**EN-ROADS FACILITATOR PROMPTS**

 **Land& Industry**

**Energy**

 **Coal**

Worst carbon emitter

High negative climate and health effects

Historically cheap and abundant globally, dominant

**Discouraging is high leverage:** keeps in ground; increases costs, lowers demand

Already phasing out as new energy is cheaper from other sources.

Subject to squeezing the balloon

**Oil**

Historically dominant for transportation; also in heating, industry, electricity.

Politically powerful and volatile.

Squeeze the balloon: must also tax others to benefit

Spill & siting equity issues

Job loss issues

**Natural Gas**

Fracking leaks methane, contaminates water

Long life infrastructure

Siting equity issues

Stop new building alone just balloons coal up

**Bioenergy**

Not very useful; emits CO2

May harm land use and food production

Scale-up problems

Burning = Air pollution

Source varies: some sustainable, some not

Model evolving **Supply**

**Renewables**

Keeps fossils in ground but may only meet new demand

Cheaper/rebound effect increases demand

Storage cost/tech issues

Carbon price helps them

Overheating, learning effect, site availability delays, long lead times.

**Nuclear**

Competes w/ renewables and new technology

Long lead times, expense, risks to radiation, water, miners.

Waste storage issues

**New Technology**

New cheap source e.g.

Fusion, Thorium fission, etc

Does not include new tech in CO2 removal, transport, electrification, energy efficiency

Unknown risks and long time to develop&scale up & displace other fuels

Cheap increases demand

See “Dynamics” & settings

**Carbon Price**

**High Leverage**; keeps FF in ground, foundational.

Reduces coal most, then gas. Less so oil (not easily subbed for transport)

Cost increase reduces use

Issues of job loss, revenue/ dividend use, equity

Powerful industry opposition likely

**Transport**

**Energy Efficiency**

Changing personal behavior & modes, not just cars: mass transit, bike, walk, tele-commute. Oil and gas fall as electrified transport more efficient

Lower costs & improved air quality

Less stress on electric grid

**Electrification**

Cars, buses, trains, ships

Oil use goes down but electricity use goes up, just not as much

Reduces GHG emission If low carbon electricity

Affordability/equity issues.

Requires charging stations

Improved air quality

Job shifts

Lithium/copper mining issues

**Buildings & Industry**

**Energy Efficiency**

**EXPLANATIONS**

**Delays & Capital Stock Turnover**

**Price, Demand, Supply linked**

**Success Builds Success**

**Fossil Fuel Growth Constrained/Time**

**Supplies Compete for Market Share**

**Non-CO2 gases = Big Temp Effects**

**BATHTUB effect**

Buildings, appliances, machines, insulation HVAC, lighting, computers, etc

**High leverage** Lowers energy use and costs

Lower pollution/health benefits.

Capital cost issues; renters may not benefit

**Electrification**

 :**00 Introduction**

 **:10 Their Scenarios**

 **:25 More Scenarios**

 **:45 Silence/Reactions**

 **:55 Hope**

**1:05 Call to Action**

**1:15 Questions/Discussion**

Can help some if FF discouraged as source

Changes demand &fuel mix

Air quality improves

Up front cost to retrofit

**Growth**

**Population**

UN scenario range used

Women’s education and access to family planning can reduce growth, energy use, overall consumption of resources

Cultural barriers vary

**Economic Growth**

Goods and services GDP per person. 2.5% BAU used

**High Leverage but lots of equity issues.** Does growth lower poverty or help wealthy? Low growth tends to lower gov’t service to poor.

GNH(Happiness)? Less consumption?

Model does not include growth feedback effects from energy prices, taxes, climate change, pandemics, etc.; Need to change those manually

**Emissions**

**Deforestation**

Often burned to clear for crops (soy, corn, palm oil [as biofuel]) or livestock.

**Relatively low leverage** due to energy CO2 so dominant but preserves indigenous peoples’ lands, biodiversity. Provides food and livelihood for some, prevents erosion &soil loss

 **Gas emissions area graph**

**Methane & Other**

Methane (agriculture, gas fracking, waste) nitrous oxide (fertilizer), F gases (industry, refrigerants)

**30% of emissions**

**High leverage but need more research to scale up**.

Plant-based diets, sustainable agriculture, reduce leakage from drilling, less fertilizer.

Cultural and food system barriers (e.g. rice paddies)

**Carbon Removal**

**REMINDERS**

**Always ask questions**

**What do you think it will do?**

**Tell where to look; REPLAY**

**Did it solve the problem?**

**Did it help?**

**Co-benefits and Equity**

**WHEN things happen matters**

**Duplicate vs additive policies**

**Time delays of rollouts**

**Stacked gas graph/methane?**

**What do KAYA Graphs say?**

**Multi-solving**

**Afforestation**

Plant new / restore old

**High theoretical potential but immense amounts of land required for large temperature impact GRAPH vs India size**

Long time to acquire land, plant and mature to capture carbon. Land rights issues. New habitat if not monoculture.

**Technological**

Enhance natural removals or manually sequester & store carbon. Includes direct air capture, bioenergy w/ carbon capture & storage, biochar, and others (but not including coal or gas CCS). CDR not yet used widely, most approaches face significant barriers to deployment.

**Land Graph**

**By Paul Fisk**