Low-carbon concrete beyond the use of SCMs

Innovative ways to reduce Embodied Carbon in Concrete

NRMCA Concrete Innovations - September 14, 2022
Cecile Roman - Innovation and Sustainability Manager - Holcim RMX US

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LAFARGE Holcim
Ambuja Cement Firestone Firestone Building Products
AGGREGATE INDUSTRIES ACC
disensa geocycle
Malarkey Roofing Products PRB

- Global leader in building materials and solutions
- Active on all continents in around 70 countries
- 72,000 employees
- Activities
  - Cement
  - Aggregates
  - **Ready-mix concrete**
  - Solutions & Products (Roofing, insulation…)
- Net Zero Climate Pledge with 2030 climate targets that are validated by the Science-Based Targets initiative (SBTi)
  - **60% of our R&D is for sustainability** (circular economy, CO2 reduction, CCUS, health and urban air quality)

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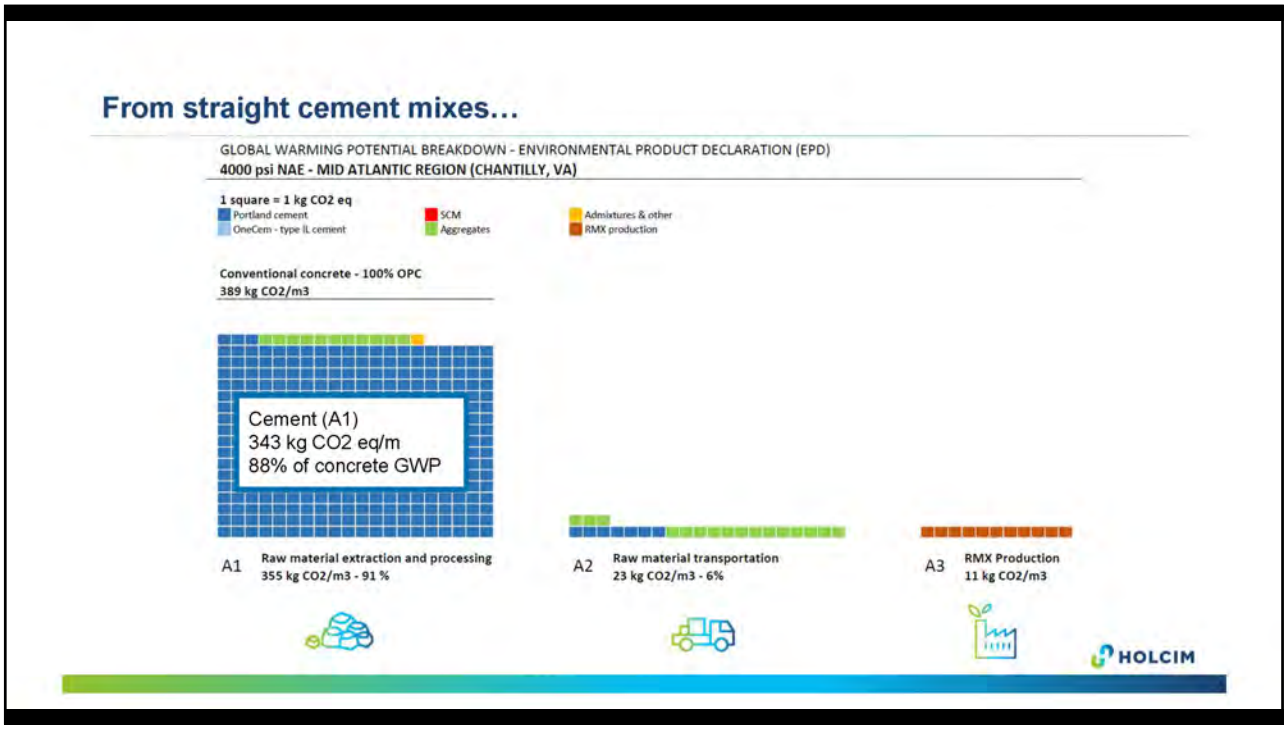
From straight cement mixes…
GLOBAL WARMING POTENTIAL BREAKDOWN - ENVIRONMENTAL PRODUCT DECLARATION (EPD)
4000 psi NAE - MID ATLANTIC REGION (CHANTILLY, VA)
1 square = 1 kg CO2 eq
Portland cement
OneCem - type IL cement
SCM
Aggregates
Admixtures & other
RMX production
Conventional concrete - 100% OPC
389 kg CO2/m3
Cement (A1)
343 kg CO2 eq/m
88% of concrete GWP
A1 Raw material extraction and processing
355 kg CO2/m3 - 91 %
A2 Raw material transportation
23 kg CO2/m3 - 6%
A3 RMX Production
11 kg CO2/m3
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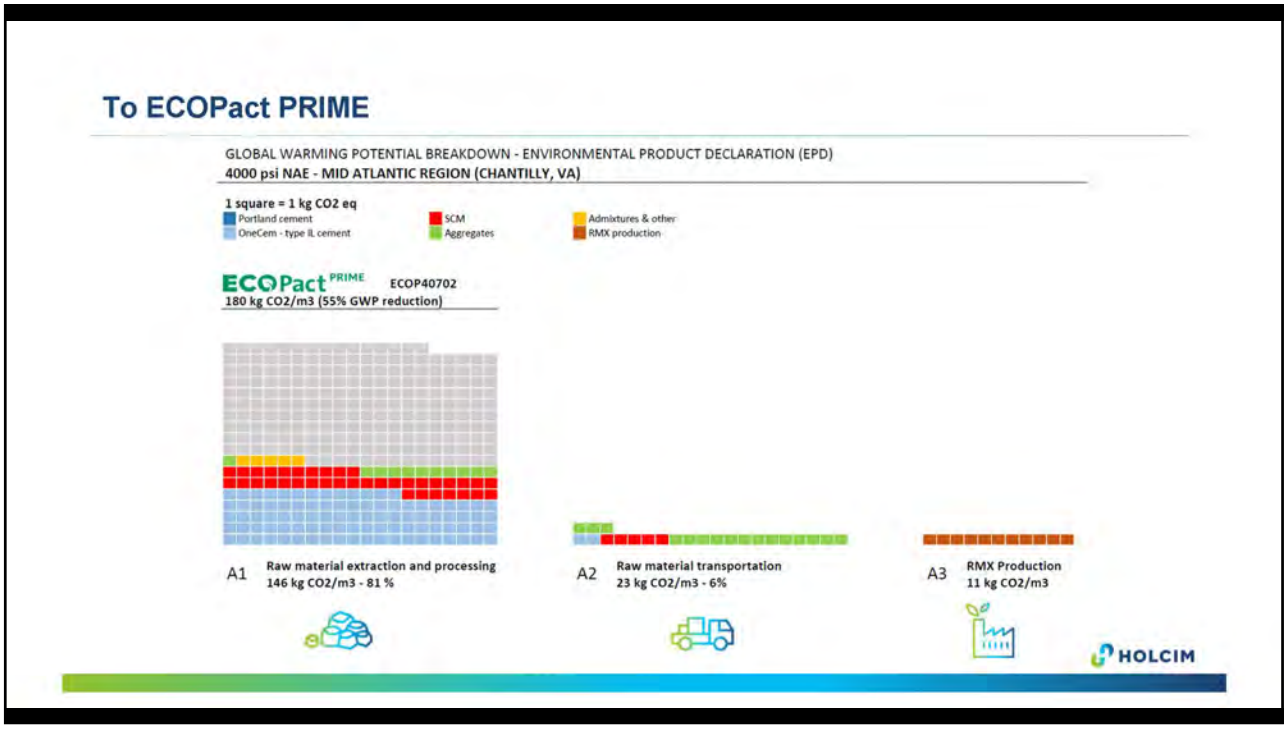
To ECOPact PRIME
GLOBAL WARMING POTENTIAL BREAKDOWN - ENVIRONMENTAL PRODUCT DECLARATION (EPD)
4000 psi NAE - MID ATLANTIC REGION (CHANTILLY, VA)
1 square = 1 kg CO2 eq
Portland cement
OneCem - type IL cement
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Aggregates
Admixtures & other
RMX production
ECOPact PRIME ECOP40702
180 kg CO2/m3 (55% GWP reduction)
A1 Raw material extraction and processing
146 kg CO2/m3 - 81 %
A2 Raw material transportation
23 kg CO2/m3 - 6%
A3 RMX Production
11 kg CO2/m3
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Tracking and reducing emissions at different scales

LCA/EPD - Product level

ECOPact
The Green Concrete

ENVIRONMENTAL IMPACTS

Declared Product:
Mix ECOS80504 • Fort Totten (DC) Plant
Description: 8000,ECOPACT, STANDARD PST NAE HRWR
Compressive strength: 8000 PSI at 28 days

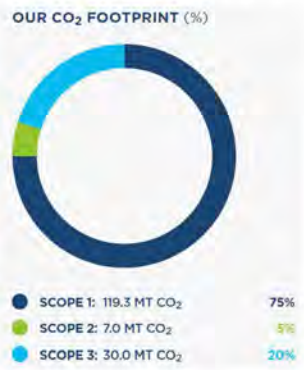
Declared Unit: 1 m³ of concrete

Global Warming Potential (kg CO_2-eq)	320
Ozone Depletion Potential (kg CFC-11-eq)	8.31E-6
Acidification Potential (kg SO_2-eq)	1.27
Eutrophication Potential (kg N-eq)	0.59
Photochemical Ozone Creation Potential (kg O_3-eq)	32.1
Abiotic Depletion, non-fossil (kg Sb-eq)	4.49E-5
Abiotic Depletion, fossil (MJ)	3.71E
Total Waste Disposed (kg)	4.37
Consumption of Freshwater (m³)	3.67

Product Components: crushed aggregate (ASTM C33), natural aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), admixture (ASTM C494), batch water (ASTM C1602)

Additional detail and impacts are reported on page three of this EPD.

GHG Protocol - Company level



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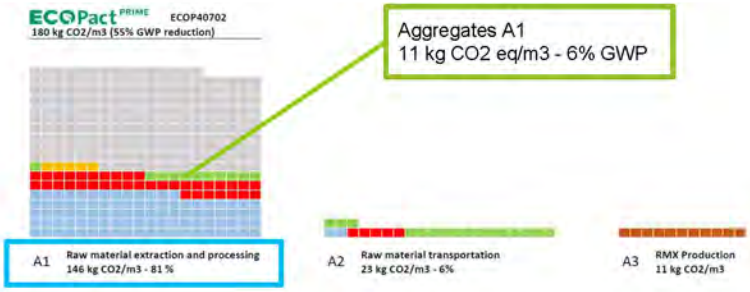
Lever 1 - Stage A1 - Using carbon storing materials

Reducing aggregate related environmental impacts

- Agg (coarse and fine) account for 15% of concrete embodied carbon (A1 & A2) in a low-carbon mix
- Virgin raw materials extraction
- CDW management issues



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Lever 1 - ECOPact Recarb
The concrete with captured CO2 - Switzerland

neustark

HOLCIM MAQER

- **Recycled concrete aggregates enriched with CO2**
- Permanent storage of biogenic CO2 into concrete
- Partnership with a Swiss startup, neustark, through our startup accelerator, **Holcim MAQER**

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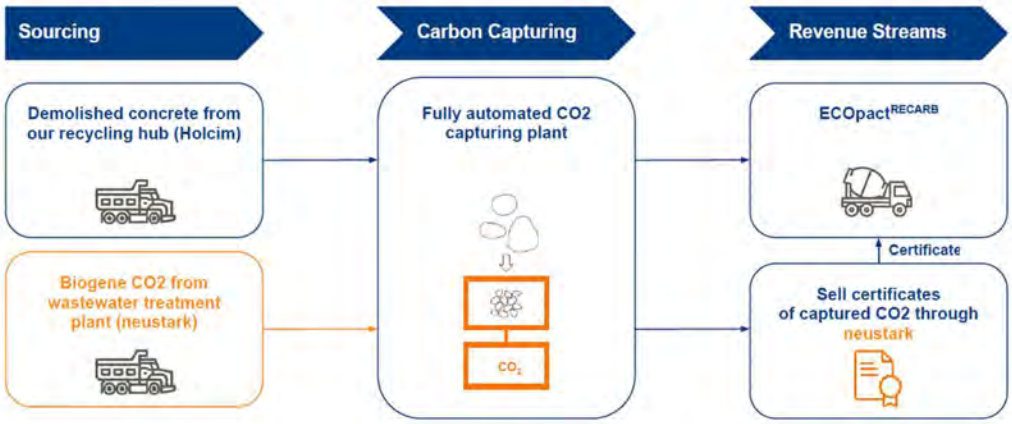
Lever 1 - ECOPact Recarb
How does it work



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Lever 1 - ECOPact Recarb
Pilot project

IMPLEMENTATION / CHALLENGES:

- Mineralized recycled aggregates used for a full scale project in Zug district in 2022
  - 5,500 cy (4,200 m3) of concrete with carbonated RCA
  - 1344 metric tons carbonated RCA
  - 40% of coarse agg. (specification)
- Onsite installation with 2 containers and a CO2 tank (minimal footprint)
  - 1 hour CO2 uptake for 15 m3 (36 metric tons)
  - Labor intensive
  - Available for any RMX plant

ENABLERS / SUCCESS FACTORS:

- Ready mix with carbonated recycled concrete aggregates prescribed in submission
- Holcim's ability to collect and process CDW in nearby facility
- Proven monitoring of the CO2 capture by startup partner Neustark

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Lever 1 - ECOPact Recarb
Benefits and next steps

OUTCOME / BENEFITS:

- 21 metric tons CO2 savings due to carbonation of recycled aggregates for the Zug project
- Minimum 5 kg CO2 eq stored by m3 of concrete
  - 6-15 kg CO2 eq/m3 stored in recycled aggregates depending on the recycled material properties
  - Additional CO2 savings up to 10% from ECOPact PRIME baseline
- Upcycling concrete in an efficient and profitable way
  - Circular economy

NEXT STEPS:

- In Switzerland, mobile installation, up and running in 1 day and fully automated
  - Adapted to existing RMX plant bins
  - Enrich 40,000 metric tons of recycled concrete aggregates annually (268 t CO2 permanently stored)
- Verify if and how cement content can be reduced due to mineralization and improved agg. performance
- In the US, similar solution with Blue Planet aggregates (CA)

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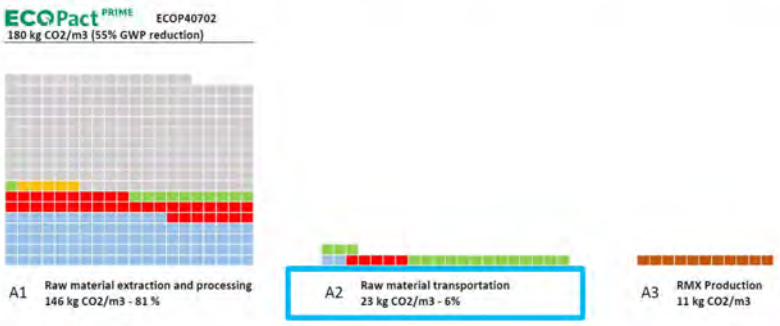
Lever 2 - Stage A2 - Reducing our transportation emissions

US Strategy:

- optimize asset utilization
- replace the existing energy sources to power our logistics assets with lower CO2 alternatives



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Lever 2 - Transitioning our fleet to cleaner energies
Our Journey in Texas

- **2021:**
  - Transitioned circa 50% of RMX deliveries to bio diesel
  - Assessment of other technologies for other transportation needs:
    - Electric Vehicles
    - Natural Gas and Renewable NG (from biogenic source)
    - Hydrogen
- **2022:**
  - Hyliion - Austin based startup:
    - First generation = Natural Gas (conventional/renewable) hybrid technology
    - Holcim committed to 10 build slots for Hypertruck ERX's (cement or aggregate transportation)
    - Expected delivery in 2023

Source: Hyliion

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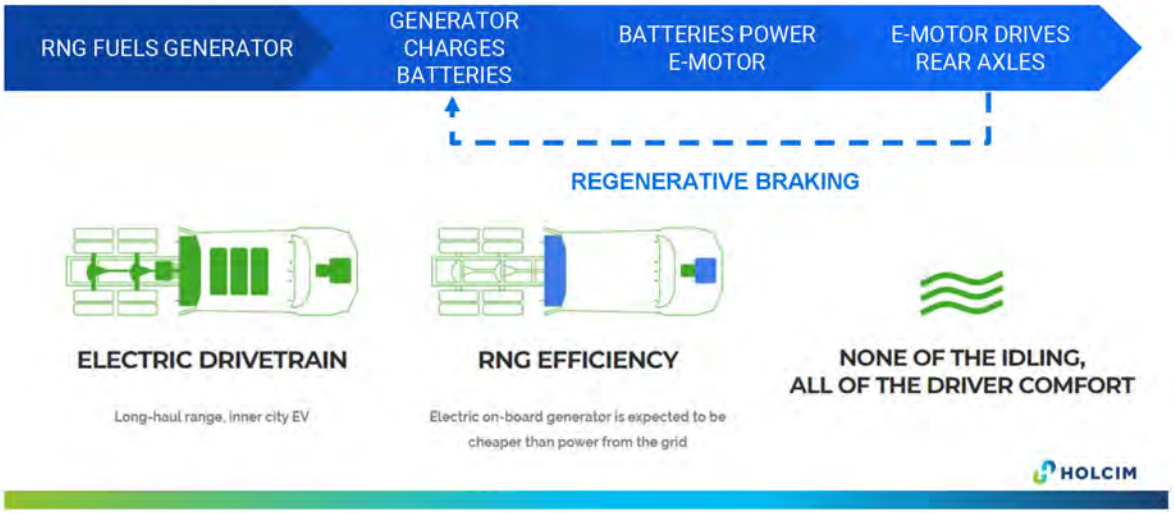
Lever 2 - Transitioning our fleet to cleaner energies
Hyliion First generation: Hypertruck ERX



Lever 2 - Transitioning our fleet to cleaner energies
Benefits and next steps

OUTCOME / BENEFITS:

- 30% CO2 savings compared to diesel - up to 100% if Renewable Natural Gas is available
  - From **7 to 20 kg CO2 eq saved per m3** of concrete (4 to 11% GWP)
- Savings on fleet operation costs (depending on diesel costs assumptions)
- Health and safety benefits for drivers (comfort) and communities (less noise and air pollution)

NEXT STEPS:

- Take delivery of Hyliion Hypertruck ERX, assess and deploy
  - Possible partnership with them on their next technologies (fuel agnostic trucks, hydrogen trucks)
- Take delivery of Tesla semi-tractors, assess and deploy
- Optimize network to reduce our transportation distances (ongoing data analysis - 2023)
  - Find EV alternatives for concrete mixers (some developed in Europe)
- Magment concrete technology: EV charging pavements

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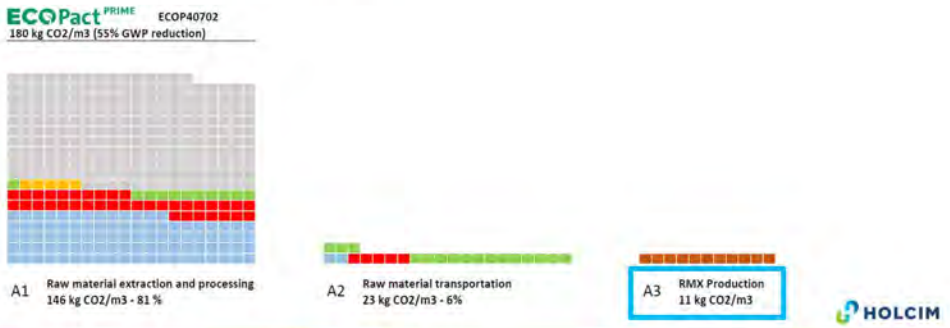
Lever 3 - Stage A3 - Switching our plants to solar energy

RMX plant Scope 2 emissions from electricity: range from 0.77 to 7.60 kg CO2 / m3

- ie 0.3 to 3% of total GWP

Decarbonization potential **with 50% solar energy**

- For 1 plant = up to 425 t CO2 eq/year
- Per m3 of concrete = up to 4 kg CO2 eq/m3



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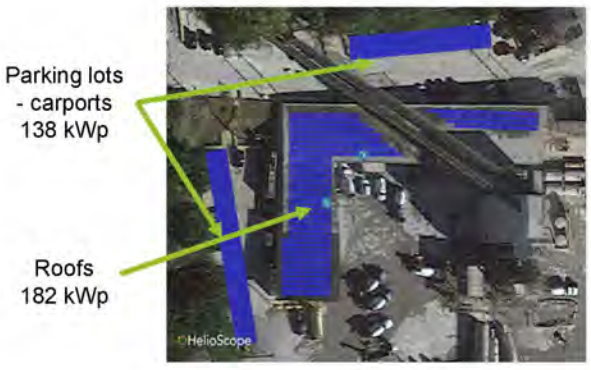
Lever 3 - Switching our plants to solar energy
Solar panel installation at a RMX plant in the Mid-Atlantic Region



Installed capacity = 320 kWp

Timeline:

- Feasibility study
- Interconnexion and permitting
- Installation and commissioning (Nov 22 to Mar 23)

Annual expected electricity generation:

- **30% of the plant's consumption**
- Slowly decreases over 20 years

CO2 savings:

- The PV system is powering our facility with solar electricity and reducing our carbon footprint

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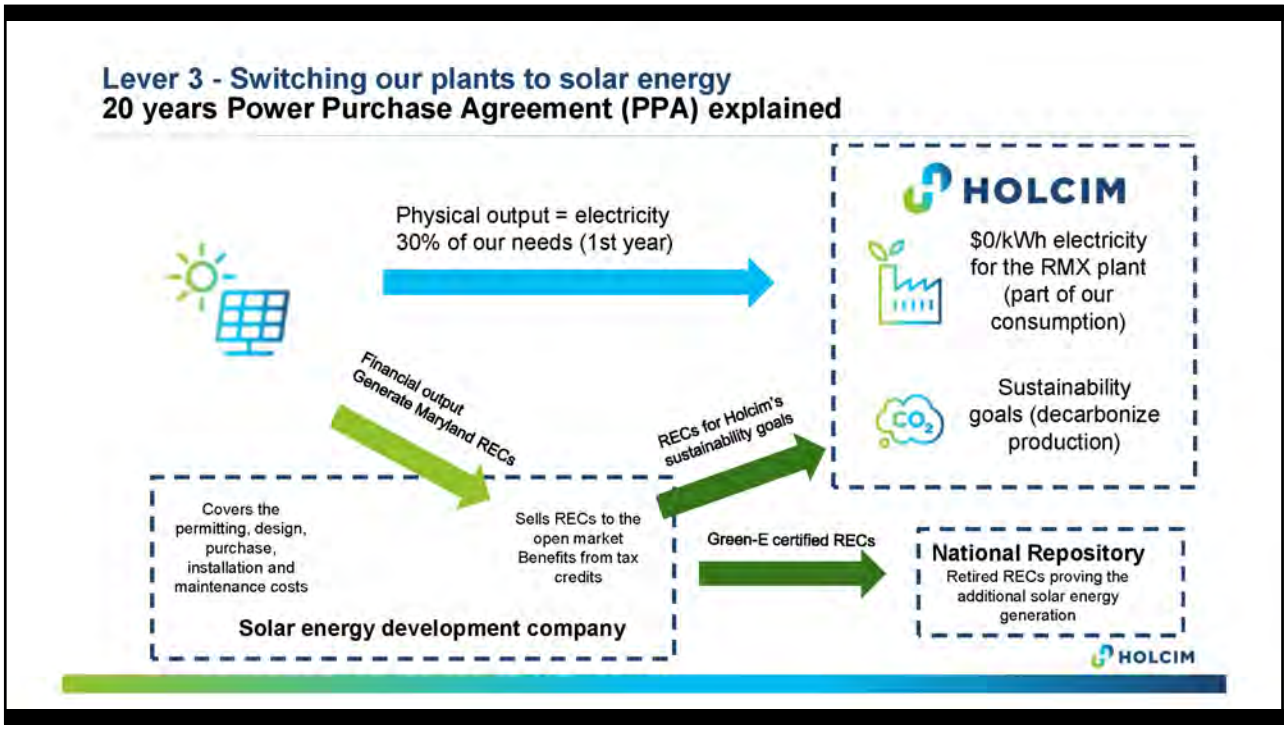
Lever 3 - Switching our plants to solar energy
20 years Power Purchase Agreement (PPA) explained
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Physical output = electricity
30% of our needs (1st year)
$0/kWh electricity for the RMX plant (part of our consumption)
Financial output
Generate Maryland RECs
RECs for Holcim's sustainability goals
Sustainability goals (decarbonize production)
Covers the permitting, design, purchase, installation and maintenance costs
Sells RECs to the open market
Benefits from tax credits
Green-E certified RECs
National Repository
Retired RECs proving the additional solar energy generation
Solar energy development company
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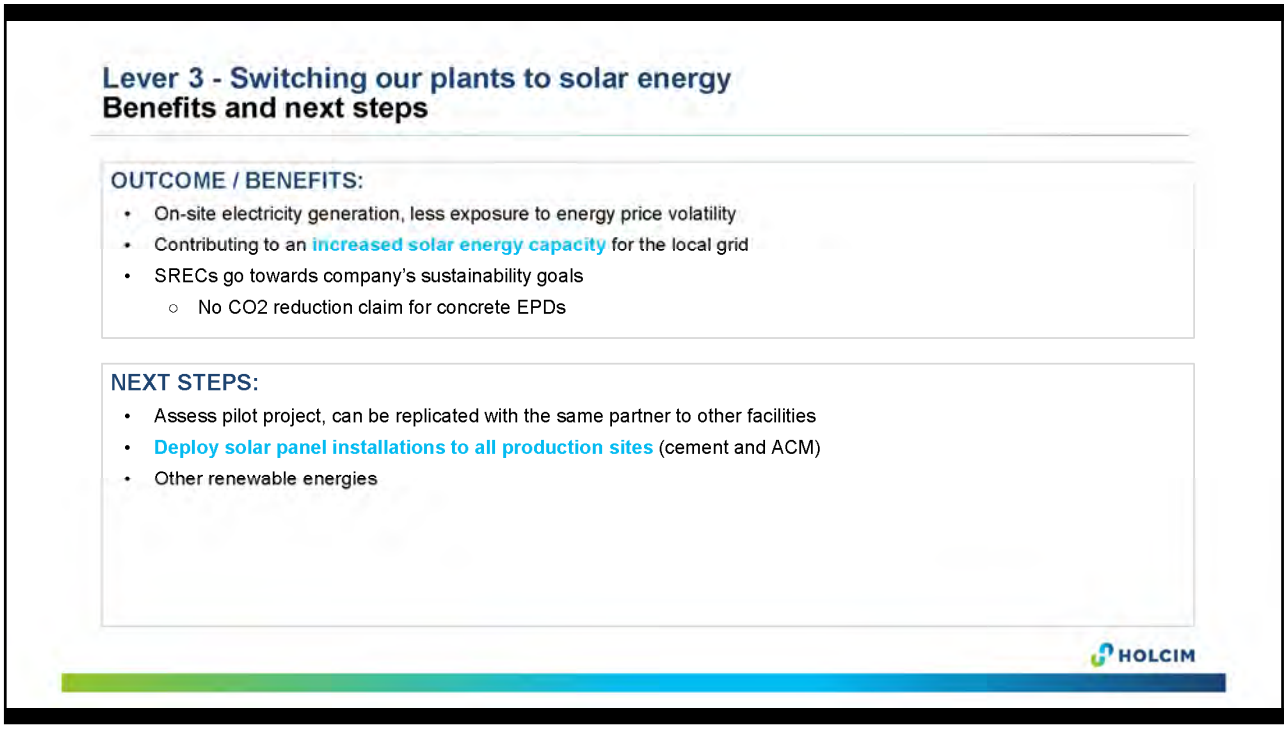
Lever 3 - Switching our plants to solar energy
Benefits and next steps
OUTCOME / BENEFITS:
On-site electricity generation, less exposure to energy price volatility
Contributing to an increased solar energy capacity for the local grid
SRECs go towards company's sustainability goals
No CO2 reduction claim for concrete EPDs
NEXT STEPS:
Assess pilot project, can be replicated with the same partner to other facilities
Deploy solar panel installations to all production sites (cement and ACM)
Other renewable energies
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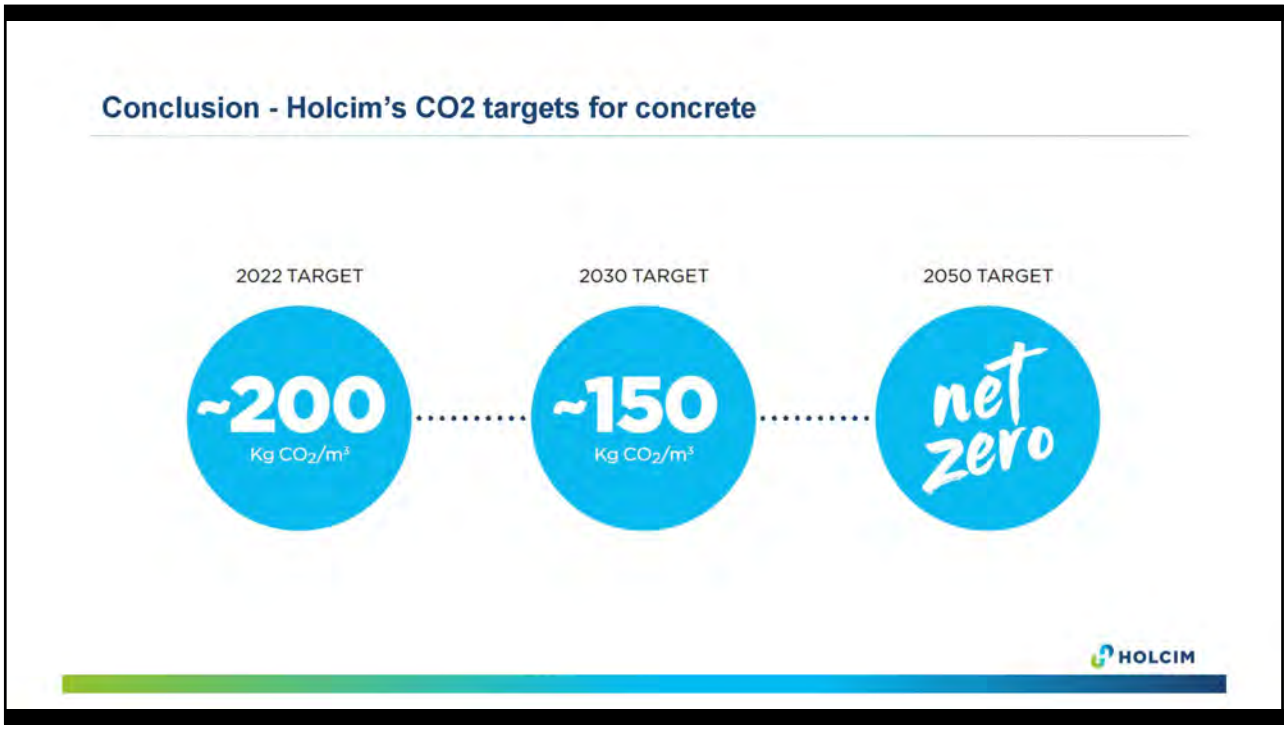
Conclusion - Holcim's CO2 targets for concrete
2022 TARGET
~200
Kg CO2/m3
2030 TARGET
~150
Kg CO2/m3
2050 TARGET
net zero
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Cecile Roman, RMX Innovation and Sustainability Manager, Holcim US
cecile.roman@holcim.com
https://www.holcim.us/ecopact