

Green Energy that Powers the World

A Pipe Comparison Carbon Footprint Study

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“Glass-reinforced epoxy (GRE) pipe is challenging metallic piping systems in today’s eco-environment due to the **lower energy requirements needed for manufacturing and the lower energy use throughout the pipes’ service life. In the face of climate change, the use of GRE pipe, relative to carbon steel pipe, **produces less carbon dioxide** in the atmosphere and thus makes it an attractive piping choice.”**

Agenda

- **Climate Change and Pipe Use**
- **Energy Required for GRE Versus CS**
- **Life Cycle Energy Balance**
- **Effects of Weight of Pipe Systems**
- **Carbon Sink Effect**
- **Conclusion**

Climate Change and Pipe Use

World Energy Consumption

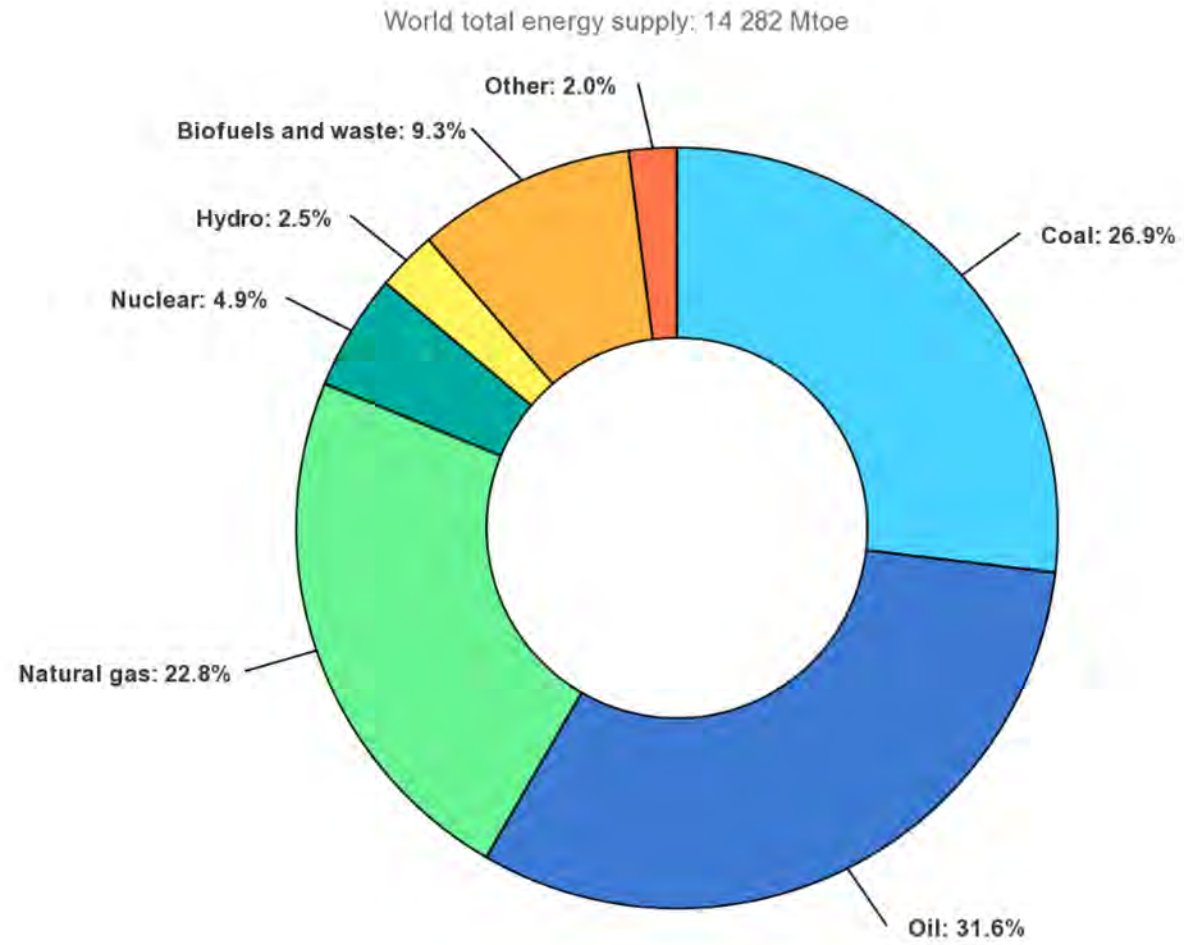


Figure ¹

¹ Global share of total energy supply by International Energy Agency (2018)



What does it mean for Pipe Manufacturing?

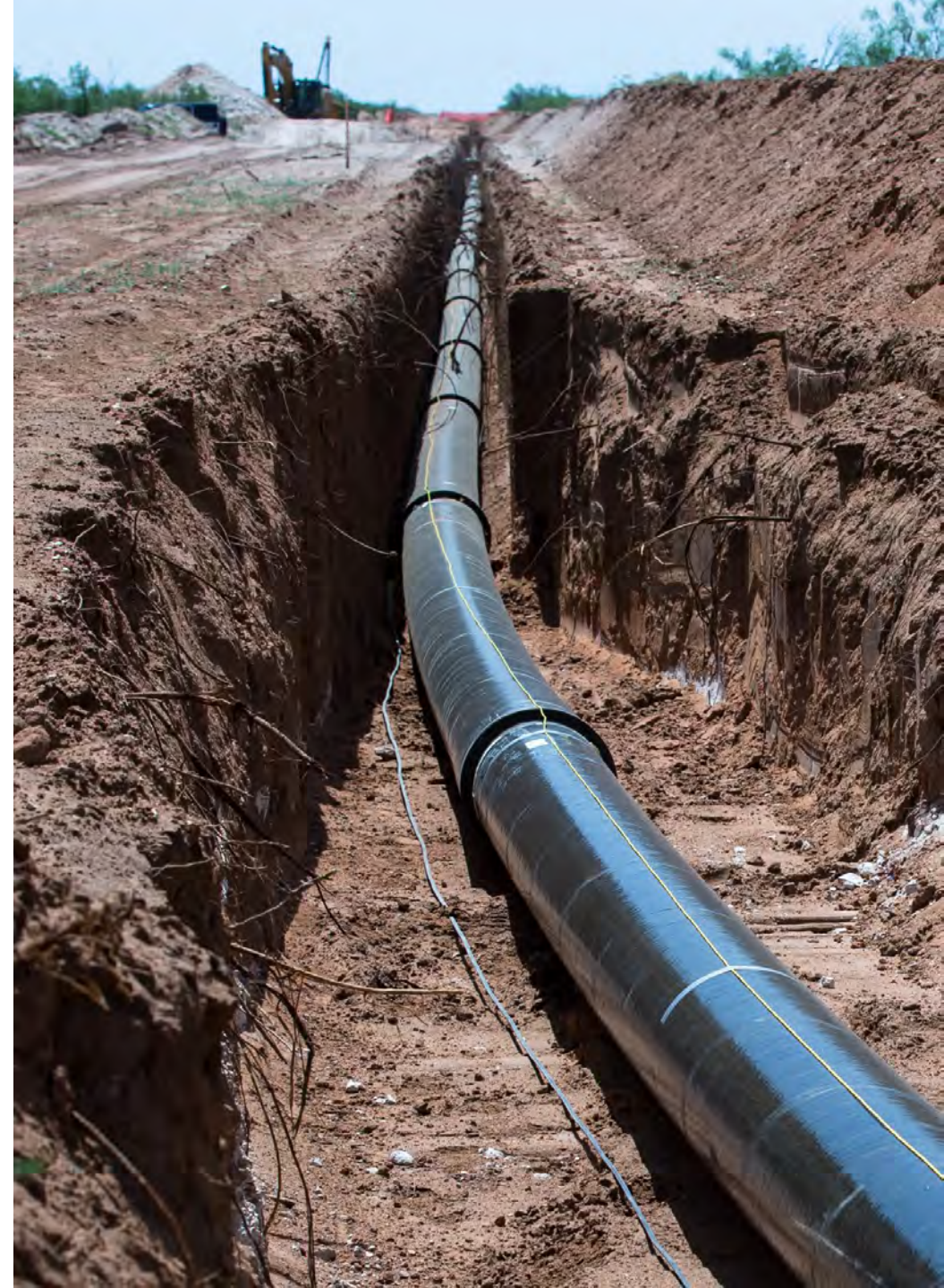
Energy efficiency can be applied across the board, and pipe manufacturing is no exception.

- Pipes play an important role in everyday life (delivering our drinking water, supplying cooking gas, and transporting oil and chemicals)

Manufacturing of pipes requires energy

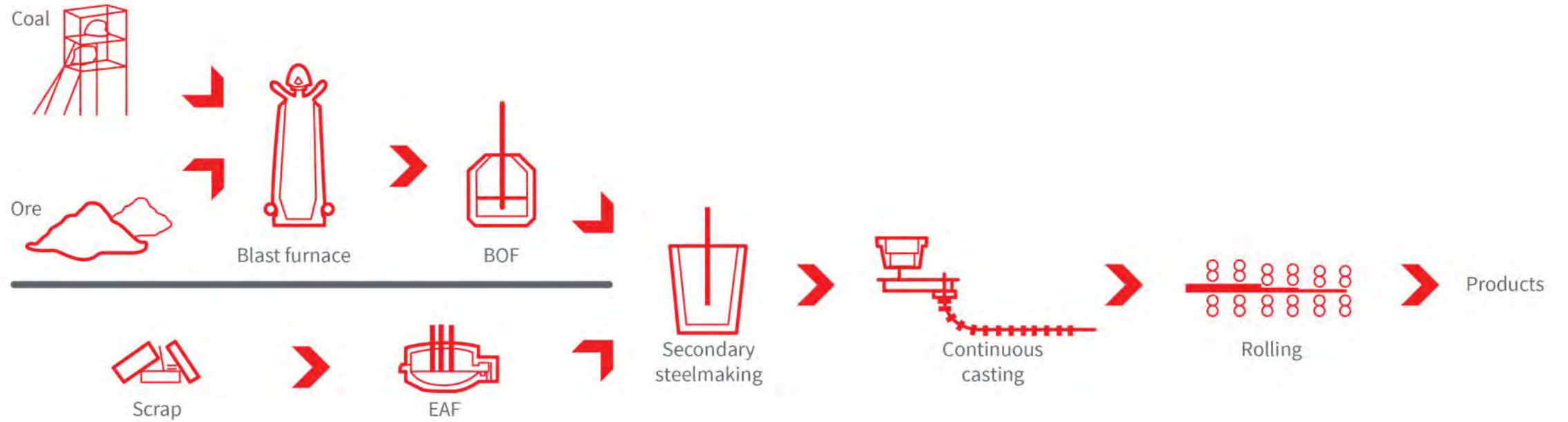
Usage of pipes consumes energy

- To reduce the harmful effects of CO₂ emission it is necessary to seek alternative energy sources



Energy Required for GRE Versus CS

Steel Production Process



Figure²

²Source: Steel data are based on Berkeley Lab (World Best Practice Energy Intensity Values for Selected Industrial Sectors)



12-in. 25-bar rated GRE 2425 vs. Schedule 40, 12-in CS pipe

(Schedule 80 and XXS CS pipe also included in comparison)

	GRE – 2425	Schedule 40 CS	Schedule 80 CS	XXS CS
Nominal Diameter [cm] (in)	30.5 (12.0)	30.5 (12.0)	30.5 (12.0)	30.5 (12.0)
Pressure Rating [bar] (psi)	25.0 (362.0)	25.5 (370.0)	33.7 (490.0)	87.6 (1270.0)
O.D. [cm] (in)	33.05 (13.01)	32.39 (12.75)	32.39 (12.75)	32.39 (12.75)
I.D. [cm] (in)	31.37 (12.35)	30.33 (11.94)	28.89 (11.37)	27.31 (10.75)
Wall Thickness [cm] (in)	0.84 (0.33)	1.03 (0.406)	1.75 (0.688)	2.54 (1.00)
Area [cm ²] (in ²)	85.0 (13.1)	101.6 (15.7)	168.3 (26.1)	238.2 (36.9)
Density [g/cm ³] (lbs/in ³)	2.6/1.19 (0.09/0.043)		7.85 (0.284)	
Weight [Tonnes/km] (lbs/in)	16.4 (0.92)	79.7 (4.46)	132.1 (7.41)	187.0 (10.5)

Energy of Pipe Production

Composite pipe vs. Metallic pipe

- Processes to transform materials into final products require different energy levels
- GRE pipe takes 20% less energy to manufacture and produces 20% less CO₂ than CS equivalent
- GRE pipe helps companies to reduce their carbon footprint

More information on calculations available upon request.



Life Cycle Energy Balance

Pumping Energy Savings

GRE pipe vs. CS pipe

- Savings and wastages are critical ecological and economical factors
- 60% less horsepower needed for a GRE pumping system versus a Schedule 40 CS pumping system

GRE Pipe

2,515 hp-hr/year

Schedule 40 Pipe

6,282 hp-hr/year

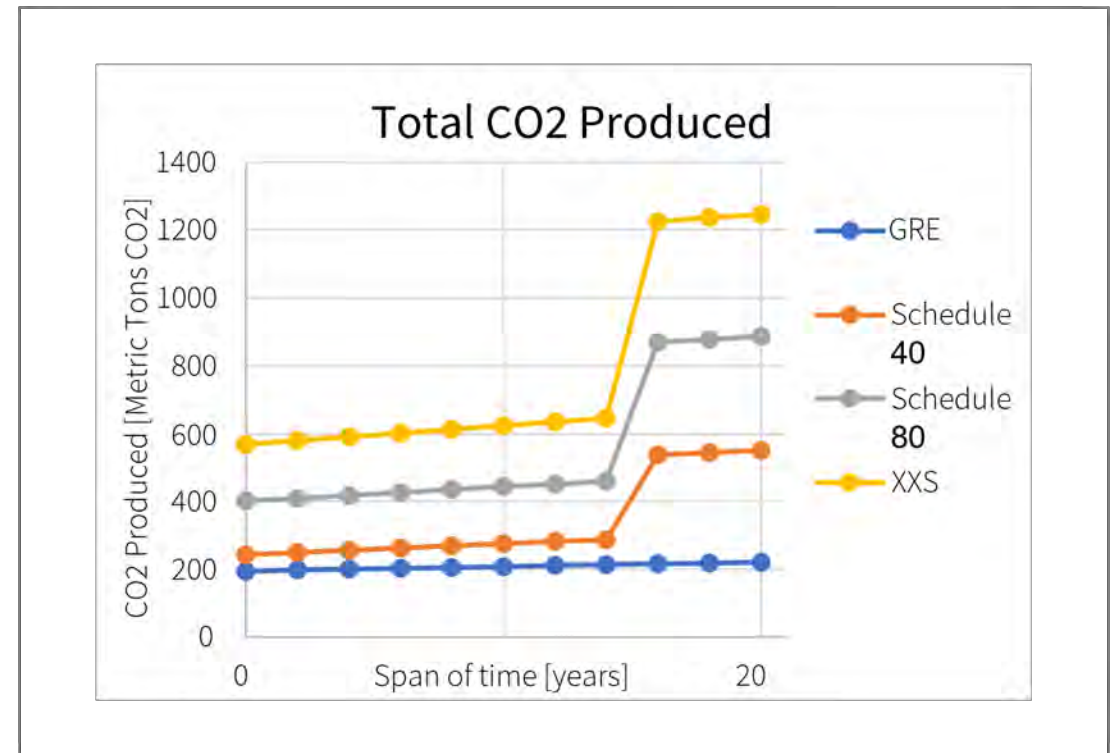
More information on calculations available upon request.



Life Cycle of a 20-Year Project

Examining CO₂ emissions

- 20-year water transmission pipeline life-cycle energy analysis
 - GRE result in 60% less emissions
 - CS pipe system will need replacing at least once - higher operating expenditures and replacement costs
 - GRE requires a smaller amount of fossil energy and is beneficial for applications requiring long service life



Effects of Weight of Pipe Systems

Truck Transportation

- Weight directly influences emissions produced when transporting material
- GRE pipe is about 20% the weight of schedule 40 CS pipe
- CS requires roughly 4.88 times the number of trips to deliver due to weight limitations
- GRE pipe delivery results in 79% less CO₂ emissions

More information on calculations available upon request.



Piping Systems in Ships

- Shipping industry is 6th largest contributor to global CO₂ emissions
- Emissions can be reduced drastically by reducing total weight of ship
 - Replacing five seawater piping systems with GRE led to 23-tons of weight reduction.
 - Emissions reduced by approx. 49,000 metric tons CO₂ per year
- Replacing all piping systems would result in even greater emission savings

More information on calculations available upon request.

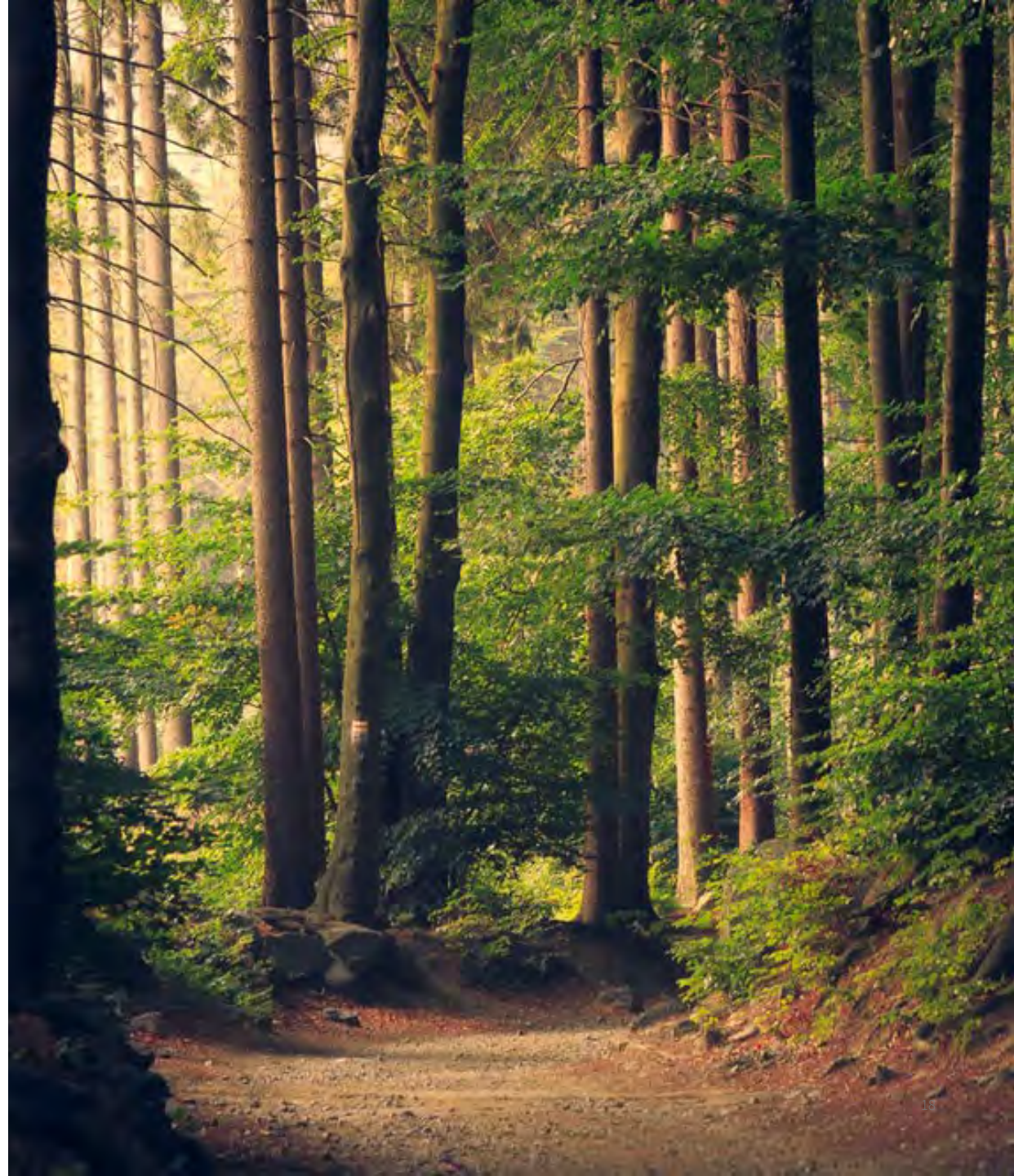


Carbon Sink Effect

Carbon Sink Effect

Repository of organic carbon in the environment

- Carbon sink is a repository of organic carbon in the environment
- Trees remove carbon from the atmosphere and store it in its tissue
- One artificial method of carbon capture is to permanently store sequestered CO₂ in finished products
- GRE pipe returns carbon into the ground by storing the carbon in the finished product during its service life.



Conclusion

Conclusions

Advantages of GRE piping systems over CS piping systems with regards to limiting climate change

- Energy Use in Manufacturing
 - GRE piping systems require 20% less energy to produce than that made from CS.
- Energy Use in Operation
 - GRE can produce 60% energy savings throughout a 20-year life cycle.
 - Effects of Weight of Piping System
 - Shipping pipe via semi-trucks - GRE can reduce the CO₂ emissions by up to 79%.
 - Changing current container ship piping systems to fiberglass can reduce the annual CO₂ emission by 49,000 tons at a minimum.
- Carbon Sequestration Effect
 - The carbon stored in GRE piping systems prevents carbon from being emitted into the atmosphere as CO₂, causing the greenhouse effect.

GRE is effective alternative to reduce the environmental impact of industrialization

