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# **Unconventional Gas in Indonesia; messages from Australian gasfield communities**

**Dr Mariann Lloyd-Smith PhD (Law)**  
**Senior Policy Advisor, National Toxics Network/IPEN**  
[info@ntn.org.au](mailto:info@ntn.org.au) / [www.ntn.org.au](http://www.ntn.org.au) / [www.ipen.org](http://www.ipen.org)



**NTN**  
NATIONAL  
TOXICS  
NETWORK





- What is the unconventional gas (UG) and hydraulic fracturing (fracking) ?
- Developments in Indonesia
- Chemicals used and released - what we know and what we don't
- Air pollution from UG
- Managing UG wastes
- Methane leaks, is UG climate friendly ?
- Impacts on human health
- References & resources



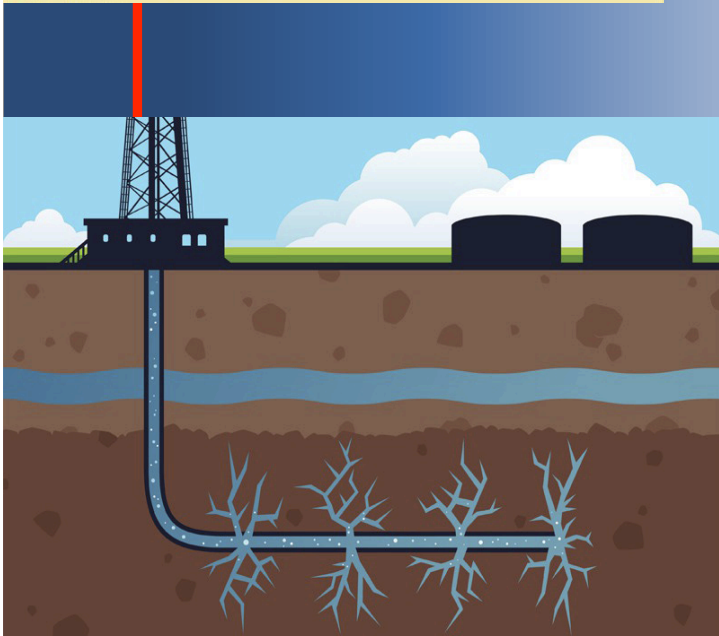
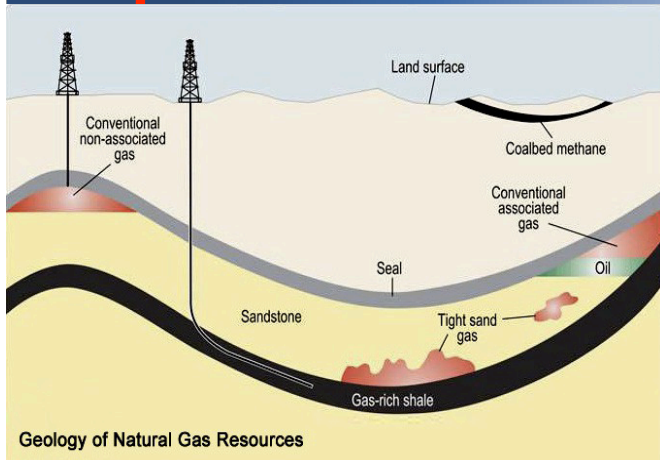
# What is the unconventional gas and fracking ?

**Shale gas:** in shale 2,000 metres below ground, hydraulically fractured to release gas, need 7.7 - 38 megalitres/ML H<sub>2</sub>O

**Coal bed methane/Coal seam gas:** adsorbed into coal, 800-1200 metres, depressurised by pumping the water out, as pressure declines about 40% wells *fracked*, need 0.2 - 1.3 ML H<sub>2</sub>O

**Tight gas:** in sandstone/limestone, acidisation, fracked

**Hydraulic fracturing (*fracking*/HF)**  
injecting wells at high pressure with water, proppants, radioactive tracers, chemical additives to fracture the formation & produce new cracks to help extract gas





# Unconventional Gas Developments in Indonesia

- Indonesian government promoting CBM & shale gas
- *estimates 1500 - 2500 Trillion Cubic Feet (tcf)*



## Coal Bed Methane (CBM)

South & Central Sumatra, East Kalimantan

## Shale gas

- 4 projects produce commercial gas 2018
- 2013 another 2 shale gas production agreements in North Sumatra

## Tight gas

- North & South Sumatra, East Kalimantan, Java

## Australian companies

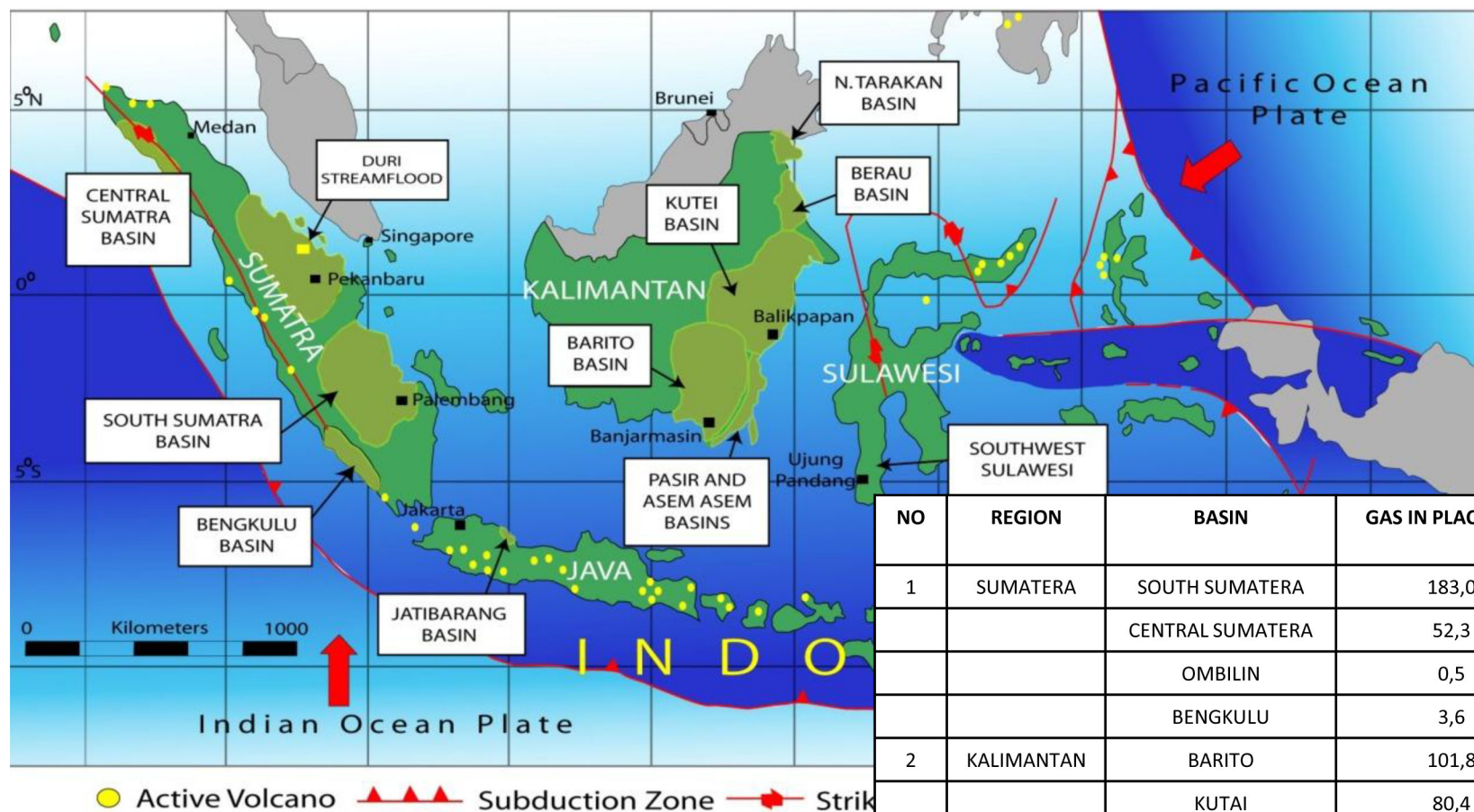
- Lion Energy Ltd, Dart Energy, Santos







## CBM RESOURCES (SPECULATIVE) IN SEDIMENTARY BASIN OF INDONESIA (ARII, 2003)



NO	REGION	BASIN	GAS IN PLACE (Tcf)
1	SUMATERA	SOUTH SUMATERA	183,0
		CENTRAL SUMATERA	52,3
		OMBILIN	0,5
		BENGKULU	3,6
2	KALIMANTAN	BARITO	101,8
		KUTAI	80,4
		PASIR & ASAM-ASAM	3,0
		NORTH TARAKAN	17,5
		BERAU	8,4
3	JAWA	JATIBARANG	0,8
4	SULAWESI	SOUTH SULAWESI	2,0
		Total Gas In Place	453,3

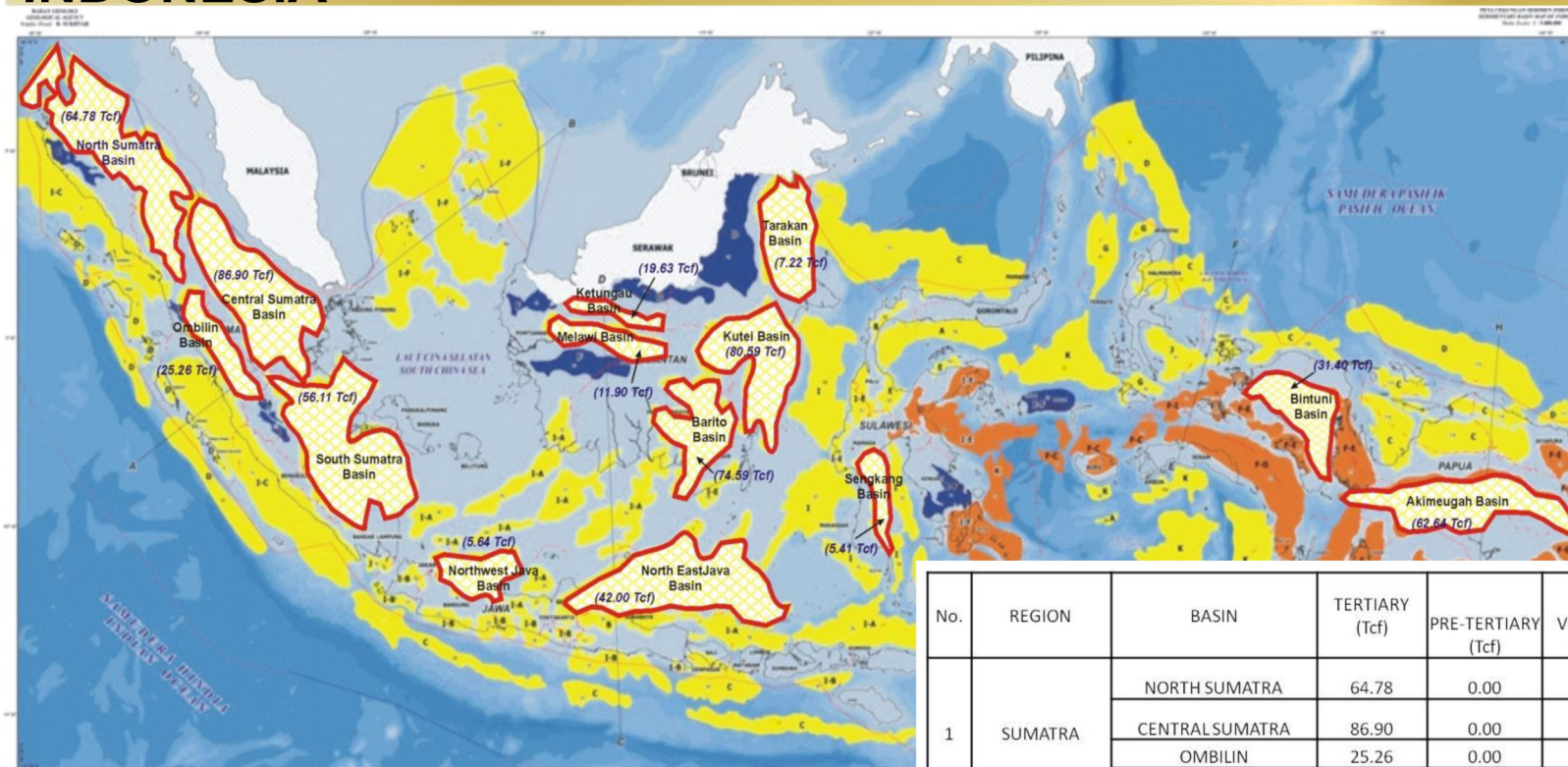
TOTAL SPECULATIVE RESOURCES OF CBM  
INDONESIA: 453,3 TCF

ARII : Advance Resource International Inc.

# SHALE GAS RESOURCES OF MAIN SEDIMENTARY BASINS OF INDONESIA



BADAN GEOLOGI KESDM



**Total Speculative Resources of Shale gas in Indonesia = 574.07 Tcf**

No.	REGION	BASIN	TERTIARY (Tcf)	PRE-TERTIARY (Tcf)	VOLUME OF GAS IN PLACE (Tcf)	TOTAL VOLUME OF GAS IN PLACE (Tcf)
1	SUMATRA	NORTH SUMATRA	64.78	0.00	64.78	233.05
		CENTRAL SUMATRA	86.90	0.00	86.90	
		OMBILIN	25.26	0.00	25.26	
		SOUTH SUMATRA	56.11	0.00	56.11	
2	JAWA					47.64
		NW JAWA	5.64	0.00	5.64	
		NE JAWA	42.00	0.00	42.00	
3	KALIMANTAN					193.93
		BARITO	74.59	0.00	74.59	
		KUTEI	80.59	0.00	80.59	
		TARAKAN	7.22	0.00	7.22	
		MELAWI	11.90	0.00	11.90	
		KETUNGAU	19.63	0.00	19.63	
4	SULAWESI					5.41
		SENGKANG	5.41	0.00	5.41	
5	PAPUA					94.04
		AKIMEUGAH	5.50	57.14	62.64	
		BINTUNI	1.15	30.25	31.40	
	TOTAL SPECULATIVE RESOURCES OF SHALE GAS					574.07





## UNEP Unconventional Gas Global Alert 2012

*'UG may have unavoidable environmental impacts. Some risks result if the technology is not used adequately but others will occur despite proper use of technology.'*



**climate, water  
contamination  
air pollution  
public health  
biodiversity**





## Chemicals used in unconventional gas

**Drilling fluids:** corrosion inhibitors, lubricants, defoamers

**Fracking fluids:** friction reducers, surfactants

- 0.5-2.0% chemical additive

Shale 15 to 100 tonnes per frack

CBM 18 tonnes, up to 40% not recovered

- carcinogens, neurotoxins, sensitisers, reprotoxins, endocrine disruptors (*Kassotis 2014*)
- ‘some dangerous at concentrations near or below chemical detection limits’ (*State Uni. of New York 2011*)

Caesium 137: borehole logging, measure flows

Proppants : silica based products / polymers

- 50 - 3,000 tonnes



## Chemical secrets, data gaps & mishaps

**American Chemical Society** : 65/190 *'hardly any toxicity information'* 34 no toxicity data, 8 toxic to mammals

**EU Commission**: unassessed interactions and mixtures eg chlorocarbons, organobromides

*(Maguire-Boyle 2014)*

Inadequate environmental fate & ecotox data

**Trade secrets**: eg fluorinated surfactants & tracers with persistent toxic break down products

Unknown impacts of accidents, well failures, blowouts, leaks, spills





## Air Pollution From Unconventional Gas

***World Health Organisation declares outdoor air pollution carcinogenic 2013***

UG gasfields & infrastructure emit a wide range of air pollutants

- NO<sub>x</sub> VOCs CO SO<sub>2</sub> PM BTEX
- Synergy of PM & air pollutants

USEPA

- UG air toxics can cause cancer, neurological problems, birth defects
- large industrial emitter of volatile organic compounds (VOCs)

**Sources:** compressors, machinery, drill rigs, vehicles, dehydration units, water treatment, flaring, venting, fugitive emissions



## Air Pollution from a Santos Gasfield

**Volatile organic compounds** 1,167,744 kg

- some carcinogens, neurotoxins, EDCs, liver, kidney

**Oxides of Nitrogen** 6,154,570 kg

- respiratory / lung damage, heart conditions

**Carbon monoxide** 849,157 kg

- poisonous if inhaled

**Particulate Matter** 30,823 kg

- respiratory problems, cancer, synergise air toxics

**Ethylene glycol** 18,520 kg

- irritate eyes, nose & throat, respiratory toxicant

**Sulfur dioxide** - respiratory illness, heart conditions

**Methanol** - CNS depression, headache, dizziness

**Phenol, Cadmium, Lead compounds**

*SANTOS Fairview Gasfield 2012-13 Report  
to Australia's National Pollutant Inventory*



## Exposure to Radioactive substances

Naturally occurring radioactive materials (NORMS) in CBM & shale deposits dependent on age & salinity eg thorium, uranium, radon



**Radium** in drinking water - lymphoma, bone cancer, leukemia

**Radon** inhaled - lung cancer, leukemia

WHO '*no safe level of exposure*'

Remobilised via drilling, fracking, waste water, earthworks

- *3 fold increase in radon inside gas field*

*(Tait et al 2013)*

Relocated via PM, resuspension, wastewater

- particle fallout & washout from rain
- pathways to domestic gardens & water tanks



## UG Wastes and Contamination

**Wastewater** - heavy metals, BTEX, NORMs

- storage ponds, partial treatment & release

**Wastes** - salts, treatment condensates,

- drilling muds - heavy metals, hydrocarbons

**Spills leaks** eg *'Santos coal seam gas project contaminates aquifer'* with Uranium

**Well integrity** - approx 7% failure rate

Benzene, Toluene, Ethylbenzene, Xylene

- BTEX in Australian water bores

***'Drawdown of ground water heads within coal seam gas aquifers is an unavoidable impact'***  
Santos GLNG 2009





## Unconventional Gas - climate friendly ?



*“...for the sake of having another 20 years of dirt cheap energy are we really going to put millions of years of evolution, of ecosystems, of ecosystem services at risk?”*

Achim Steiner  
Director, UNEP 2014





# Methane - a potent Greenhouse Gas

**Sources:** pipe & valve leaks, venting, leaking wells, flaring, fugitive emissions, soil seepage



*‘3-fold increase in methane concentration inside gas field compared to outside with significant relationship with well numbers’*

Methane 6.89 ppm in gasfields  
<2ppm outside

*(Tait et al 2013, Damien et al 2014)*

26/58 gas wells tested leak  
*(Qld govt 2011)*



## Methane in drinking water

Methane levels in water wells increase closer to gas-drilling sites (*Jackson et al 2013*)



Methane in:

- Australian drinking water bores
- CBM Discharge water 68 X background levels
- Regional water supply Wallumbilla, Qld 2014



Condamine River in Queensland's  
gasfields bubbling methane  
along 5 kilometres  
80% Lower Explosive Level

<http://www.dnrm.qld.gov.au/mining/coal-seam-gas>



# Toxic Air Pollutants around homes near Australian CBM Gasfields

## Tara Residential Estate, Queensland

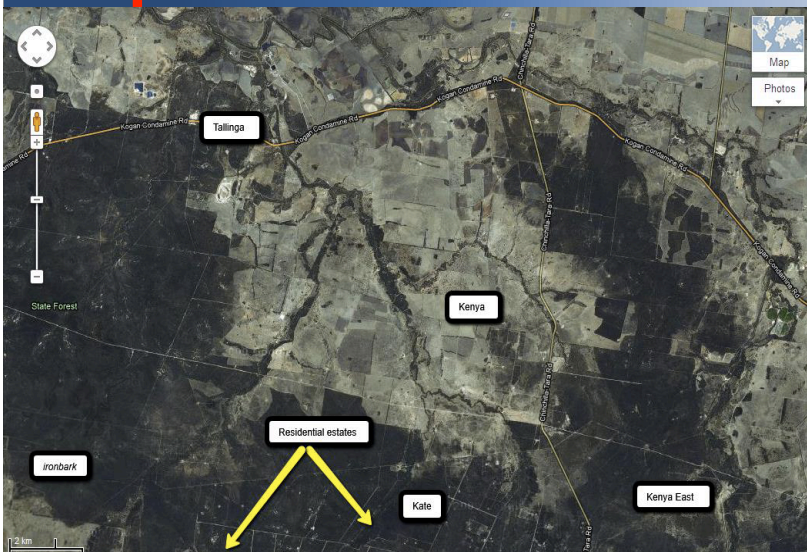
Air samples 2012-13 found wide range of toxic VOCs eg, BTEX, phenol, acetone, benzene, toluene, vinyl acetate, naphthalene, methylene chloride

## Chlorofluorocarbons near gasfields

- CFC ozone depletors

## Residents Drinking Water Tanks

- lead, cadmium, aluminium, methylene chloride, NORMS, Caesium 137





## Queensland Health Study

*“some evidence that might  
associate some residents’  
symptoms to exposures to  
airborne CSG  
contaminants”*

Qld.Govt.Health Report 2013

***Six Tara families  
bought out by UG  
company 2014***



## Reported Health Impacts

### Tara Community Survey 2013

38 households / 113 people, 58% health affected

- skin & eye irritation, rashes, severe headaches, nose bleeds, chest pain / tightness, cough, joint pains, muscle pains & spasms, nausea & vomiting, paraesthesia
- (MacCarron 2014)



Similar symptoms in Pennsylvania, Texas USA

(Earthworks 2012)

Farm animals and pets also affected

(Bamberger et al 2012)

### US Risk Assessment

- living  $\leq 1/2$  mile of shale well gave higher risks for respiratory & neurological effects, excess lifetime cancer risk

(McKenzie et al 2012)





## Intergenerational Equity

### 'Children are not little adults'....

***'Children have special vulnerabilities to the toxic effects of chemicals...exposure at critical stages development may have severe long-term consequences for health' WHO***



Proximity to well pads during pregnancy associated with low birth weight & increased incidence of congenital heart defects & neural-tube defects

(Hill, 2012) (McKenzie et al 2014 )



***NSW State government introduces 2 kilometre exclusion zone around villages, suburbs, towns & agricultural infrastructure***

# Thank you for listening



*the voice of reason*



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## Examples of Toxic Chemicals used in Fracking and Drilling fluids

***Sodium Persulfate*** - sensitizer, rashes/eczema, irritate eyes, long-term exposure affect lung function

***2-Butoxyethanol*** - high doses reproductive problems, birth defects, red blood cells, high mobility, low degradation, contaminate aquifers

***Ethylene Glycol*** - irritate eyes, nose & throat, respiratory toxicant, increased risks of spontaneous abortion, birth defects in animals

***Methanol*** - CNS depression, headache, dizziness, nausea, lack of coordination

***Naphthalene*** - IARC '*possible human carcinogen*', US '*reasonably anticipated to be human carcinogen*', cataracts, workers' urine

***Isopropanol*** - reprotoxin, CNS, degenerative brain changes in rats

***Glutaraldehyde*** - respiratory toxin, induced occupational asthma, mutagen

***Brominated biocides*** - irritants, sensitizers, very toxic to aquatic organisms

***Ethoxylated 4-nonylphenol*** - persistent, bioaccumulative, endocrine disruptor, breast cancer in mice, EU '*very toxic to aquatic organisms*'

# RESOURCES

## NGO websites

<http://www.ntn.org.au>

<http://www.lockthegate.org.au>

<http://www.ipen.org>

<http://www.npi.gov.au> UG industry's emission reports

<http://www.lockthegate.org.au/films> Australian UG documentary, 'Fractured Country'

<http://frackmanthemovie.com> *The Frackman* - movie about Australian farmer Dayne Pratzky taking on the giant gas mining corporations.

<http://www.youtube.com/watch?v=wCMcr27uAg4> ABC documentary, 'Gas Rush'

<https://www.youtube.com/watch?v=PELxZ3K2o0c> 60 Minutes Australia, 'Fracking, The Coal Seam Gas Land Grab'

## Health Impacts

[http://www.health.ny.gov/press/reports/docs/high\\_volume\\_hydraulic\\_fracturing.pdf](http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf)

<http://concernedhealthny.org/wp-content/uploads/2014/07/CHPNY-Fracking-Compendium.pdf>

<http://endocrinedisruption.org>

<http://www.keh.org>

<http://www.healthandenvironment.org>

<http://www.env-health.org>

## Well integrity

<https://www.youtube.com/watch?v=WJ0cBZxpghg> Professor Ingraffea

## Campaigning

<http://www.ucsusa.org/sites/default/files/legacy/assets/documents/center-for-science-and-democracy/fracking-informational-toolkit.pdf>