UNIVERSITY of the WESTERN CAPE

SLR

global environmental solutions

REGULATIONS AND WATER SCIENCE PLAN FOR UNCONVENTIONAL GAS PRODUCTION

16/09/2015

CONTEXT

- Energy demand
  - Coal and imported crude
- High greenhouse gas emissions
- Constrained electricity supply
- Need to diversify primary energy mix

GAS OPTIONS

Share of energy consumption 2030 – Policy adjusted Integrated Resource Plan for Electricity (DoE, 2013b).

Type	Total capacity	
	MW	%
Coal	41071	45.9
Open cycle gas turbine	7330	8.2
Closed cycle gas turbine	2370	2.6
Pumped storage	2910	3.3
Nuclear	11400	12.7
Hydro	4759	5.3
Wind	9200	10.3
Concentrating solar power	1200	1.3
Photo-voltaic	8400	9.4
Other	890	1
Total	**89532**	

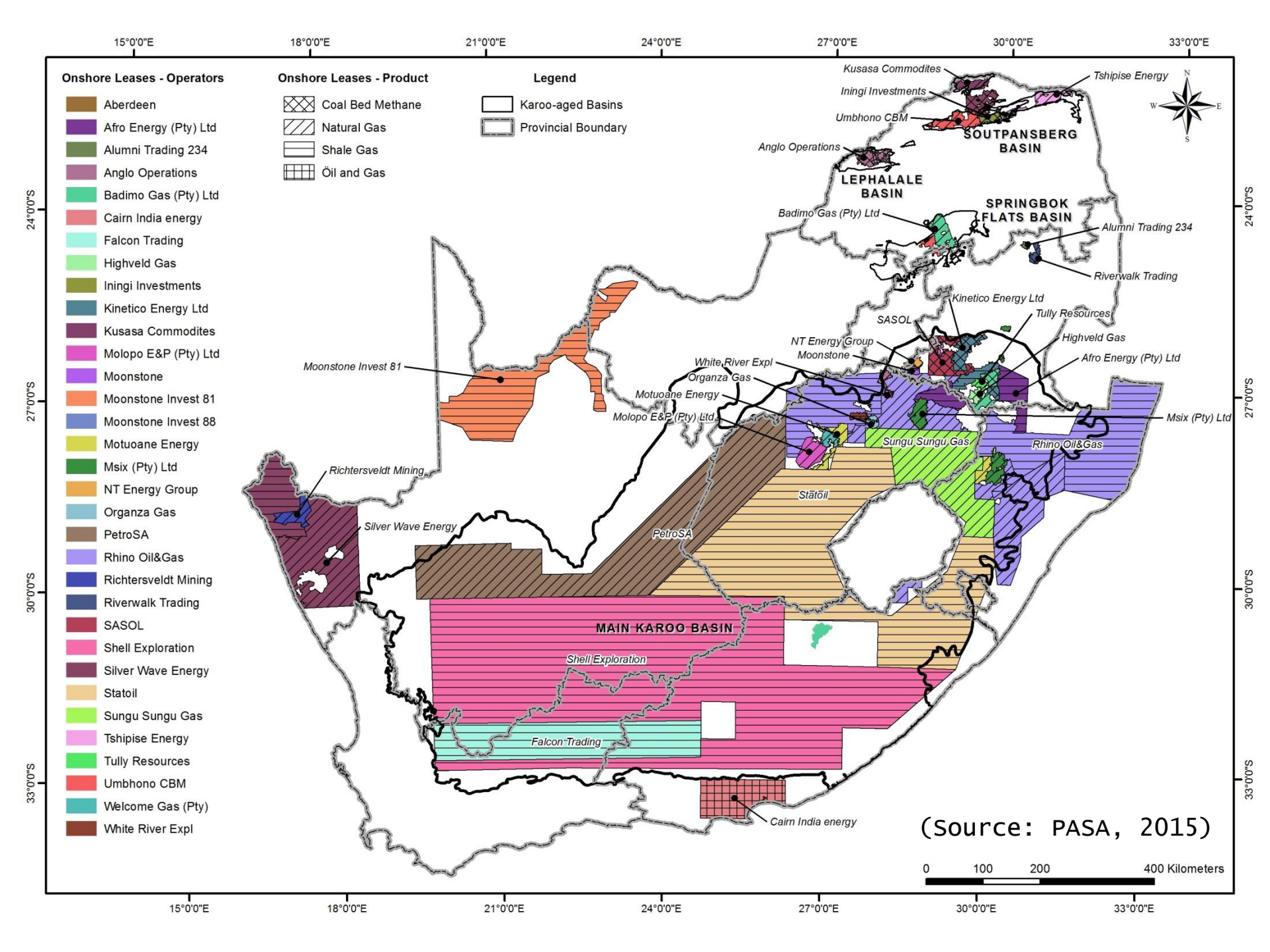
GAS TURBINES

Source: http://essentialbusinessmag.com/wp-content/uploads/2015/03/Ankerlig-Open-Cycle-Gas-Turbines.jpg

UNCONVENTIONAL GAS RESOURCES

- Coalbed methane (CBM)
- Shale gas

CBM production well (photograph taken by Prof Danie Vermeulen - courtesy of Origin Energy).


Onshore Leases - Operators
Aberdeen
Afro Energy (Pty) Ltd
Alumni Trading 234
Anglo Operations
Badimo Gas (Pty) Ltd
Cairn India energy
Falcon Trading
Highveld Gas
Iningi Investments
Kinetico Energy Ltd
Kusasa Commodites
Molopo E&P (Pty) Ltd
Moonstone
Moonstone Invest 81
Moonstone Invest 88
Motuoane Energy
Msix (Pty) Ltd
NT Energy Group
Organza Gas
PetroSA
Rhino Oil&Gas
Richtersveldt Mining
Riverwalk Trading
SASOL
Shell Exploration
Silver Wave Energy
Statoil
Sungu Sungu Gas
Tshipise Energy
Tully Resources
Umbhono CBM
Welcome Gas (Pty)
White River Expl
Onshore Leases - Product
Coal Bed Methane
Natural Gas
Shale Gas
Öil and Gas
Legend
Karoo-aged Basins
Provincial Boundary
Kusasa Commodites
Tshipise Energy
Iningi Investments
Umbhono CBM
SOUTPANSBERG BASIN
Anglo Operations
LEPHALALE BASIN
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Rhino Oil&Gas
Richtersveldt Mining
Statoil
Silver Wave Energy
PetroSA
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Shell Exploration
Falcon Trading
Cairn India energy
(Source: PASA, 2015)
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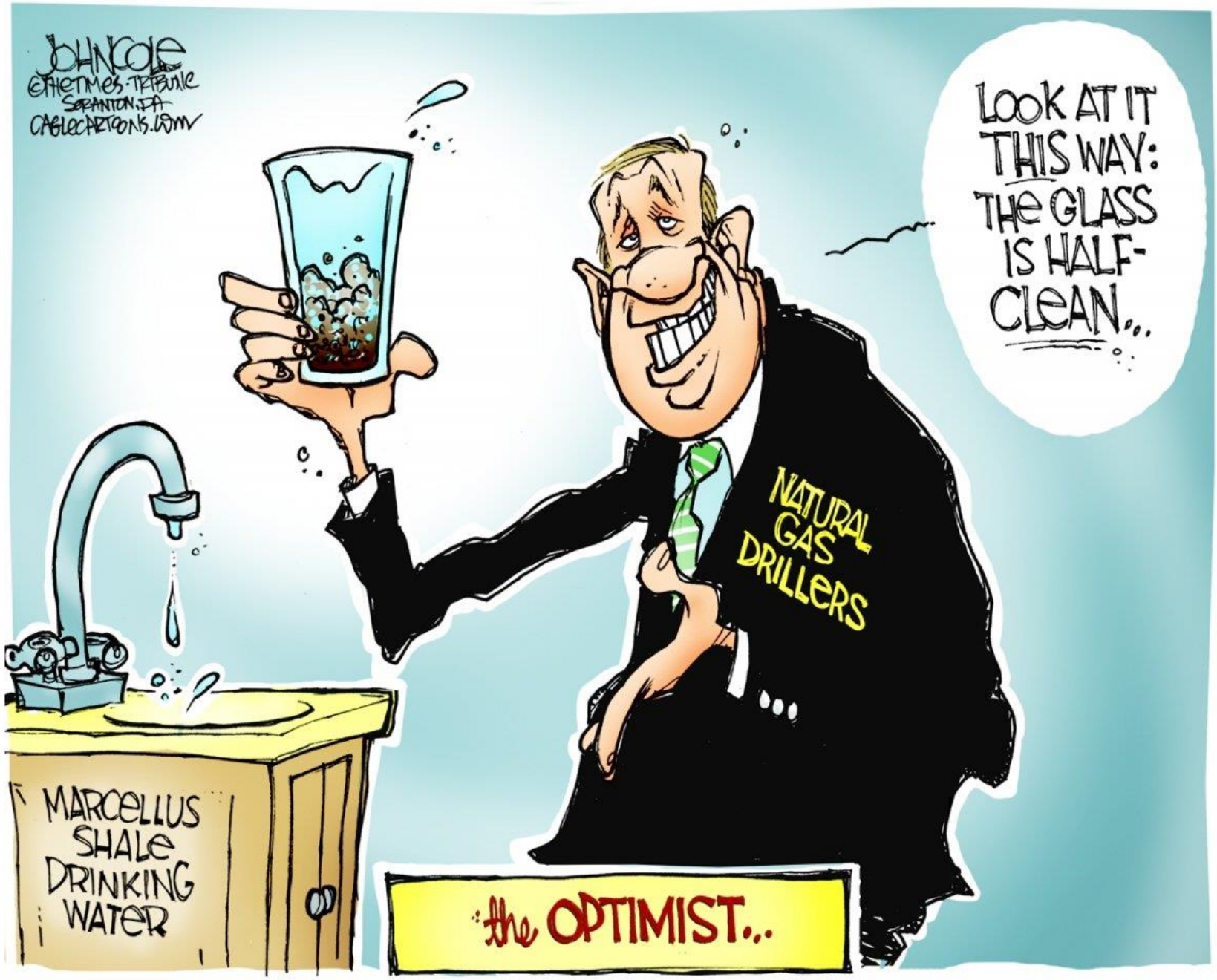
JOHN COLE
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SCRANTON, PA
COLECARTOONS.COM
LOOK AT IT THIS WAY: THE GLASS IS HALF-CLEAN...
NATURAL GAS DRILLERS
MARCELLUS SHALE DRINKING WATER
the OPTIMIST..

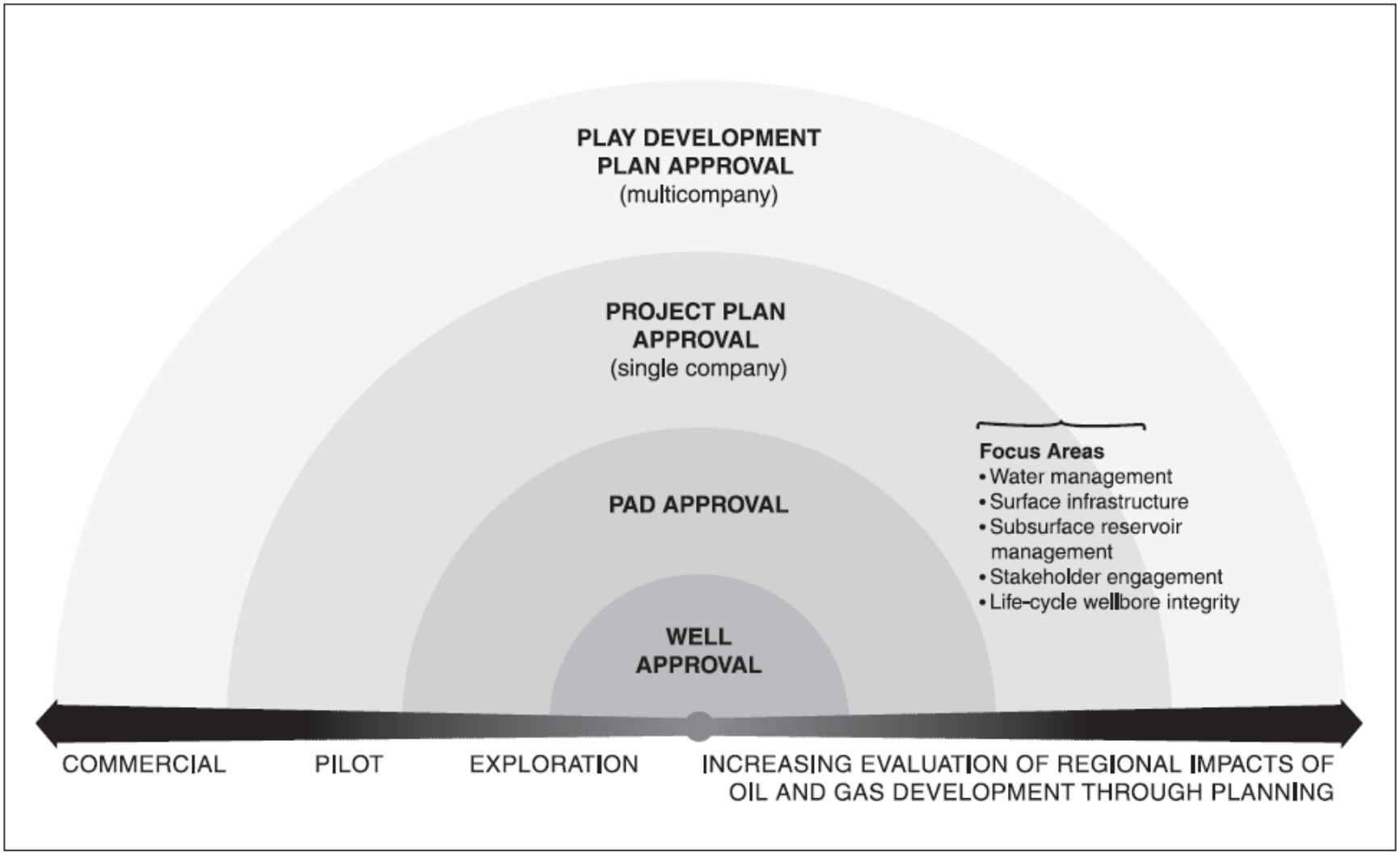
WATER CONCERNS

CBM	Shale gas
• Disposal of co-produced water – "salt management" • Groundwater abstraction and the lowering of the groundwater level • Contamination of water resources by hydraulic fluids • Upward migration of stray gas • Compromised wellbore integrity leading to groundwater contamination incidents	• Leakage of stray-gas from the target formation through faulty well casings to contaminate groundwater • Flowback and produced water from hydraulic fracturing operations risk to surface water resources • The wastewater residue deposits associated with shale gas production carries a risk of groundwater contamination • The development of shale gas water use will be a competing water demand in already stressed water catchments

REGULATORY LESSONS FROM INTERNATIONAL JURISDICTIONS

- Goal-based vs. prescriptive regulation
- Disclosure of hydraulic injection fluid
- The credibility of compliance monitoring and enforcement
- Transparency in decision-making (and research)
- Trade-offs / tolerance levels
- Pre-development monitoring

PLAY-BASED REGULATION



(Energy Resources Conservation Board 2013)

Category	Context	Criterion	Gap
Setting policies	Groundwater policies within overall water policy	Sustainability in quantity and quality	3
		Efficiency in allocation and use within and between sectors	3
		Equity by ensuring fair access and protection of water rights	3
	Cross-sector policy coordination	Coordination with other government departments and regulatory bodies	2
Strategic level governance	IWRM	An IWRM planning function capable of allocating water in line with society's policy goals	3
	Laws, rights and regulatory instruments	A framework of laws, rights and regulatory instruments adapted to the context	3
		Goal-based regulatory framework	2
		Disclosure of hydraulic injection fluid	2
		Compliance monitoring and enforcement	2
	Incentive framework	An incentive framework (prices, subsidies, trade controls etc.) that supports good groundwater management	1
	Subsidiarity and local water management	A framework for subsidiarity and support to local water management	3
	Knowledge and capacity	Acquisition and management of information and knowledge, and communication with stakeholders	2
		Research and knowledge production	2
		Education and training	2
		Information and brokerage	2
		Network and service rendering	2
Local level governance	Baseline measurements	To detect groundwater pollution	1
		To determine resource status	1
	Licenses	Review of licenses and setting conditions	1
	Transgressions	Dealing with non-compliant operators	1
	Prevention of	Mitigation options in place	1

Context	Criterion	Gap	Rank
Cross-sector policy coordination	Coordination with other government departments and regulatory bodies		9
Laws, rights and regulatory instruments	Goal-based regulatory framework		7
	Disclosure of hydraulic injection fluid		8
	Compliance monitoring and enforcement		3
Incentive framework	An incentive framework (prices, subsidies, trade controls etc.) that supports good groundwater management		11
Subsidiarity and local water management	A framework for subsidiarity and support to local water management		10
Baseline measurements	To detect groundwater pollution		1
	To determine resource status		5
Licenses	Review of licenses and setting conditions		2
Transgressions	Dealing with non-compliant operators		4
Prevention of pollution	Mitigation options in place		6

DATA NEEDS

- Pre-drilling baseline conditions
- Hydrogeology
- Monitoring
- Test-bed design
- Drilling, completion, well stimulation, integrity
- Chemicals, additives, and pathways
- Economic Indicators
- Sustainability

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RESEARCH DIRECTIONS

- **Technologies**
  - Drilling and completion
  - Green chemicals
  - Green completions
  - Alternative proppants
  - Water use efficiency/ reuse systems
- **Analytical Tools**
  - Chemical and microbial fingerprinting
  - Sensors
  - Isotopes/tracers
- **Big Data**
  - Real-time information
  - Analytics
  - Visualization
  - Modeling and simulation
  - Decision tools

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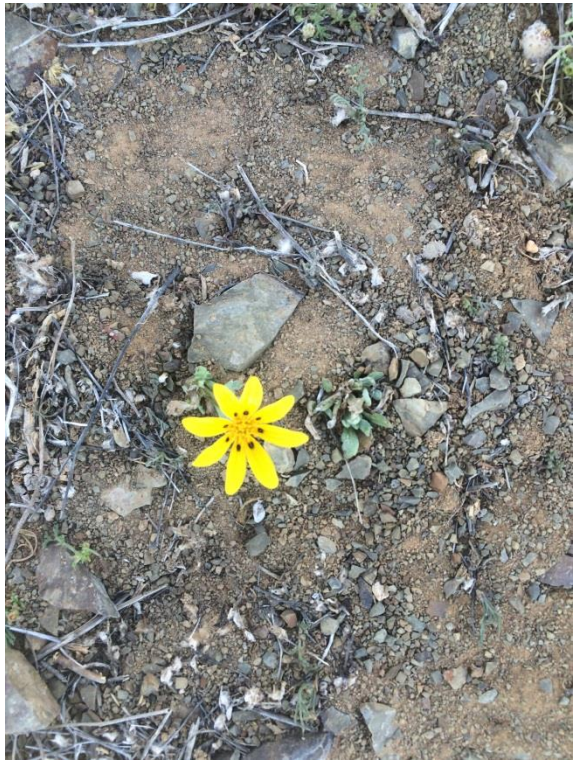
RESPONSES

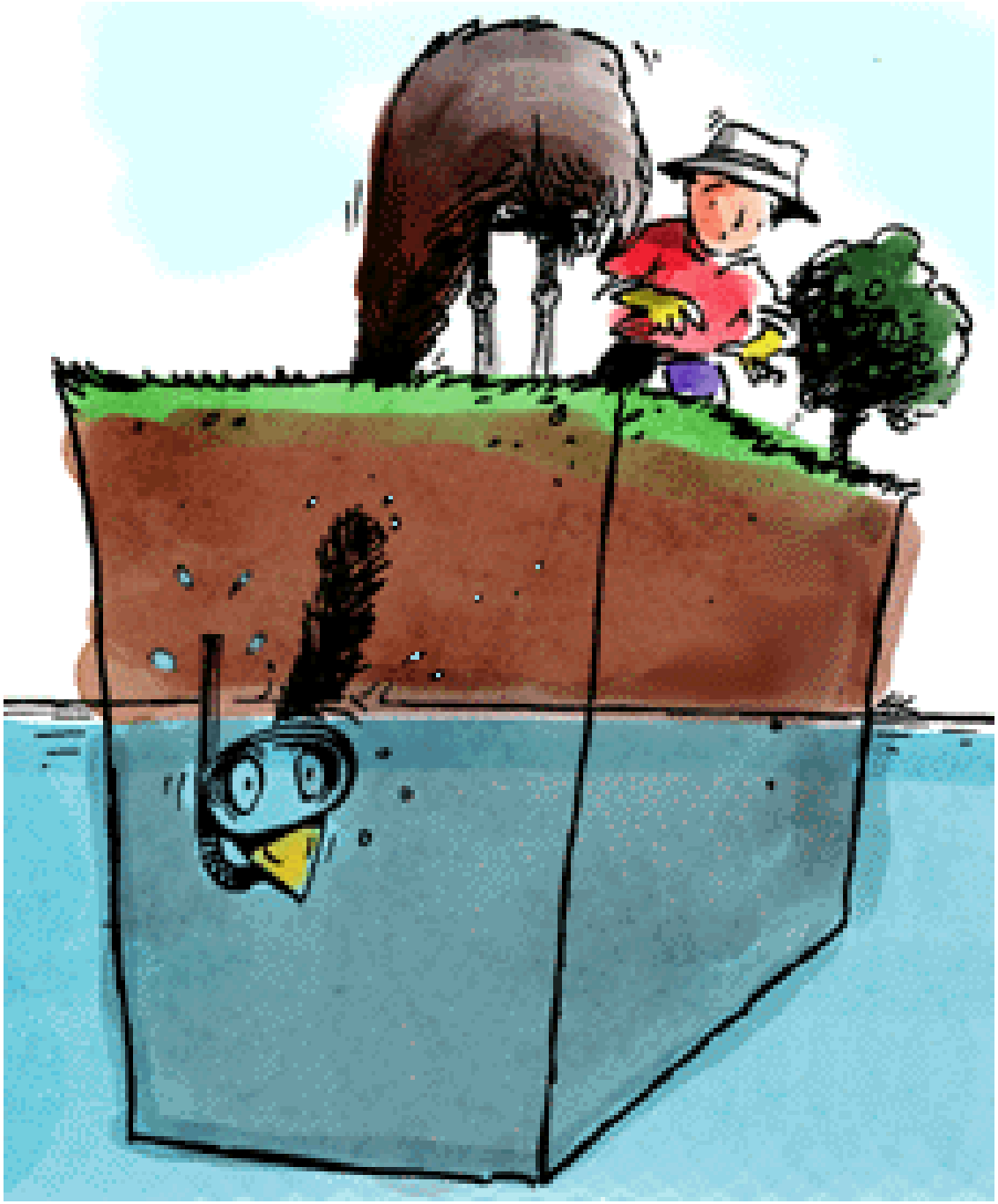
- +50 activities
  - Government departments DEA / DMR / DST / DST
  - CGS
  - Operators
  - SANEDI
  - Universities
  - WRC
  - …

WATER SCIENCE PLAN

- Testbed for technology and evaluation



Thank you



Source: Dennis (2006)