MYTH #1

“Copper loops corrode and fail”

→ Alternatives: “Ground eats the copper”; “Minerals in the ground will cause the copper to leak”

- **Copper**
  - Extracted from the ground itself
  - Long history of use in HVAC
  - A **noble** metal naturally resistant to corrosion
  - Naturally compatible with > 90% of the land in North America

- **Corrosion in Copper**
  - Patina: a natural **protective coating**

- **Earth Loop Protection System (EPS)**
  - Impressed Current Cathodic Protection (ICCP)
    - Anode connected to a DC source
    - Optimized to provide enough current for protection of target structure
  - Permanent, **uniform** and **automatic** protection
  - Long life and reliability
MYTH #2 “Systems contain too much refrigerant”

→ Alternatives: “The code requires an industrial type machinery room for these systems”

- EarthLinked® Geothermal Systems
  - ≈5 to 7 pounds of refrigerant per nominal ton of system capacity

- ASHRAE standards
  - Standard 15-2013 and Standard 34-2013
  - Complies with 2012 International Mechanical Code
  - Refrigerant Concentration Limit (RCL) = allowed concentration in occupied space
    - RCL(R-410A) = 26 lb/Mcf = 26 lb/1000 ft³

- Case study: extreme scenario
  - 2000 ft² home → 4-ton job
  - EarthLinked system: 28 lb of R-410A
  - 7-foot ceilings → 14000 ft³ of conditioned space → ≈ 9 Mcf of occupied space
  - 410A Concentration = \( \frac{28}{9} \) = 3.11 lb/Mcf → 8 times less than RCL
MYTH #3

“They are not recognized by the Code”

→ Alternatives: “These systems don’t comply to the Mechanical Code”

- **ASHRAE standards**
  - Standard and guidelines for the HVAC industry
  - Complies with 2012 International Mechanical Code

- **IgCC**: DX is mentioned in the International Green Construction Code

- **CSA**
  - C448 Series-16
  - “Design and installation of earth energy systems”
  - Bi-national Standard for Design and Installation
  - A reference for IGSHPA

- **Testing standards**

- **Member of GEO**
MYTH #4

“Leakages could contaminate the ground”

→ Alternatives: “What if there is a leak?”

- **EarthLinked® Geothermal Systems**
  - Refrigerant-based
  - No antifreeze
  - Very limited risk
  - Seal tested at factory
  - Seal test in the field (400 PSIG nitrogen for a minimum of 8 hours)

- **R-410A refrigerant**
  - Boiling point: **-60.5°F**
  - Would immediately **vaporize** and seek the atmosphere
  - MSDS available

- **POE oil**
  - Insoluble in water → would not contaminate aquifers
  - MSDS available
MYTH #5

“Loops in DX are too short”

→ Alternatives: “The ground cannot keep up”, “The ground will heave or dry out”, “Copper is too conductive for the ground”

薇 Fourrier’s law (1807)

\[ Q = -k \cdot A \cdot \frac{dT}{dx} \]

薇 Compact loop system

- Higher thermal conductivity of Copper
- Greater temperature range of operation for R-410A
- The combination of Copper + R-410A allows for a larger temperature gradient (ΔT) than HDPE and an antifreeze solution would

薇 Proper design

- Design the system to meet Q (House load)
  - Heating and Cooling loads -> Manual J
  - Geographic location of the site
  - Selection of Earth Loop configuration depending on space, performance and installation cost
- Otherwise: performance issues
- True for all geothermal systems
MYTH #5

“Loops in DX are too short”

Case of a multilayered cylinder:

\[
Q = \frac{2\pi \times L \times (T_4 - T_1)}{\ln\left(\frac{r_2}{r_1}\right) + \ln\left(\frac{r_3}{r_2}\right) + \ln\left(\frac{r_4}{r_3}\right)} \left/ \frac{1}{k_{\text{copper}}} \right. \left. + \frac{1}{k_{\text{cement}}} \right. \left. + \frac{1}{k_{\text{ground}}} \right. \right)
\]

- **Q**: Conductive heat transfer (BTUH)
- **\(k_{\text{copper}} / k_{\text{cement}} / k_{\text{ground}}\)**: Thermal conductivity (BTU/(h.°F.ft²))
- **A**: Surface area (ft²)
- **\(\frac{dT}{dx}\)**: Temperature gradient (°F/ft)
- **T₁ / T₂ / T₃ / T₄**: Temperatures at the surface of the layer (°F)
- **r₁ / r₂ / r₃ / r₄**: Radius of the layer
- **R_{\text{copper}} / R_{\text{cement}} / R_{\text{ground}}**: R-value or Thermal resistance of the layer ((ft².°F.hr)/BTU)
MYTH #6

“Complicated and expensive to install”

→ Alternatives: “DX is harder to install than water-source”

❖ Simple
  - NO anti-freezing agents, system flushing, circulating pump, water well drilling or plumbing
  - Earth loops are pre-engineered and factory-assembled
  - Less maintenance
    - No need to top off water and glycol levels

❖ Compact
  - Smaller **footprint** (see Myth #5)
    - Reduced installation cost (drilling and excavating)
    - Smaller borehole diameters
    - Smaller drill rigs
  - No deeper than 100’

❖ Efficient
  - One-step heat exchange process
    - More efficient
  - Lower installation cost
  - Quicker to install
MYTH #7

“Bad oil return burns compressors”

→ Alternatives: “Bad oil return could cause a compressor failure”; “Oil returns are an issue”

- R-410A and POE oil: perfectly soluble
- Patented oil return mechanism: boils the refrigerant out of the ACC
- No compressor failure since 2010
- Proper sizing
  - Adequate refrigerant velocity
Alternatives: “*Without the circulator pump the workload of the compressor is increased*”

- **Run time**
  - Our compressors do not run any longer
  - Operated within recommended operating conditions
    - Proper designing
  - Many differences between water-based and refrigerant-based

- **Compression ratio**
  - Apples to apples comparison
  - CASE STUDY
    - Compression ratio = \( \frac{\text{absolute discharge pressure (psia)}}{\text{absolute suction pressure (psia)}} \)
Alternatives: “Most DX manufacturers don’t hold their product line long”

- **Direct Geoexchange**
  - Oldest type of geothermal heat pump technology
  - Robert C. Webber (1940s)

- **EarthLinked Technologies**
  - Established in 1980 by Robert Cochran, PE
  - Older than most water-source companies
  - Thousands of units sold worldwide
    - > 100,000,000 hours of service
    - 18 countries and 48 US states
  - Reputable and excellent track-record
  - Tested by the EPA: 75% energy savings

- **Time-tested**
  - Our oldest systems (1980s) still performing as designed today
  - Technology: mature and innovative
MYTH #10

“It’s only a small part of the market”

→ Alternatives: “Direct Exchange geothermal is a fraction of the geothermal market”

- HVAC market
  - Geothermal heat pumps as a whole are only ≈2% of the HVAC industry

- Geothermal market
  - Growing quickly
  - Will triple by 2020
  - Predicted Compound Annual Growth Rate ≈14% (between 2015 and 2020)

- Current market barriers: why EarthLinked has key advantages
  - US Department of Energy
  - Technological challenges
    - Loops are complex and expensive
    - Installation-specific design and engineering of the ground loop
  - Market challenges
    - Initial upfront cost and Payback
    - Space constraints
    - Outdated Regulatory Policies
    - Low market awareness