Circular Economy beyond Energy: Recycling and Reducing Waste

Circular economy and more sustainable materials for electric infrastructures

Francisco Puente, Escan energy consulting
Circular economy and more sustainable materials for electric infrastructures with focus on:

Transformers, Pipes and Wiring

Civil work
CIVIL WORK AND BUILDING

RECYCLED CONCRETE

Use of recycled aggregates up to 70%, cheaper, but need of more cement or additives, then price ends up being very similar to standard concrete. Energy used in the recycling process is higher than the one needed in the extraction of conventional sand and gravel. Full commercial.

Pros:
• Wastes reduction
• Lower density, savings in transportation costs
• Reduces the need natural matters

Cons:
• Pollutants and contaminants need to be removed, consume energy
• Cost don’t differ much from standard concrete

➢ Aprox.: 350 kgCO2/m3
Concrete reinforcement systems by means of fiberglass or embedded in polyester resin. Variants with the addition of graphene also exist, which are newer, better, and more sustainable. The environmental savings of synthetic fiber against the metallic ones is about 9 times less when we compare the carbon footprint of the metallic fibers. This material is in the commercial phase.

**Pros:**
- Improved mechanical properties
- No corrosion, higher durability and reduces curing time
- Less energy required / m3
- Not affected by currents (Foucault)
- Reduced the use of raw materials in 40%-60%
- Can be mixed with recycled concrete

**Cons:**
- Very few suppliers (i.e. Graphene)
- Difficult handling, need expertise

Source: Myphor

➢ Aprox.: 7 kgCO2/m3 (fibers)
TRANSFORMERS, PIPES AND WIRING

RECYCLED ALUMINUM

Material for the shell and support structure of the transformer and other elements of the substation, one of the most efficient and sustainable materials. The second most recycled material in the world. It can also be used for wiring and transmission cables.

Pros:
• Recycling it means saving 95% of the energy it cost to manufacture it
• Durable
• Lightweight

➢ Aprox.: 20 times less carbon footprint

Cons:
• High cost
• High environmental impact in manufacturing
Green Power Transformers offer significant environmental benefits, including better product performance, covering the 3 phases of the product life:

- **Manufacturing**: reduced consumption of natural resources
- **Operation**: lower CO2 emissions (SF6 free), limitation of environmental-risk, noise reduction, space savings, and energy efficiency
- **End of life**: recycling of most parts

Some characteristics:

- Filled with mineral oil or biodegradable ester liquid
- Hermetically-sealed tank design
- Innovative technologies to reduce acoustic energy transferred and optimize design
- Solvent-free painted

Source: Ormazabal
## Transformers, Pipes and Wiring

### Circular Economy in Smart Meters

<table>
<thead>
<tr>
<th>Modular design and recycling old meters</th>
<th>Production</th>
<th>Reverse/circular logistic</th>
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<tbody>
<tr>
<td></td>
<td>95% of the plastic and 100% of the copper recycled to produce new smart meters</td>
<td>To consider also the reuse, recycling, uninstall, surplus materials, packaging reuse, etc.</td>
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<td>Second Life</td>
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<td>5% of mixed plastic recycled for a “second-life” production</td>
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Source: Enel
OTHER INNOVATIONS

PHOTOCATALITIC COATINGS (Indoor, outdoor, surfaces)

The inorganic compounds incorporated into the photocatalytic products are mainly titanium oxides, which are also used in sun creams, toothpastes, and a good number of cleaning and cleaning products. Organic and inorganic substances are transformed by the photocatalytic process into compounds totally harmless to people’s health.

BOROSILICATE GLASS

This material is made of the same four components of regular glass but in different percentages. Borosilicate glass has the potential to be used for more applications, especially in electronics, as an insulator. It can replace plastic in electric and electronic devices, with similar or better performance and lower environmental impact. The cons are its higher cost and density.
ABOUT FRANCISCO PUENTE

Francisco Puente is Business Development Director at Escan Energy Consulting, a firm dedicated to energy policies, energy markets, energy efficiency, sustainable energy, power generation and smart grids.

He is responsible to find opportunities and develop cost-effective initiatives based on sustainable technologies. He is member of the European network of regional and local organizations (FEDARENE), the World Sustainable Energy Days (WSED), the energy transition platform (ENLIT) and the European Technology Platform on Renewable Heating & Cooling (RHC-ETIP)