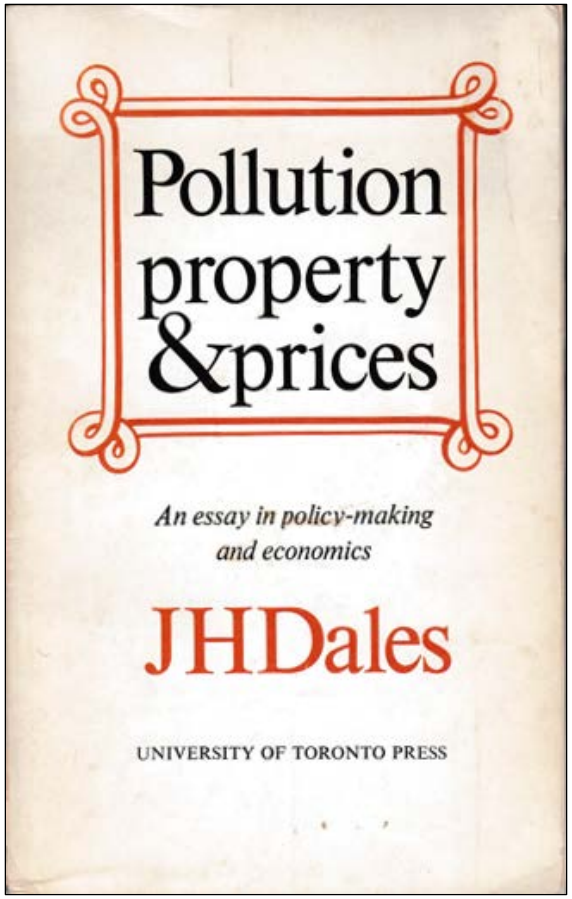
Application of economic tools in China's environmental management

R. Raufer

International Water Rights Forum
Hohai University
Nanjing, P.R. China
17 December 2018

Pioneering environmental market classic



1968

Used Province of Ontario water pollution as example:

- **'Table of equivalents' needed to deal with different effluent wastes;**
- **Needed to 'defer the run-off [i.e., non-point-source] problem';**
- **Needed to define smaller, sub-Provincial 'water control regions':**

  "I haven't said how many water control regions there should be because I don't know how many there should be."

If it is feasible to establish a market to implement a policy, no policy-maker can afford to do without one.

-- J.H. Dales, 1968, p. 100

Engineering vs. Economic Worldviews

	Engineering	Economics
Goals	**EQ Standards**	**MAC = MSB**

Regulatory Means

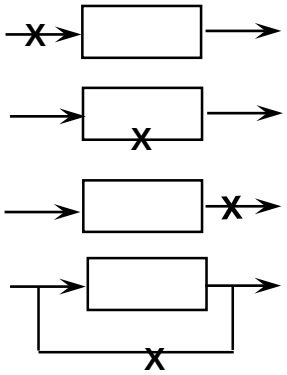
Technology-Based Standards	Economic Mechanisms

Input/Fuel Stds.

Design Stds.

Emission/Effluent Stds.

Performance Stds.

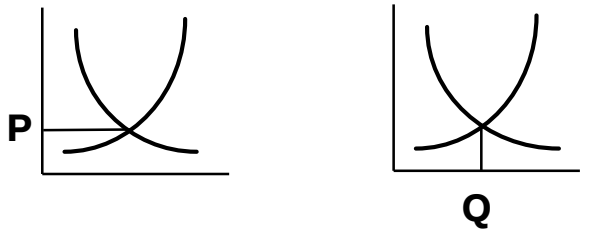


Pollution Taxes (Price-based)

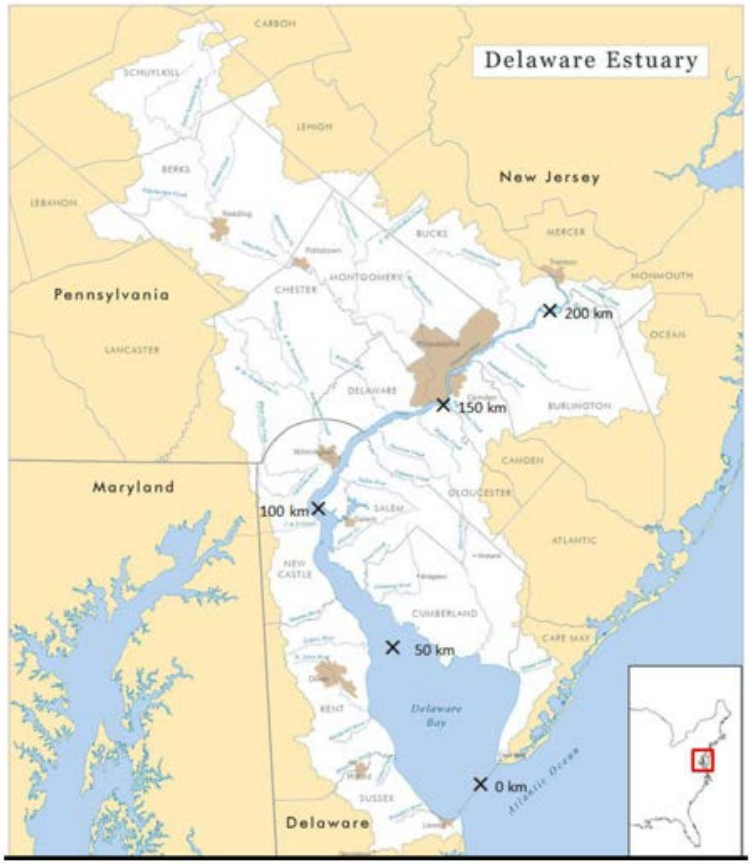
Pigouvian taxation

Pollution Markets (Quantity-based)

Emissions Trading



First significant attempt to determine MAC & MSB



"…the first study to embody at least a rudimentary ecological model into an economic optimization framework"

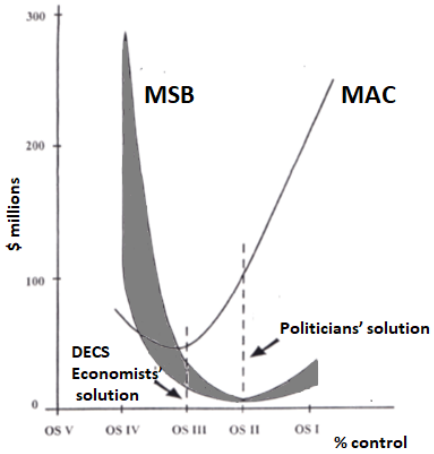
--A. Kneese, 1977

- **Delaware Estuary Comprehensive Study (DECS)**
- **U.S. Public Health Service / Dept. Of Interior**
- **1961-1966**
  - **Needed to link pollution levels to physical environment**
  - **Delaware is estuary, not regular river – so needed new physical model (R. Thomann's Ph.D.)**
  - **Model established five "objective sets", with varying levels of dissolved oxygen**

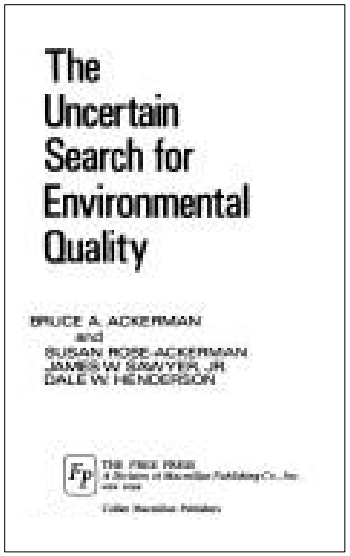
Source: http://www.mdpi.com/2077-1312/2/2/386/htm; Raufer, *Pollution Markets in a Green Country Town*, 1998

DECS results & Ackerman et al's review

Pollution control	Dissolved oxygen (DO) (mg/l)	Marginal abatement costs (MAC) ($millions)	Marginal social benefits (MSB) ($millions)
OS-V	1.0		
		80	115-280
OS-IV	2.5		
		45	30
OS-III	3.0		
		120	10
OS-II	4.0		
		215	20-35
OS-1	4.5		



Sterling Professor of Law and Political Science, Yale Law School



Winner of the Henderson Prize awarded by the Harvard Law School in 1982 for the best book in administrative law

Source: DECS, 1966; Raufer, *Pollution Markets in a Green Country Town*, 1998

The 'Uncertain Search' (cont.)

- **Government could use MAC & MSB for 'enlightened' command/control, but DECS results: *"An outstanding example of decision by cliché."***

- **DECS researchers assumed a price-based approach (i.e., effluent charge) if economic instruments employed;**

- **But Ackerman et al introduced a new idea: the quantity-based approach**

  - **following Dales' work (six years earlier);**
  - **lessened governmental information-gathering tasks;**
  - **eliminated potential gov't mistake in judging marginal cost of control;**
  - **put growth onus on industry, not government.**

Photo credit: https://delawarerivertowns.com/

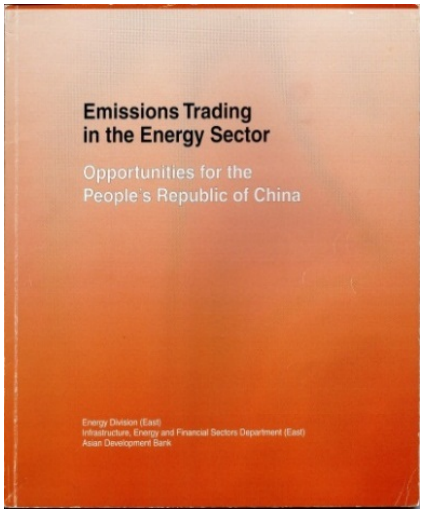
China's P-based experience

- Taxation before there was money
- Millennia of experience
- At least 25 different types of tax (e.g., VAT, consumption, business, income, property, behavior, etc.)
- Resource / energy taxes
- Price-based pollution levy system
- Current Environmental Protection Tax Law
- Forthcoming 2020 MOF-supported carbon tax (on non-ETS sectors)

China's Q-based experience

- 1980s/early 1990s – academic/ government interest
- 1996 – Total Amount Control (TAC) introduced
- 1999 – SEPA & US EPA study
- 1999 – ADB listed 10 trading case studies
- 2001 – ADB-sponsored SO_2 effort in Taiyuan
- Today
  - 10 Province MEP SO_2 trading program
  - 7 NDRC-supported pilots for GHG
  - National ETS under development (2017-2020)
  - RECs, CCERs, energy consumption quotas, etc., etc.

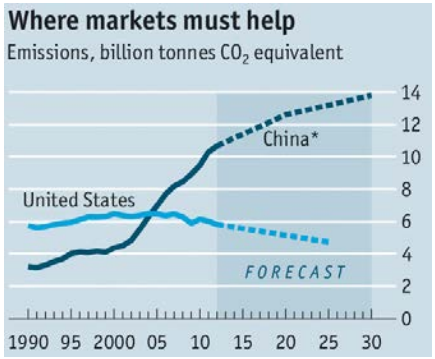
Taiyuan, Shanxi Province

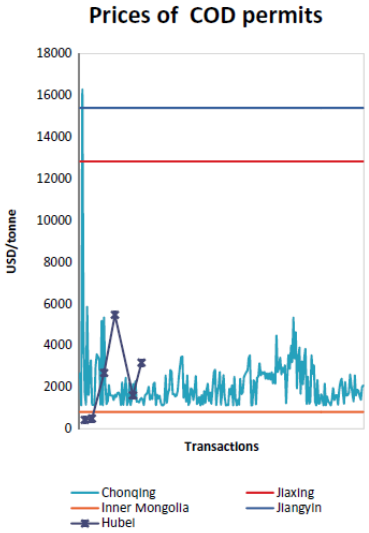


Taiyuan photo: http://www.voanews.com/a/china-war-on-pollution/3653801.html

Larger role for markets in "ecological reform"

INTEGRATED REFORM PLAN FOR PROMOTING ECOLOGICAL PROGRESS
September 21, 2015
CPC Central Committee and State Council





Reform Plan calls for *"...a market system which allows economic levers to play a greater role in environmental governance"*

Source: CO2 markets from *The Economist*, 3 Oct 2015; citing WRI; Green & Stern, 2015; * "Optimistic" emissions reduction scenario; COD prices from Zhang, B. et al, *Environmental Politics*, 2016; SO2 markets from Chang, Tsinghua U., May 2013; http://english.gov.cn/policies/latest_releases/2015/09/22/content_281475195492066.htm; Other graphics: https://china.ahk.de/market-info/

Too much, too soon?

RENEWABLE ENERGY WORLD

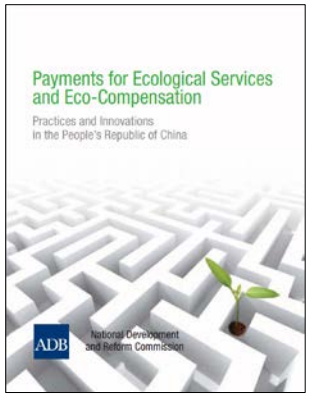
China to Launch Green Certificates in Renewable Energy Sector

March 30, 2017

By Liu Yuanyuan
Director of Operations

China to Start Trial Trading in Energy Use to Cap Consumption

Bloomberg News
September 21, 2016 — 1:20 PM CST



Nov., 2015 Journal of Resources and Ecology Vol.6 No.6

J. Resour. Ecol. 2015 6 (6) 355-362
DOI:10.5814/j.issn.1674-764x.2015.06.002
www.jorae.cn

Eco. Compensation

Current Status and Future Trends for Eco-compensation in China

XIE Gaodi[1]*, CAO Shuyan[1,2], LU Chunxia[1], ZHANG Changshun[1] and XIAO Yu[1]

First step in C/C to economic transition: Credit trading (1976)

Goals

Environmental Quality Standards

Regulatory Means

1. *Prohibitions*

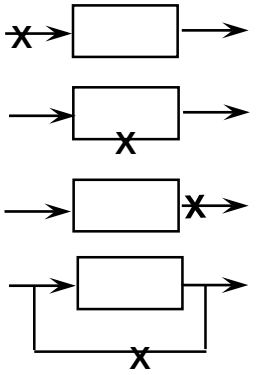
2. *Technology-Based Standards*

Input/Fuel Stds.

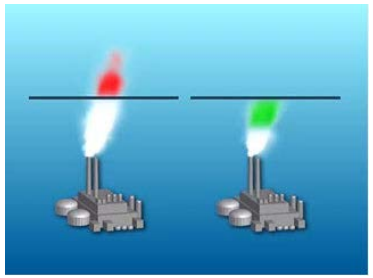
Design Stds.

Emission Stds.

Performance Stds.



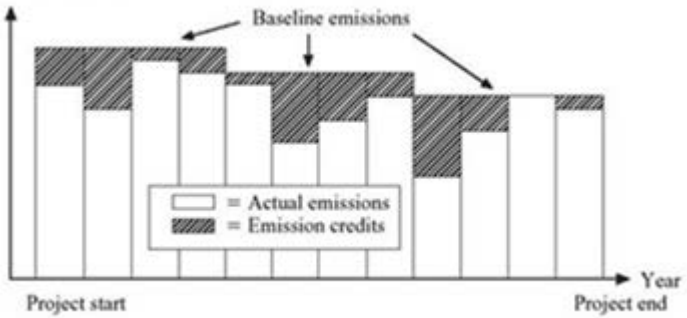
US EPA's Emissions Trading Program (ETP)



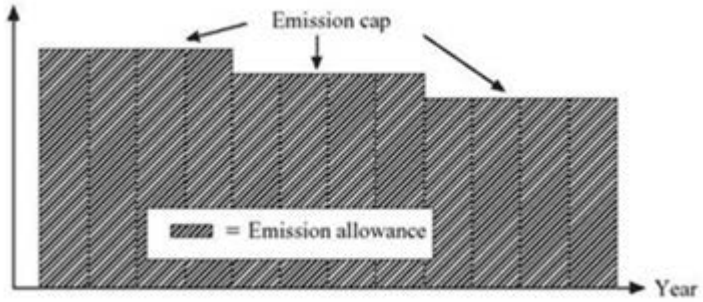
Emission Reduction Credits (ERCs)

Brokerage Opportunities

Engineers' Approach: 'Baseline-and-Credit' Trading



Economists' Approach: 'Cap-and-Trade'



Source: Figures adapted from OECD, 1997

Emission Trading Program (ETP) & Emission Reduction Credits (ERC)

4 ETP Components

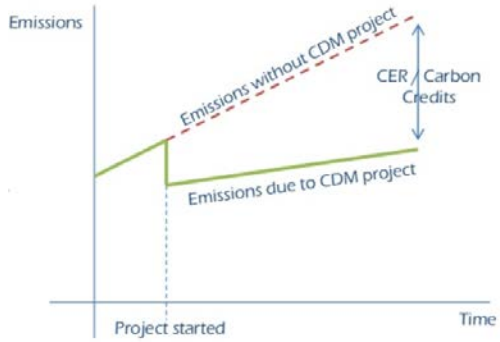
- 1976: Offsets
- 1979: Bubbles
- 1979: Netting
- 1979: Banking

4 ERC Characteristics

- Quantifiable
- Enforceable
- Permanent
- Surplus

ERC's 'command/control' 'surplus' in the ETP….

….became counterfactual 'additionality' in 1997 Kyoto Protocol's CDM



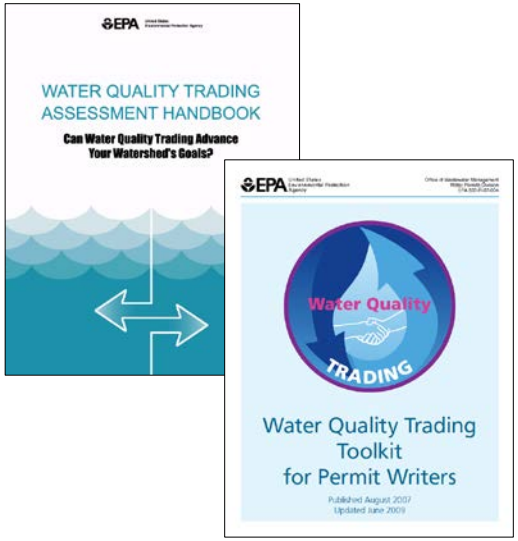
In water quality trading (WQT):

- **Total Maximum Daily Loads (TMDLs) serve as cap (i.e., Q);**
- **Waste Load Allocations (WLAs, for point sources) & Load Allocations (LAs, for non-point sources) serve as baseline;**
- **Point source 'surplus' based upon water-quality based effluent limitations (WQBEL), not technology (i.e., no credit trading to meet TBEL);**
- **Non-point source 'additionality' based on Best Management Practices (BMP), usually with high trading ratio.**

Source: efficientcarbon.com; at: https://www.slideshare.net/harshayadav/clean-development-mechanism-basics

U.S. WQT highlights

- Fox River (Wisconsin) point-point source effluent trading (1981)
- Dillon Reservoir (Colorado) point-nonpoint source effluent trading (1984).
- U.S. EPA sets draft framework for WQT (1996)

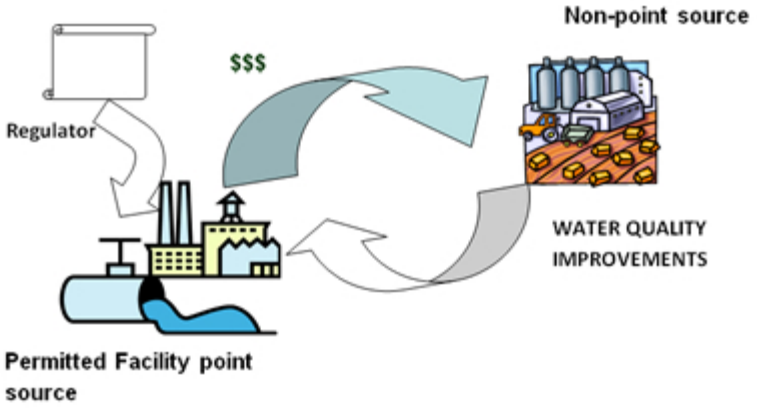


- U.S. EPA releases its Water Quality Trading Policy (2003)
- U.S. EPA publishes *Water Quality Trading Assessment Handbook* (2004)
- U.S. EPA publishes *Water Quality Trading Toolkit for Permit Writers* (2007)

WQT more difficult than air emissions trading

WQT difficulties:

- Linear & mono-directional nature of transport/dissipation;
- Limited geographically within watersheds of various scales (e.g., streams, estuaries, etc.);
- Less expensive control sources (i.e., non-point-sources) often not regulated;
- Can constrain trading to upstream-only sources for buyers;
- Limits market size & reduces liquidity



Ranking of key elements of WQT:

- Location
- Baseline
- Trade ratio calculation
- Trade duration
- Compliance/enforcement
- Monitoring/quantifying credits
- Trade administration
- Legislation, legal issues & rules

Difficulties: http://www.ecosystemmarketplace.com/articles/water-quality-trading-in-the-united-states/; Ranking: https://www.epa.gov/sites/production/files/2015-10/documents/day2_2bkirsch.pdf; Figure: http://bearriverinfo.org/water-quality-trading/trading-conclusions

China has had difficulties in air markets…

Environment and Planning C: Government and Policy 2009, volume 27, pages 175 – 188

doi:10.1068/c0768

Between market and state: dilemmas of environmental governance in China's sulphur dioxide emission trading system

Julia Tao
Department of Public and Social Administration, and Governance in Asia Research Centre, 7/F, Academic Building, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong; e-mail: sajulia@cityu.edu.hk

Daphne Ngar-yin Mah
Governance in Asia Research Centre, City University of Hong Kong, 7/F, Block 2, To Yuen Building, 31 To Yuen Street, Kowloon Tong, Hong Kong; e-mail: gadaphne@cityu.edu.hk
Received 24 July 2007; in revised form 10 July 2008

- **Major problems in three areas of governance capacities:**
  - **State**
  - **Policy**
  - **Administrative**
- **Resulted in development of State-led 'pseudo-market'**

Extremely limited role for independent 3rd parties:

- **Revenue source for gov't research institutes**
- **Loss of control of information**
- **Reluctance to give over regulatory function to market**

...& environmental market performance has so far proven "disappointing"

ENVIRONMENTAL POLITICS, 2016
http://dx.doi.org/10.1080/09644016.2016.1165951

Routledge
Taylor & Francis Group

The indecisive role of the market in China's SO_2 and COD emissions trading

Bing Zhang[a,b], Hanxun Fei[a], Pan He[a], Yuan Xu[c,d], Zhanfeng Dong[e] and Oran R. Young[f]

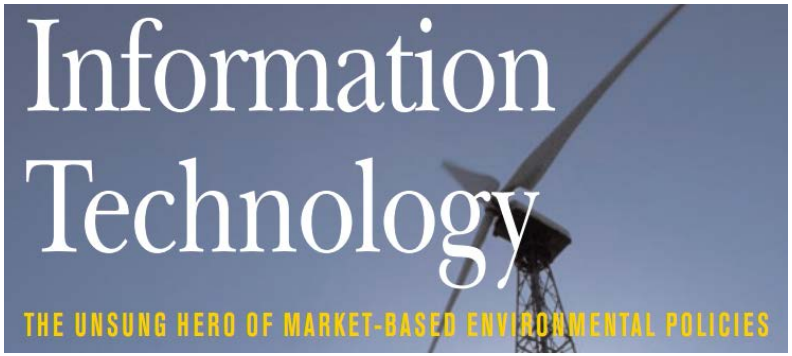
Three key factors:

- **"the design is flawed.... and enforcement is porous..."**
- **"governmental intervention is often excessive and inappropriate"**
- **"other policies often do not coordinate well with emissions trading"**

Concerns about China's environmental markets

- **Very opaque data collection systems**
- **Goal-setting also opaque (no BAU or complementary policy analyses)**
- **Tightly regulated SOEs**
  - **Non-cost-minimizing behavior**
  - **No cost recovery (e.g., electricity pricing tightly controlled, hence no allowance pricing pass-through);**
- **Legal status not fully tested**
- **Potential conflicts with economic development**
  - **Promotion policies of officials**
  - **Financial system still underdeveloped (e.g., spot vs futures trading, low liquidity, etc.)**

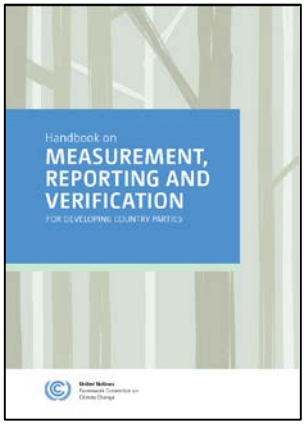
Environmental markets now depend upon digital infrastructure



B.P. Henriquez, *Resources*, Fall/Winter 2004

The concept of a market in emissions allowances was attractive in theory, but information technology made it happen.

- **Air markets depend upon:**
  - **Continuous Emissions Monitoring System (CEMS);**
  - **Emissions Tracking System (ETS);**
  - **Allowance Tracking System (ATS)**
- **Monitoring, Reporting & Verification (MRV):**
  - **Jurisdictional (e.g., country; administrative region; city)**
  - **Entity scale (e.g., business; facility)**
  - **Project level (e.g., emission reduction project)**



Role of Information Technology: 'Big Data' is coming!

Contents lists available at ScienceDirect

Energy

journal homepage: www.elsevier.com/locate/energy

Emissions trading in China: A conceptual 'leapfrog' approach?

Roger Raufer [a,*], Shaoyi Li [b]

[a] University of Pennsylvania, Hayden Hall, 240 S. 33rd St., Philadelphia, PA 19104-6316, USA
[b] Energy Resources Section, Environment and Development Division, United Nations Economic and Social Commission for Asia and the . Nok Avenue, Bangkok 10200, Thailand

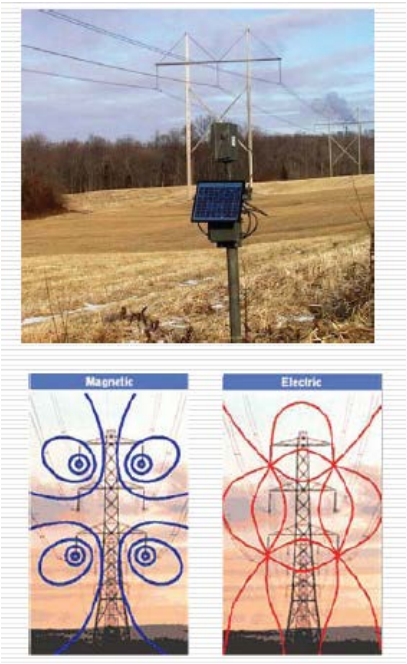
ARTICLE INFO

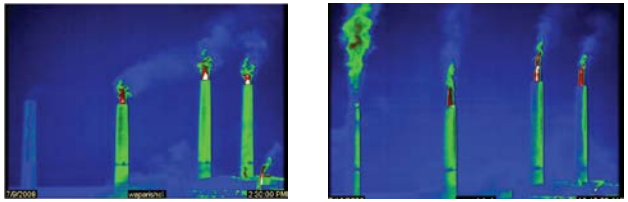
Article history:
Received 19 December 2008
Received in revised form
6 March 2009
Accepted 21 March 2009
Available online xxx

ABSTRACT

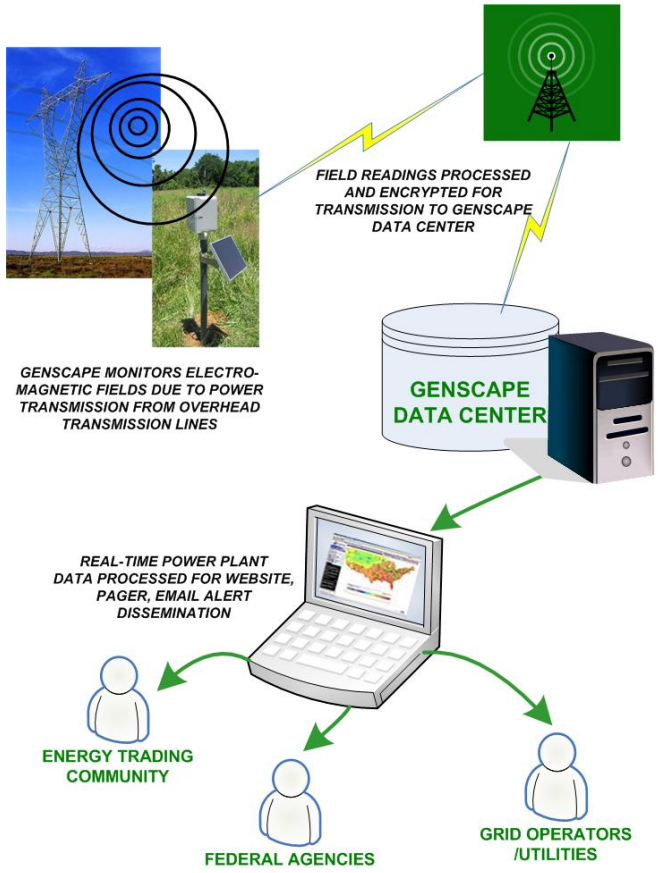
China is well aware of th
for domestic pollution c
Guangdong, and other lo
emissions trading progr
component parts: (1) a r
health concern

Independent, third-party, real-time monitoring for emissions





Source: Alphenaar, 2007; EPA Solutions, 2008



Source: Genscape, Inc., 2010

Blockchain apps: carbon credits & distributed energy

technode

FEATURES NEWS EXPLAINERS DAILY BRIEFING VIDEO PODCASTS EVENTS JOIN US

The People's Daily says China will lead global blockchain innovation and regulation

Feb 26, 2018 Frank Hersey

Bitcoin and blockchain, News Analysis

CHINA US Focus

Blockchain and Climate: A New Energy Frontier

Oct 23 , 2018


Roger Raufer
Resident Professor of Energy, Resources, and Environment at SAIS's


Nicholas Manthey
Graduate student at the Hopkins-Nanjing Center in Nanjing


Anneliese Gegenheimer
Graduate student at Johns Hopkins' School of Advanced International

https://technode.com/2018/02/26/peoples-daily-blockchain/

Comparable real-time apps for WQT?

Drones, Sensors and Blockchain for water quality control in the Volga river to promote trustworthy data and transparency

November 28th, 2018 - Libelium

In Russia, approximately 70% of drinking water comes from surface, while the rest comes from groundwater. **Twenty-five per cent of the world's fresh water is located in Russian territories**.

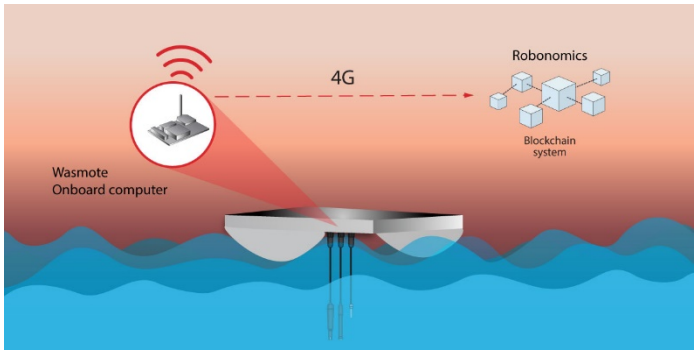
Unfortunately, water pollution is a major issue in this country, with **more than 10 million Russians currently lacking access to quality drinking water**. According to the Russian regulatory bodies, around 35 to 60% of total reserves of drinking water do not meet sanitary standards. This fact favors the proliferation of health issues in many cities and villages across the country, as **only 8% of the wastewater is correctly treated** before being returned to the waterways.

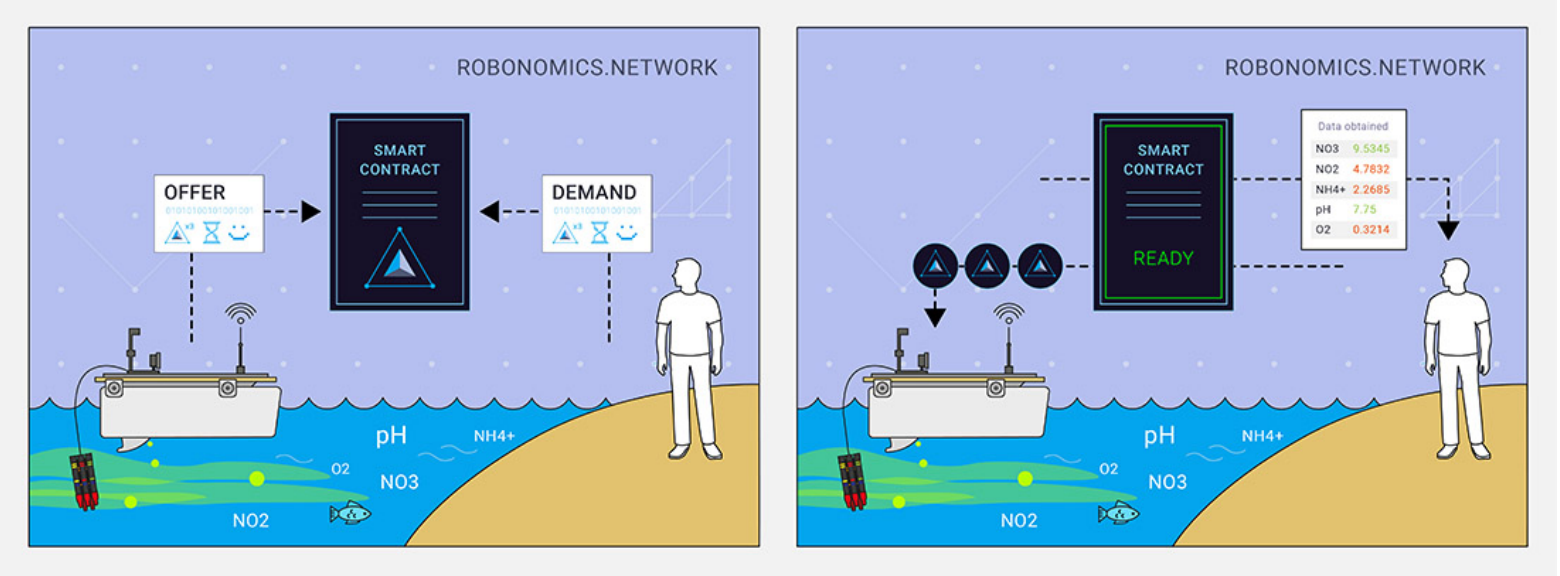
libelium

Location of Tolyatti, Russia

http://www.libelium.com/drones-sensors-and-blockchain-for-water-quality-control-in-the-volga-river-to-promote-trustworthy-data-and-transparency/

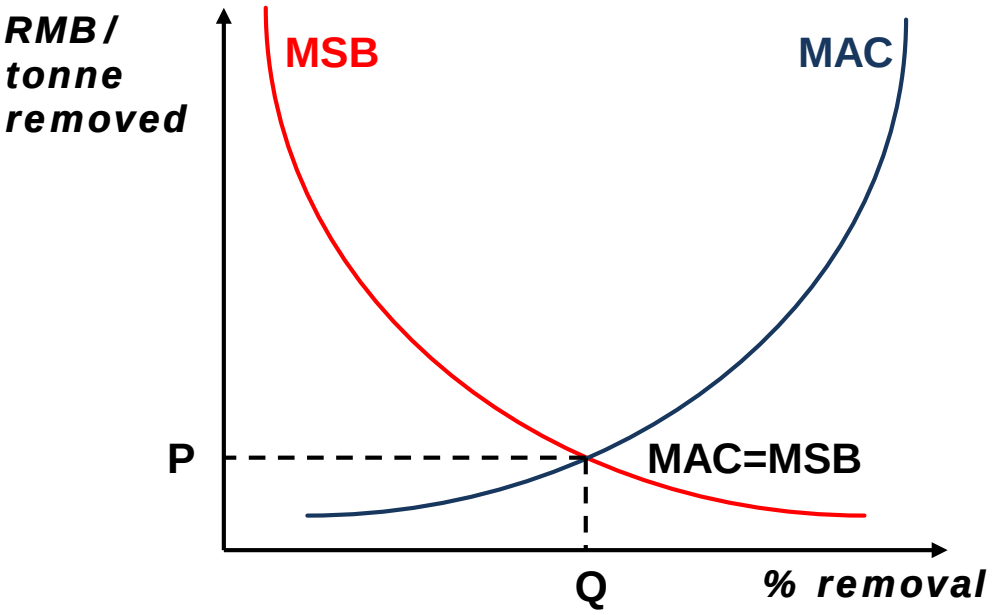
Smart contracts for WQT: the future?





http://www.libelium.com/drones-sensors-and-blockchain-for-water-quality-control-in-the-volga-river-to-promote-trustworthy-data-and-transparency/

谢谢



中国污染控制