Session 3: Technical Guidance Documents, Tools and Incentives

DTSC's Green Remediation Team

International Perspectives in Green Remediation—Making *Clean* "Green"

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Presentation Outline

- Green Remediation Team History & Goals
- Challeges
- Definitions of Green Remediation
- Regulatory Framework and CEQA update
- Sustainability Analysis Principles for Clean-ups
- GRT's Assessment Approach—Life-Cycle Management (as part of the Life-Cycle Framework)
- Brownfield Applications—Social and Economic Justice Aspects of Sustainability
- Application of DTSC Evaluation Checklist/Matrix to Pilot Project—Site Characterization at DuPont TiO_2 Production Site
- Next Steps
- Bonus—only if time: Application of LCA to a Sacred Cow
- Acknowledgements
- References

Green Remediation Team History

- Formed February 2007
- Nine active members from Southern and Northern California—monthly meetings by video conference
- Current projects:
  - This Symposium
  - Development of a GR Guidance Document
  - Co-participants with DuPont Corporation in a pilot Site Characterization project at a former TiO_2 plant.
  - Member participation in SuRF, ASTSWMO, USEPA Engineering Forum & Green Clean-up Standard Workgroup, and ITRC,

Current Team Goals

- Develop a tool for sustainability assessments of green technologies and treatment alternatives
- Offer technical symposia by researchers, technology innovators, assessors, and RPs
- Develop training for clean-up program technical staff

Team Goals (continued)

- Propose legislative changes and regulatory incentives
- Develop a plan to educate local environmental and redevelopment agencies
- Initiate pilot projects at sites suitable for utilizing green technologies or approaches

Challenges

- Exploring without a map & breaking ground w/o a tool—lacking…
  - widely, consensually-accepted and standardized
    - Definitions of “Green”, “Green Remediation”, and “Sustainability”
    - Criteria
    - Metrics
    - Assessment methodologies and approaches
  - adequate, qualified data sets
- Avoiding facilitation of the “No-Action Alternative” or “Monitored Natural Attenuation”—preference for treatment & source reduction/elimination
- Reconciling sustainability within existing regulatory framework

Challenges (cont'd)

Developing a ~~"perfect"~~ versatile tool:

- Straightforward to apply
- Comprehensive in scope
- Considers qualitative and quantitative factors
- Scalable for project size
- Allowance for site-specificity
- Adaptable for multiple purposes:
  - Debunking "greenwashed" performance claims
  - Initial screening of remedies
  - Advanced comparison of alternatives
  - Optimizing existing remedial applications

What does **Green Remediation** mean???

New and improved ?

Uses Solar Panels and Biodiesel ?

Accomodates Natural Attenuation?

Made from recyclable or biodegradable materials ?

Reduces Greenhouse Gas Emissions?

“Sustainable” ?

And how about…?

Sustainable

DTSC-Green Remediation Team
Green Remediation Definition

Green Remediation technologies and practices:

- Minimize direct and *indirect (higher order)* detrimental impacts to the environment
- during *all phases* of the clean-up project,
- via a net reduction in the consumption of *natural resources,*
- through reduction/elimination of *solid and liquid wastes,* emission of *air pollutants and GHGs* generated as remediation by-products, and
- while achieving established clean-up goals through minimizing or eliminating the targeted source of contamination, whenever feasible.

Reconciling Sustainability within the Clean-up Regs

- CERCLA/RCRA: Criteria for Treatment Alternative acceptability:
- Nothing regarding Sustainability !
  - *Threshold* (Protection of human health & compliance with specific requirements—"ARARs")
  - *Balancing* (Short- & long-term treatment effectiveness/source reduction, cost effectiveness, implementability)
  - *Modifying* (Acceptability to State and Community)

  → California Environmental Quality Act (CEQA)

CEQA

- Requirement: Agency Assessment of Potential Significant Environmental Impacts of (New) Projects
  - *Exemptions*—CEQA not applicable
  - *Negative Declaration*—certainty of no impact
  - *Mitigated Negative Declaration*—potential impacts, but to be avoided or eliminated
  - *Environmental Impact Report*—unavoidable impacts likely or certain—requires quantitative evaluation
- No CEQA requirement for consideration of GHGs

…yet

SB 97--CEQA Modifications for GHGs

- AB 32: "Global Warming Solutions Act" (2006)

  → GHG reduction to 1990 levels by 2020 ("little Kyoto")
- SB 97: "CEQA: Greenhouse Gas Emissions" (2007): → GHG consideration within CEQA:
  - OPR: develop draft guidelines
    - July 1, 2009
  - Resources Agency: certify & adopt final guidelines
    - January 1, 2010
  - CARB: tasked to define "significance" thresholds
    - California Air Resources Board, *Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for GHGs under CEQA,* October, 24, 2008

Implementing Sustainability Principles in Clean-Ups

Traditional Assessment:

- Focus on endpoints: Site restoration & protection of health
- Boundary of concern limited: Impacts to site & immediate surroundings only
- Analysis period constrained—duration of treatment alternative application

Implementing Sustainability Principles in Clean-Ups

Sustainability Assessment:

- Holistic, systems approach
- Focus on processes as well as endpoints
  - Site characterization, remedy deployment and operation, monitoring, & closure
- Expansion of the impact boundary
- Consideration of non-environmental elements of sustainability

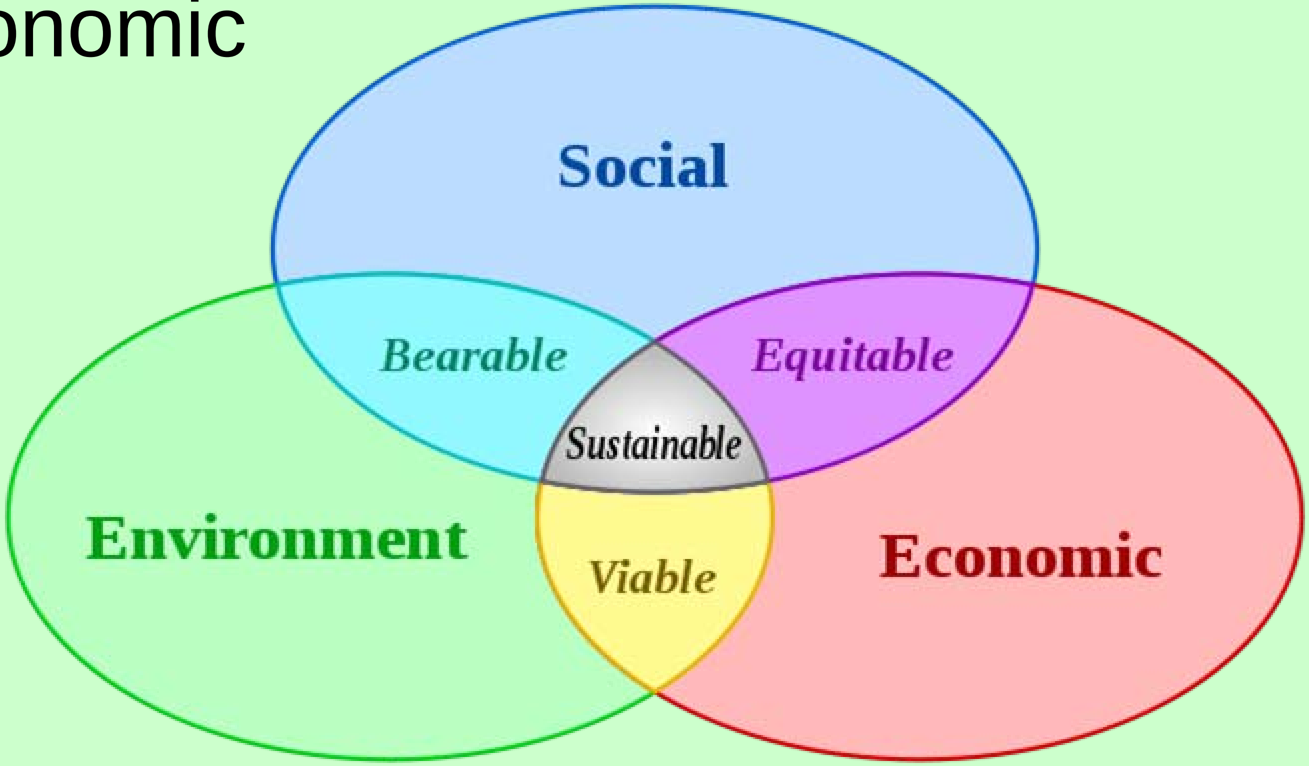
Implementing Sustainability Principles in Clean-Ups

- Expansion of impact boundary:
  - Spatially to ecosphere
    - Consumption of natural resources, including energy
    - Solid/Liquid waste disposal, air emissions of GHGs and priority pollutants
    - Consequences for ecoservices (e.g. habitat disruption, loss of species diversity)
  - Chronologically to past and future:
    - origin to fate of project equipment & consumables

      (cradle-to-grave consumption and/or cradle-to-cradle recycling/reuse)
    - time to ecosystem stasis

Implementing Sustainability Principles in Clean-Ups

- Consideration of non-environmental elements of sustainability: social and economic



First Attempts

- Composed a matrix of Technologies x Process Steps & Impacts:
  Ranking of impacts from the stressors within each of three steps:
  - Resource Extraction
  - Manufacture
  - Use
- Became bogged down in the details and excessive factors
  - Do we consider the sustainability of the front loader or of the plant where it was constructed?
- Considered other approaches, particularly that of Merriam Diamond, C.A. Page, et al. from University of Toronto.

→ Life-Cycle Framework approach

"Life-Cycle Framework for Assessment of Site Remediation Options: Method and Generic Survey", *Environmental Toxicology and Chemistry*, 18:4, p. 788-800, 1999.

Existing Approaches

Simple

- Qualitative: checklists, rankings, surveys
- Quantitative: calculators (spreadsheets and programmed, computational routines)
  - Electricity & fuel consumption
  - Air emissions calculations (NO_X, SO_X, CO_2, PM_{10}, $PM_{2.5}$)
  - → CO_2 equivalency & sequestration credits
  - Safety hazard exposure hours

Existing Approaches (cont'd)

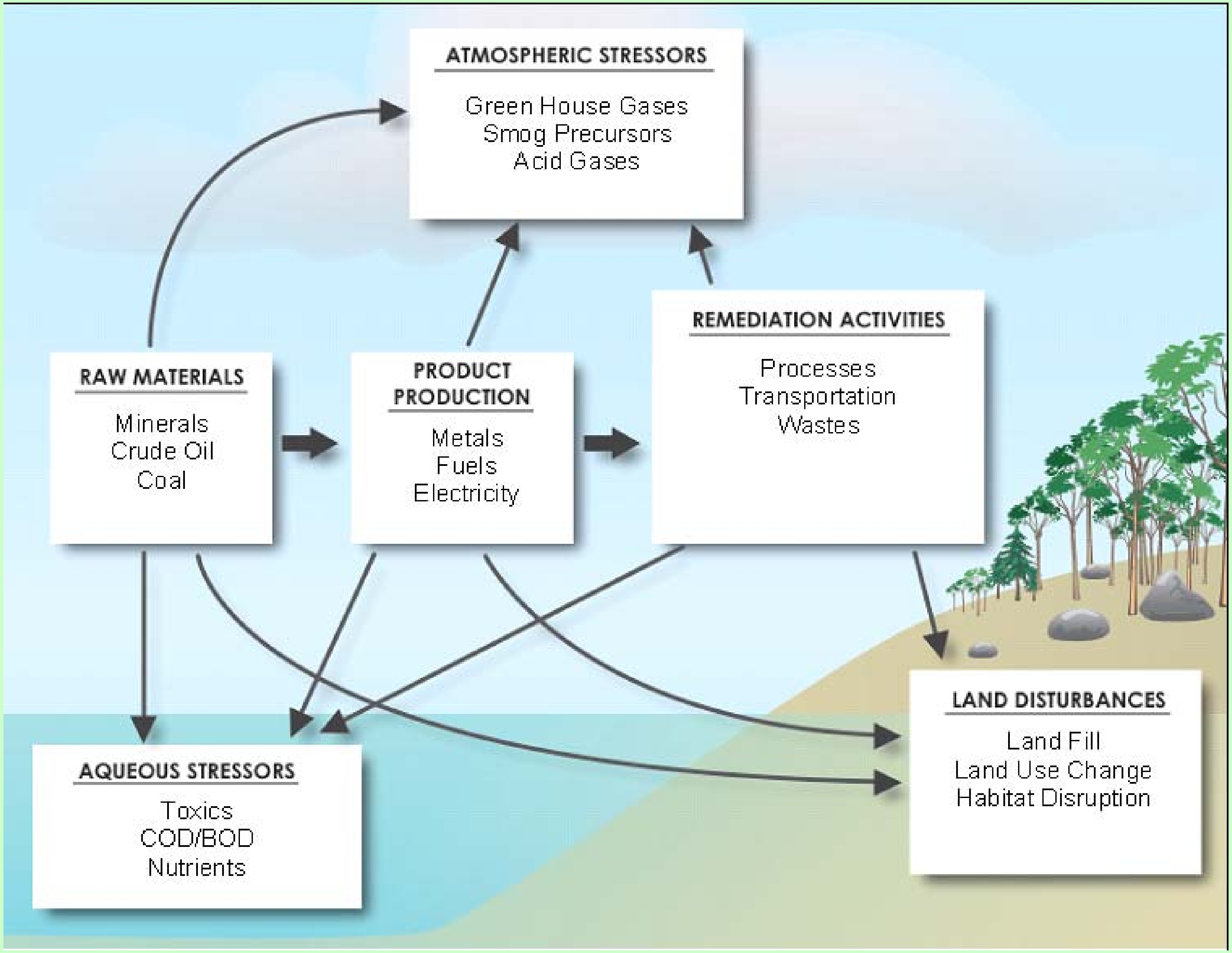
Complex (quantitative):

- Net Environmental Benefit Analysis (NEBA) and Habitat Equivalency Analysis (HEA)
- Life-Cycle Assessment (LCA)
- Cost-Benefit Analysis

DTSC's Interim Approach

- Sustainability as a factor for consideration, not a make-or-break factor (i.e. not a threshold criterion)
- Simple screening tool for remedy evaluation
- *Mixed Quali-Quantitative* Matrix-checklist—user may quantify resource use, while ranking qualitative, subjective factors
- Follows Life-Cycle Management (LCM) approach—simpler to apply than an LCA

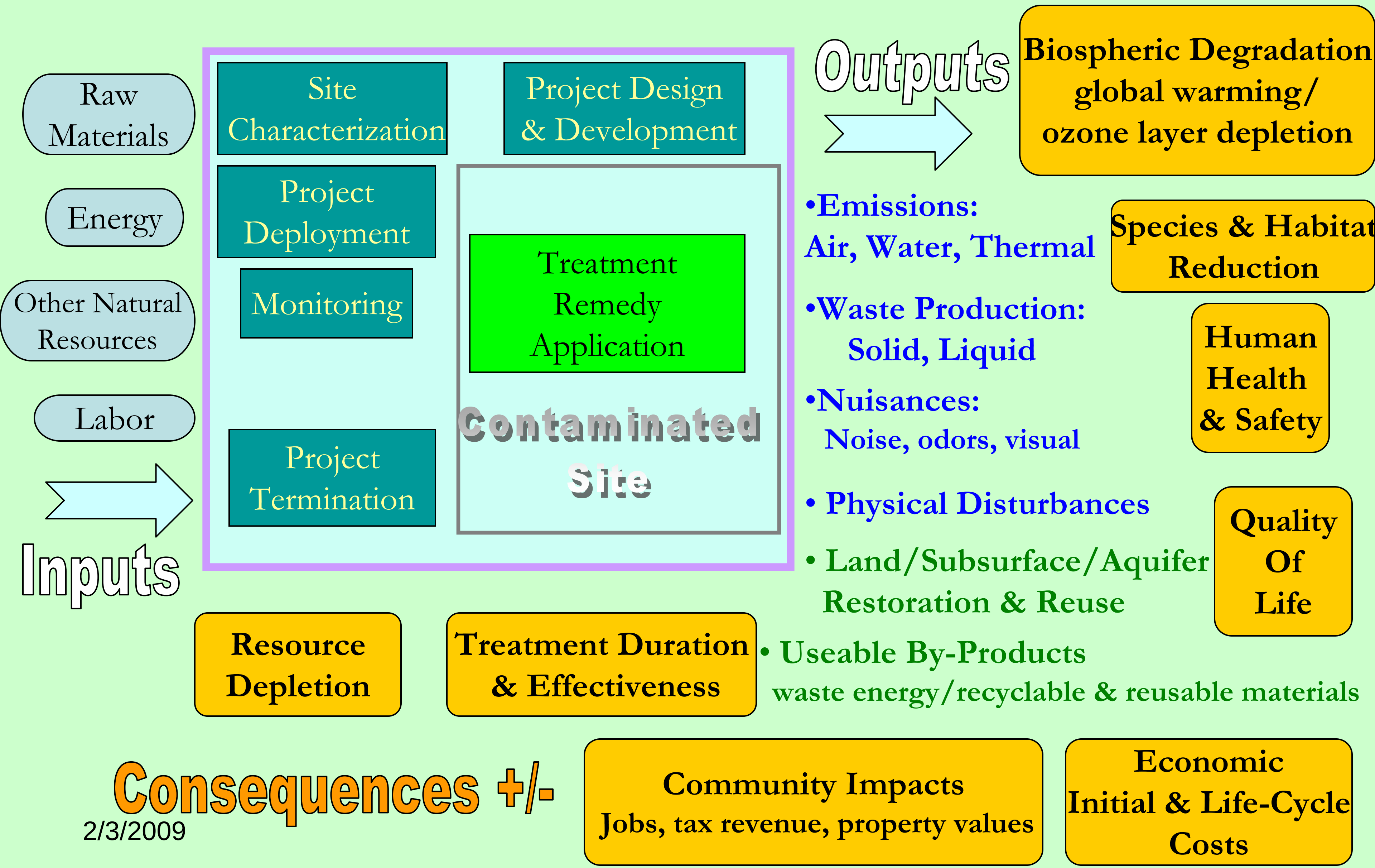
Life-Cycle Framework



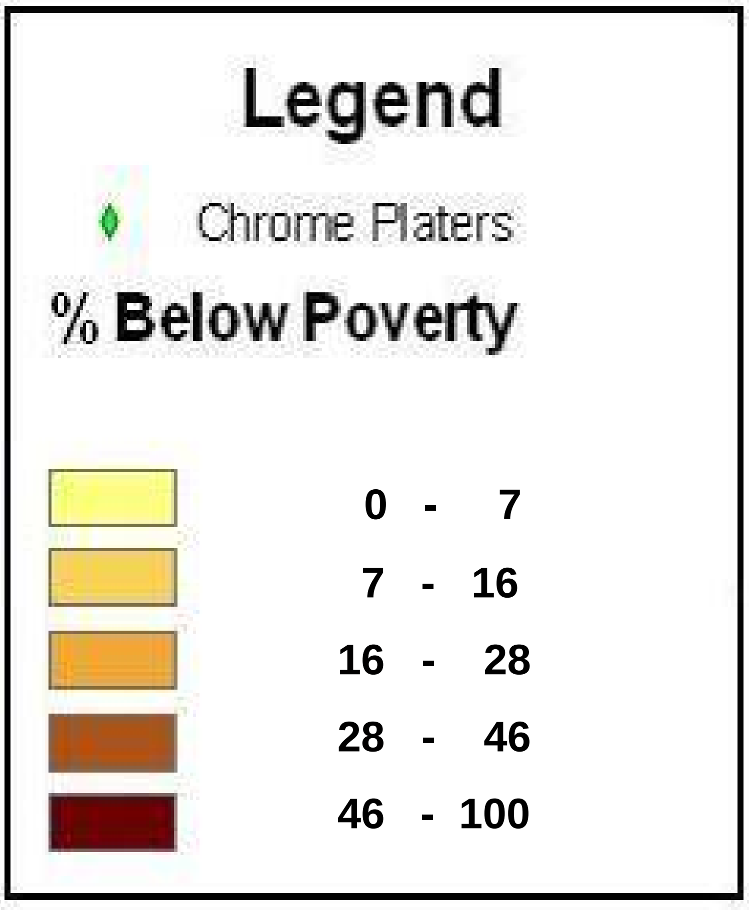
Life-Cycle Framework Evaluation Process

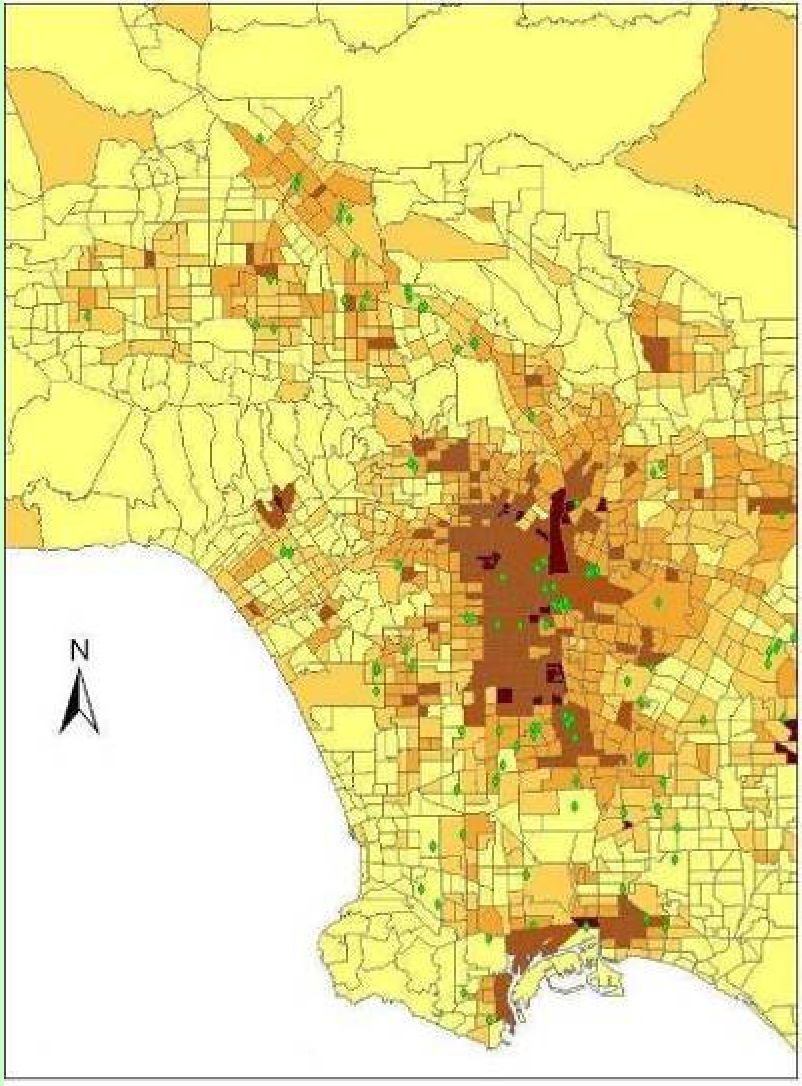
- Define System Boundary
- Inventory Flows
  - Inputs
  - Internal processes and conversions
  - Outputs
- Evaluate Resulting Environmental Stressors & Impacts—two possible approaches:
  a. Life Cycle Management (LCM)—simple, qualitative
  b. Life Cycle Assessment (LCA)—complex, quantitative

Life-Cycle Evaluation Framework



Los Angeles County—Areas Below Poverty Level & Chrome Plating Shop Locations





Brownfield Site Opportunities

Hiring Locally:

- "Green Collar" jobs—Solar electric ("PV") panel installation; wind turbines, wave/tidal power (Van Jones, *The Green Collar Economy, 2008)*
- "Green Glove" jobs—sample collector, site safety worker, jobs, *Registered Environmental Assessor*, construction worker, equipment operator

→Environmental benefit, Economic & Social uplift

Matrix Application: Site Characterization Project

Stressors

Green Remediation Evaluation Matrix (GREM)				
Stressors	**Affected Media**	**Mechanism/ Effect**	*** Y/N ***	**Score**
Substance release/production				
Airborne NOx & SOx	Air	Acid rain & Photochemical smog	Y	☹
Chloro-fluorocarbon vapors	Air	Ozone Depletion	N	
Greenhouse gas emissions	Air	Atmospheric warming	Y	☺
Airborne particulates/Toxic vapors/gases/Water vapor	Air	Gen Air Pollution/Toxic air/Humidity increase	Y	☹
Liquid waste production	Water	water toxicity/sediment toxicity/sediment	Y	😐
Solid waste production	Land	Land use/toxicity	Y	☹
Thermal releases				
Warm water	Water	Habitat warming	N	
Warm vapor	Air	Atmospheric humidity	N	

dust

lab waste, methanol

DUPONT

More Stressors

Physical disturbances/disruptions					
Soil structure disruption	Land	Habitat destruction/ Soil Infertility	N		
Noise/Odor/Vibration	Gen Env	Nuisance & Safety	Y	☺	
Traffic	Land; Gen Env	Nuisance & Safety	Y	☺	
Land Stagnation	Land; Gen Env	Remediation time; Cleanup efficiency;re-development	N		
Resource Depletion/Gain (Recycling)					
Petroleum (energy)	Subsurface	Consumption	Y	☺	
Mineral	Subsurface	Consumption	N		
Construction Material	Land	Consumption/reuse	N		back fill
Land & space	Land	Impoundment/reuse	N		
Surface water & groundwater	Water, Land (subsidence)	Impoundment/ Sequester/reuse	N		
Biology Resources (Plants/trees/animals/microorganisms)	Air, Water, Land, Subsurface	Species Disappearance/ Diversity Reduction Regenerative Ability Reduction	N		

* state whether the impact applies or does not apply to the alternative and continue the evaluation

Other

25/ Impact on community

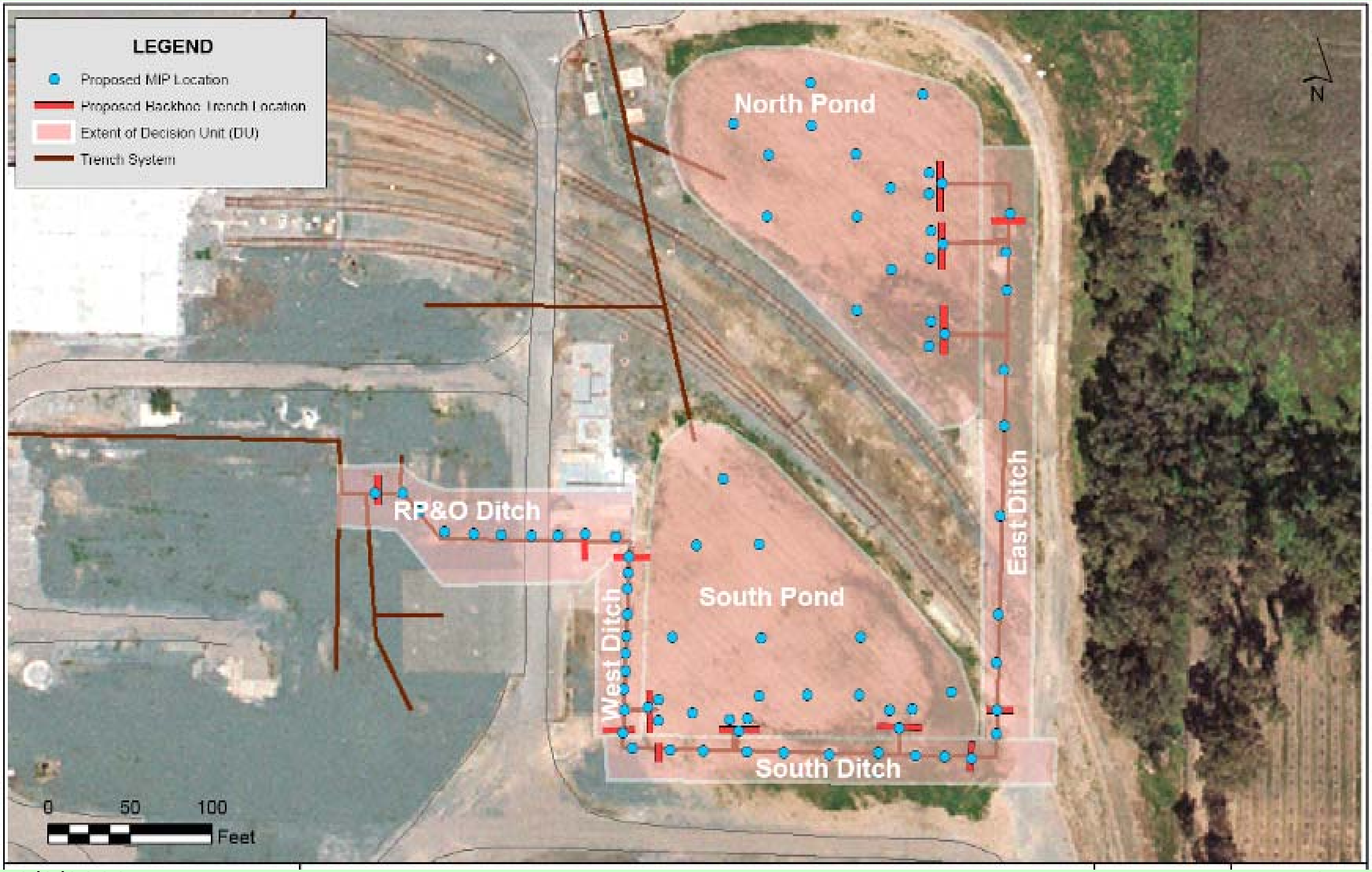
Community equity, eg jobs

DuPont Oakley TiO_2 Mfg.Site
South Pond – 1960's

South Retention Pond

Oakley Field Investigation

Aerial photograph 1970



Next Steps

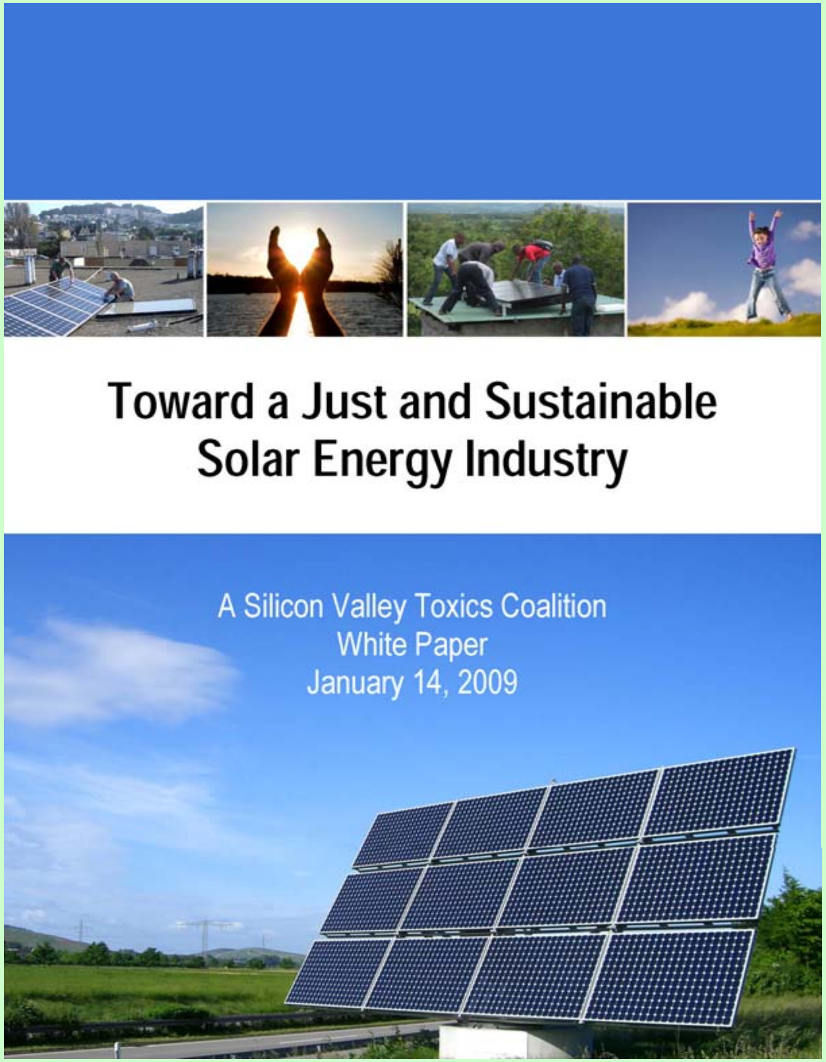
- Confer collectively with Team and professionals in GR industry → refocus our direction and share in the development of the field of GR
- Develop pilot projects and demonstrations:
  - Opportunity to collect of data here-to-fore unavailable
  - Serves as field verification of theoretical estimates
  - Hands-on experience
- Continue with the development of tools and guidance for the clean-up practitioners—straightforward to apply—building upon the work of others
- Propose incentives and legislation

Next Steps

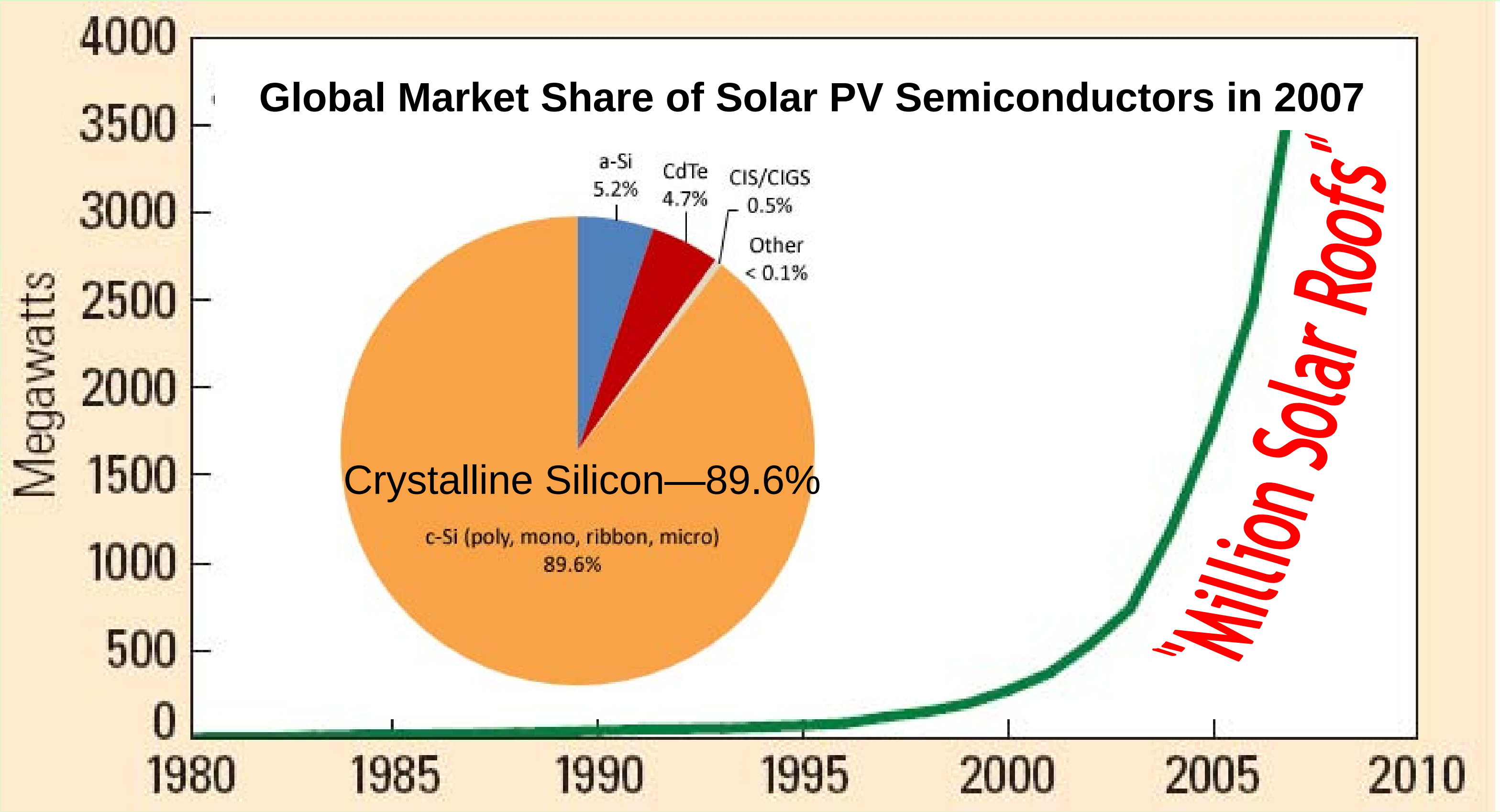
Possibilities currently under discussion:

- Perform series of LCAs on protypical soil and groundwater remediation systems for performance and impact benchmarking
- Include sensitivity analyses to determine variables of significance affecting outcome → multi-variable performance and impact estimates using correlations generated from these analyses
- Estimate the impact on GHG reduction in California from a variety of GR implementation scenarios at clean-up sites

Applying Life-Cycle Analysis to A Sacred Cow

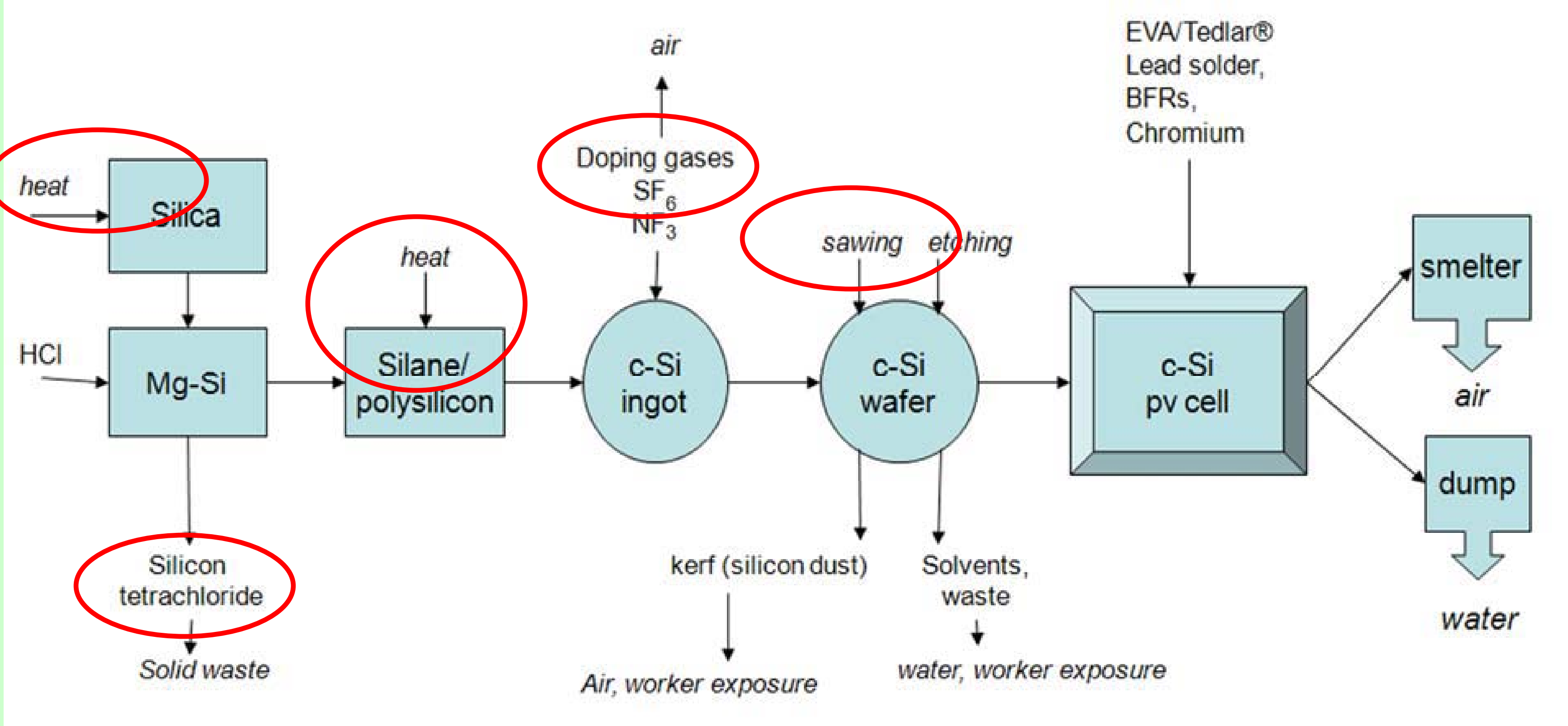


Annual Global Production of Photovoltaic Cells: 1980–2007



Production graph courtesy of Worldwatch Institute, *Vital Signs Online*, www.worldwatch.org

Crystalline Silicon Generic Process Diagram



From Fig 7., *Toward a Just and Sustainable Solar Energy Industry*

Manufacturing of Silicon Crystal Photovoltaic Cells

- Used in the manufacture of Silicon cells:
  - Highly explosive silane gas (SiH_4)
  - Toxic silicon tetrachloride ($SiCl_4$)
  - Sulfur hexafluoride (SF_6), a GHG
  - Highly energy intensive, due to the high purities required and the manufacturing inefficiencies

Silicon Valley Toxics Coalition, White Paper: *Toward a Just and Sustainable Solar Energy Industry*, January 14, 2009

California GHG Definition

Health & Safety Code, section 38505:

(same as Kyoto Protocol gases)

CO_2 **N_2O** **SF_6**

HFCs

H_2O

0_3

CH_4

PFCs

GWP for SF_6 = 23,900; conc =0.0065 ppm

GWP for CO_2 = 1; conc = 380 ppm

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- Chris Parent, B&ERP, Cal Center

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