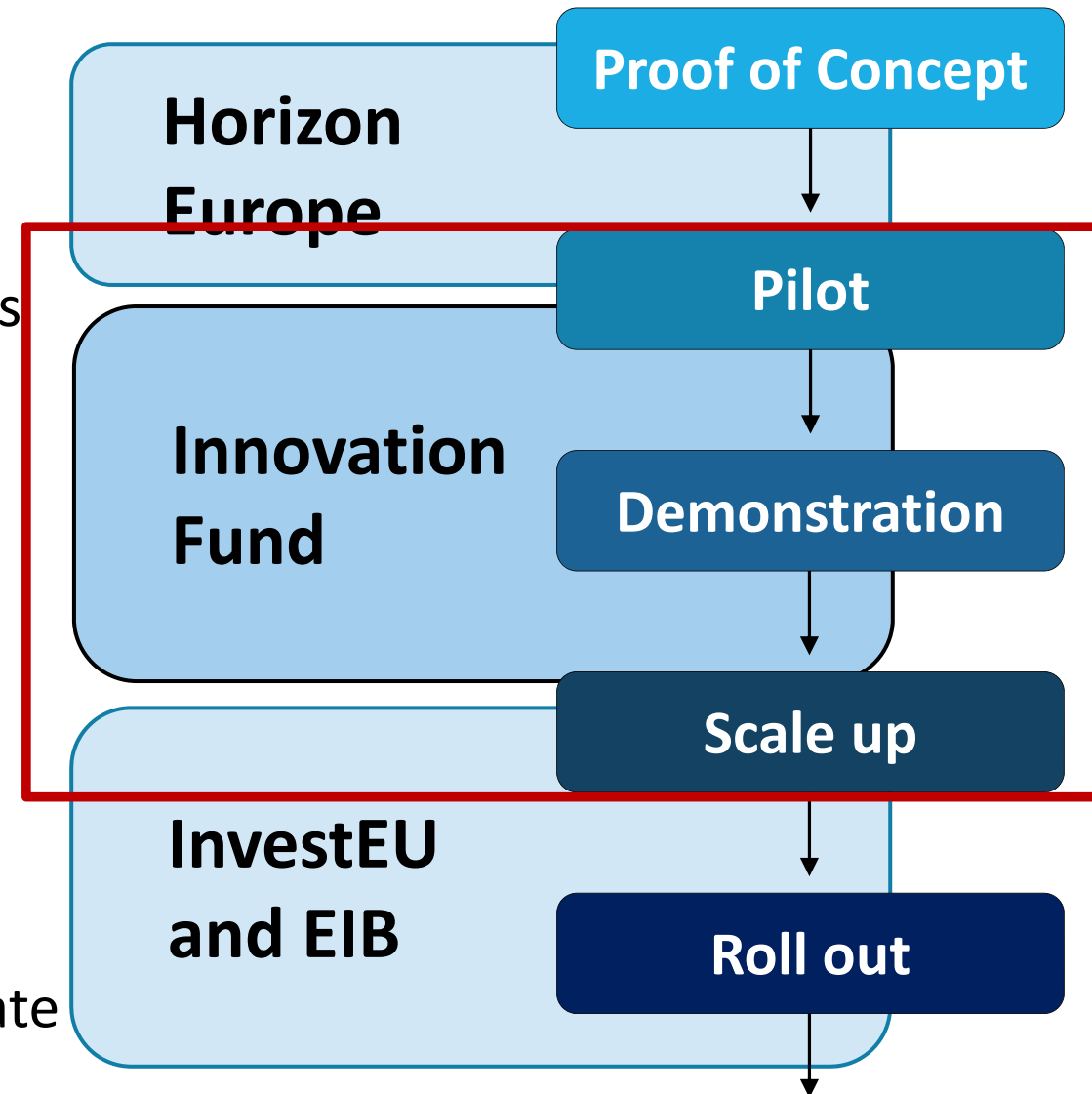
European Union (1 of 3)

- Horizon2020 (2014-2020) budget of €77 billion
 - €17 billion for advancing industry
 - Faster funding compared with prior programs
 - Interim evaluation
- Horizon Europe (2021-2027) program targets
 - Research and development
 - Proof of concept projects
- Funded Heidelberg Cement plant
 - Oxyfueled kiln with flue gas recirculation
 - €12 million from Horizon Europe
 - Created public/private working group for future low carbon cement initiatives



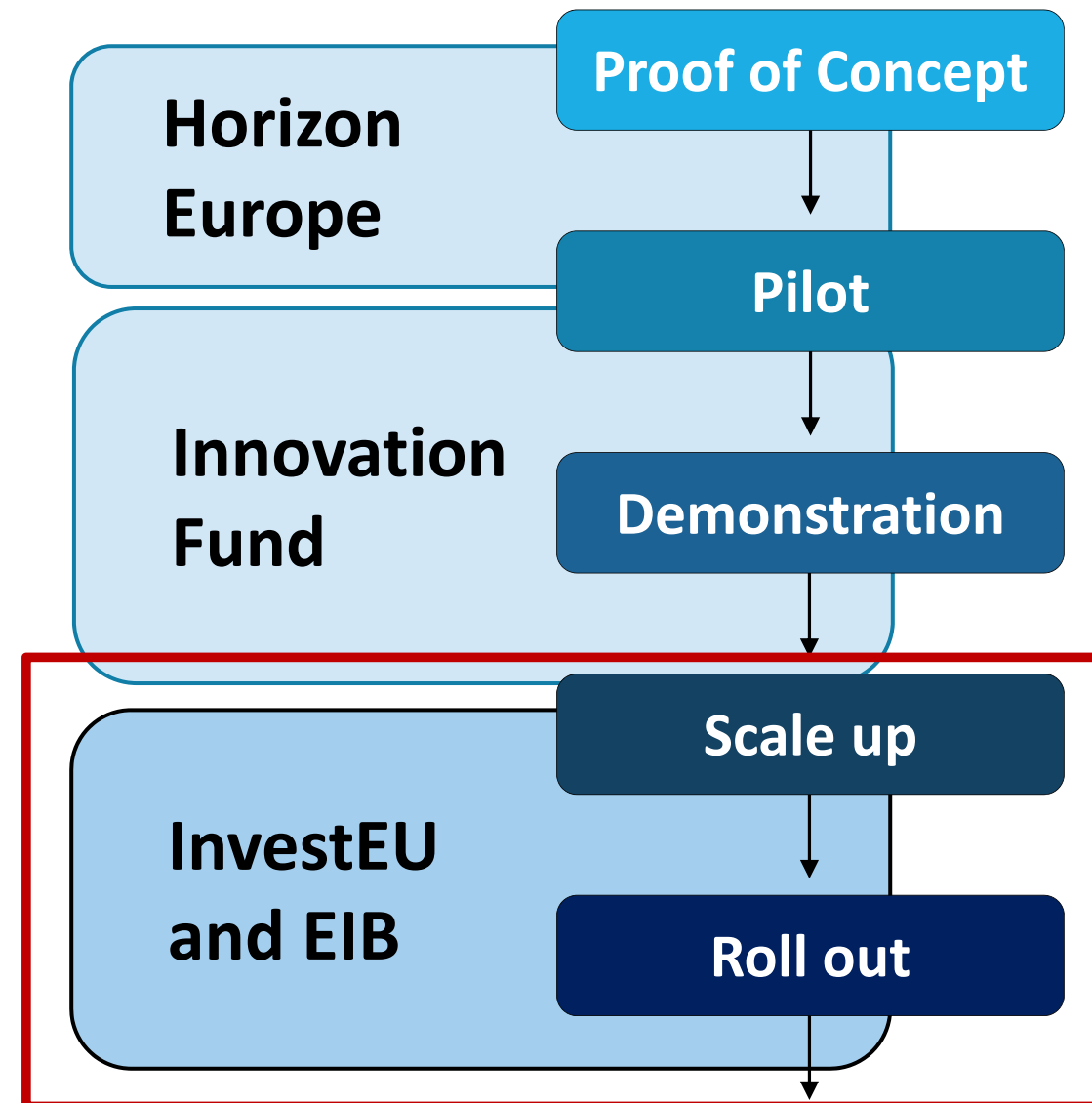
European Union (2 of 3)

- **NER300 (2013 to 2020)**
 - €2.1B from 2010-2012 auction of 300 million EU ETS allowances
 - EITE projects limited to biofuel and CCS in certain sectors
 - No EU payment until project operational
- **Funded Vercelli cellulosic ethanol plant**
 - First-of-kind cellulosic ethanol production (€28M)
- **Stakeholder feedback on post-2020 design**
- **Innovation Fund (2021 to 2030)**
 - Auction ~425 million EU ETS allowances (~ €10B)
 - All EITE low-carbon technologies allowable, earlier payment based on milestones, higher EU contribution rate



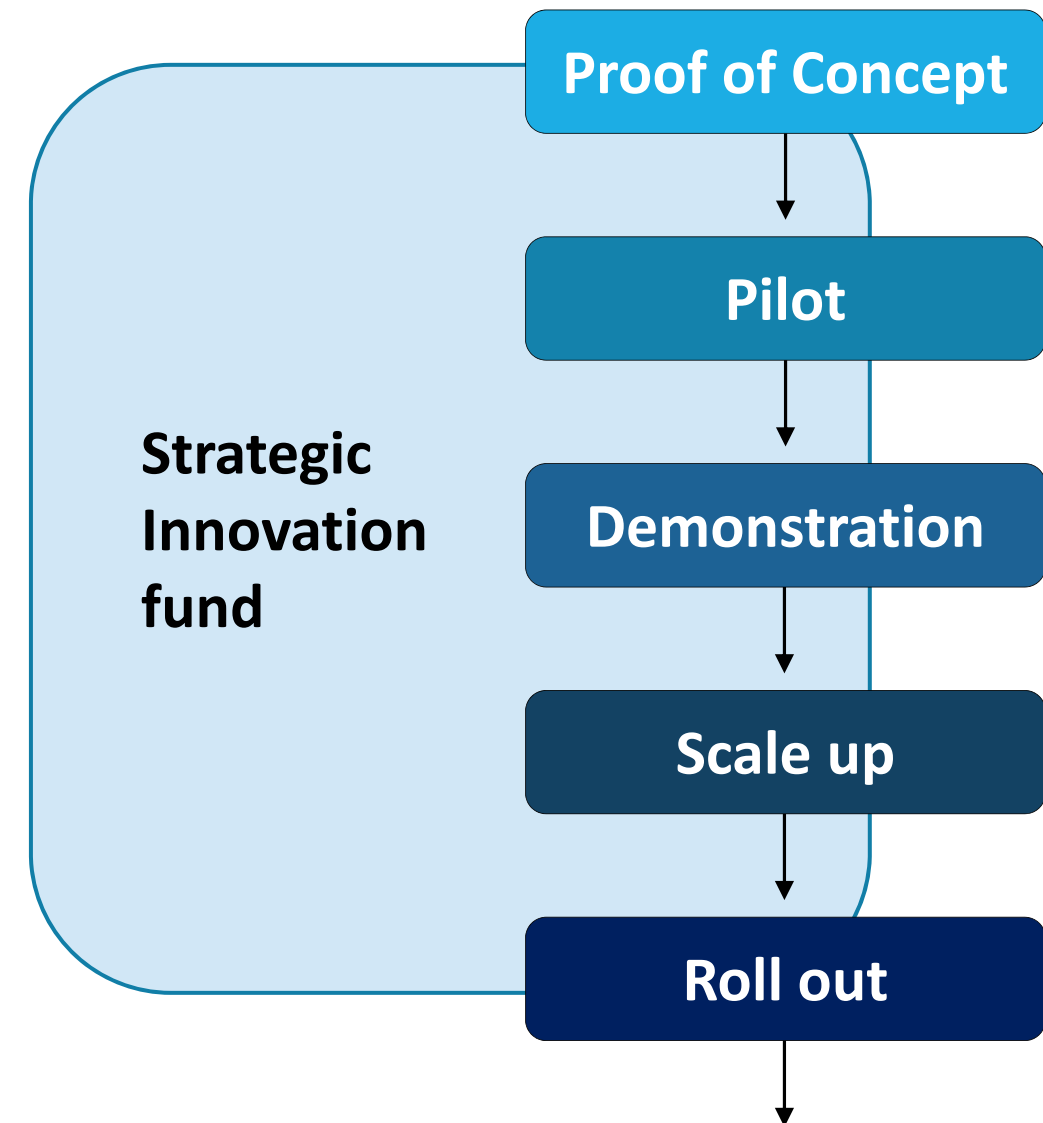
European Union (3 of 3)

- InvestEU
 - Loan guarantee to high risk projects for low carbon technologies
 - Stimulates private capital at lower interest rate
- European Investment Bank (EIB) Financing
 - Any mature technology
 - Subsidized loan rates
- Programs funded Äänekoski bio-product mill
 - Converts wood to chemicals; electricity producer
 - €1.2 billion cost
 - €275 million EIB loan; €75 InvestEU loan guarantee



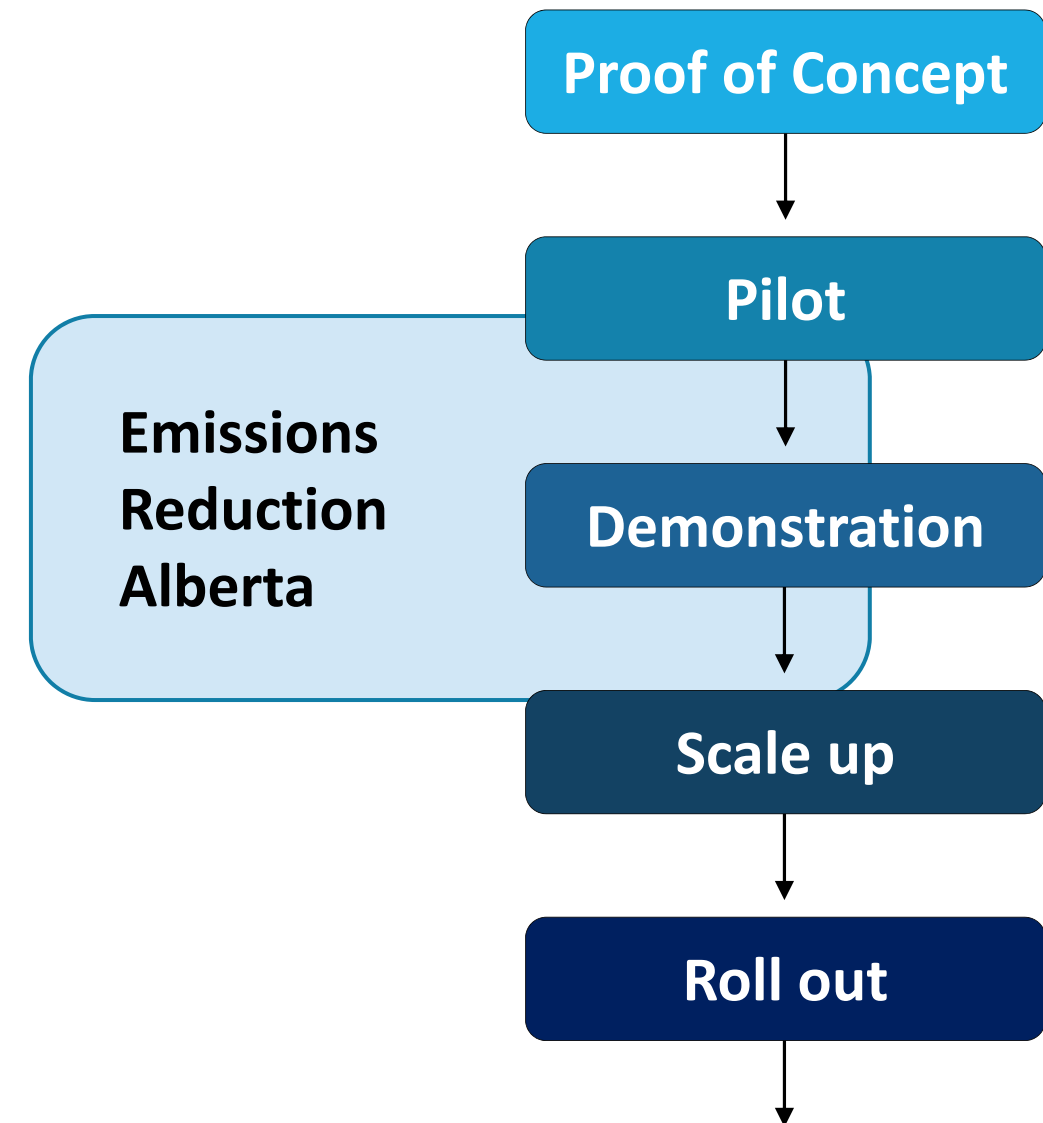
Canada (1 of 3)

- Strategic Innovation Fund (2017 – Current)
 - Five streams of funding for large projects (\$10-50M (CAD) requested contribution)
 - Contribution is determined by review committee: non-repayable grant, government loan, or both
 - \$250M for the steel and aluminum sector for growth and expansion
 - Since 2017, 64 projects announced; \$2B in funding; \$43B total investment leveraged; 67k jobs created



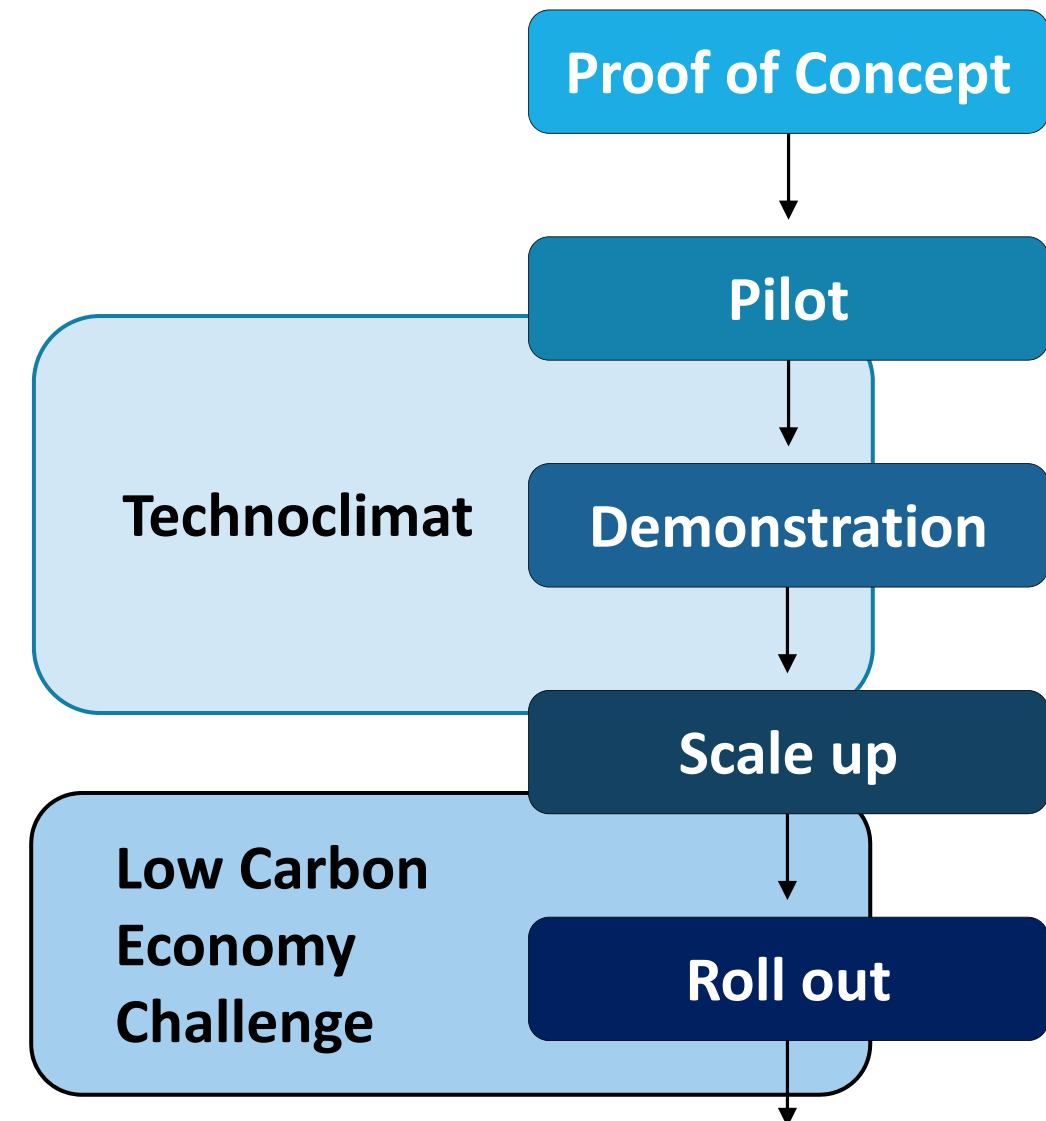
Canada (2 of 3)

- Emissions Reduction Alberta program (2009 – Current)
 - Call-for proposal based on targeted themes (Methane Challenge (2017) and Industry Efficiency Challenge (2019))
 - Funds and terms depend on opportunity
 - Two part application process: Expression of Interest and Full Project Proposal
 - To date: \$565M (CAD) funding 165 projects
- CleanBC Industry Fund (2020)
 - Reinvests a portion of carbon tax revenues to reduce emissions of covered industrial emissions.



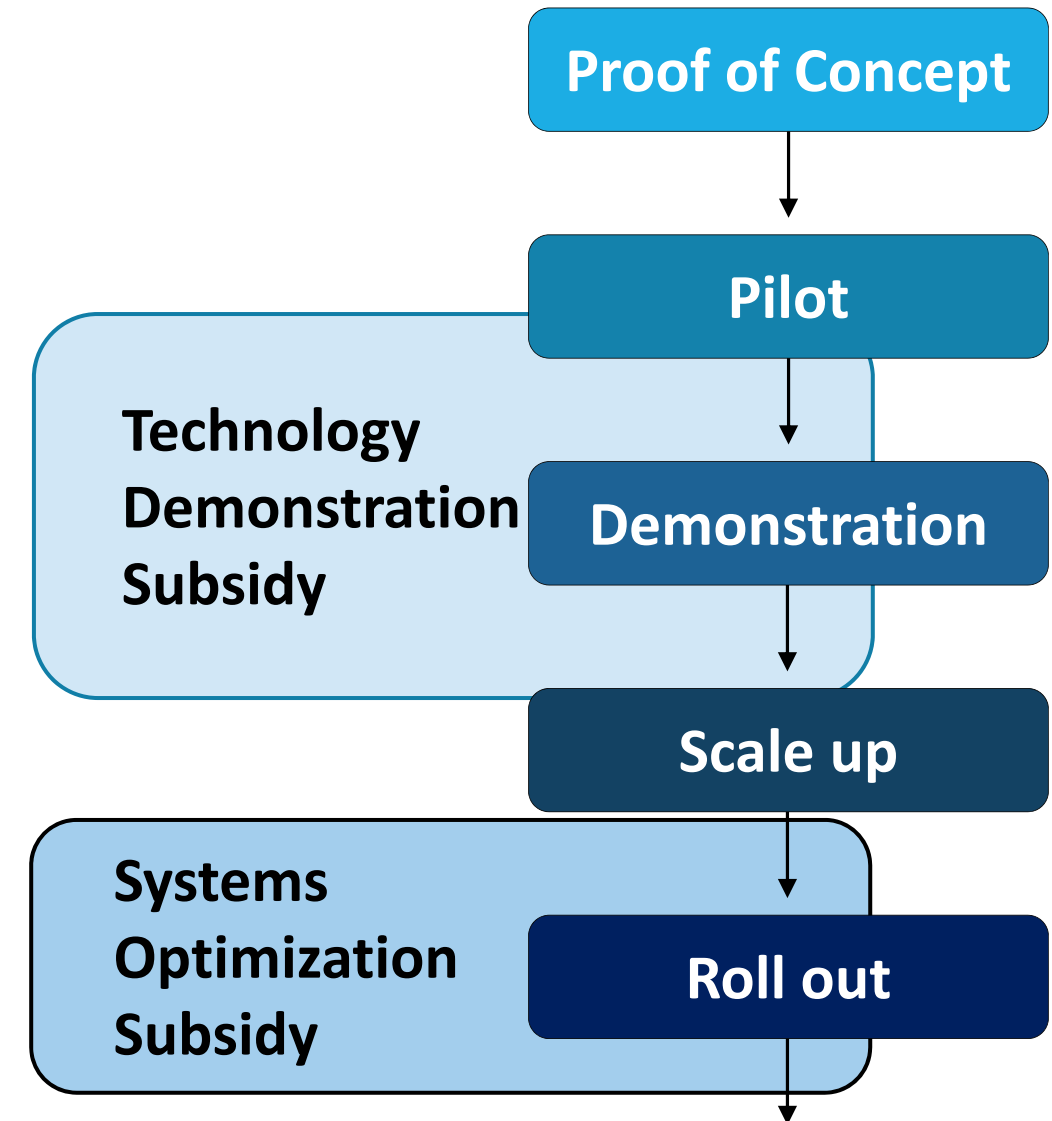
Canada (3 of 3)

- **Technoclimat (2019)**
 - Eligible only to industry covered by Cap-and-Trade
 - Grants up to \$3M, maximum 50% eligible expenses
- **Low Carbon Economy Challenge (2019)**
 - Wide range of sectors eligible
 - Proposals evaluated on risk and feasibility, cumulative GHG reduced per federal dollar invested; other co-benefits
 - \$20,000 – \$250,000, up to 25% of the total eligible expenses



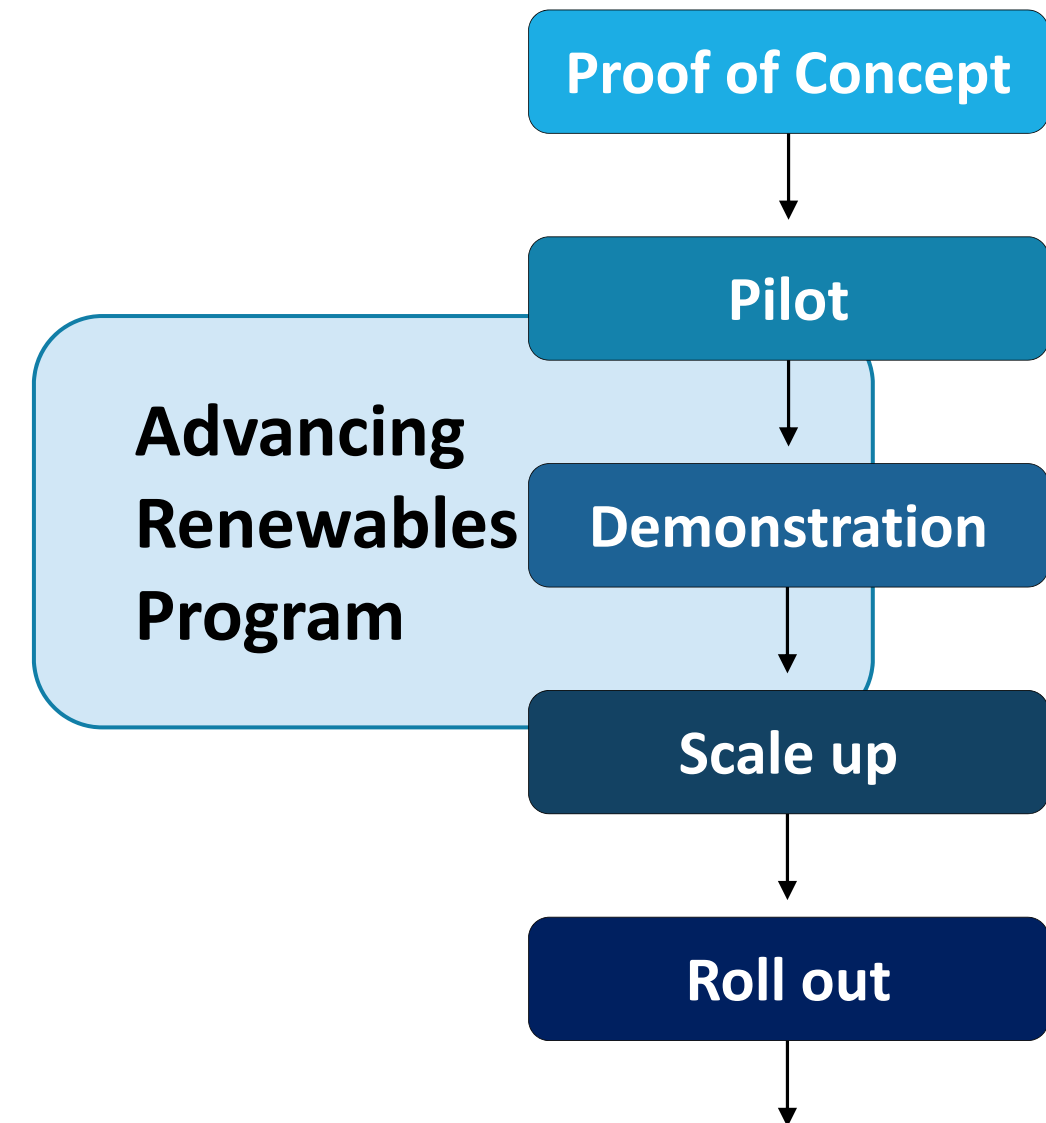
New Zealand

- Energy Efficiency and Conservation Authority (EECA): Technology Demonstration Subsidy
 - Supports implementing underutilized technologies and process improvements
 - Funds up to 40% of total project costs up to a maximum of \$250,000 (NZ)
 - Ex: An installed milk snap chilling system led to 30% savings and widespread adoption after demonstration
- EECA Systems Optimization Subsidy
 - Provides for certified independent consultants to optimize systems, including process heat, motors, plant heat, compressed air, refrigeration, and HVAC systems
 - Funds up to 40% of costs up to a maximum of \$100,000



Australia

- Australian Renewable Energy Agency (ARENA): Advancing Renewables Program
 - Supports a broad range of development, demonstration, and pre-commercial projects for renewable energy
 - Grants will be between \$100,000 and \$50 million (AUD), with applicants expected to at least match the funding
 - Information-sharing requirement
 - Ex: A fuel-switching project at a canola oil plant replaced LPG boilers with a 5 MW biomass boiler that combusts locally sourced timber residue and led to ~80,000 MTCO₂e in emission reductions over the project life. This \$5.4M project was funded with \$2M from ARENA

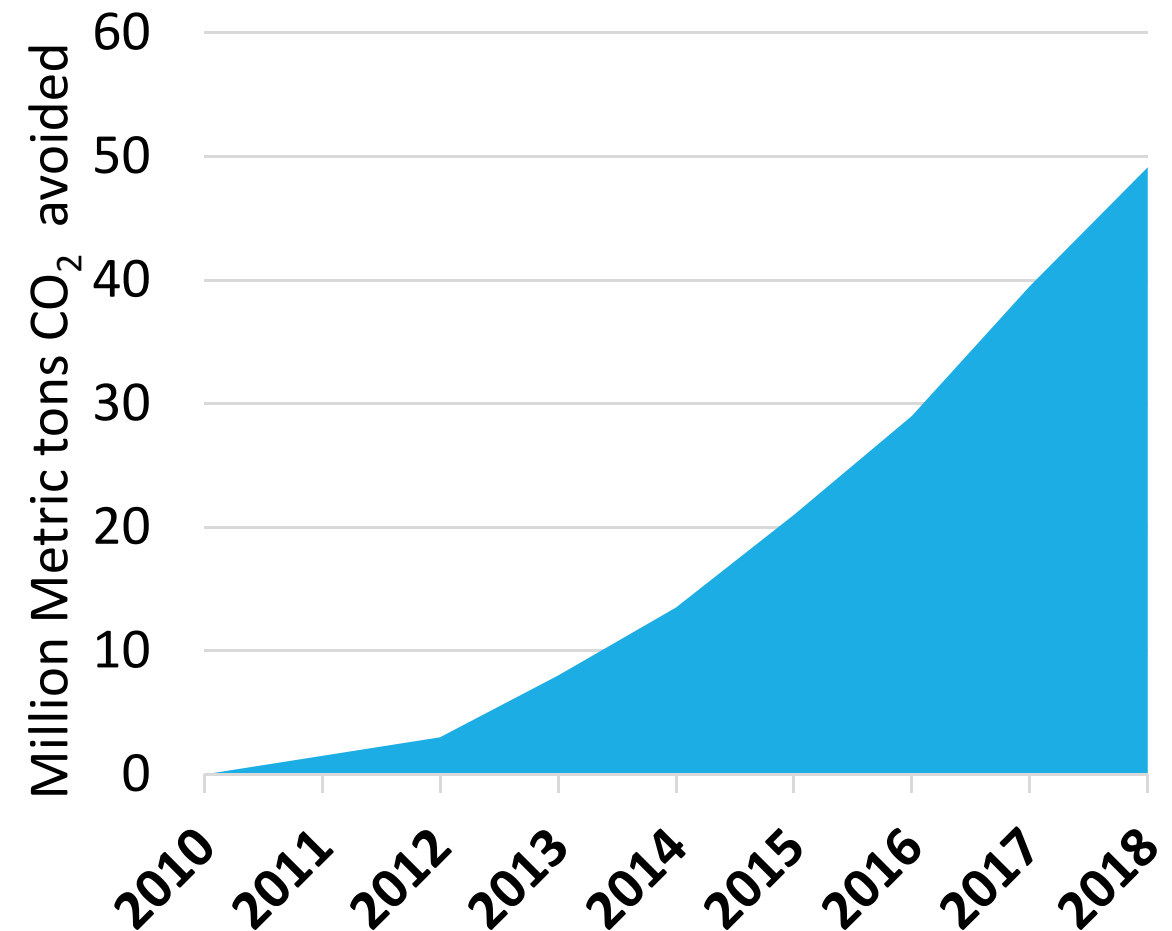


U.S. Loan Programs

- U.S. Department of Energy (DOE) Loans and Loan Guarantee Program
 - Provide debt and loan guarantees to support purchasing advanced vehicles and low-carbon energy
 - Payments exceeded losses by 3 to 1 (as of 2018)
 - Estimated 50 million MT CO₂ avoided (to 2018)

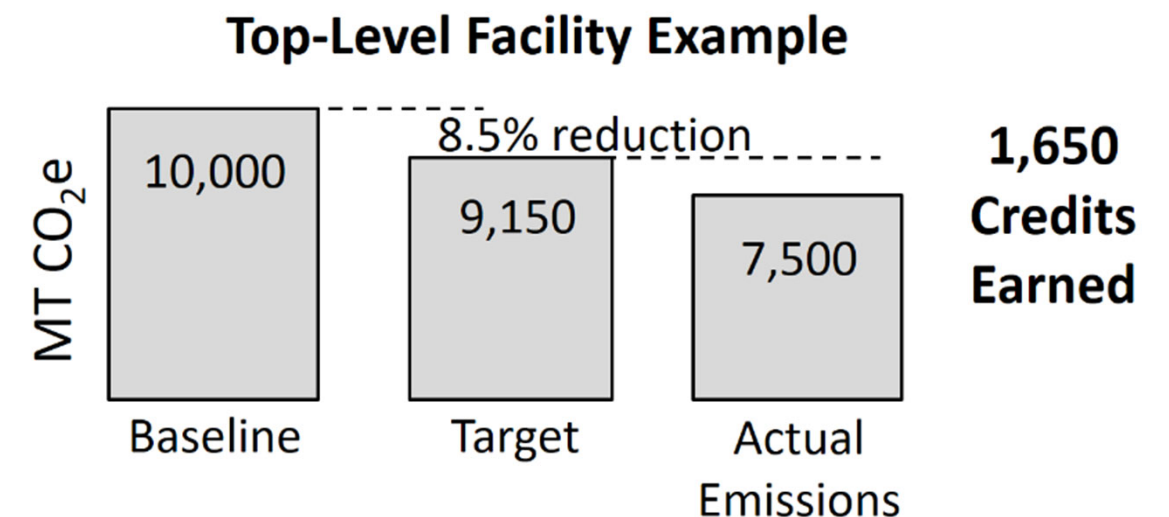
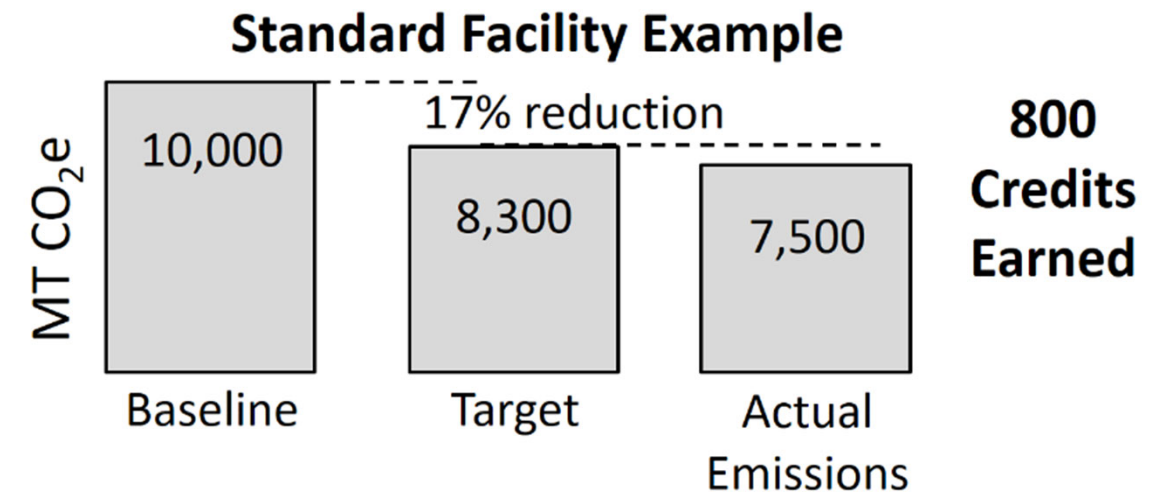
“The [U.S. DOE] loan guarantee program has been successful in bringing to market good projects with good credit support that absolutely would not have been built.”

- **NRG Energy, Inc.**



Tokyo

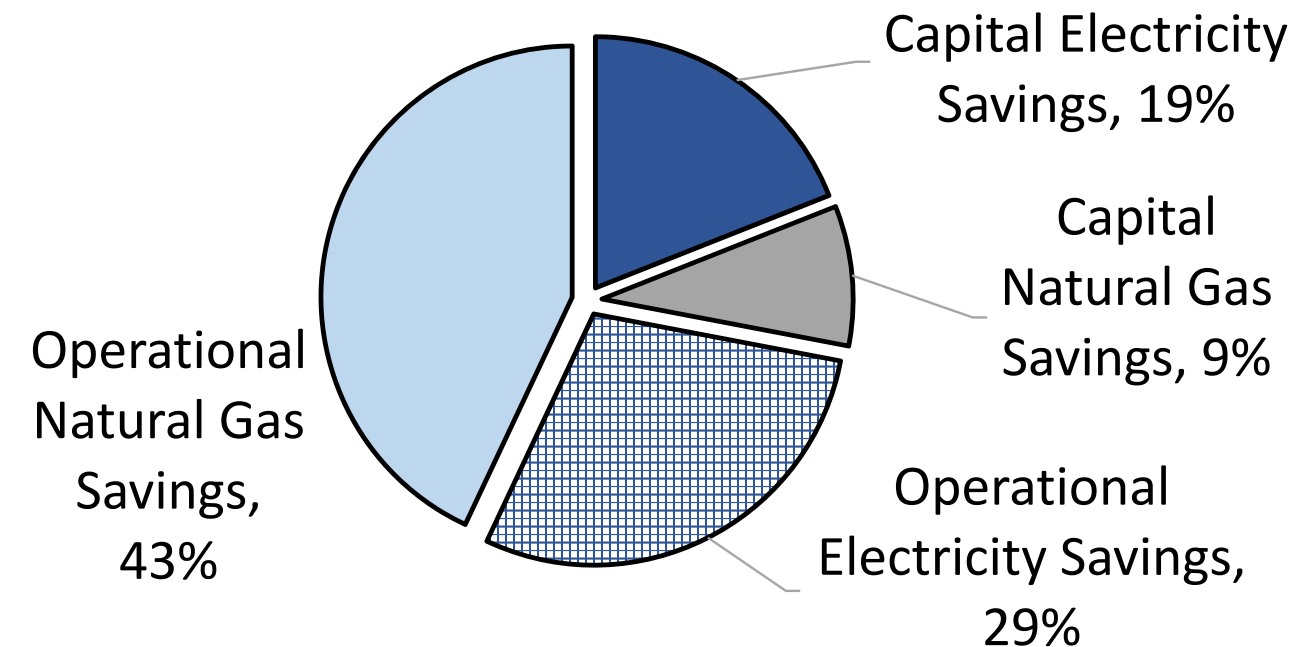
- **Top-Level Facility Certification**
 - Decreases stringency of facility's emissions target
 - Requires implementation of several hundred energy saving measures
 - Stringency is reduced by 50% for top-level facilities and 25% for near-top-level facilities
 - For the same level of actual emission reductions, more credits are earned with a lower stringency emission target
 - 66 facilities were top-level certified as of 2017



Energy Management Standard

- International Energy Management Standard (ISO 50001) Adoption
 - Framework for energy performance improvement, but does not prescribe improvement goals
 - Over 40,000 sites worldwide are ISO 50001 certified, with over 80% in Europe
 - Several jurisdictions provide financial incentives
 - U.S. DOE recognizes ISO 50001 standards under its Superior Energy Performance (SEP) program, but provides no financial incentives
 - Example: 13 certified 3M sites collectively improved energy performance 4.2% from 2016 to 2018, reducing emissions by more than 165,600 MT CO₂e over that period.

3M savings breakdown from implementing ISO 50001 at 5 facilities



Summary of Programs Incentivizing Industrial Sector GHG Reductions

- Growth in carbon-pricing systems worldwide
- Grants, loans, loan guarantees, energy management standards
 - Technology improvements
 - Fuel-switching
 - Energy efficiency
- Incentive provisions within carbon-pricing programs
 - Credit generation within Tokyo cap-and-trade system
 - Crediting mechanisms within California's Low Carbon Fuel Standard
- Wide range of programs in terms of scope, size, process, and requirements

Potential Additional Tools for California's Industrial Sector

- Use Cap-and-Trade Program allowance value to further incentivize industrial emissions reductions
 - Set aside a pool of allowances that would be available to industrial facilities for technology upgrades based on applications to CARB, reported emissions data, or some other approach. Example concept: March 2009 - Recognizing and Crediting Early Action in a California Cap-and-Trade Market available online at:
<https://ww3.arb.ca.gov/cc/capandtrade/meetings/031009/presentation.pdf>
 - Set aside a pool of allowances for natural gas suppliers to make renewable fuel use more cost-effective at industrial facilities and to promote decarbonizing the natural gas supply. Example concept: Comments to CARB after April 2018 workshop available online at:
<https://www.arb.ca.gov/lispub/comm2/bccommlog.php?listname=ct-4-26-18-wkshp-ws>

Questions for Stakeholders

- What are your thoughts about the programs in other jurisdiction that were surveyed in this presentation? What elements of these programs might be worth considering for California?
- What other programs administered by CARB could be leveraged or adjusted to support further reductions in the industrial sector?
- What hurdles does California face for decarbonizing the industrial sector? How can CARB help overcome these hurdles?
- Please submit comments by 5:00 p.m. on Friday, March 6 at https://www.arb.ca.gov/lispub/comm2/bcsubform.php?listname=cn-industry-web-ws&comm_period=1

Resources

- CARB, 2017. California's 2017 Climate Change Scoping Plan: https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf
- IPCC, 2018. Global Warming of 1.5°C: <https://www.ipcc.ch/sr15/>
- USGCRP, 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: <https://nca2018.globalchange.gov/>
- McKinsey & Company, 2018. Decarbonization of industrial sector: the next frontier: <https://www.mckinsey.com/business-functions/sustainability/our-insights/how-industry-can-move-toward-a-low-carbon-future>
- Innovation for a Cool Earth Forum, 2019. Industrial Heat Decarbonization Roadmap: https://www.icef-forum.org/pdf2019/roadmap/ICEF_Roadmap_201912.pdf

Links to Programs in Other Jurisdictions

- Horizon2020: <https://ec.europa.eu/programmes/horizon2020/en> (Slide 16)
- Innovation Fund: https://ec.europa.eu/clima/policies/innovation-fund_en (Slide 17)
- InvestEU: https://europa.eu/investeu/home_en (Slide 18)
- Strategic Innovation Fund: <https://www.ic.gc.ca/eic/site/125.nsf/eng/home> (Slide 19)
- Emissions Reduction Alberta: <https://www.eralberta.ca/> (Slide 20)
- Technoclimat: <https://transitionenergetique.gouv.qc.ca/en/innovation/program/technoclimat> (Slide 21)
- Low Carbon Economy Challenge: <https://www.canada.ca/en/environment-climate-change/services/climate-change/low-carbon-economy-fund/challenge.html> (Slide 21)
- Technology Demonstration Subsidy: <https://www.eecabusiness.govt.nz/funding-and-support/technology-demonstration-projects/> (Slide 22)
- Systems Optimization Subsidy: <https://www.eecabusiness.govt.nz/funding-and-support/systems-optimisation/> (Slide 22)
- Advancing Renewables Program: <https://arena.gov.au/funding/advancing-renewables-program/> (Slide 23)
- Loans and Loan Guarantee Program: <https://www.energy.gov/lpo/loan-programs-office> (Slide 24)
- Top-Level Facility Certification: https://www.kankyo.metro.tokyo.lg.jp/en/climate/cap_and_trade/ (Slide 25)
- ISO 50001: <https://www.iso.org/iso-50001-energy-management.html> (Slide 26)

Thank You

- Climate Change Scoping Plan
 - <https://ww3.arb.ca.gov/cc/scopingplan/scopingplan.htm>
- Carbon Neutrality Workshops
 - <https://ww3.arb.ca.gov/cc/scopingplan/meetings/meetings.htm>