Opportunities to advance no and low inadvertent PCB (iPCB) pigments

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Goal:

- Reduce PCB levels in the Spokane River,
- Increase recycled content in paper, and
- Maintain the vibrant colors of our printing inks

Chemistry, Challenges, and Opportunities

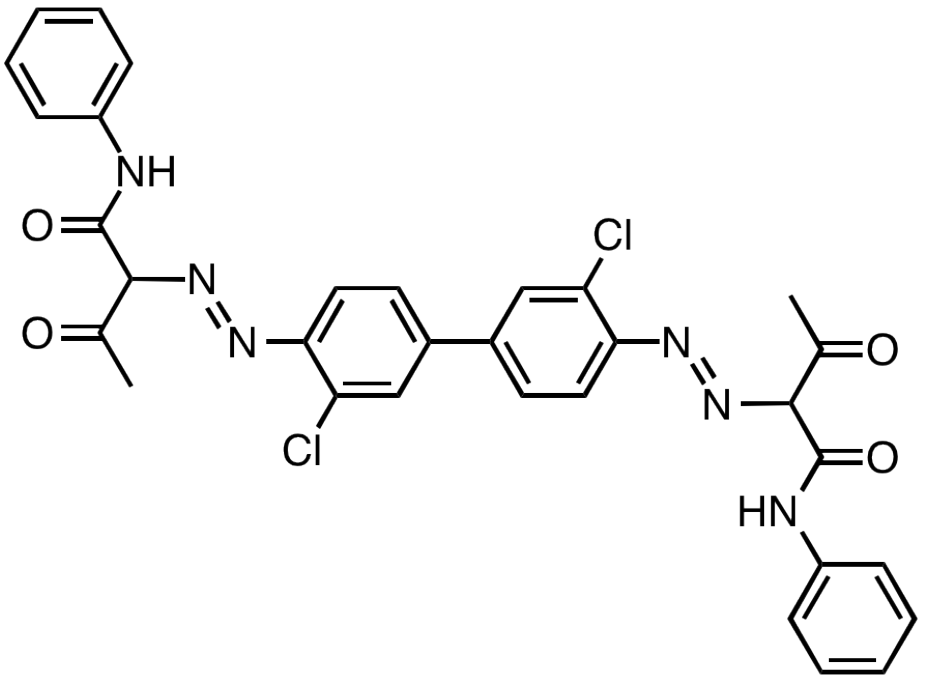
Yellows: Diarylides
- iPCB generation
- Options to reduce iPCBs
- Options to eliminate iPCBs

Blues & Greens: Phthalocyanines
- iPCB generation
- Options to eliminate iPCBs

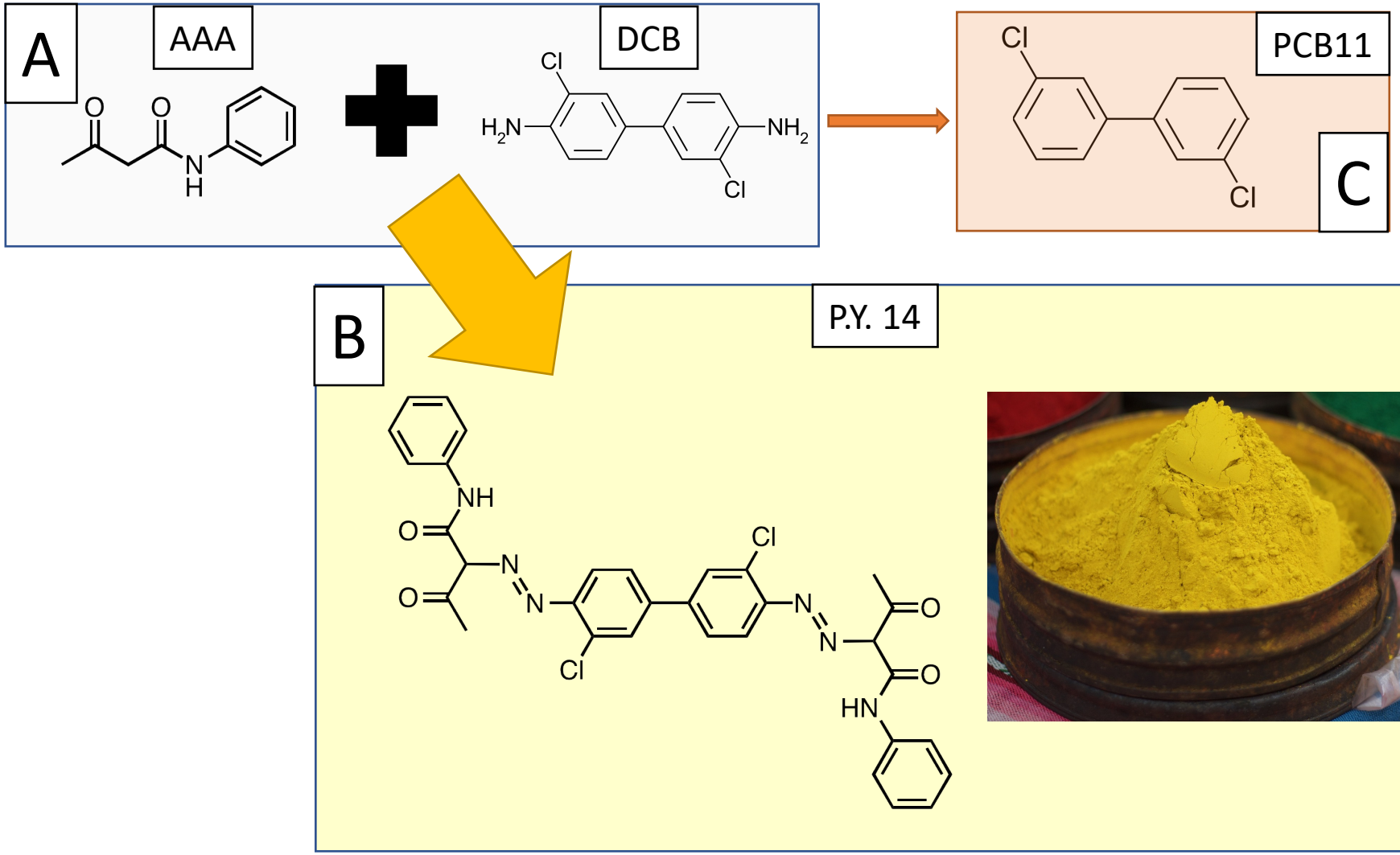
Opportunities for advancing no and low iPCB pigments

Diarylide yellows

- Share a common structure and common synthesis route
- Example Pigment Yellow (P.Y.):
  - 14
  - 83
  - 12, 13, 17



iPCBs: Byproducts linked to key substrate in synthesis of diarylides



Process controls reduce iPCBs in diarylide yellows

Options

- Minimize time
- Minimize temperature
- Control pH
- Additives

Benefits

- Reduces iPCBs
- No need to reformulate
- Same performance

Drawbacks

- Doesn't eliminate iPCBs
- May already be implemented by top manufacturers

Alternative pigments eliminate iPCBs from pigment synthesis

Options

- Monoazo pigments
- P.Y. 1, 65, 74
- Bisacetoacetarylide pigments
- P.Y. 155

Benefits

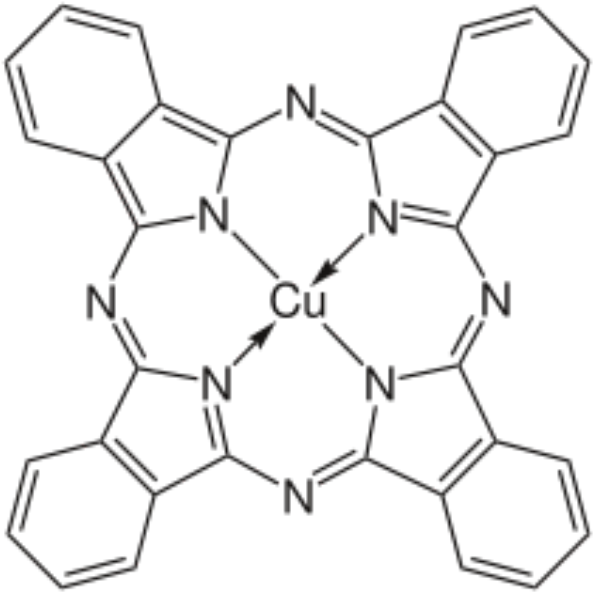
- Improved performance: UV resistance
- iPCBs from pigment synthesis eliminated

Drawbacks

- Lower performance: color strength
- Increased cost
- Limited availability of raw materials
- Reformulation necessary

Phthalocyanine blues & greens

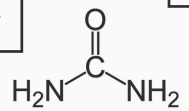
- Share a common structure and common synthesis route
- Example Pigment Blue (P.B.) and Pigment Green (P.G.):
  - P.B. 15
  - P.B. 15 mixed with yellow
  - P.G. 7

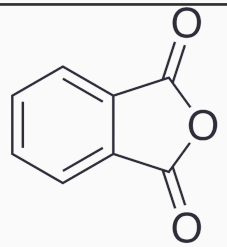


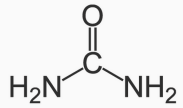
iPCBs: Byproducts from solvents

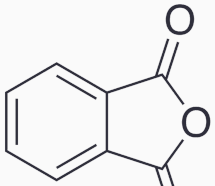
A

Phthalic anhydride

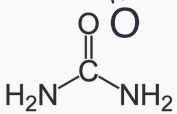


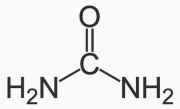


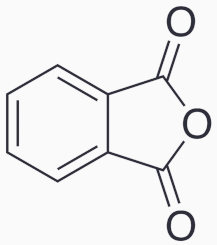




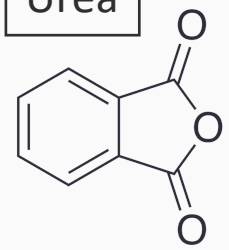
CuCl



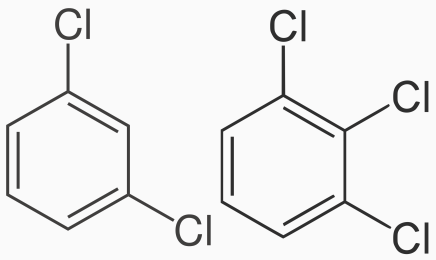




Urea

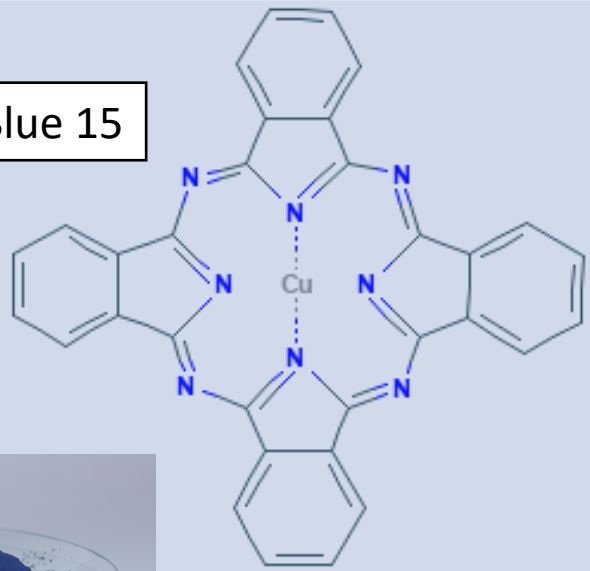


Chlorobenzenes (solvent)

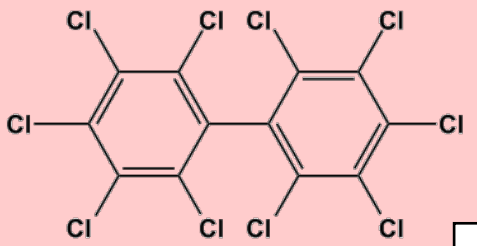


B

Pigment Blue 15



C



PCB209

Alternative solvents eliminate iPCBs from pigment synthesis

Options

- Alternative solvents
- Kerosene, naphthalene, others
- Dry bake – no solvent

Benefits

- Eliminates iPCBs
- Viable: Used in the 70s
- Avoids hazards of chlorobenzenes

Drawbacks

- Alternative solvents are also hazardous
- Dry bake pigment less pure, harsh on equipment


Technical Solutions:
Any burning questions
? ?

Opportunities for advancing no and low iPCB pigments

Regulations

- What is reasonable?
- Monitoring & enforcement
- Unintended consequences

Procurement

- Can drive demand but must be actionable, practical
- Unintended consequences

Supply chain engagement

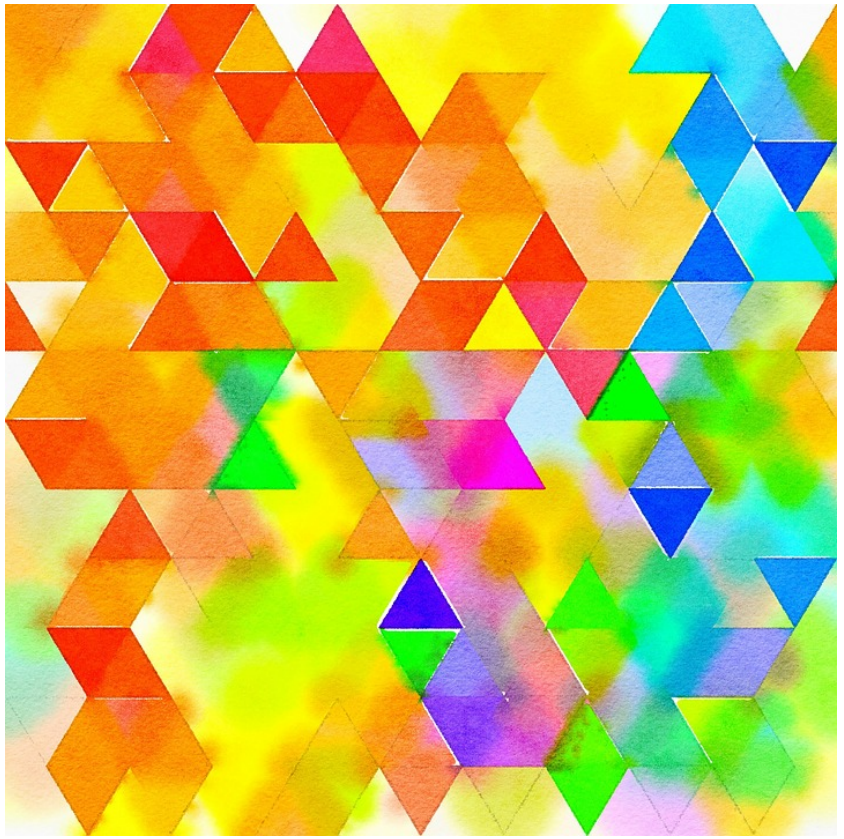
- Process controls: Pigment manufacturers; industry association leadership
- Pigment selection: Pigment / printing ink manufacturers, knowledge of iPCB levels

Regulations

- Requires specific limits
- Enforcement – Stockholm Convention, Japan METI study
- Needed alignment– TSCA, Clean Water Act, recycling policies

Procurement

- Regulatory / government
- Private business requirements (e.g. approved materials)
- Value of unified procurement policies
- Reaching consensus
- Is specificity needed for different products?



PCB Limits

Reasonable

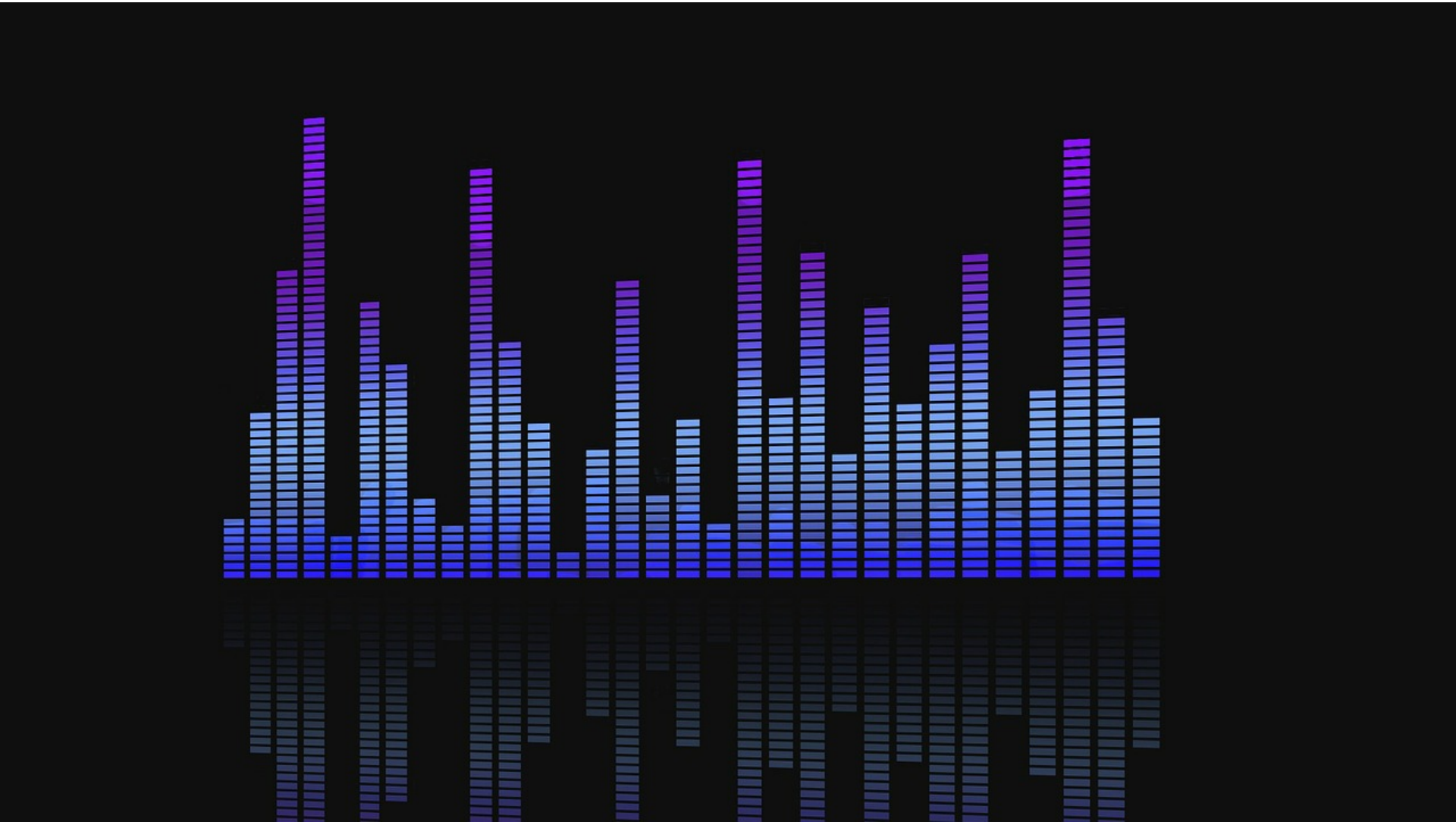
Actionable

Measurable

What limit is necessary on pigments to achieve water quality standards in recycling effluent?

Photo by thom masat on Unsplash

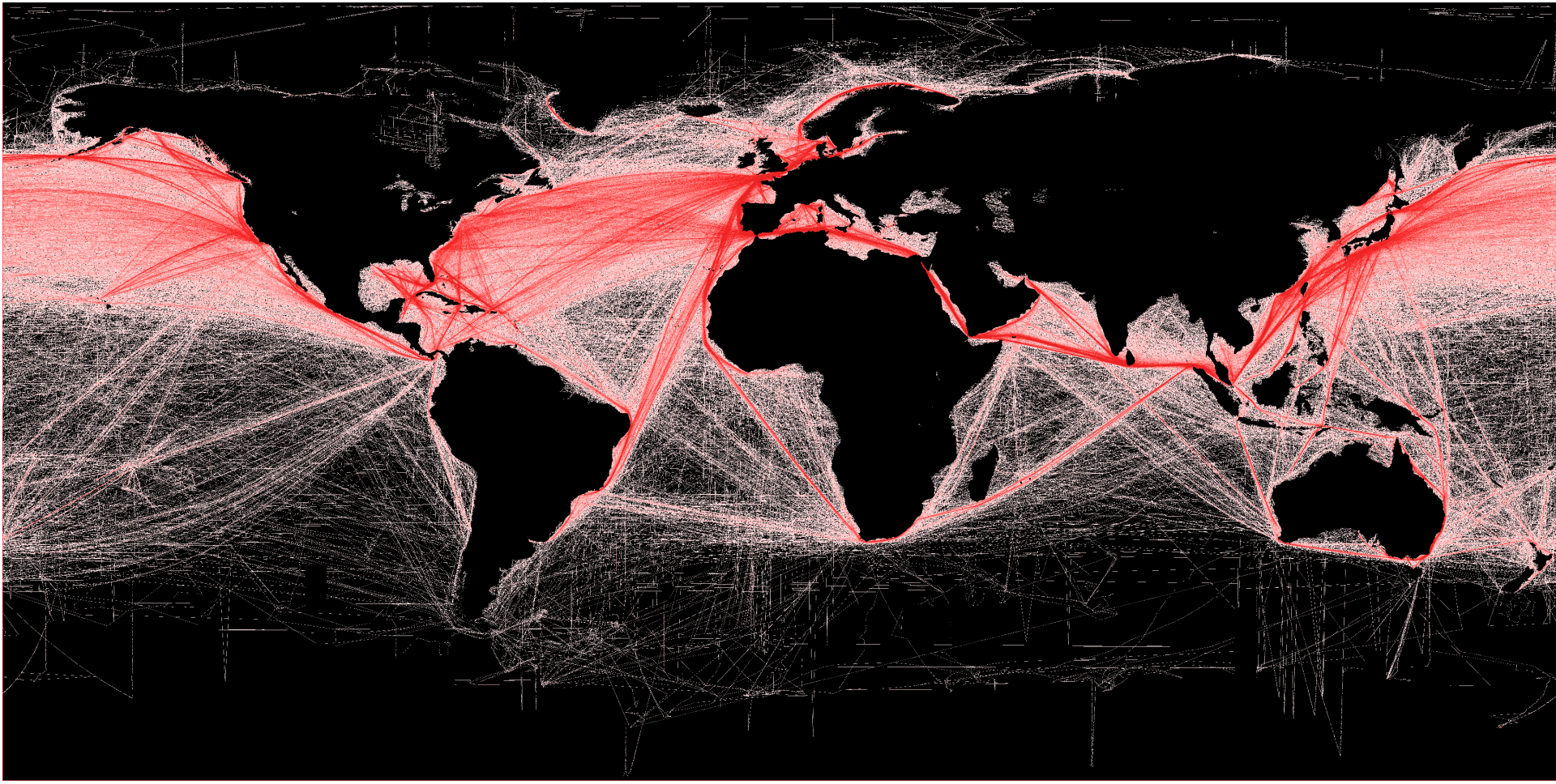
Verification



Certification

- Outsource verification requirements
- Simplification for procurement specialists
- Engaging leading brands
- May require additional specifications or not align with your interests

Supply chain engagement



B.S. Halpern (T. Hengl; D. Groll) / Wikimedia Commons

Availability

Flix Trigger, Market pigments, Flickr

Implementation

Regulations

Procurement

PCB limits

Verification

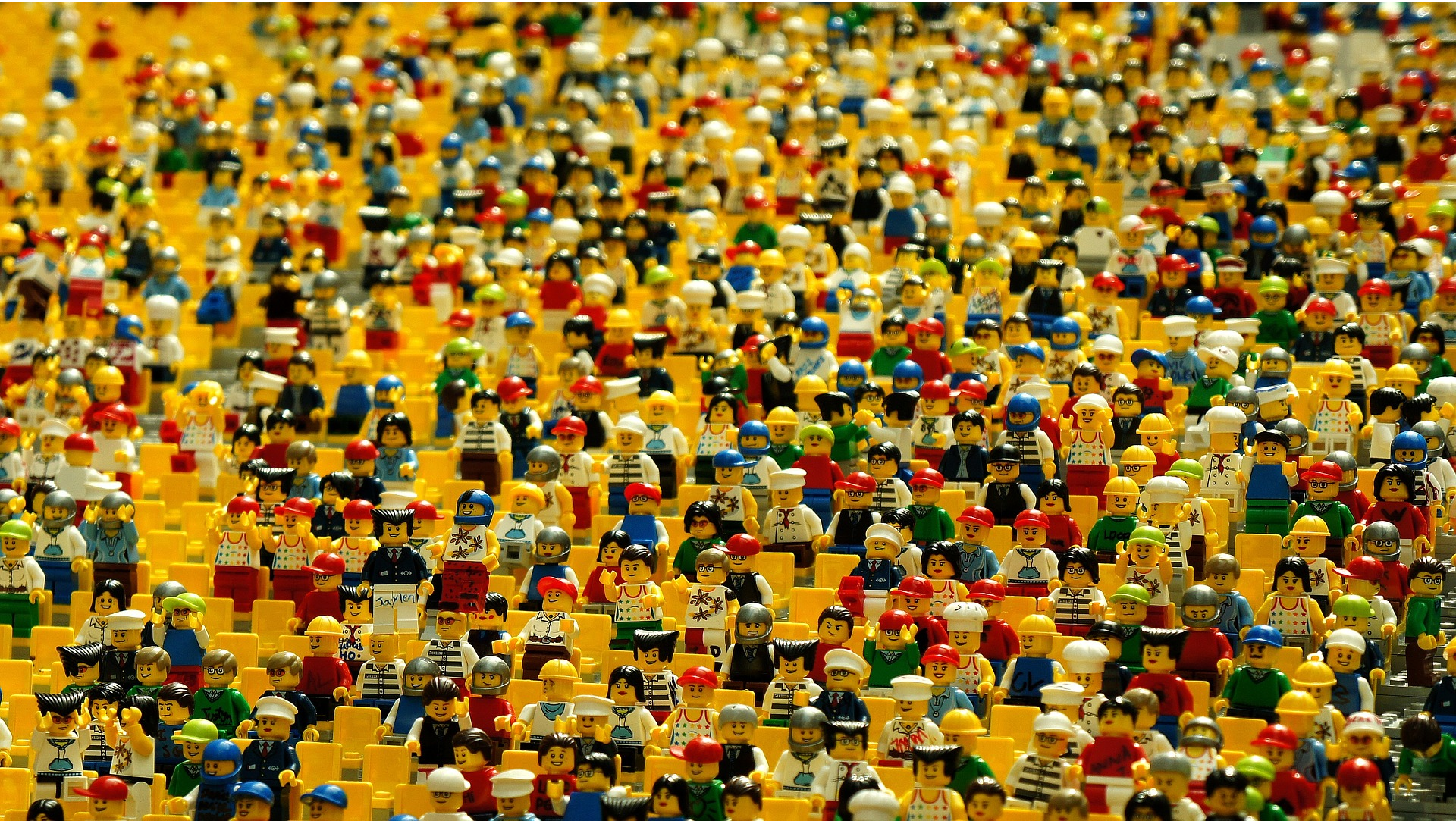
Certification

Supply chain engagement

Availability

Need: Collaborative approach to action

Audience input: Opportunities



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