



UNCONVENTIONAL GAS DEVELOPMENT: REDUCING THE “ENVIRONMENTAL FOOTPRINT” OF HYDRAULIC FRACTURING

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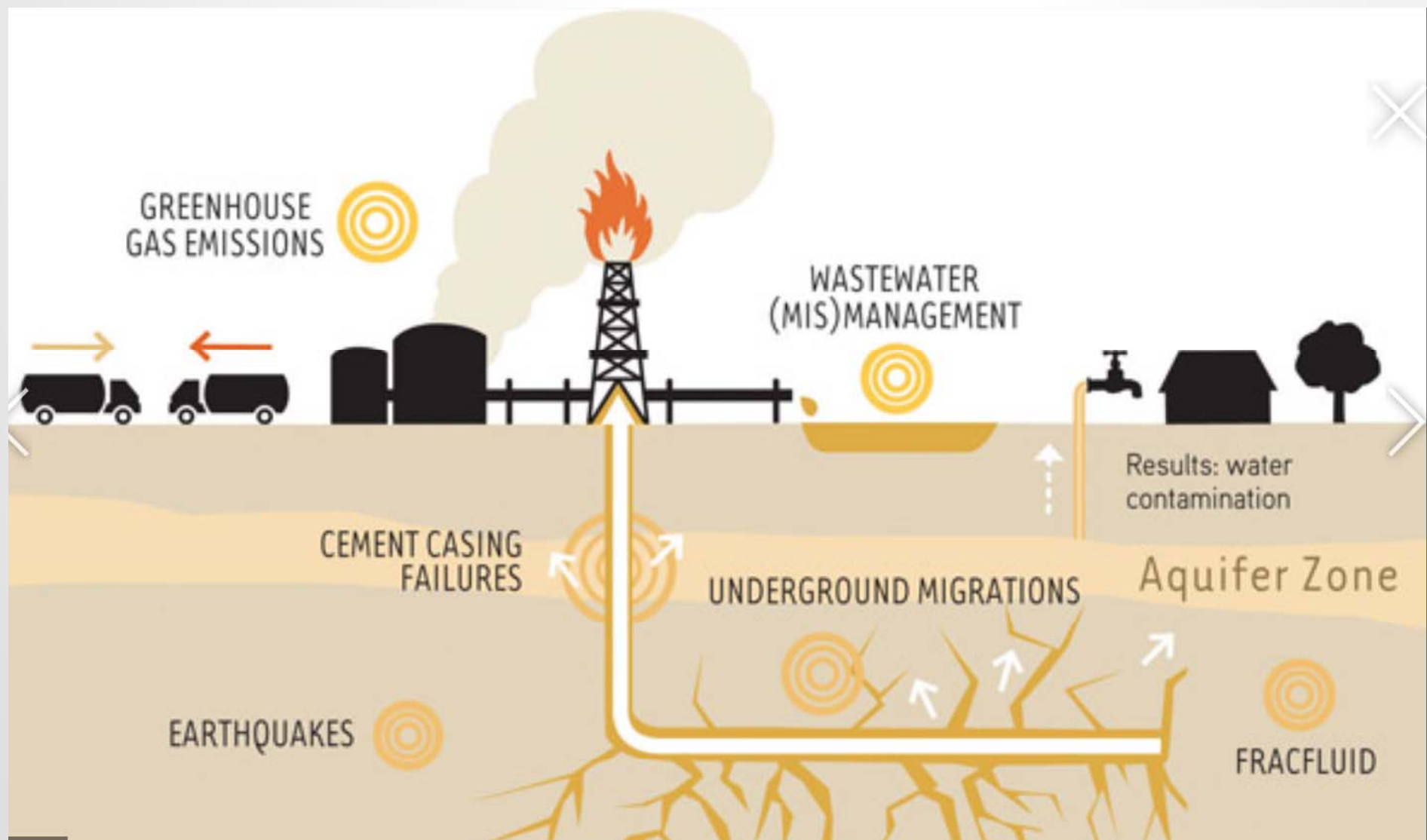
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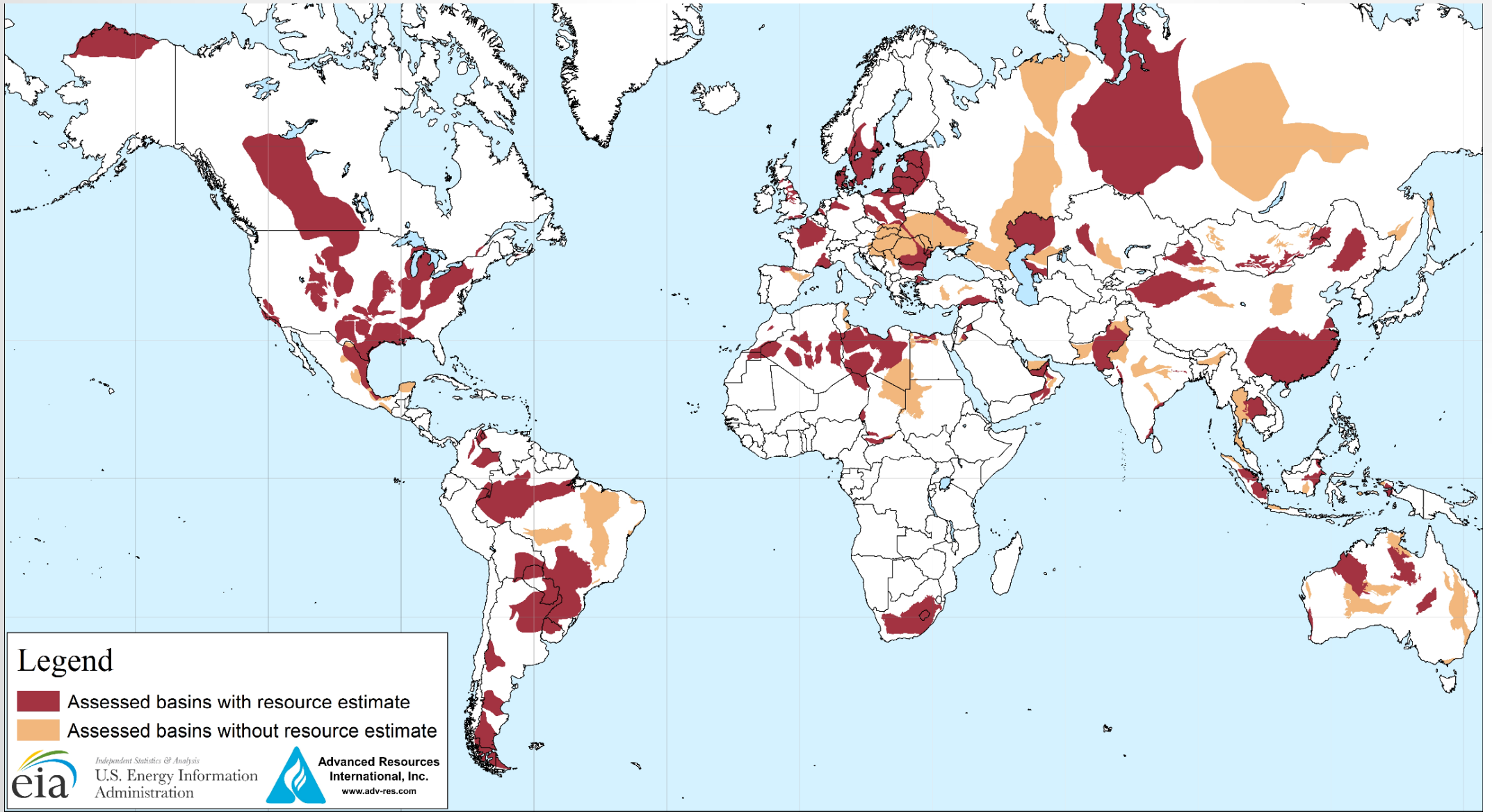
THE ROLE OF NATURAL GAS IN REDUCING CC

- Natural gas-fired electricity production is 50 percent less “carbon intensive” than coal-fired electricity production
- In addition, gas-fired electricity avoids the emission of other pollutants such as sulphur dioxide, nitrogen oxide and mercury
- As a result there has been much “switching” of production fuels from coal to gas and a reduction in carbon emissions
- However, if care is not taken the unconventional production of natural gas may minimize carbon-reduction benefits
- Additionally, there can be severe water-related difficulties including use of water, pollution and earthquakes

WHAT IS "FRACKING"

- Also called hydraulic fracturing, this innovative method for producing gas (and oil) has revolutionized the petroleum sector
- For example, U.S. oil and gas production has grown substantially in the last 10 years
- The combination of more abundant gas production and the increasing concern about electricity generated from coal has meant a substantial change in the energy market, particularly the electricity generation sector





FROM THE GAS STANDPOINT...

- A key challenge is to reduce methane leaks; methane is a very strong greenhouse gas
- Methane leaks can happen in any aspect of the “production system”
 - Leaks need to be detected and repaired as quickly as possible
 - There is technology available that detects methane, but much of it now requires human intervention
 - The concept of using “remote sensing” is becoming recognized as a practical option; but this will take funding and organization that is not at the moment in place

FROM THE WATER STANDPOINT...

- Much shale gas is located in parts of the world that suffer scarcity of water
- One approach to addressing this is to use technologies that require less water
 - Atmospheric water harvesting
 - Use of reusable “gels” as the source of fracking fluid; the gel undergoes very rapid expansion underground
- Another key challenge, and one that has more recently come to the forefront, is “induced seismicity”
 - Scientists now know that the disposal of wastewater in underground injection wells may, depending on the underlying geology, set off earthquakes
 - There is now a computer program aimed at predicting where earthquakes may happen

MEANS OF ENCOURAGING ADOPTION



- Voluntary adoption by companies
- Industry voluntary standards
- Government regulation

COLORADO BECOMES "FIRST MOVER"



- Fracking grows substantially between 2008-2014
- Governor brings together regulators, industry and environmental groups
- Collaboration agreement on new methane reduction measure to eliminate 95 percent of emissions
- No law suits, no political challenges, wide support by public



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