

A low-latency, high-resolution CO₂ and CH₄ emissions monitoring framework for Spain

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PHENOMENA: sPanish EmissioN mOnitoring systeM for grEenhouse gAses

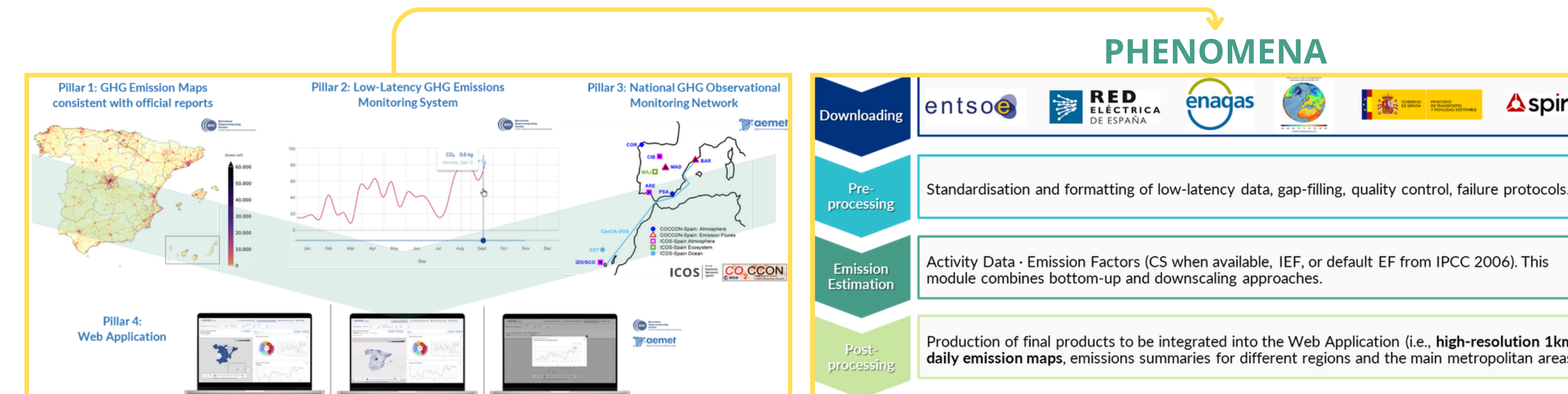
Reliable and timely GHG emissions data is essential for evaluating mitigation policies and supporting verification modelling frameworks. Official inventories are reported with a 1–2 year lag and coarse temporal resolution, limiting their use for near-real-time monitoring.

PHENOMENA is a low-latency framework developed within the RESPIRE-CLIMATE project (WMO-IG3IS endorsed) that delivers daily, high-resolution CO₂ and CH₄ emission estimates across Spain's main combustion sectors.

RESPIRE CLIMATE High Resolution Emission System to SuPport Modelling and MonitoRing Efforts in Spain

Four pillars integrating activity-based and observation-based high-resolution CO_{2,ff} and CH₄ emissions

- Meeting diverse needs of policymakers, scientific communities, industries, and the public by providing comprehensive, high-resolution GHG emissions data.
- Facilitating data-driven decisions for emissions reductions across different scales.
- Contributing to identifying co-benefits and trade-offs with air quality.

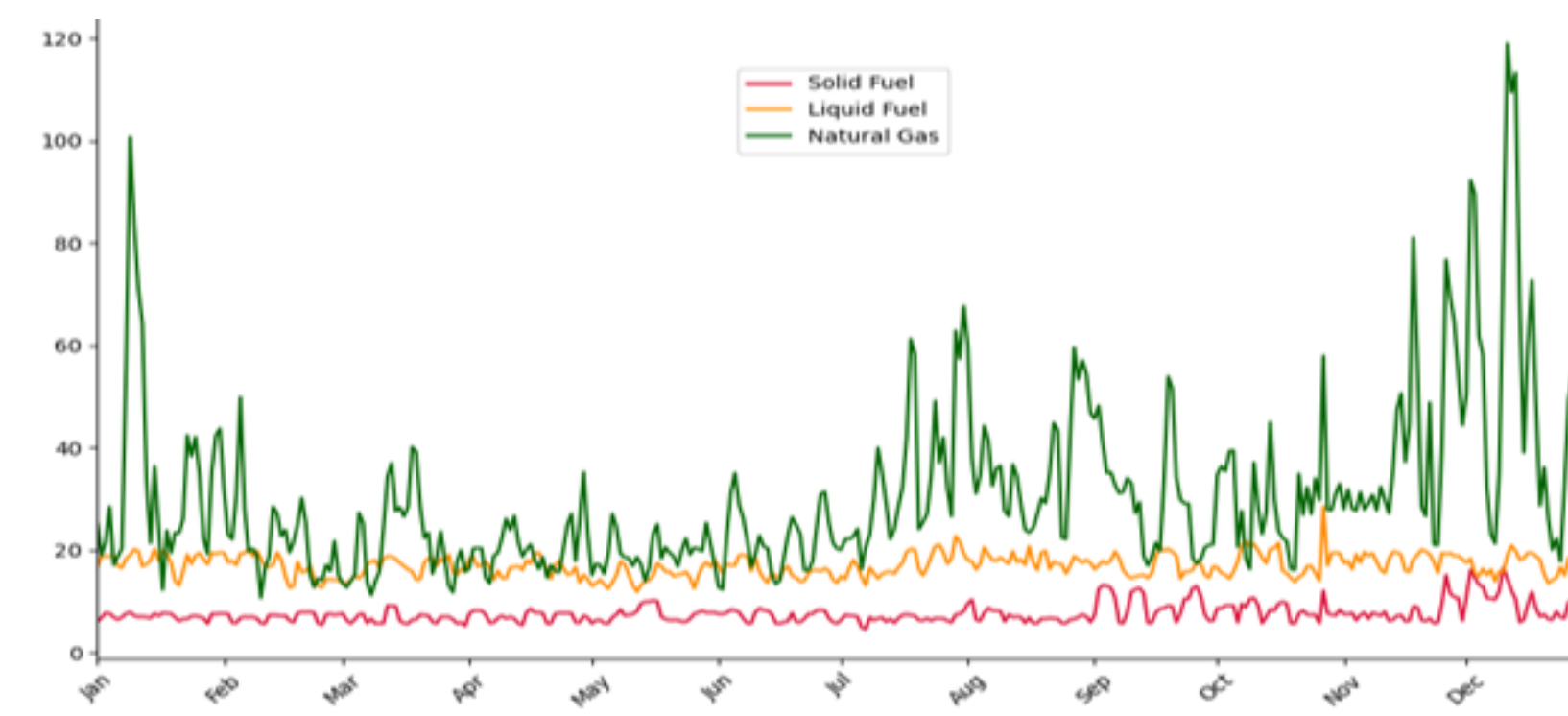


Pillar 2: Low Latency GHG Emissions Monitoring System (delay up to 3 months)

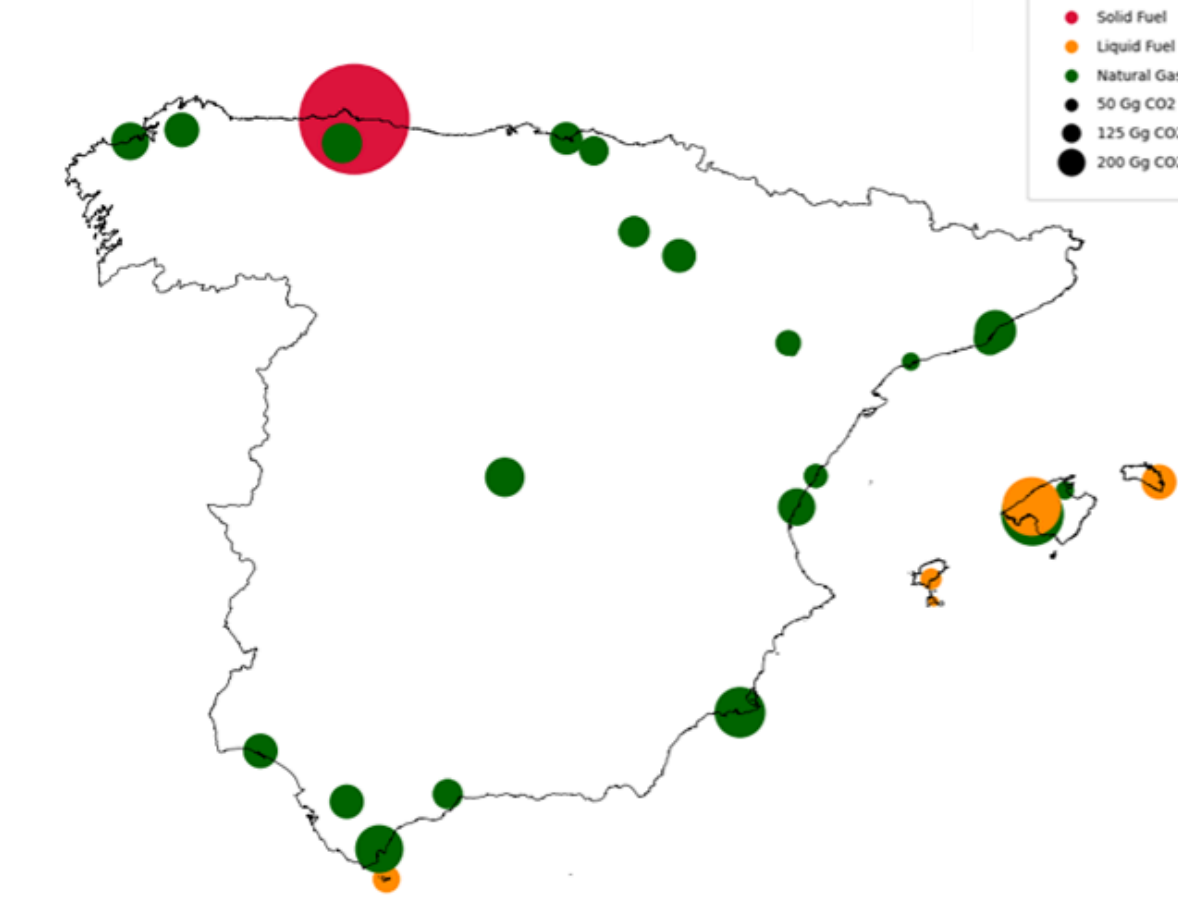
- **Species:**
 - CO_{2,ff}, CH₄
- **Sectors:**
 - Electricity Generation, Industrial Processes (Cement, Iron&Steel), Residential and Commercial, Fugitives, Road Transport, Shipping, Aviation.
- Python-based, open-source system made up of four main modules.
- PHENOMENA delivers daily CO₂ and CH₄ emissions at up to 1km² resolution across 6 sectors in Spain.
- Near-real-time capability enables policy-relevant monitoring not achievable with official inventories.
- The emissions computed with PHENOMENA allows representing the intra-weekly and seasonal variability of GHG emissions as well as changes in their spatial patterns, which can be linked to specific policy, socioeconomic, and weather impacts.

RESULTS

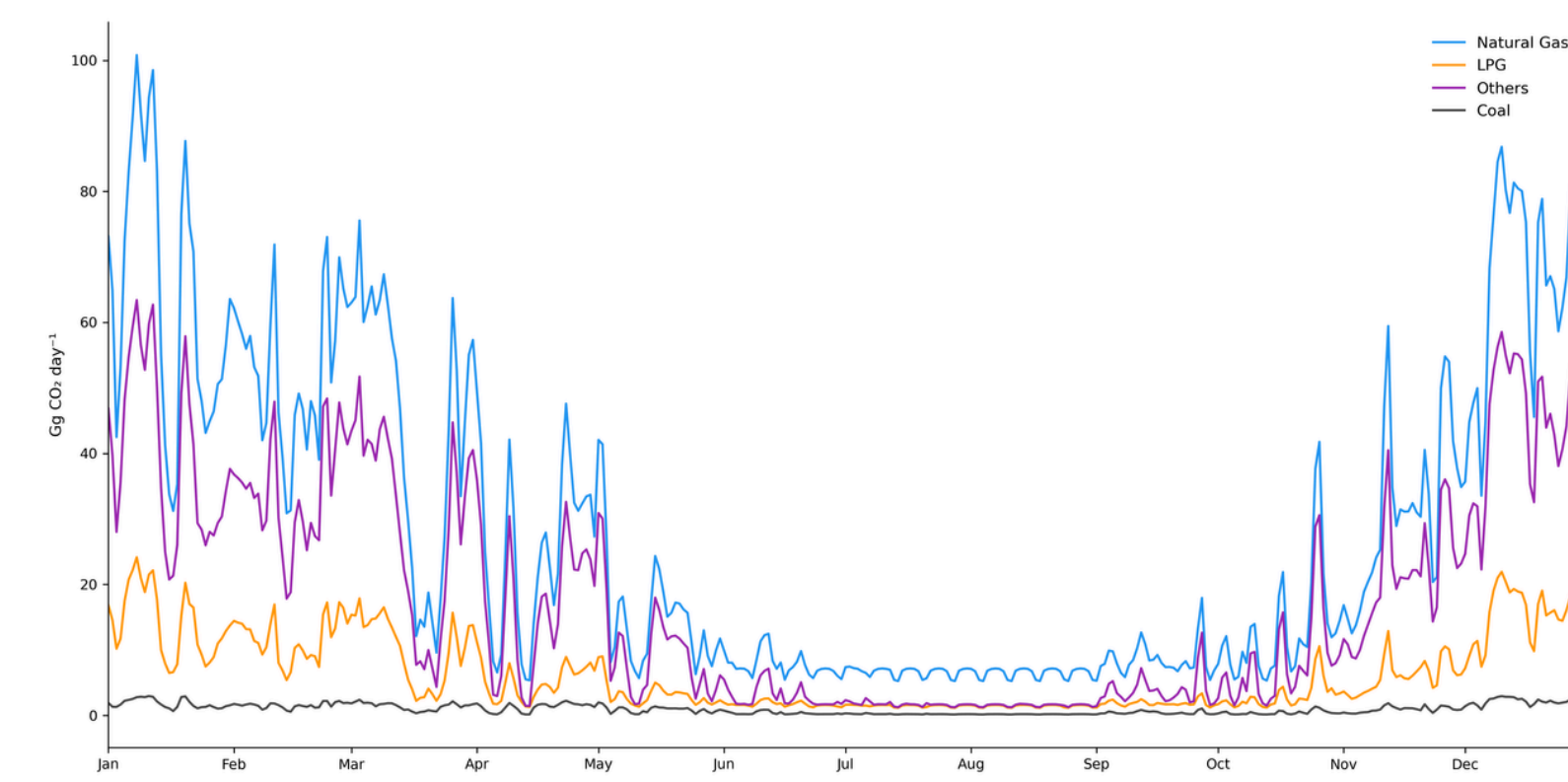
Daily CO₂ emissions (Gg/day) from thermal power plants in Spain



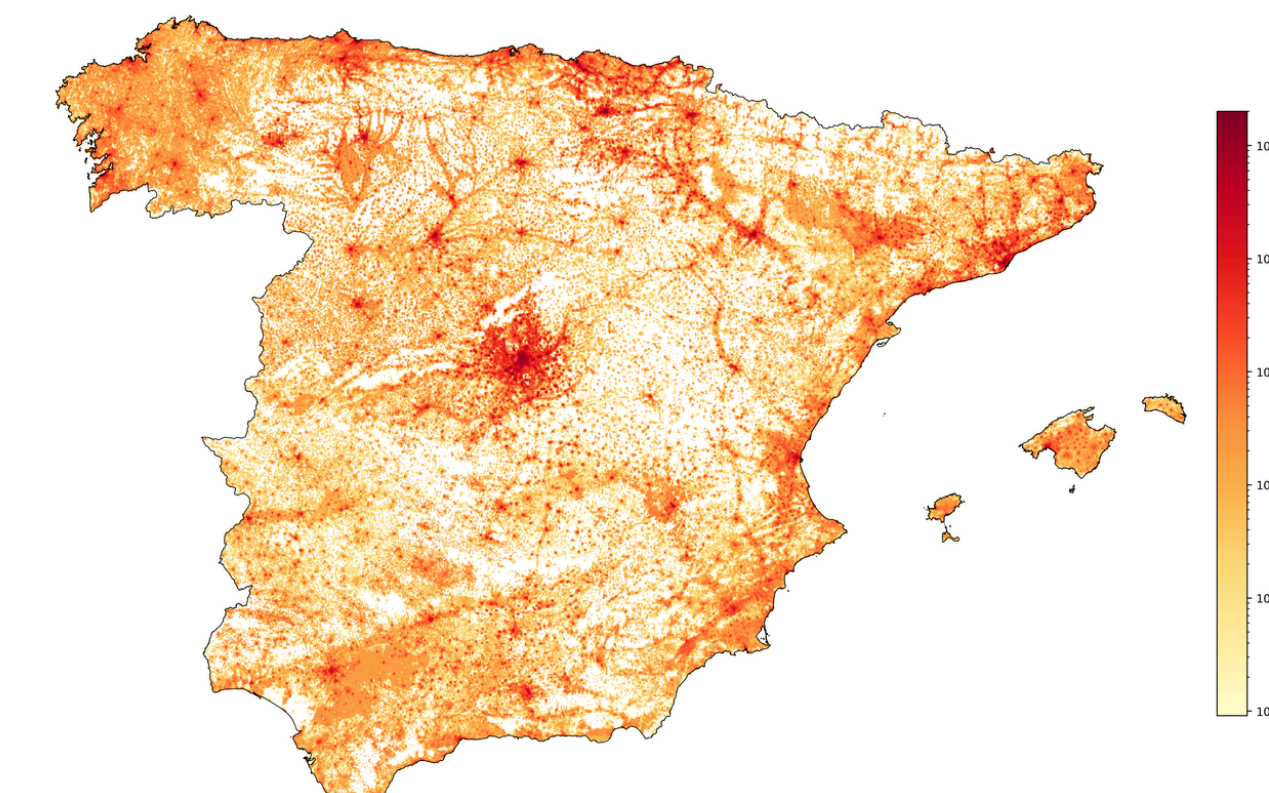
Accumulated CO₂ emissions (Gg) per facility



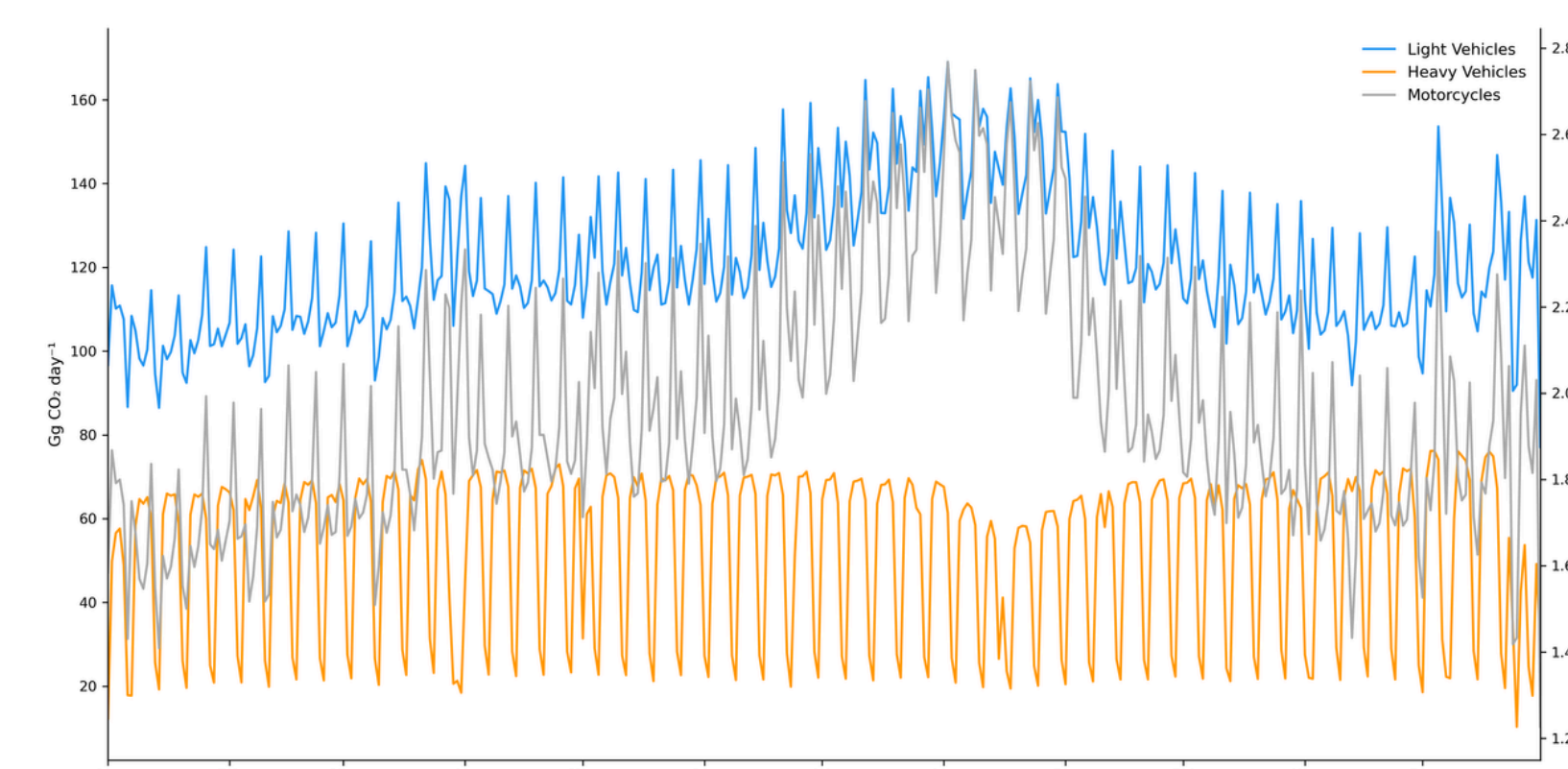
Daily CO₂ emissions (Gg/day) from residential



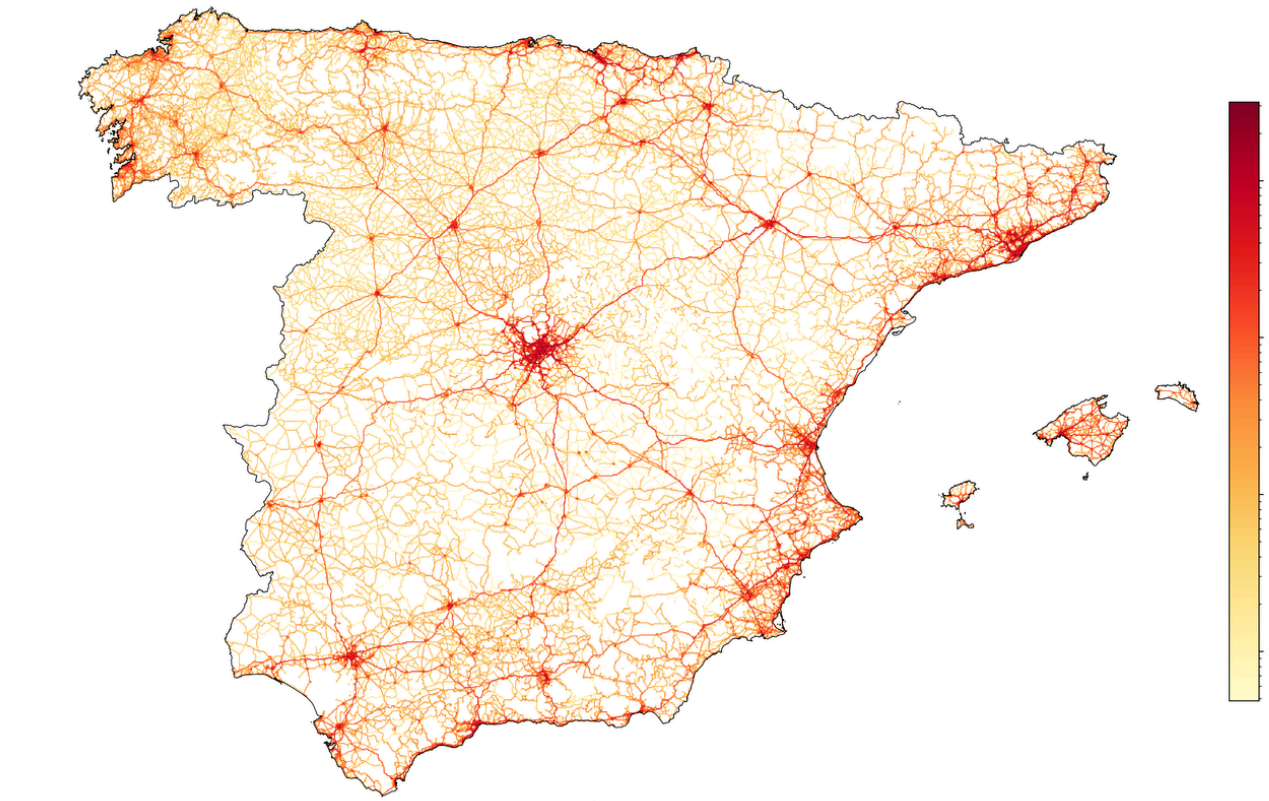
Accumulated CO₂ emissions (Gg) in Spain



Daily CO₂ emissions (Gg/day) from road transport

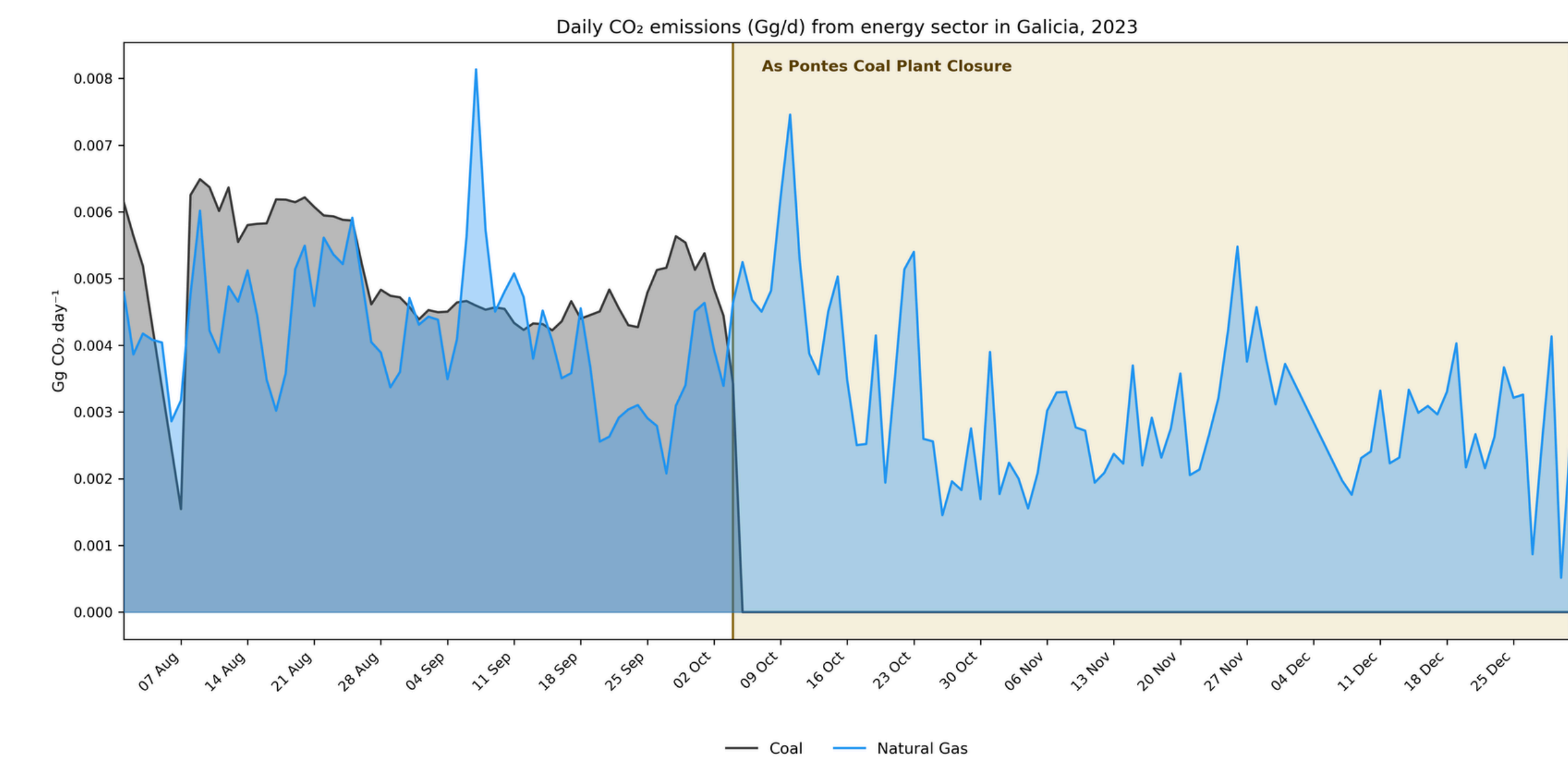


Accumulated CO₂ emissions (Gg) in Spain

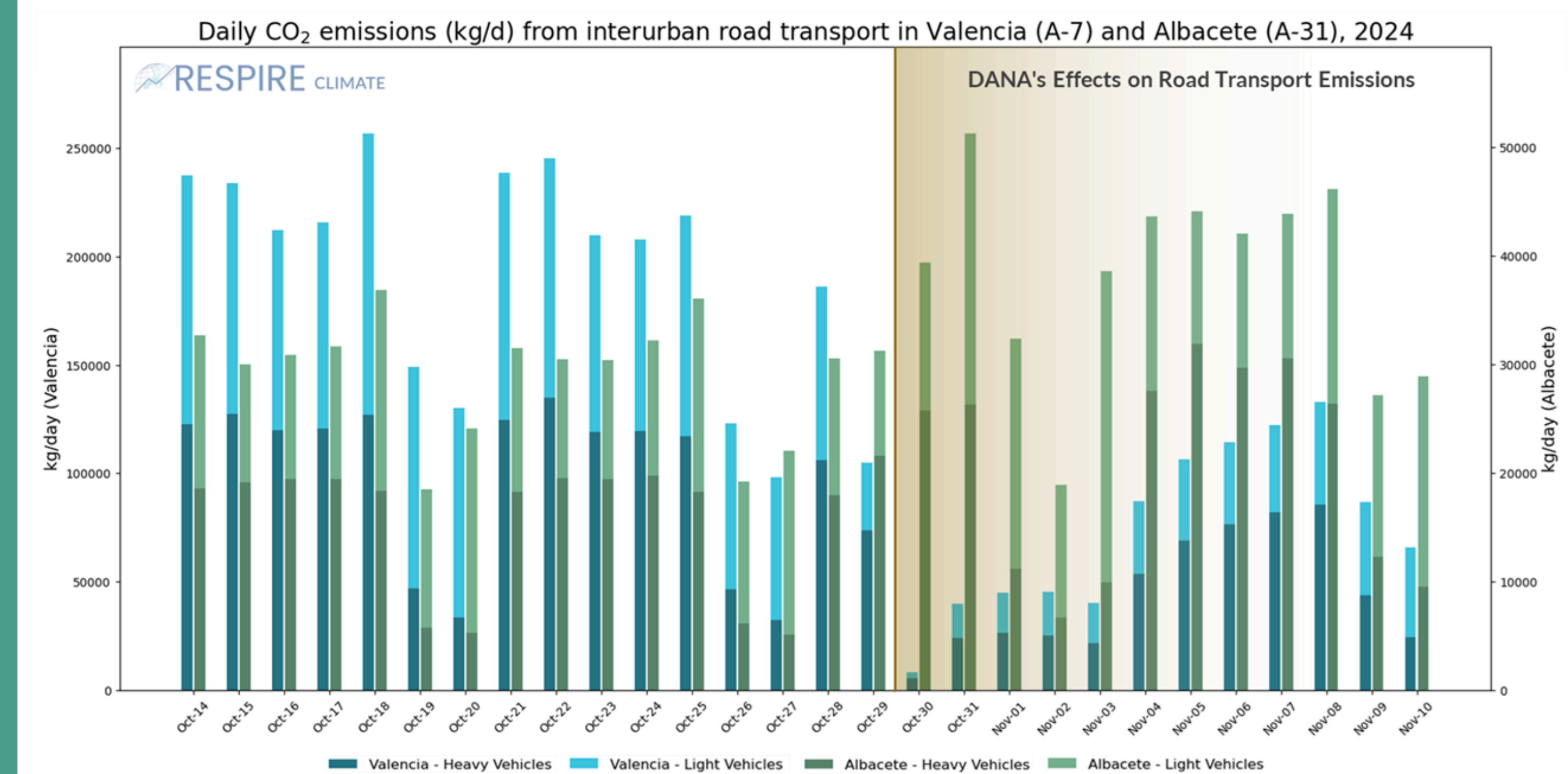


EMISSION STORIES

“As Pontes” Coal Plant Closure



DANA's Impact on Road Transport



RESPIRE - CLIMATE is recognized internationally by IG3IS (WMO initiative)

The project is part of the Recovery, Transformation and Resilience Plan (Plan de Recuperación, Transformación y Resiliencia, PRTyR) funded by the European Union – NextGenerationEU.

*P. Castesana acknowledges her AI4S fellowship within the “Generación D” initiative by Red.es, Ministerio para la Transformación Digital y de la Función Pública, for talent attraction (C005/24-ED CV1), funded by NextGenerationEU through PRTR