OIL SANDS

ESTIMATES GLOBAL CARBON IMPACT

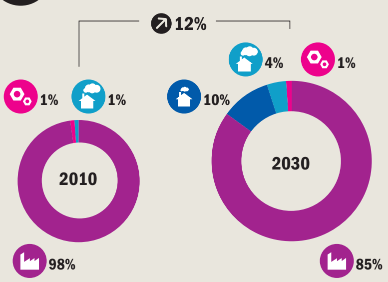
2010 EFFECT TODAY

USD **LOSS** PER YEAR **5 BILLION**

2030 EFFECT TOMORROW

USD **LOSS** PER YEAR **25 BILLION**

ECONOMIC IMPACT



CONFIDENCE
INDICATIVE

SEVERITY

AFFECTED

MDG EFFECT

- Oil sands, or tar sands, are an unconventional source of petroleum extracted from an asphalt bitumen sand-like substance
- With the projected expansion of oil demand over the next twenty years, unconventional fuels, like synthetic crude from oil sands, will make up a significant proportion of the new supply
- Oil sands involve large scale localized ecological damage that is costly to remedy: some environmental damage is thought irreversible
- Oil sand exploitation is highly concentrated with over 90% of all today's production in Canada, although a small number of mainly developing countries also have important reserves

RELATIVE IMPACT

$$$$$$ 2010
54

$$$$$$$$$$ 2030
100

HOTSPOTS

2010	$	2030
7,250	**CANADA**	20,000
0	**NIGERIA**	1,500
0	**MADAGASCAR**	750
85	**INDONESIA**	600
50	**RUSSIA**	350

GEOPOLITICAL VULNERABILITY

BRIC, G8, G20, LDCs, OECD, SIDSs

Economic Cost (2010 PPP non-discounted)
Developing Country Low Emitters
Developed
Developing Country High Emitters
Other Industrialized

$ = Losses per 10,000 USD of GDP

Change in relation to overall global population and/or GDP

$ = Millions of USD (2010 PPP non-discounted)

So-called "unconventional fuels", including oil sand-derived synthetic crude as well as shale oil and gas, make up an increasing share of the global energy mix and are poised to contribute significantly to meeting the surging global demand for fossil fuels expected in the two decades ahead (US EIA, 2011). Unconventional fuels are more costly to extract than ordinary crude oil or natural gas because they involve separating out the hydrocarbon fuels from rocks, sand and other debris.
The extraction process is water, energy and emission intensive, and generates large volumes of environmental debris and toxic sludge waste (Severson-Baker and Reynolds, 2005; Tenenbaum, 2009; Giesey et al., 2010). Over 600km2 of land in Canada has now been disturbed by oil sand exploitation with 600 million tons of toxic waste by-products from this process now held in over 100km2 of "slurry" ponds (Reuter et al., 2010).
The potential growth in environmental risks is significant: proven recoverable reserves are 300 times today's annual production and bitumen deposits that could become recoverable, given technological advances, lie beneath some 140,000 km2 of land, an area almost the size of Bangladesh (GoA, 2012). The Canadian government aims to make Canada an "Energy Superpower" on the back of its oil sand production. Prime Minister, Stephen Harper, has likened this aspiration to "the building of the pyramids or China's Great Wall. Only bigger" (Canada OPM, 2006). Oil sands are expected to more than double in production scale over the next 20 years, with a handful of countries outside Canada also having important deposits of the resource (CAPP, 2011; World Energy Council, 2010).

HAZARD MECHANISM

There are two main types of oil sands exploitation: open pit mining, which involves digging and excavation of bitumen sands containing oil, and various forms of pumping, termed "in situ" extraction. Both processes involve large quantities of water and often solvents to aid the extraction by increasing the fluidity of otherwise highly dense and viscous bitumen sands (Canada NEB, 1996). In order to access the sands via mining, as much as 75 metres of ground soil including all vegetation, usually boreal forests, is removed. On average some two tons of land is removed per barrel of oil extracted (Reuter et al., 2010). Pumping out bitumen oil in situ involves injecting steam and industrial solvents into the ground before pumping out liquefied bitumen (OSDG, 2009).
Each barrel of oil produced generates eight barrels of waste slurry (so-called "fine tailings") with current production at around 1.5 million barrels of oil a day (Reuter et al., 2010; CAPP, 2011). The refuse slurry generated by extraction is highly acidic and acutely toxic to aquatic life (Allen, 2008). Numerous different types of pollutants from these processes, including cadmium, copper, lead and mercury, have been released into adjacent waterways, exceeding in many cases local concentration guidelines for fresh water in nearby populated areas (Kelly et al., 2010).
To date there has only been minimal reclamation of land to remedy the degradation caused. Experts have estimated that around two thirds of all peatlands damaged by oil sand exploitation would be permanently impaired and irrecoverable (GoA, 2012; Rooney et al., 2012).
If action is not taken to treat open waste ponds, through steps such as "bioremediation", which accelerates natural processes to reduce their toxicity, the environmental damage in terms of human health, water, ecosystems and otherwise, is very likely to exceed any treatment costs (Reuter et al., 2010).

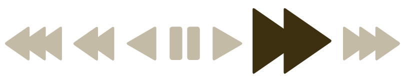
IMPACTS

The environmental impact of oil sands is estimated at over seven billion dollars a year today. As oil sand production is expected to expand, including into other countries, the total environmental costs are set to grow to nearly 25 billion dollars a year in 2030, assuming that much of the world's known reserves have been brought into production (World Energy Council, 2010).
Current and prospective oil sand reserves outside Canada include those found in Angola, China, Congo, Indonesia, Italy, Madagascar, Nigeria, Russia, Trinidad and Tobago and the US. Indonesia, Russia and the US have already commenced small-scale levels of production.
Canada is, and will continue to be, worst affected by the environmental impact of oil sands. By 2030, however, Madagascar, Congo and Nigeria are also expected to suffer significant costs linked to the exploitation of this resource, provided exploitation is carried out. The costs for Canada would grow from seven to 20 billion dollars a year by 2030.

BIGGER PICTURE

N/A

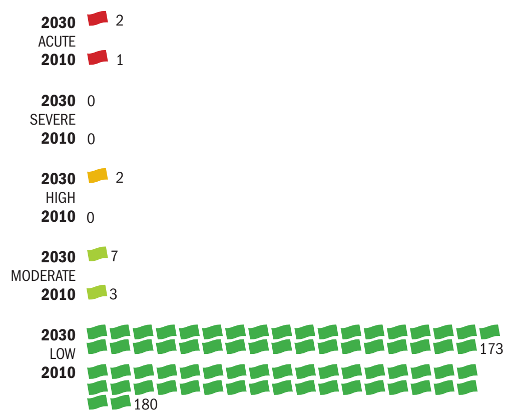
SURGE



OCCURRENCE

N/A

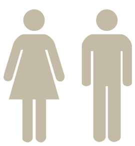
VULNERABILITY SHIFT



PEAK IMPACT

N/A

GENDER BIAS



INDICATOR INFORMATION

MODEL: CAPP, 2011; CERES, 2010

BASE DATA: World Energy Council, 2010

= 5 countries (rounded)

Acute Severe High Moderate Low

THE INDICATOR

The indicator measures the environmental costs of oil sands exploitation by the proxy of measuring the costs of accelerated clean-up, through "bioremediation", of toxic wastes generated. It is assumed that remediation costs are less than or equal to the environmental and health damages that would result if no measures were taken to protect the environment. Currently Canadian oil firms are subject to regulations that could be more forceful in ensuring strict environmental protection measures are complied with: to date the vast majority of toxic waste is untreated (Reuter et al., 2010). Only a small group of countries with significant reserves (four with existing production) are taken into account (World Energy Council, 2010). Environmental "bioremediation" costs per barrel of oil are assumed to be equal for all countries concerned, which could prove an estimation limitation. However, there are few precedents against which to assess the costs.

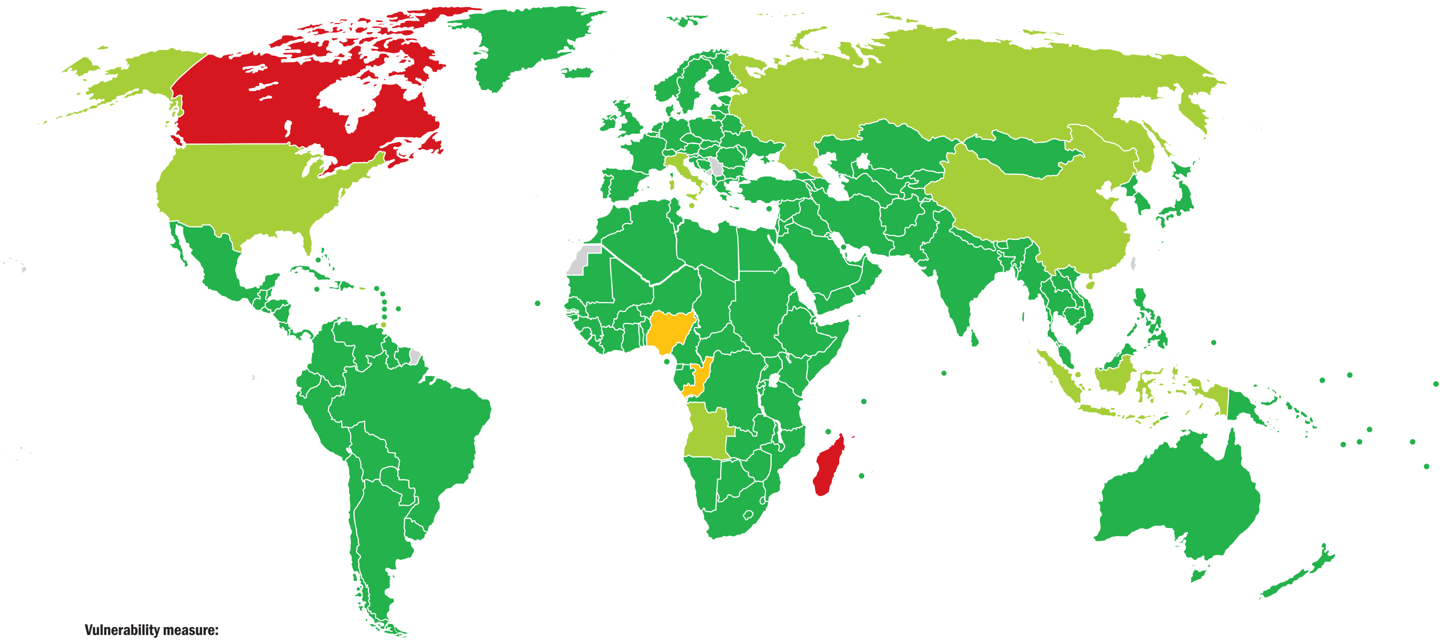
ESTIMATES COUNTRY-LEVEL IMPACT

COUNTRY	$ 2010	$ 2030	☢ 2010	☢ 2030
ACUTE				
Canada	7,250	20,000	150,000	300,000
Madagascar		750		2,000
HIGH				
Congo		150		650
Nigeria		1,500		5,000
MODERATE				
Angola		150		600
China		95		200
Indonesia	85	600	1,250	2,250
Italy		20		250
Russia	50	350	700	1,250
Trinidad and Tobago		30		100
United States	60	150	1,250	2,250
LOW				
Afghanistan				
Albania				
Algeria				
Antigua and Barbuda				
Argentina				
Armenia				
Australia				
Austria				
Azerbaijan				
Bahamas				
Bahrain				
Bangladesh				
Barbados				
Belarus				
Belgium				
Belize				
Benin				
Bhutan				
Bolivia				
Bosnia and Herzegovina				
Botswana				
Brazil				
Brunei				
Bulgaria				
Burkina Faso				
Burundi				
Cambodia				
Cameroon				
Cape Verde				
Central African Republic				
Chad				
Chile				
Colombia				
Comoros				
Costa Rica				
Cote d,Ivoire				
Croatia				
Cuba				
Cyprus				
Czech Republic				
Denmark				
Djibouti				
Dominica				
Dominican Republic				
DR Congo				
Ecuador				
Egypt				
El Salvador				
Equatorial Guinea				
Eritrea				
Estonia				
Ethiopia				
Fiji				
Finland				
France				
Gabon				
Gambia				
Georgia				
Germany				
Ghana				
Greece				
Grenada				
Guatemala				
Guinea				
Guinea-Bissau				
Guyana				
Haiti				
Honduras				
Hungary				
Iceland				
India				
Iran				
Iraq				
Ireland				
Israel				
Jamaica				
Japan				
Jordan				
Kazakhstan				
Kenya				
Kiribati				

$ Additional economic costs (million USD PPP) - yearly average

CARBON VULNERABILITY

Acute · Severe · High · Moderate · Low



Vulnerability measure: comparative losses as a share of GDP in USD (national)

	$		☢	
COUNTRY	2010	2030	2010	2030
Kuwait				
Kyrgyzstan				
Laos				
Latvia				
Lebanon				
Lesotho				
Liberia				
Libya				
Lithuania				
Luxembourg				
Macedonia				
Malawi				
Malaysia				
Maldives				
Mali				
Malta				
Marshall Islands				
Mauritania				
Mauritius				
Mexico				
Micronesia				
Moldova				
Mongolia				
Morocco				
Mozambique				
Myanmar				
Namibia				
Nepal				
Netherlands				
New Zealand				
Nicaragua				
Niger				

	$		☢	
COUNTRY	2010	2030	2010	2030
North Korea				
Norway				
Oman				
Pakistan				
Palau				
Panama				
Papua New Guinea				
Paraguay				
Peru				
Philippines				
Poland				
Portugal				
Qatar				
Romania				
Rwanda				
Saint Lucia				
Saint Vincent				
Samoa				
Sao Tome and Principe				
Saudi Arabia				
Senegal				
Seychelles				
Sierra Leone				
Singapore				
Slovakia				
Slovenia				
Solomon Islands				
Somalia				
South Africa				
South Korea				
Spain				
Sri Lanka				

	$		☢	
COUNTRY	2010	2030	2010	2030
Sudan/South Sudan				
Suriname				
Swaziland				
Sweden				
Switzerland				
Syria				
Tajikistan				
Tanzania				
Thailand				
Timor-Leste				
Togo				
Tonga				
Tunisia				
Turkey				
Turkmenistan				
Tuvalu				
Uganda				
Ukraine				
United Arab Emirates				
United Kingdom				
Uruguay				
Uzbekistan				
Vanuatu				
Venezuela				
Vietnam				
Yemen				
Zambia				
Zimbabwe				

☢ Tonnes of toxic waste (thousands) - yearly average