

Supplementary Materials: Energy Return on Investment of Canadian Oil Sands Extraction from 2009 to 2015

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This Supporting Information consists of three tables (Tables S1–S3), namely, Proportion of projects number and production of selected *in situ* projects, Oil sands projects considered in this paper, and Direct energy input and energy output items included in this paper.

Table S1. Proportion of projects number and production of selected *in situ* projects.

Proportion of selected <i>in situ</i> projects	2009	2010	2011	2012	2013	2014	2015
% of number of <i>in situ</i> projects considered in total number of <i>in situ</i> projects included in AER reports	10%	11%	10%	11%	11%	12%	10%
% of production of <i>in situ</i> projects considered in production of all <i>in situ</i> projects included in AER reports	59%	74%	75%	76%	75%	77%	68%
% of production of <i>in situ</i> projects considered in total <i>in situ</i> production published by CAPP	57%	79%	81%	82%	82%	84%	74%

AER: Alberta Energy Regulator; CAPP: Canadian Association of Petroleum Producers.

Table S2. Oil sands projects considered in this paper.

Type of oil sands projects	2009	2010	2011	2012	2013	2014	2015
Mining oil sands projects	SUNCOR ENERGY OSG ABOS0077 189	SUNCOR ENERGY OSG ABOS0077 189	SUNCOR ENERGY OSG ABOS0077 189	AUX SABLE HEARTL AND OFFGAS PLANT ABOS0117 863	AUX SABLE HEARTL AND OFFGAS PLANT ABOS0117 863	AUX SABLE HEARTL AND OFFGAS PLANT ABOS0117 863	AUX SABLE HEARTL AND OFFGAS PLANT ABOS0117 863
	SYNCRU DE MILDRED LAKE ABOS0077 533	SYNCRU DE MILDRED LAKE ABOS0077 533	SYNCRU DE MILDRED LAKE ABOS0077 533	SUNCOR ENERGY OSG ABOS0077 189	SUNCOR ENERGY OSG ABOS0077 189	SUNCOR ENERGY OSG ABOS0077 189	SUNCOR ENERGY OSG ABOS0077 189
	SYNCRU DE AURORA ABOS0080 249	SYNCRU DE AURORA ABOS0080 249	SYNCRU DE AURORA ABOS0080 249	SYNCRU DE MILDRED LAKE ABOS0077 533	SYNCRU DE MILDRED LAKE ABOS0077 533	SYNCRU DE MILDRED LAKE ABOS0077 533	SYNCRU DE MILDRED LAKE ABOS0077 533
	WILLIAM S FORT MCMURRAY ABOS0080 431	WILLIAM S FORT MCMURRAY ABOS0080 431	WILLIAM S FORT MCMURRAY ABOS0080 431	SYNCRU DE AURORA ABOS0080 249	SYNCRU DE AURORA ABOS0080 249	SYNCRU DE AURORA ABOS0080 249	SYNCRU DE AURORA ABOS0080 249
	ALBIAN SANDS ENERGY INC.	ALBIAN SANDS ENERGY INC.	ALBIAN SANDS ENERGY INC.	WILLIAM S FORT MCMURRAY AY	WILLIAM S FORT MCMURRAY AY	WILLIAM S FORT MCMURRAY AY	WILLIAM S FORT MCMURRAY AY

	ABOS0077 303	ABOS0077 303	ABOS0077 303	ABOS0080 431	ABOS0080 431	ABOS0080 431	ABOS0080 431
	SHELL SCOTFOR D UPGRAD ER ABOS0077 192	SHELL SCOTFOR D UPGRAD ER ABOS0077 192	SHELL SCOTFOR D UPGRAD ER ABOS0077 192	ALBIAN SANDS ENERGY INC. ABOS0077 303	ALBIAN SANDS ENERGY INC. ABOS0077 303	ALBIAN SANDS ENERGY INC. ABOS0077 303	ALBIAN SANDS ENERGY INC. ABOS0077 303
	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231	SHELL JACKPIN E MINE ABOS0098 351	SHELL JACKPIN E MINE ABOS0098 351	SHELL SCOTFOR D UPGRAD ER ABOS0077 192	SHELL SCOTFOR D UPGRAD ER ABOS0077 192	SHELL SCOTFOR D UPGRAD ER ABOS0077 192	SHELL SCOTFOR D UPGRAD ER ABOS0077 192
	OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231	SHELL JACKPIN E MINE ABOS0098 351	SHELL JACKPIN E MINE ABOS0098 351	SHELL JACKPIN E MINE ABOS0098 351	SHELL JACKPIN E MINE ABOS0098 351
		OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317	OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231	CNRL HORIZO N OIL SANDS PROJECT ABOS0093 231
				OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317	OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317	OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317	OPTI LONG LAKE PROJECT UPGRAD ER ABOS0098 317
					KEARL MINE PROJECT 2-9-097- 07W4M ABOS0101 871	KEARL MINE PROJECT 2-9-097- 07W4M ABOS0101 871	KEARL MINE PROJECT 2-9-097- 07W4M ABOS0101 871
<i>In situ</i> oil sands projects	Cenovus Christina Lake 8591	Cenovus Christina Lake 8591	Cenovus Christina Lake 8591	Baytax Cliffdale 11034	Baytax Cliffdale 11034	Baytax Cliffdale 11034	Cenovus AIDROH 11618
	Cenovus Foster Creek 8623	Cenovus Foster Creek 8623	Cenovus Foster Creek 8623	Cenovus Christina Lake 8591	Cenovus AIDROH 11618	Baytex Gemini 11789	Cenovus Christina Lake 8591
	Connacher Great Divide 10587	CNRL Primrose and Wolf Lake 9140	CNRL Primrose and Wolf Lake 9140	Cenovus Foster Creek 8623	Cenovus Christina Lake 8591	Cenovus Pelican 11469	Cenovus EnCAID10 440
	ConocoPhi llips Surmont 9426	Connacher Algar 11253	Connacher Algar 11253	CNRL Primrose and Wolf Lake 9140	Cenovus Foster Creek 8623	Cenovus AIDROH 11618	Cenovus Foster Creek 8623
	ConocoPhi llips	Connacher Great	Connacher Great	Connacher Algar	CNRL Kirby 11475	Cenovus Christina Lake 8591	CNRL Kirby 11475

Surmont Pilot 9460	Divide 10587	Divide 10587	11253/10587			
Devon Jack Fish 10097	ConocoPhillips Surmont 9426	ConocoPhillips Surmont 9426	Connacher Great Divide 10587	CNRL Primrose and Wolf Lake 9140	Cenovus EnCAID10 440	CNRL Primrose and Wolf Lake 9140
Husky Tucker Lake 9835	ConocoPhillips Surmont Pilot 9460	ConocoPhillips Surmont Pilot 9460	ConocoPhillips Surmont 9426	Connacher Algar 11253/10587	Cenovus Foster Creek 8623	Connacher Algar 11253/10587
Imperial Cold Lake 8558	Devon Jack Fish 10097	Devon Jack Fish 10097	ConocoPhillips Surmont Pilot 9460	Connacher Great Divide 10587	CNRL Kirby 11475	Connacher Great Divide 10587
JACOS Hangingstone 8788	Husky Tucker Lake 9835	Husky Tucker Lake 9835	Devon Jack Fish 10097	ConocoPhillips Surmont 9426	CNRL Primrose and Wolf Lake 9140	ConocoPhillips Surmont 9426
MEG Christina Lake 10159	Imperial Cold Lake 8558	Imperial Cold Lake 8558	Husky Tucker Lake 9835	ConocoPhillips Surmont Pilot 9460	Connacher Algar 11253/10587	ConocoPhillips Surmont Pilot 9460
Nexen Long Lake 9485	JACOS Hangingstone 8788	JACOS Hangingstone 8788	Imperial Cold Lake 8558	Devon Jack Fish 10097	Connacher Great Divide 10587	Devon Jack Fish 10097
Shell Orion 10103	MEG Christina Lake 10159	MEG Christina Lake 10159	JACOS Hangingstone 8788	Husky Tucker Lake 9835	ConocoPhillips Surmont 9426	Husky Tucker Lake 9836
Shell Peace River 8143	Nexen Long Lake 9485	Nexen Long Lake 9485	MEG Christina Lake 10159	Imperial Cold Lake 8558	ConocoPhillips Surmont Pilot 9460	JACOS Hangingstone 8788
Suncor Firebag 8870	Shell Orion 10103	Shell Orion 10103	Nexen Long Lake 9485	JACOS Hangingstone 8788	Devon Jack Fish 10097	MEG Christina Lake 10159
Suncor MacKay River 8668	Shell Peace River 8143	Shell Peace River 8143	Pengrowth Lindbergh 6410	Laricina Germaine 1509	Husky Tucker Lake 9835	Nexen Long Lake 9485
	Statoil Leismer 10935	Statoil Leismer 10935	Penn West Seal 11377	MEG Christina Lake 10159	Imperial Cold Lake 8558	Pengrowth Lindbergh 6410
	Suncor Firebag 8870	Suncor Firebag 8870	Shell Orion 10103	Nexen Long Lake 9485	JACOS Hangingstone 8788	Shell Orion 10103
	Suncor MacKay River 8668	Suncor MacKay River 8668	Shell Peace River 8143	Pengrowth Lindbergh 6410	Laricina Germaine 1509	Shell Peace River 8143
			Statoil Leismer 10935	Penn West Seal 11377	MEG Christina Lake 10159	Statoil Leismer 10935
			Suncor Firebag 8870	Shell Orion 10103	Nexen Long Lake 9485	Suncor Firebag 8870
			Suncor MacKay River 8668	Shell Peace River 8143	Pengrowth Lindbergh 6410	Suncor MacKay River 8669

	Statoil Leismer 10935	Penn West Seal 11377
	Suncor Firebag 8870	Shell Orion 10103
	Suncor MacKay River 8668	Shell Peace River 8143
		Statoil Leismer 10935
		Suncor Firebag 8870
		Suncor MacKay River 8668

Note: this table lists the projects included in this paper for each year from 2009 to 2015. The number of oil sands projects covered in this paper varies yearly, due to a limitation of complete source data regarding both energy output and energy input for all oil sands projects.

Table S3. Direct energy input and energy output items included in this paper.

Type of energy flow	Mining Oil Sands	<i>In situ</i> Oil Sands
Direct Energy Input	Coke–fuel & plant use	Natural gas consumption
	Process gas–further processing	
	Process gas–fuel & plant use	
	Paraffinic solvent–fuel & plant use	Electricity consumption
	Diluent naphtha–fuel & plant use	
	SCO–fuel & plant use	
Energy Output	Natural gas purchased	Diesel consumption
	Electricity purchased	
	SCO delivered	
	Bitumen delivered	Bitumen produced
	Intermediate hydrocarbons delivered	
	Paraffinic solvent delivered	Electricity exported
	Diluent naphtha delivered	
	Electricity exported	