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# Press-in Piling Technology as a Pathway to Decarbonized Foundation Construction

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## Background: Construction & CO2



- The building **construction sector** contributes significantly to global emissions (39%)
- Foundation construction** plays a key role in decarbonization

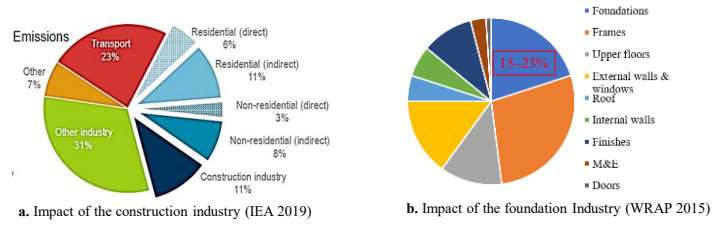


Fig. 1. Global energy-related CO2 emissions

## Urban Climate Policy and Construction Challenges



- Many countries and cities target **carbon neutrality** by the mid-21st century
- Construction** is one of the **priorities** due to **high operational and embodied emissions**
- Policies promote: **Zero-emission construction**; **Electric equipment**; **Material efficiency and reuse**

- Urban foundation projects are further constrained by **site-specific conditions**
- Dense environments and limited working space**
- Noise and vibration restrictions**
- Historic structures and social acceptance**

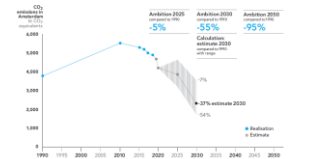
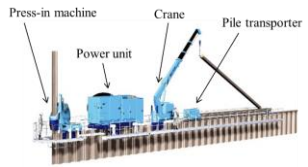


Fig. 2. CO2 emissions in Amsterdam (Roadmap Amsterdam Climate Neutral 2050: 2021)



Fig. 3. City of Amsterdam ([https://www.giken.com/en/news-cat/release/4\\_sep\\_2025](https://www.giken.com/en/news-cat/release/4_sep_2025))

## Press-in Piling Concept



- Static hydraulic installation**
- Low noise and vibration**
- Suitable for **constrained urban sites**

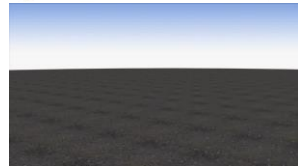


Fig. 4. Typical mechanism of the press-in piling



### Press-in Method for Sheet Piles

- Static installation with **precise control**
- Extraction enables **reuse**
- Adaptable **penetration modes**

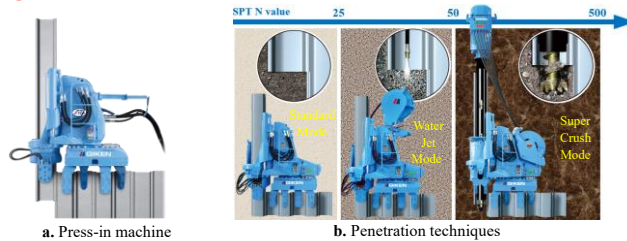


Fig. 5. Press-in method for sheet piles

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### Press-in for Tubular Steel Piles

- Static press-in for **soft to dense ground**
- Rotary cutting mode for **rock and reinforced concrete**
- High **structural accuracy**

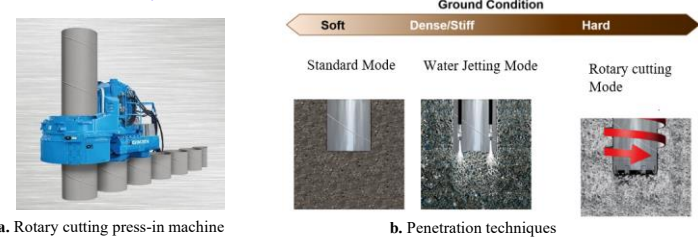


Fig. 6. Rotary cutting press-in for steel tubular piles

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### Decarbonization Mechanisms

#### ❖ Efficient energy transmission

- Press-in piling uses **static hydraulic force**, transmitting **energy directly into the soil**
- **Reduces energy losses** compared to standard piling (**less noise, vibration, stress waves**)
- Improves **energy-use efficiency** at the **pile–soil interface**



Fig. 4. Typical mechanism of the press-in piling

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### Decarbonization Mechanisms

#### ❖ Compact equipment and reduced logistics

- Press-in equipment is **compact and modular**, with a smaller footprint.
- Uses **reaction from installed piles**, reducing the need for cranes and heavy support machinery.
- Requires **less transport and logistics**
- Leads to **lower on-site fuel use and reduced embodied emissions**
- Well-suited for **spatially constrained** or urban construction environments



Fig. 7. The compact and modular design of press-in equipment, enabling efficient deployment in spatially constrained environments.

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### Decarbonization Mechanisms



❖ *The logistics and organization of a press-in piling site*

- Press-in piling typically **eliminates** the need for **supporting temporary works** such as large cranes or temporary frameworks
- **Simplified site logistics** with fewer machines and **reduced truck movements**
- **Less temporary works** (no large cranes or heavy temporary structures)
- **Lower material consumption** → **reduced indirect emissions**
- **Reduced fuel use on site** → **lower direct emissions**



Fig. 8. Comparison of construction footprints between conventional piling and press-in technology.

### Decarbonization Mechanisms



❖ *Electric Press-in Systems & Decarbonization*

- **Electric/battery-powered** press-in systems → **no on-site combustion emissions**
- **Reduced local emissions** when powered by **renewable or low-carbon electricity**
- **Lower overall carbon intensity** compared with diesel equipment
- **Higher energy efficiency** through precise torque control and responsive power output
- **Reduced energy consumption per pile** → **lower indirect emissions during construction**

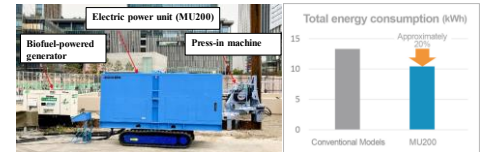


Fig. 9. Press-in system with electric power unit for low-carbon construction

### Decarbonization Mechanisms



❖ *Material Reuse and Embodied Carbon Reduction*

- Supports **material reuse**: Low-damage installation allows extraction and multiple reuse of steel piles.
- **Reduces embodied carbon**: Less need for new steel production.
- **Enables circular construction**: Reusable elements for temporary works and excavation support.
- **Lowers lifecycle emissions**: Addresses both operational and material-related carbon impacts.



Fig. 10. Embodied carbon reduction via pile reuse, enabled by the press-in method.

### Decarbonization Mechanisms



❖ *Integrated Pathways to Decarbonized Foundation Construction*

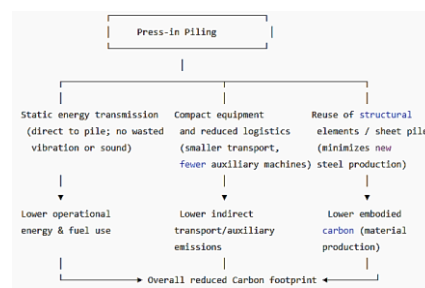


Fig. 11. Decarbonization Pathways of Press-in Piling

Table 1. Operational and life-cycle emissions: press-in piling in comparison with conventional piling methods

Metric	Press-in Piling
Energy transmission	More direct energy application with static hydraulic force
Noise and vibration	Much lower
Site emissions	Much lower or zero (electric options)
Equipment size	More compact, modular
Auxiliary works	Minimal
Transport/logistics	Lower (fewer support vehicles)
Reuse potential (sheet piles)	Higher (minimal damage)
Embodied carbon (material lifecycle)	Lower (reuse + circular design)

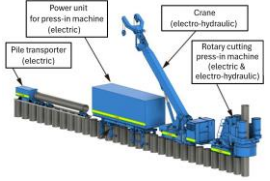


### Case History: IPK Project



❖ **Pilot phase**

- The **Innovation Partnership Quay Wall Project (IPK)** in Amsterdam
- Historic quay wall renewal using **electrified press-in piling** for **low-emission, low-impact** construction.
- Pilot phase (2021–2023) proved a **reduced-emission** installation in dense urban conditions.



Recognized as a model for sustainable urban foundation works.



Fig. 12. Electrified rotary cutting press-in system

Fig. 13. IPK Project pilot phase

### Case History: IPK Project



❖ **Electric Quay-Wall Replacement at Kloveniersburgwal**



Fig.14. Quay-wall replacement at Kloveniersburgwal

Reference case for decarbonized urban foundation construction.

Table 2: Environmental performance indicators

Aspect	Outcome Summary
On-site emissions	Zero CO <sub>2</sub> (electric power)
Power source	Grid electricity + battery support
Noise & vibration	Very low / virtually imperceptible
Community impact	High acceptance, minimal disturbance
Machinery	Electric press-in rigs (rotary cutting press-in machine, spatially effective press-in piling system (Fig.3))
Historic environment suitability	Excellent (no structural vibration)



Fig. 15. IPK Project: Kloveniersburgwal job site

### Conclusion



- **Press-in piling** provides a practical pathway to **low-impact** and **low-carbon** foundation construction in dense urban environments.
- **Static hydraulic installation** eliminates **impact energy**, significantly **reducing noise, vibration, and unnecessary energy losses**.
- **Compact, modular** equipment simplifies logistics and reduces transport, temporary works, and associated emissions.
- **Electrified press-in systems** reduce **on-site emissions** and improve **energy efficiency**.
- Real projects in Amsterdam confirm that **electric press-in piling** delivers **silent, vibration-free, and socially acceptable** construction.
- **Press-in piling**, particularly in its **electric configuration**, is a key enabling technology for **decarbonized urban infrastructure** development worldwide.

