Meta's Road to Net Zero:
How Artificial Intelligence Can Be Leveraged by Project Teams to Scale Use of Low Carbon Concrete

ACI Convention, San Francisco
04/04/2023

Meta OZINGA Mortenson construction STŌK

Agenda

1. Net Zero Goals
2. Pilot Execution, Tracking & Results
3. Lessons Learned
4. Future of Low Carbon Concrete
5. Q&A

Meta Goal: Net Zero in 2030

Net Zero Emissions for Meta’s value chain

Data Center Design/Construction Net Zero Focus Areas

Construction Fuel

Exploring opportunities for electrification and reduced energy usage

Materials and Equipment

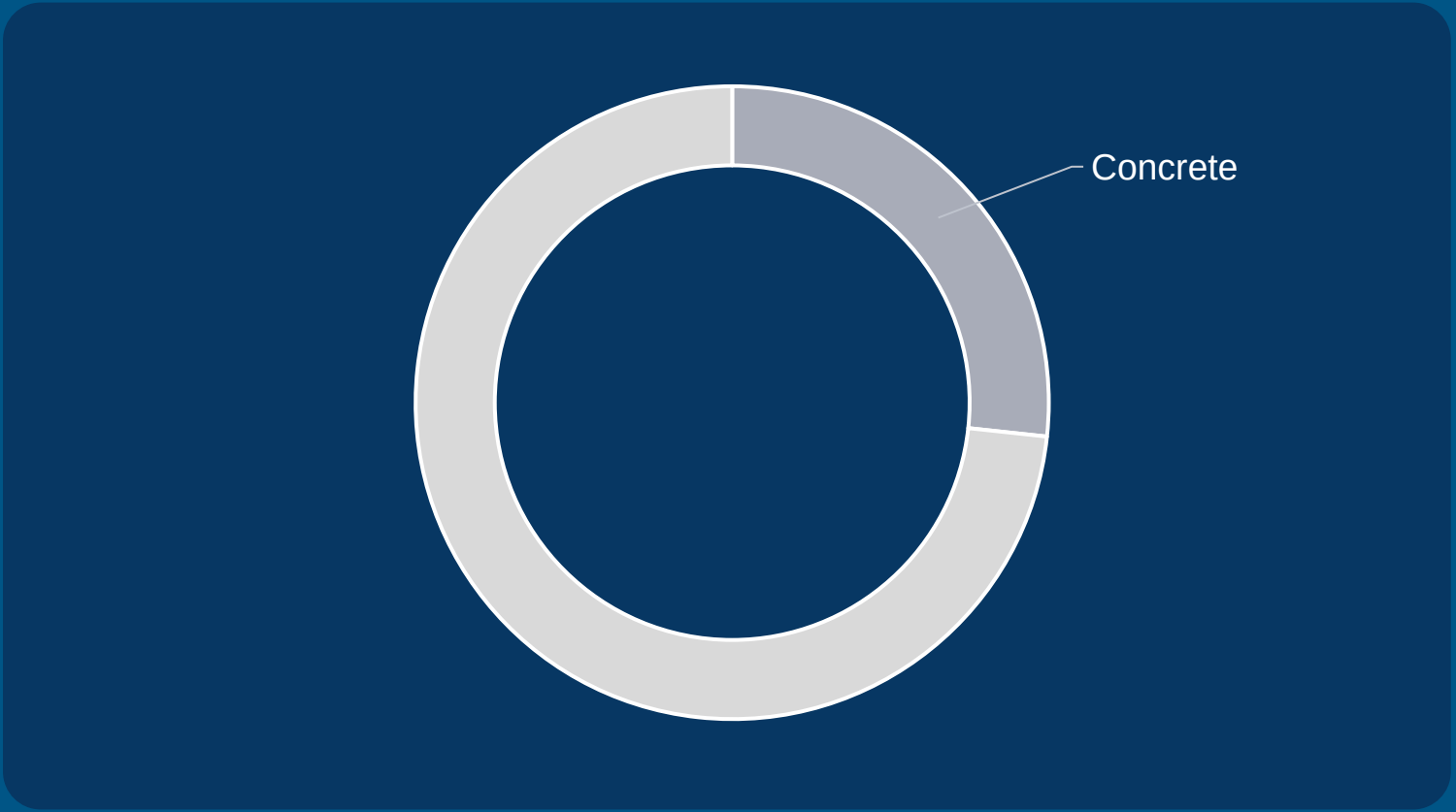
Utilizing low carbon concrete, lower embodied carbon options for typical materials and equipment

Construction Waste

Achieving Zero Waste for diversion and minimization

Contribution of **Concrete** to Owner's Data Center Embodied Carbon Footprint

(Cradle to Grave)



REDUCE

Cement content

REDUCE

Cement content

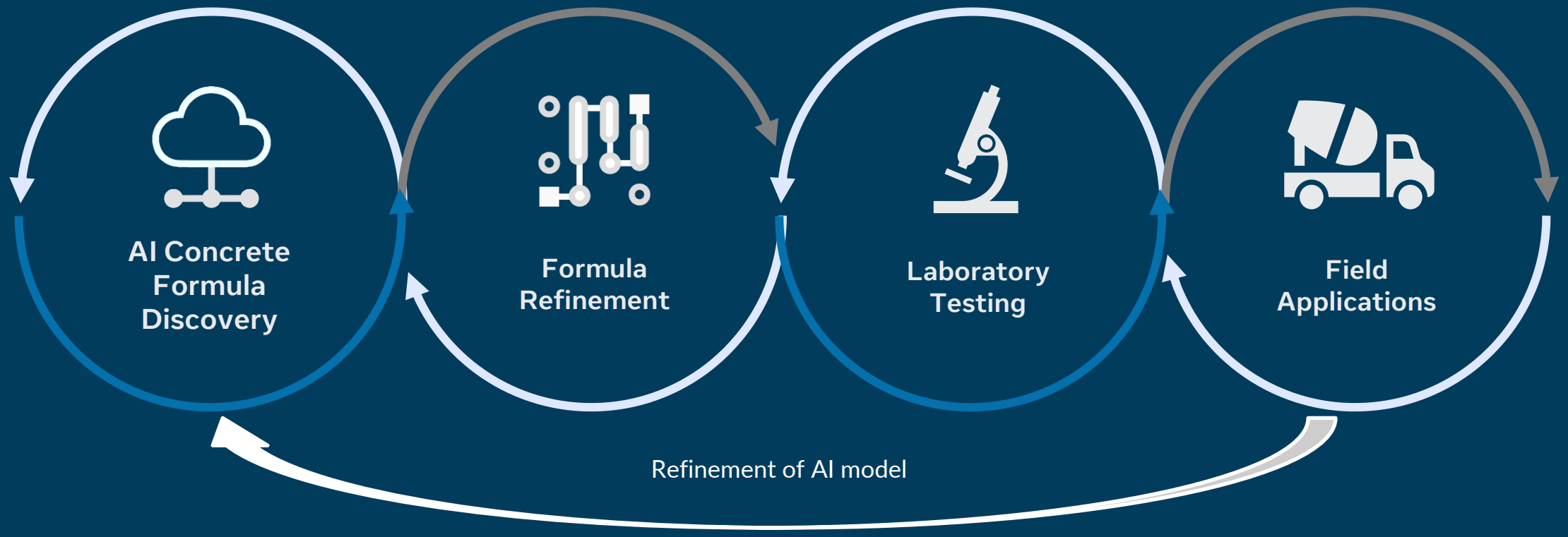
REPLACE

Cement or aggregates with greener options

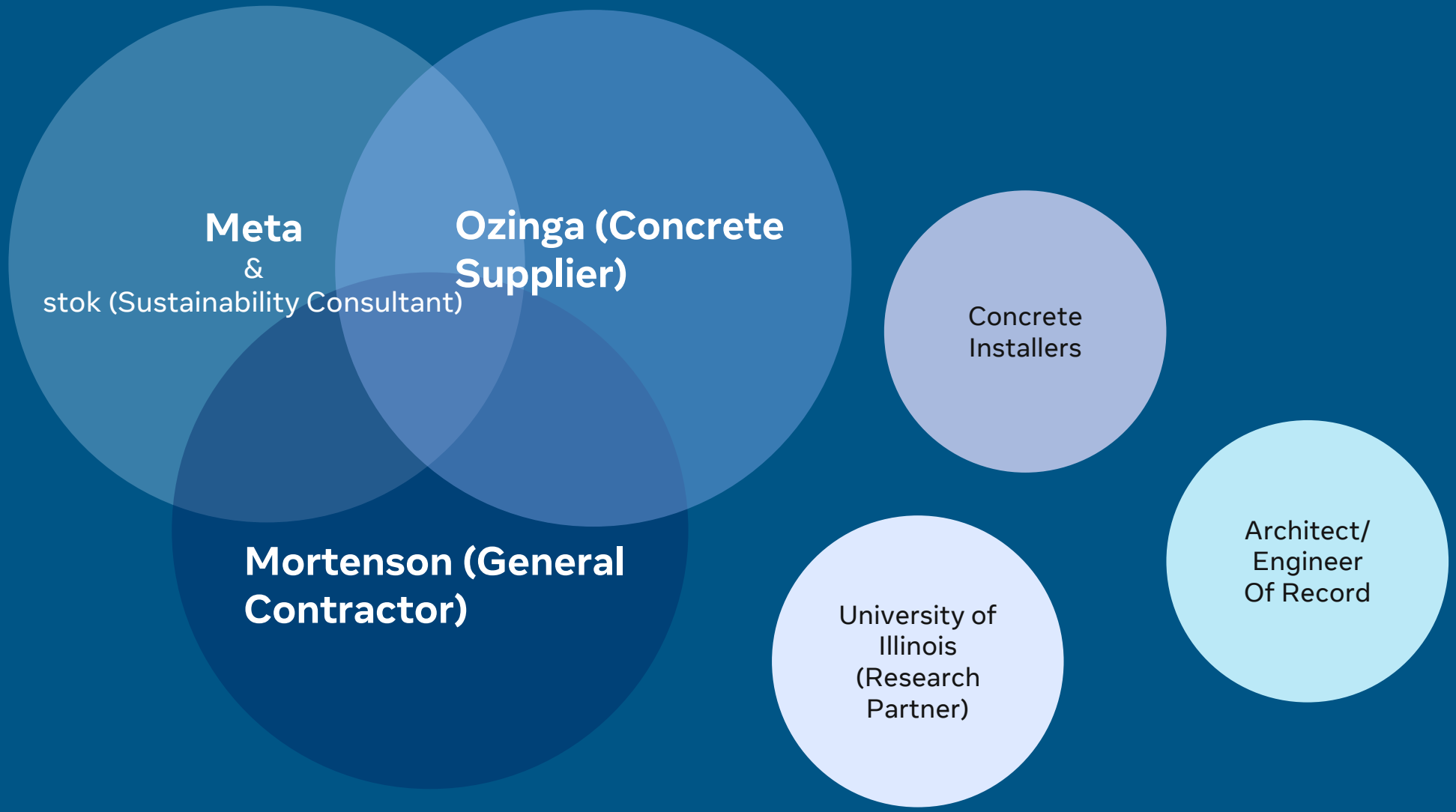
Slag
Fly ash
Recycled concrete
Ground glass
Geosynthetic aggregates
Calcined clays
Natural pozzolans

Artificial Intelligence (AI) Approach

This pilot leveraged Artificial Intelligence to evaluate hundreds of field-applied concrete formulas and their validated attributes, including compressive strength and carbon footprint. The AI model then generated new/innovative concrete mixes that met Owner requirements *and* showed lower embodied carbon than industry standard. The most promising options were further refined through extensive lab and field testing with the help of industry experts as well as engineers from a local university.



Key Stakeholders



Project Background and Concrete Applications

The most suitable locations for the pilot pours were selected based on the following criteria:

- Schedule
- Risk tolerance
- Impact

After a comprehensive list of samples was determined, the General Contractor was heavily relied on to coordinate on site logistics.

Slab on Grade

WWW.OZINGA.COM
Duct Bank

Duct Bank

Exterior Paving

Exterior Paving

Slab on Grade

Metrics Tracked

Technical (Quantitative)
Compressive strength
Slump
Air content
Shrinkage
Density
Thermal Resistivity (Electric Duct Bank Only)

Technical (Qualitative)
Set time/Strength gain
Workability
Saw cut timing
Cracking
Fill around conduits (Duct Bank Only)
Finishing/Aesthetics

Financial
Cost premium

Sustainability
Carbon reduction

Impact Summary | Scope

	APPLICATION	SIZE (CUBIC YARDS)	CEMENT CONTENT/SUBSTITUTION
PILOTS	Interior Slab on Grade	670 CY	44% Cement, **56% Fly Ash/Slag**
	Exterior Flatwork & Paving	160 CY	35% Cement, **65% Fly Ash/Slag**
	Above Ground Duct Bank Mockup	2 CY	57% Cement, **43% Fly Ash/Slag**
AT SCALE	Foundation	20,000+ CY	50% Cement, **50% Slag**
	Roof Slab	12,600+ CY	
	Interior Slab on Grade	18,900+ CY	83% Cement, **18% Fly Ash/Slag**
	Interior Slab on Metal Deck	8,100+ CY	
	Underground Duct Bank	11,000+ CY	57% Cement, **43% Fly Ash**
	Exterior Flatwork & Paving	17000+ CY	65% Cement, **35% Fly Ash/Slag (Pending Approval)**
	TOTAL	**71,400+ CY**	

Impact Summary | Results

	APPLICATION	SIZE	CARBON REDUCTION*	QUALITY/ SPEC	COST	SCHEDULE
PILOTS	**Slab on Grade** (Half 1)	335 CY	**40%**		Neutral	2-day Delay
	Slab on Grade (Half 2)	335 CY	**40%**		Marginal Premium	Delay Mitigated
	Exterior Flatwork & Paving	160 CY	**40-50%**		Neutral	1-day Delay
	Above Ground Duct Bank Mockup	2 CY	**33%**		Cheaper	
AT SCALE	**Foundation**	20,000+ CY	**33%**		Marginal Premium	
	Roof Slab	12,600+ CY	**33%**		Marginal Premium	
	Interior Slab on Grade	18,900+ CY	**4%**		Neutral	
	Interior Slab on Metal Deck	8,100+ CY	**4%**		Neutral	
	Underground Duct Bank	11,000+ CY	**33%**		Cheaper	

**Relative to National Ready Mix Concrete Association (NRMCA) Regional Baselines*

Roadblocks & Lessons Learned

TECHNICAL/ SCHEDULE IMPACT

- Establish Owner **expectations for performance** proactively
- Set priorities for **early strength gain or reduced labor time** on site
- Allot sufficient time for material testing (such as ASTM or RHO)

SUPPLY CHAIN/ COST PREMIUM

- **Availability of cement replacements** in local market is critical to crafting a scalable mix
- Admixtures may be needed to **accelerate set time** (can include cost premiums per CY)
- Use iterative process to redesign a stronger mix for the next pour

WEATHER IMPLICATIONS

- **Environmental factors** can have a major impact on mix performance
- **Prepare ahead** - plan pilot pours around ideal local forecast or within a controlled environment

SUBCONTRACTOR EDUCATION

- Many installer teams are still becoming familiar with low carbon concrete
- Encourage education through small pre-pilot mockups, pre-pour syncs, etc.

Future of Low Carbon Concrete – Owner Perspective

Approach Goals Holistically

- Reduce the amount of concrete used
- Utilize low carbon forms of concrete
- Require low carbon concrete in specs

Establish Strategies

- Assess various means to identify viable low carbon concrete mixes
- Partner with industry leaders to vet options

Focus on Impact

- Leverage AI to quickly vet mixes and optimize designs
- Open source

2030 & Beyond

- Implement into design and construction practices at scale programmatically

neu
An ACI Center of Excellence for Carbon Neutral Concrete

Questions?

Thank you!

Amruta Sudhalkar
Sustainability Program Manager, Meta

amrutasudhalkar@meta.com

Meta

Julius Kusuma
Research Scientist, Meta

jkusuma@meta.com

Meta

Ryan Cialdella
VP of Innovation & Market Development, Ozinga

RyanCialdella@ozinga.com

OZINGA

Julianne Laue
Director of Building Performance, Mortenson

Julianne.Laue@mortenson.com

Mortenson construction

Katie Stanford
Sustainability Account Manager, Stok

katies@stok.com

STŌK