

TITLE



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 785155



BIMcert ©-Construction skills - Energy efficiency



***Reducing the energy footprint
in the built environment***



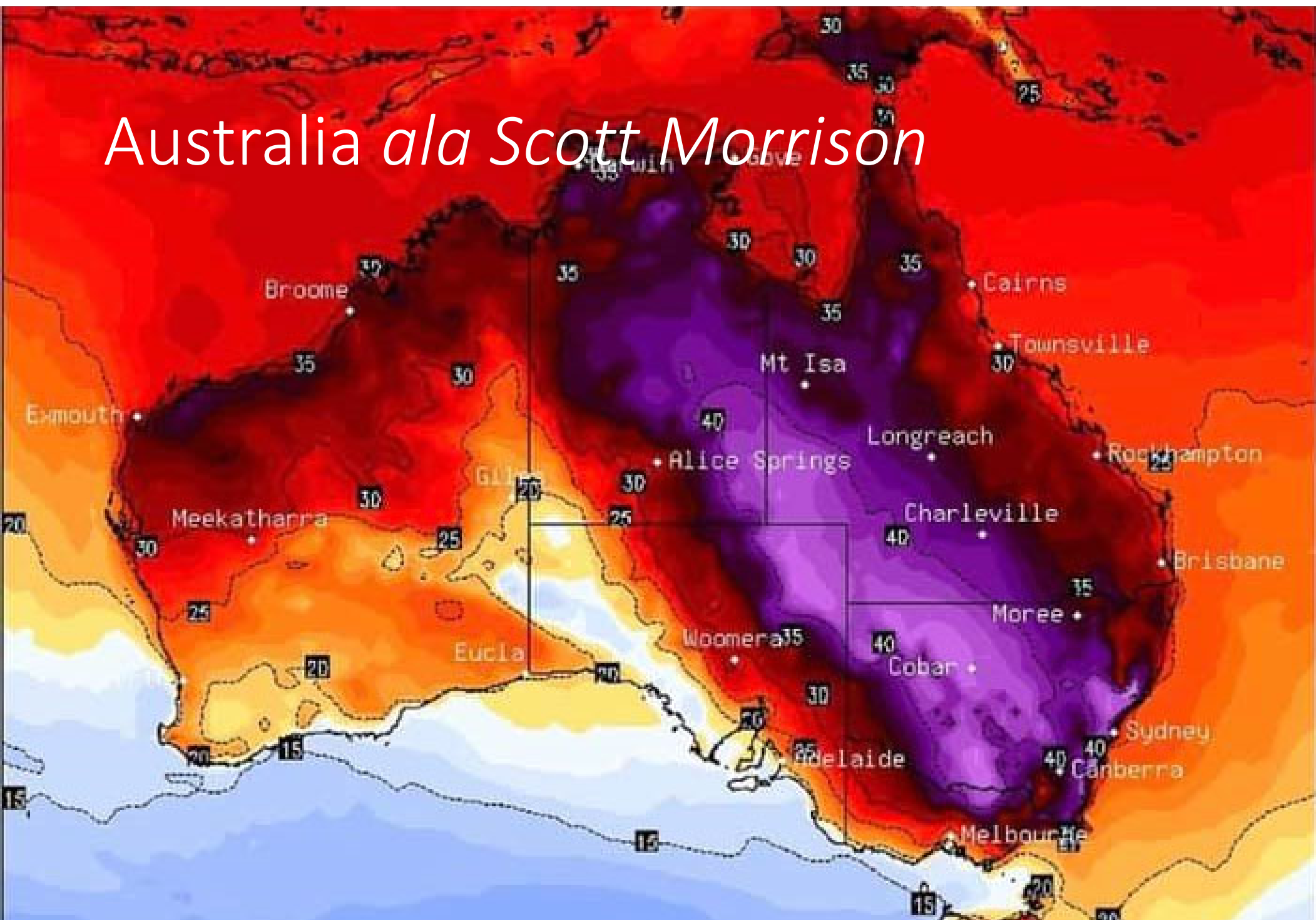
Dr James Harty

*BIM & the energy
Performance of Buildings
until 2030*

Making Sustainability Digital



Australia *ala* Scott Morrison



Climate Crisis



© Renata Peters via Facebook

Global Warming



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This is Not a Time for Inaction



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Fossil Fuels Fuel Wars

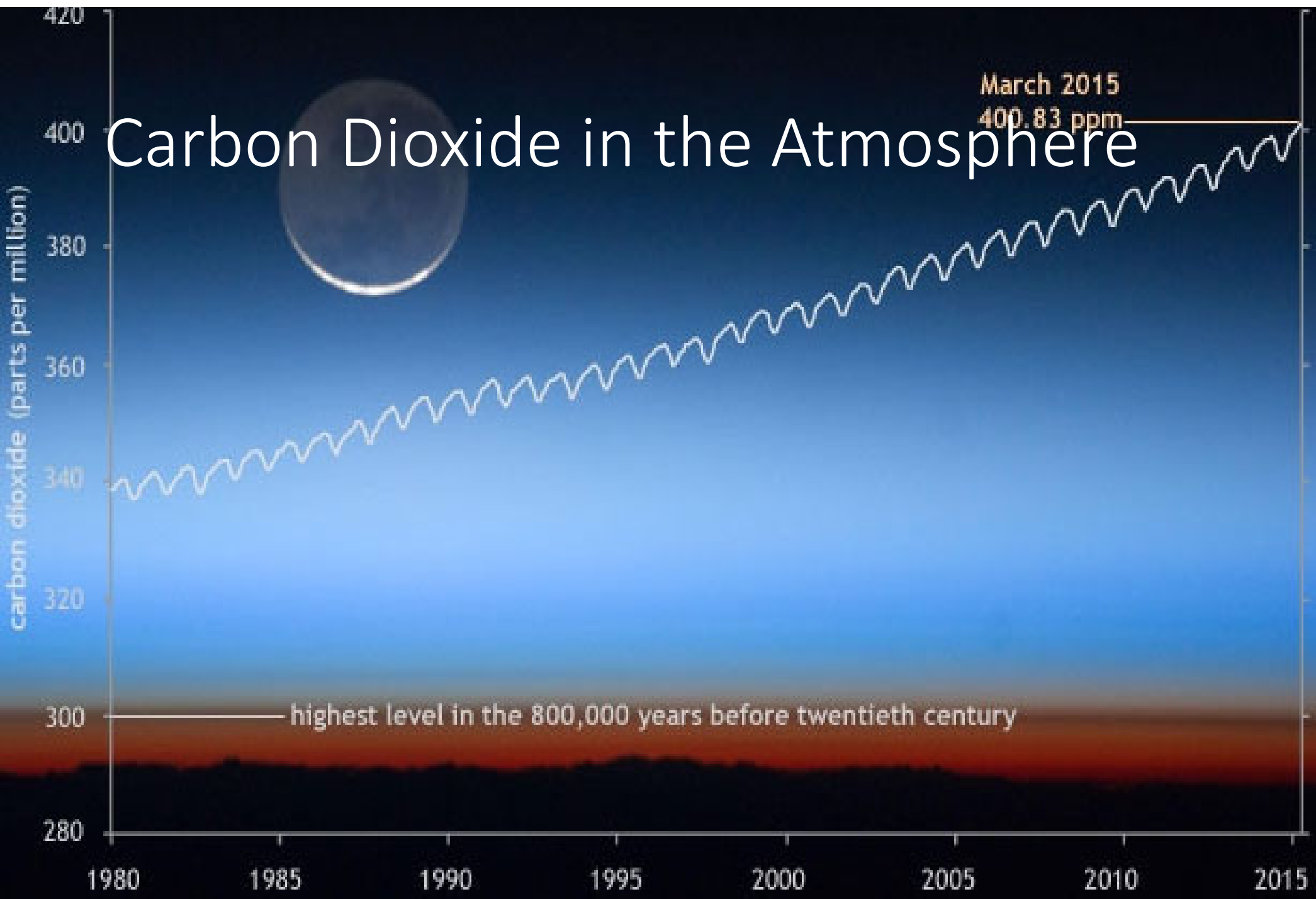


What to do?



© Renata Peters via Facebook

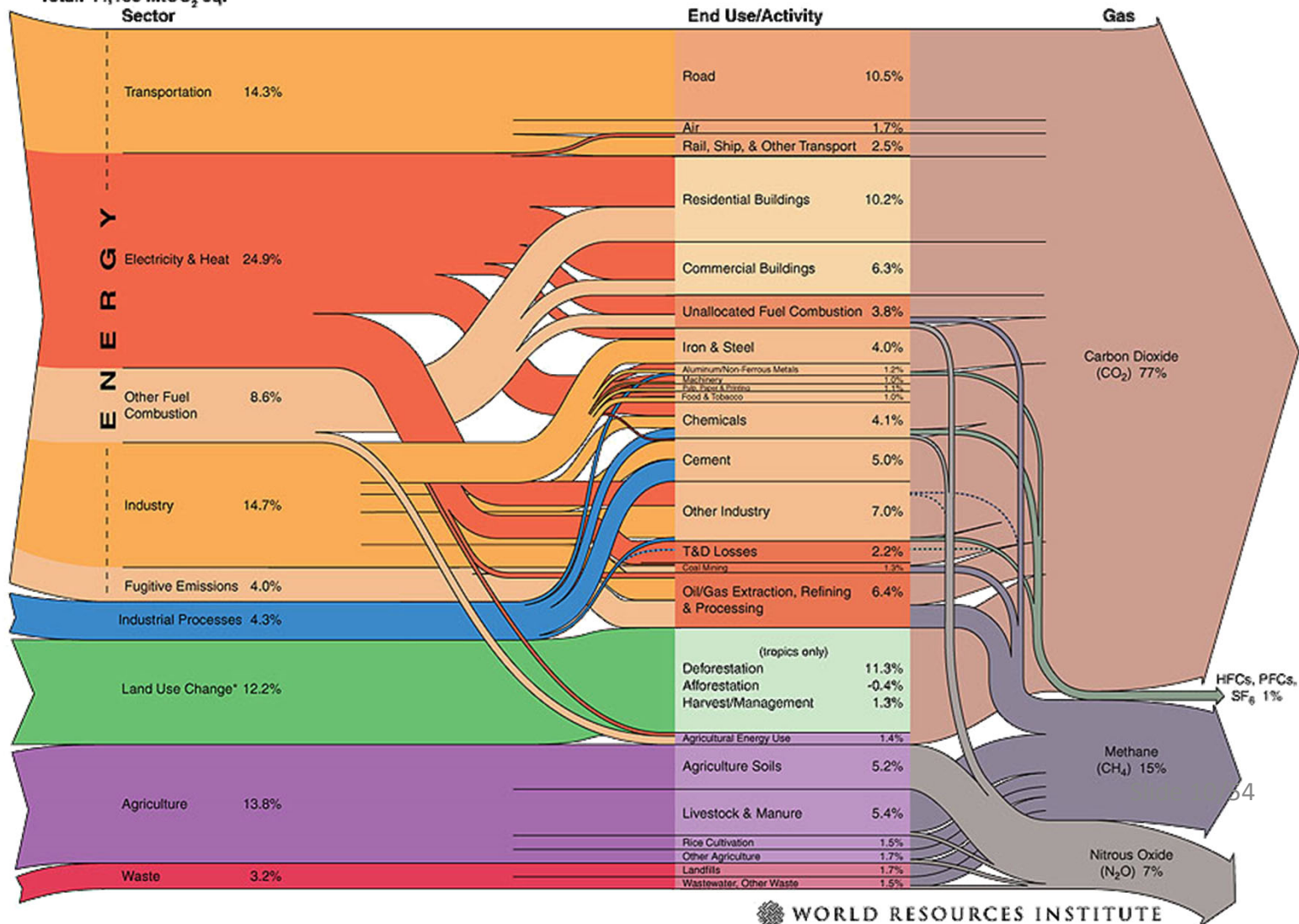
Carbon Dioxide in the Atmosphere





Greenhouse Gases

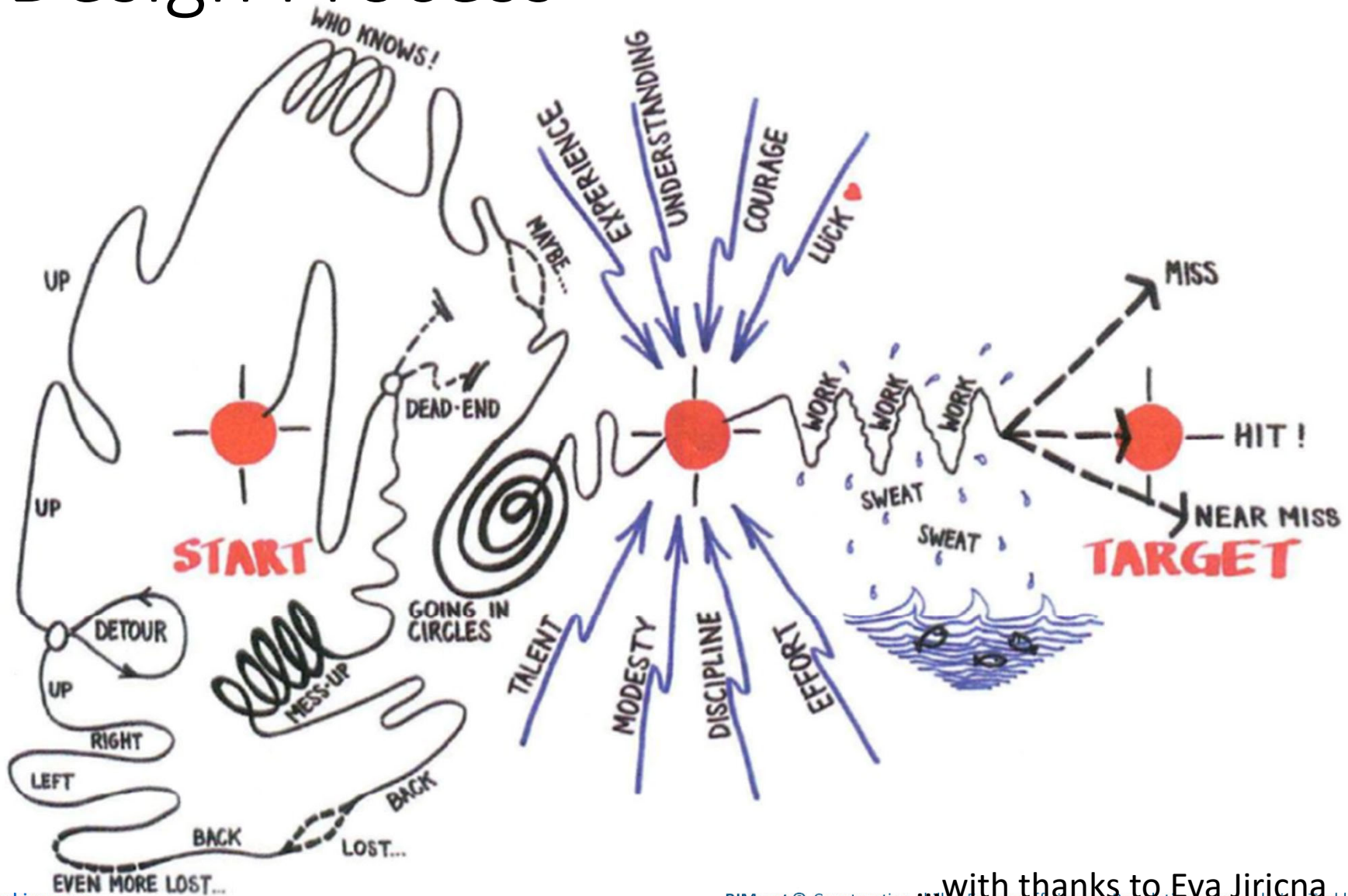
World Greenhouse Gas Emissions in 2005
Total: 44,153 MtCO₂ eq.



WORLD RESOURCES INSTITUTE

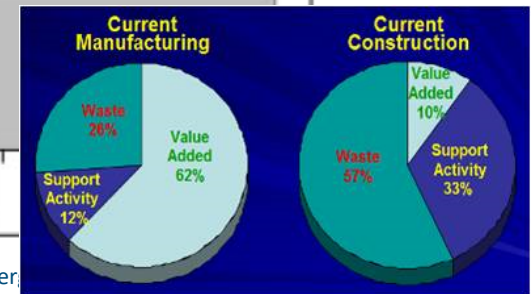
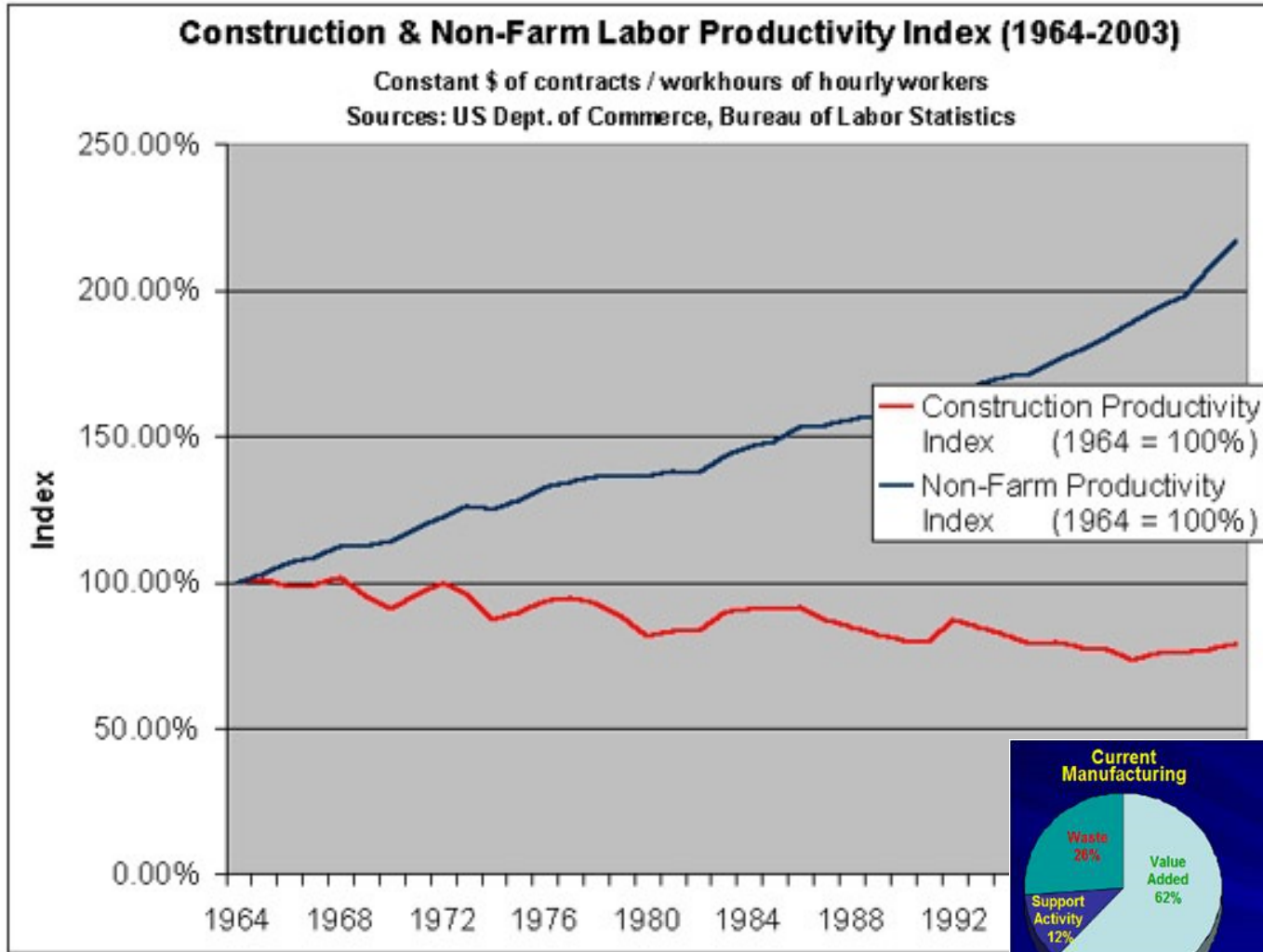
BIMcert © - Construction skills - Energy efficiency - Regulating supply chain - Tackling climate change

Design Process



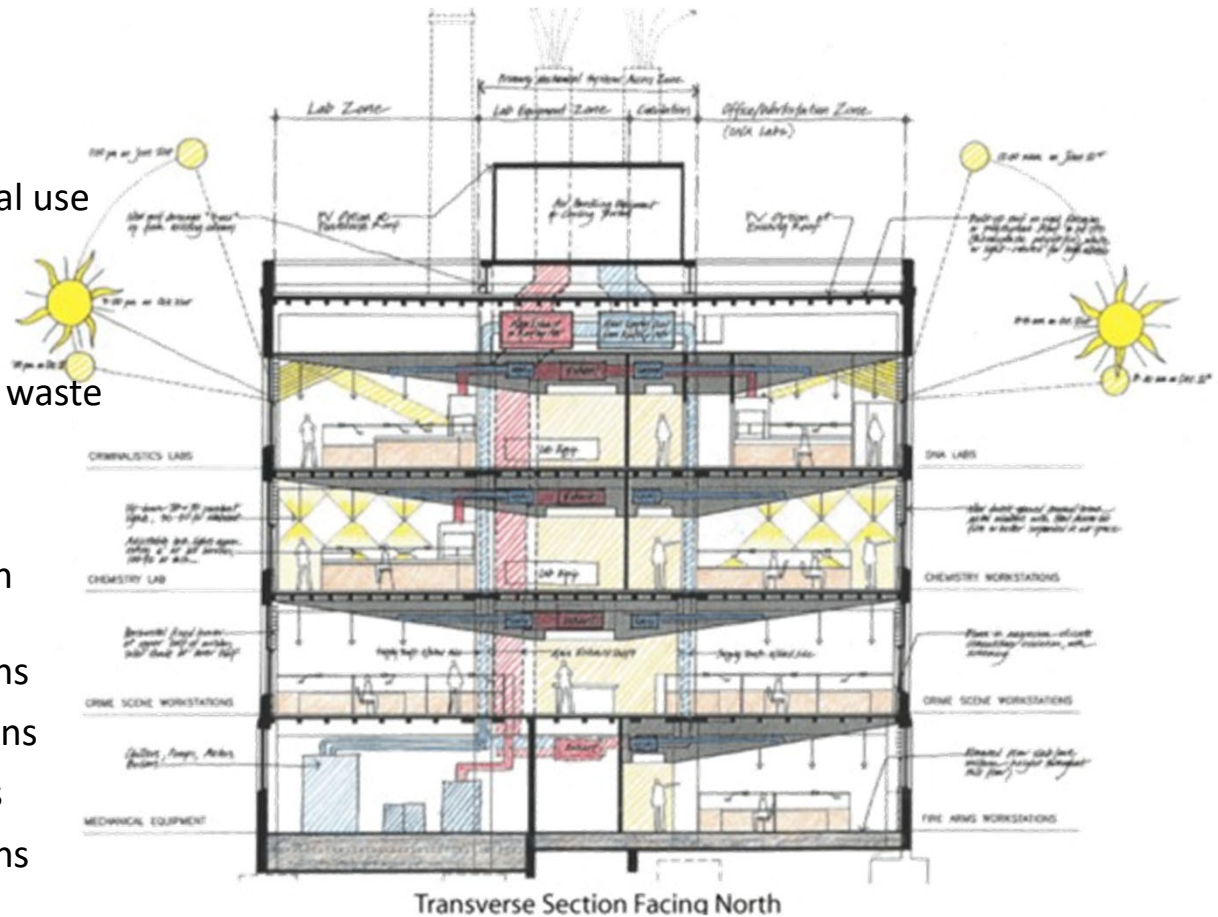
...with thanks to Eva Jiricna

The Price of this Method



Building Impacts:

- 37% of Primary Energy Use
- 68% of all Electricity use
- 60% of Non-food/fuel Raw Material use
- 40% of Nonindustrial Solid Waste
 - (136 M tons of construction and demolition debris per annum)
- 31% of Mercury in municipal solid waste
- 12% of Potable Water
- 36B gallons of Water use per day
- 20% loss of Potable Water in urban systems due to leakage
- 38% of all Carbon Dioxide emissions
- 49% of all Sulphur Dioxide emissions
- 25% of all Nitrous Oxide emissions
- 10% of particulate matter emissions
 - Sustainable Preservation
 - Jean Carroon Wiley 2010





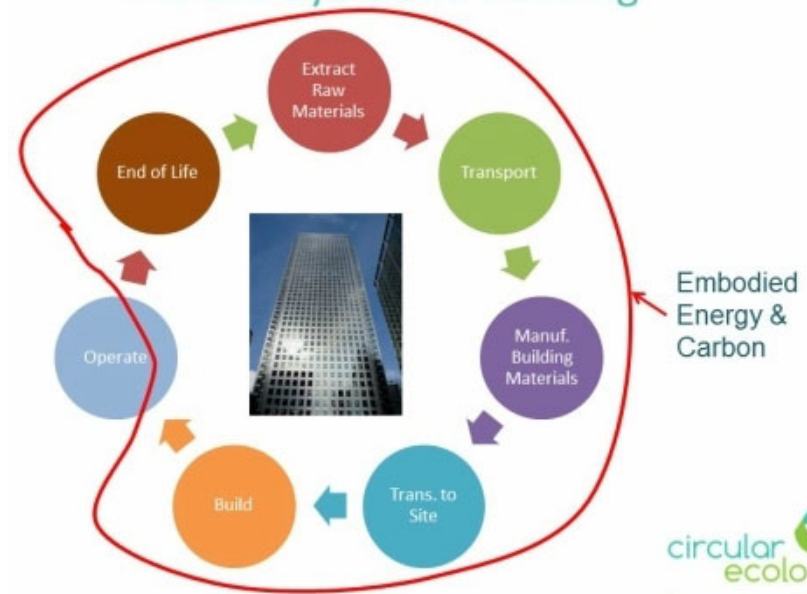
UN 17 SDG's



Embodied Carbon

- Embodied carbon refers to carbon dioxide emitted during the manufacture, transport and construction of building materials, (together with end-of-life emissions).
 - So for example, if you are specifying concrete on a project then carbon will have been emitted making that concrete.

Embodied Energy and Carbon The Life Cycle of a Building

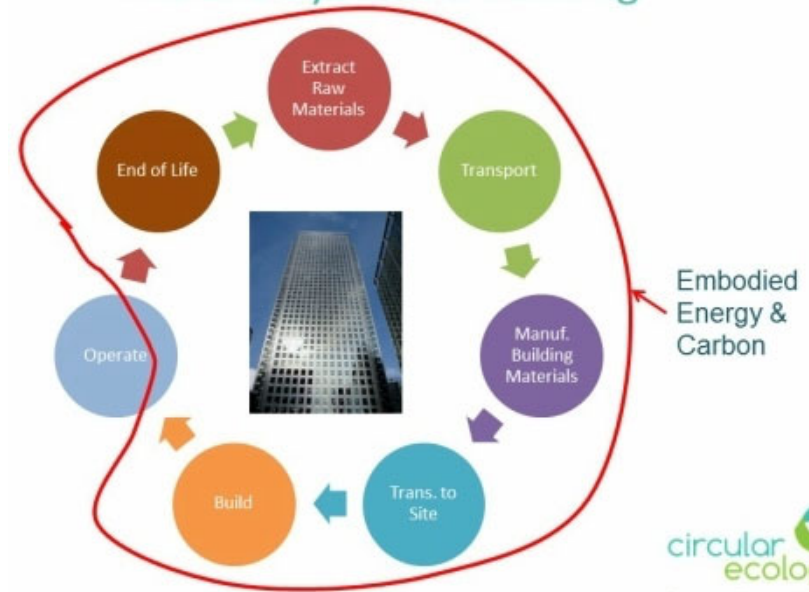


Embodied Energy

- Embodied Energy is the description of energy used directly and indirectly in:
 - raw-material acquisition,
 - production of materials and
 - the assemblage of those materials into a building.



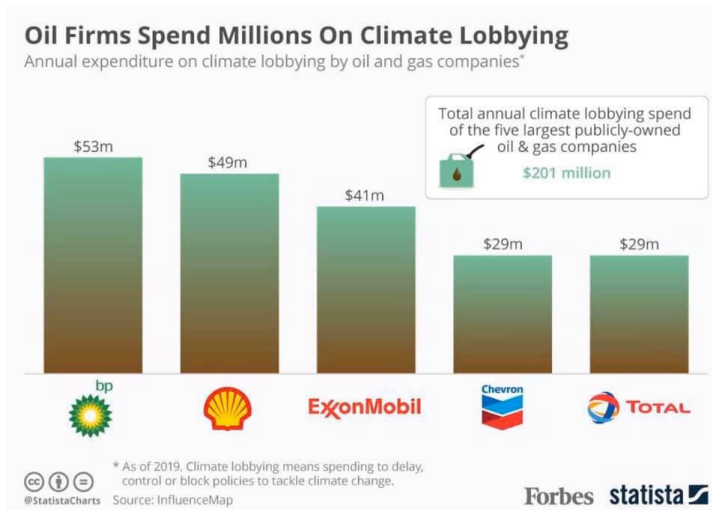
Embodied Energy and Carbon The Life Cycle of a Building



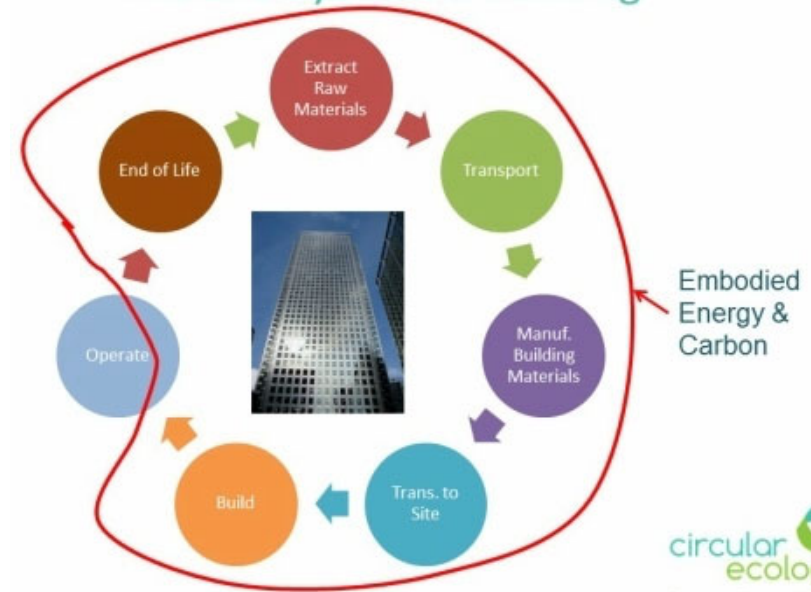


Embodied Energy

- Every building starts with an environmental debt that includes
 - resource depletion,
 - energy and
 - manufacturing from the impact of construction.







Embodied Energy and Carbon The Life Cycle of a Building





95 Environmental Rules Being Rolled Back Under Trump

	58 ROLLBACKS COMPLETED	37 ROLLBACKS IN PROCESS	95 TOTAL ROLLBACKS
 Air pollution and emissions	16	9	25
 Drilling and extraction	10	9	19
 Infrastructure and planning	11	1	12
 Animals	7	3	10
 Toxic substances and safety	5	3	8
 Water pollution	4	6	10
 Other	5	6	11

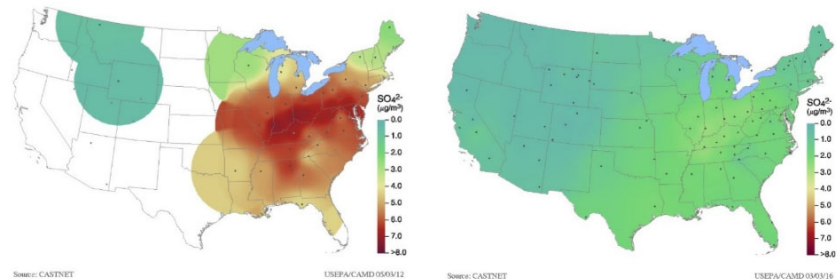


<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>



25 Environmental Rules: Air Pollution & Emissions

- 1. Cancelled a requirement for oil and gas companies to report methane emissions.
- 2. Revised and partially repealed an Obama-era rule limiting methane emissions on public lands, including intentional venting and flaring from drilling operations.
- 3. Replaced the Obama-era Clean Power Plan, which would have set strict limits on carbon emissions from coal- and gas-fired power plants, with a new version that would let states set their own rules.
- 4. Revoked California's power to set its own more stringent emissions standards for cars and light trucks.
- 5. Repealed a requirement that state and regional authorities track tailpipe emissions from vehicles traveling on federal highways.
- 6. Loosened a Clinton-era rule designed to limit toxic emissions from major industrial polluters.
- 8. Amended rules that govern how refineries monitor pollution in surrounding communities.
- 9. Stopped enforcing a 2015 rule that prohibited the use of hydrofluorocarbons, powerful greenhouse gases, in air-conditioners and refrigerators.
- 10. Weakened an Obama-era rule meant to reduce air pollution in national parks and wilderness areas.
- 11. Weakened oversight of some state plans for reducing air pollution in national parks.
- 12. Directed agencies to stop using an Obama-era calculation of the "social cost of carbon" that rulemakers used to estimate the long-term economic benefits of reducing carbon dioxide emissions.
- 13. Withdrew guidance that federal agencies include greenhouse gas emissions in environmental reviews. But several district courts have ruled that emissions must be included in such reviews.
- 4. Lifted a summertime ban on the use of E15, a gasoline blend made of 15 percent ethanol. (Burning gasoline with a higher concentration of ethanol in hot conditions increases smog.)
- 15. Changed rules to allow states and the E.P.A. to take longer to develop and approve plans aimed at cutting methane emissions from existing landfills.
- 16. Revoked an Obama executive order that set a goal of cutting the federal government's greenhouse gas emissions by 40 percent over 10 years.
- 17. Proposed relaxing Obama-era requirements that companies monitor and repair methane leaks at oil and gas facilities.
- 18. Proposed weakening Obama-era fuel-economy standards for cars and light trucks.
- 19. Submitted notice of intent to withdraw the United States from the Paris climate agreement. The process of withdrawing cannot be completed until November 2020.
- 20. Proposed eliminating Obama-era restrictions that in effect required newly built coal power plants to capture carbon dioxide emissions.
- 21. Proposed a legal justification for weakening an Obama-era rule that limited mercury emissions from coal power plants.
- 22. Proposed revisions to standards for carbon dioxide emissions from new, modified and reconstructed power plants.
- 23. Began a review of emissions rules for power plant start-ups, shutdowns and malfunctions. In April, the E.P.A. proposed reversing a requirement that Texas follow the emissions rule, with implications for 35 other states.
- 24. Proposed the repeal of rules meant to reduce leaking and venting of hydrofluorocarbons from large refrigeration and air conditioning systems.
- 25. Opened for comment a proposal limiting the ability of individuals and communities to challenge E.P.A.-issued pollution permits before a panel of agency judges.



<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>

<https://energybimcert.eu>

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19 Environmental Rules: Drilling & Extraction

- 26. Made significant cuts to the borders of two national monuments in Utah and recommended border and resource management changes to several more.
- 27. Rescinded water pollution regulations for fracking on federal and Indian lands.
- 28. Scrapped a proposed rule that required mines to prove they could pay to clean up future pollution.
- 29. Withdrew a requirement that Gulf oil rig owners prove they could cover the costs of removing rigs once they have stopped producing.
- 30. Approved construction of the Dakota Access pipeline less than a mile from the Standing Rock Sioux reservation. Under the Obama administration, the Army Corps of Engineers had said it would explore alternative routes.
- 31. Revoked an Obama-era executive order designed to preserve ocean, coastal and Great Lakes waters in favour of a policy focused on energy production and economic growth.
- 32. Changed how the Federal Energy Regulatory Commission considers the indirect effects of greenhouse gas emissions in environmental reviews of pipelines.
- 33. Permitted the use of seismic air guns for gas and oil exploration in the Atlantic Ocean. The practice, which can kill marine life and disrupt fisheries, was blocked under the Obama administration.
- 34. Lifted ban on drilling in the Arctic National Wildlife Refuge.
- 35. Loosened offshore drilling safety regulations implemented by the Obama administration after the Horizon explosion and oil spill, including blowout prevention systems.
- 36. Proposed opening most of America's coastal waters to offshore oil and gas drilling, but delayed the plan after a federal judge ruled that Mr. Trump's reversal of an Obama-era ban on drilling in the Arctic Ocean was unlawful.
- 37. Lifted an Obama-era freeze on new coal leases on public lands. But, in April 2019, a judge ruled that the Interior Department could not begin selling new leases without completing an environmental review. A month later, the agency published a draft assessment that concluded restarting federal coal leasing would have little environmental impact.
- 38. Repealed an Obama-era rule governing royalties for oil, gas and coal leases on federal lands, which replaced a 1980s rule that critics said allowed companies to underpay the federal government. A federal judge struck down the Trump administration's repeal. The Interior Department is reviewing the decision.
- 39. Proposed revising regulations on offshore oil and gas exploration by floating vessels in the Arctic that were developed after a [2013 accident](#). The Interior Department previously said it was "considering full rescission or revision of this rule."
- 40. Proposed "streamlining" the approval process for drilling for oil and gas in national forests.
- 41. Recommended shrinking three marine protected areas, or opening them to commercial fishing.
- 42. Proposed opening land in the Alaska National Petroleum Reserve for oil and leasing. The Obama administration had designated the reserve as a conservation area.
- 43. Proposed lifting a Clinton-era policy that banned logging and road construction in Alaska's Tongass National Forest.
- 44. Approved the Keystone XL pipeline rejected by President Barack Obama, but a federal judge blocked the project from going forward without an adequate environmental review process. Mr. Trump later attempted to side-step the ruling by issuing a presidential permit, but the project remains tied up in court.



<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>



12 Environmental Rules: Infrastructure & Planning

- 45. Revoked Obama-era flood standards for federal infrastructure projects, like roads and bridges. The standards required the government to account for sea-level rise and other climate change effects.
- 46. Relaxed the environmental review process for federal infrastructure projects.
- 47. Revoked a directive for federal agencies to minimize impacts on water, wildlife, land and other natural resources when approving development projects.
- 48. Revoked an Obama executive order promoting “climate resilience” in the northern Bering Sea region of Alaska, which withdrew local waters from oil and gas leasing and established a tribal advisory council to consult on local environmental issues.
- 49. Reversed an update to the Bureau of Land Management’s public land use planning process.
- 50. Withdrew an Obama-era order to consider climate change in managing natural resources in national parks.
- 51. Restricted most Interior Department environmental studies to one year in length and a maximum of 150 pages, citing a need to reduce paperwork.
- 52. Withdrew a number of Obama-era Interior Department climate change and conservation policies that the agency said could “burden the development or utilization of domestically produced energy resources.”
- 53. Eliminated the use of an Obama-era planning system designed to minimize harm from oil and gas activity on sensitive landscapes, such as national parks.
- 54. Eased the environmental review processes for small wireless infrastructure projects with the goal of expanding 5G wireless networks.
- 55. Withdrew Obama-era policies designed to maintain or, ideally improve, natural resources affected by federal projects.
- 56. Proposed plans to streamline the environmental review process for Forest Service projects.



<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>



10 Environmental Rules: Animals

- 57. Changed the way the Endangered Species Act is applied, making it more difficult to protect wildlife from long-term threats posed by climate change.
- 58. Overturned a ban on the use of lead ammunition and fishing tackle on federal lands.
- 59. Overturned a ban on the hunting of predators in Alaskan wildlife refuges.
- 60. Amended fishing regulations for a number of species to allow for longer seasons and higher catch rates.
- 61. Withdrew proposed limits on the number of endangered marine mammals and sea turtles that can be unintentionally killed or injured with sword-fishing nets by people who fish on the West Coast. (In 2018, California issued a state rule prohibiting the use of the nets the rule was intending to regulate.)
- 62. Rolled back a roughly 40-year-old interpretation of a policy aimed at protecting migratory birds, potentially running afoul of treaties with Canada and Mexico.
- 63. Overturned a ban on using parts of migratory birds in handicrafts made by Alaskan Natives.
- 64. Opened nine million acres of Western land to oil and gas drilling by weakening habitat protections for the sage grouse, an imperilled
- 65. Proposed ending an Obama-era rule that barred using bait to lure and kill grizzly bears, among other sport hunting practices that many people consider extreme, on some public lands in Alaska. bird with an [elaborate mating dance](#). An Idaho District Court injunction blocked the measure.
- 66. Proposed relaxing environmental protections for salmon and smelt in California's Central Valley in order to free up water for farmers.



<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>

08 Environmental Rules: Toxic Substances & Safety

- 67. Rejected a proposed ban on chlorpyrifos, a pesticide linked to developmental disabilities in children. (A European Union ban is to take effect in 2020.)
- 68. Narrowed the scope of a 2016 law mandating safety assessments for potentially toxic chemicals like dry-cleaning solvents. The E.P.A. said it would focus on direct exposure and exclude indirect exposure such as from air or water contamination. In November, a court of appeals ruled the agency must widen its scope to consider full exposure risks.
- 69. Reversed an Obama-era rule that required braking system upgrades for “high hazard” trains hauling flammable liquids, like oil and ethanol.
- 70. Removed copper filter cake, an electronics manufacturing by-product comprised of heavy metals, from the “hazardous waste” list.
- 71. Ended an Occupational Safety and Health Administration program to reduce risks of workers developing the lung disease silicosis.
- 72. Proposed changing safety rules to allow for rail transport of liquefied natural gas, which is highly flammable.
- 73. Rolled back most of the requirements of a 2017 rule aimed at improving safety at sites that use hazardous chemicals that was instituted after a chemical plant exploded in Texas.
- 74. Announced a review of an Obama-era rule lowering coal dust limits in mines. The head of the Mine Safety and Health Administration said there were no immediate plans to change the dust limit but has extended a public comment period until 2022.



<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>



10 Environmental Rules: Water Pollution

- 75. Scaled back pollution protections for certain tributaries and wetlands that were regulated under the Clean Water Act by the Obama administration.
- 76. Revoked a rule that prevented coal companies from dumping mining debris into local streams.
- 77. Withdrew a proposed rule aimed at reducing pollutants, including air pollution, at sewage treatment plants.
- 78. Withdrew a proposed rule requiring groundwater protections for certain uranium mines.
- 79. Proposed a rule exempting certain types of power plants from parts of an E.P.A. rule limiting toxic discharge from power plants into public waterways.
- 80. Proposed allowing the E.P.A. to issue permits for federal projects under the Clean Water Act over state objections if they don't meet local water quality goals, including for pipelines and other fossil fuel facilities.
- 81. Proposed extending the lifespan of unlined coal ash holding areas, which can spill their contents because they lack a protective underlay.
- 82. Proposed a regulation limiting the scope of an Obama-era rule under which companies had to prove that large deposits of recycled coal ash would not harm the environment.
- 83. Proposed a new rule allowing the federal government to issue permits for coal ash waste in Indian Country and some states without review if the disposal site is in compliance with federal regulations.
- 84. Proposed doubling the time allowed to remove lead pipes from water systems with high levels of lead.



<https://www.nytimes.com/interactive/2019/climate/trump-environment-rollbacks.html>



11 Environmental Rules: Other

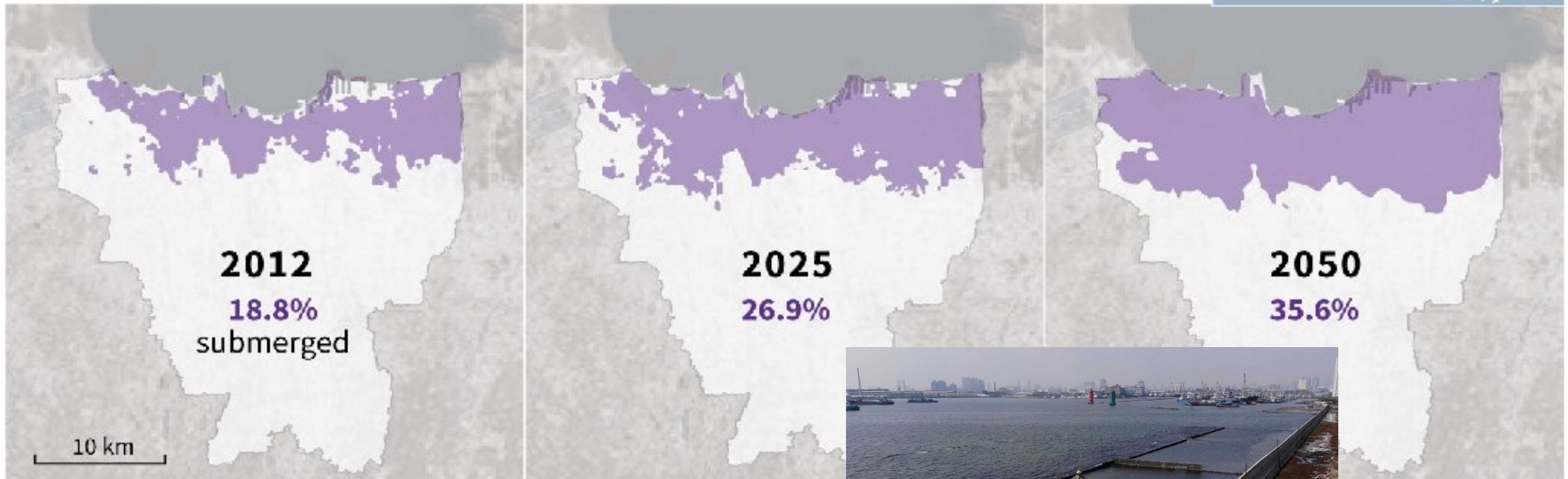
- 85. Repealed an Obama-era regulation that would have nearly doubled the number of light bulbs subject to energy-efficiency standards starting in January 2020. The E.P.A. also blocked the next phase of efficiency standards for general-purpose bulbs already subject to regulation.
- 86. Allowed coastal replenishment projects to use sand from protected beaches.
- 87. Limited funding environmental and community development projects through corporate settlements of federal lawsuits.
- 88. Announced intent to stop payments to the Green Climate Fund, a United Nations program to help poorer countries reduce carbon emissions.
- 89. Reversed restrictions on the sale of plastic water bottles in national parks designed to cut down on litter, despite a Park Service report that the effort worked.
- 90. Ordered a review of water efficiency standards in bathroom fixtures, including toilets.
- 91. Proposed limiting the studies used by the E.P.A. for rulemaking to only those that make data publicly available. (Scientists widely criticized the proposal, who said it would effectively block the agency from considering landmark research that relies on confidential health data.)
- 92. Proposed changes to the way cost-benefit analyses are conducted under the Clean Air Act, Clean Water Act and other environmental statutes.
- 93. Proposed withdrawing efficiency standards for residential furnaces and commercial water heaters designed to reduce energy use.
- 94. Created a product category that would allow some dishwashers to be exempt from energy efficiency standards.
- 95. Initially withdrew then delayed a proposed rule that would inform car owners about fuel-efficient replacement tires. (The Transportation Department has scheduled a new rulemaking notice for 2020.)



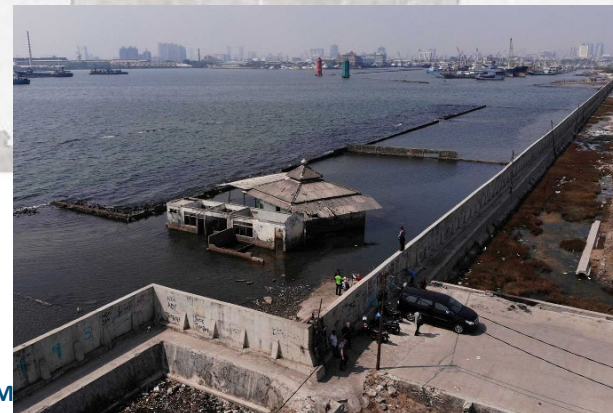
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Sinking Jakarta

More than a third of the Indonesian capital could be submerged by 2050, according to expert forecasts

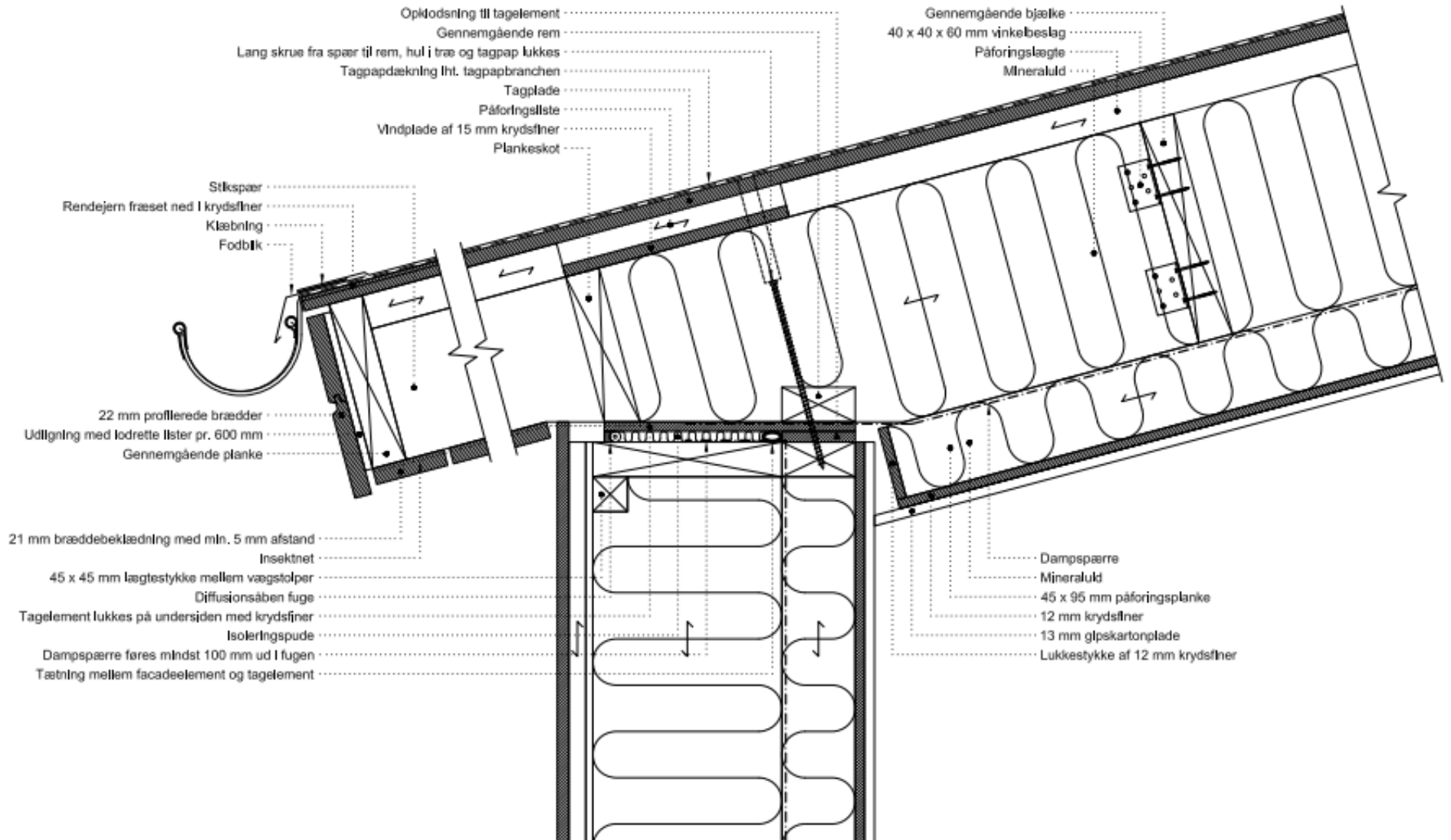


Source: Bandung Institute of Technology



© AFP

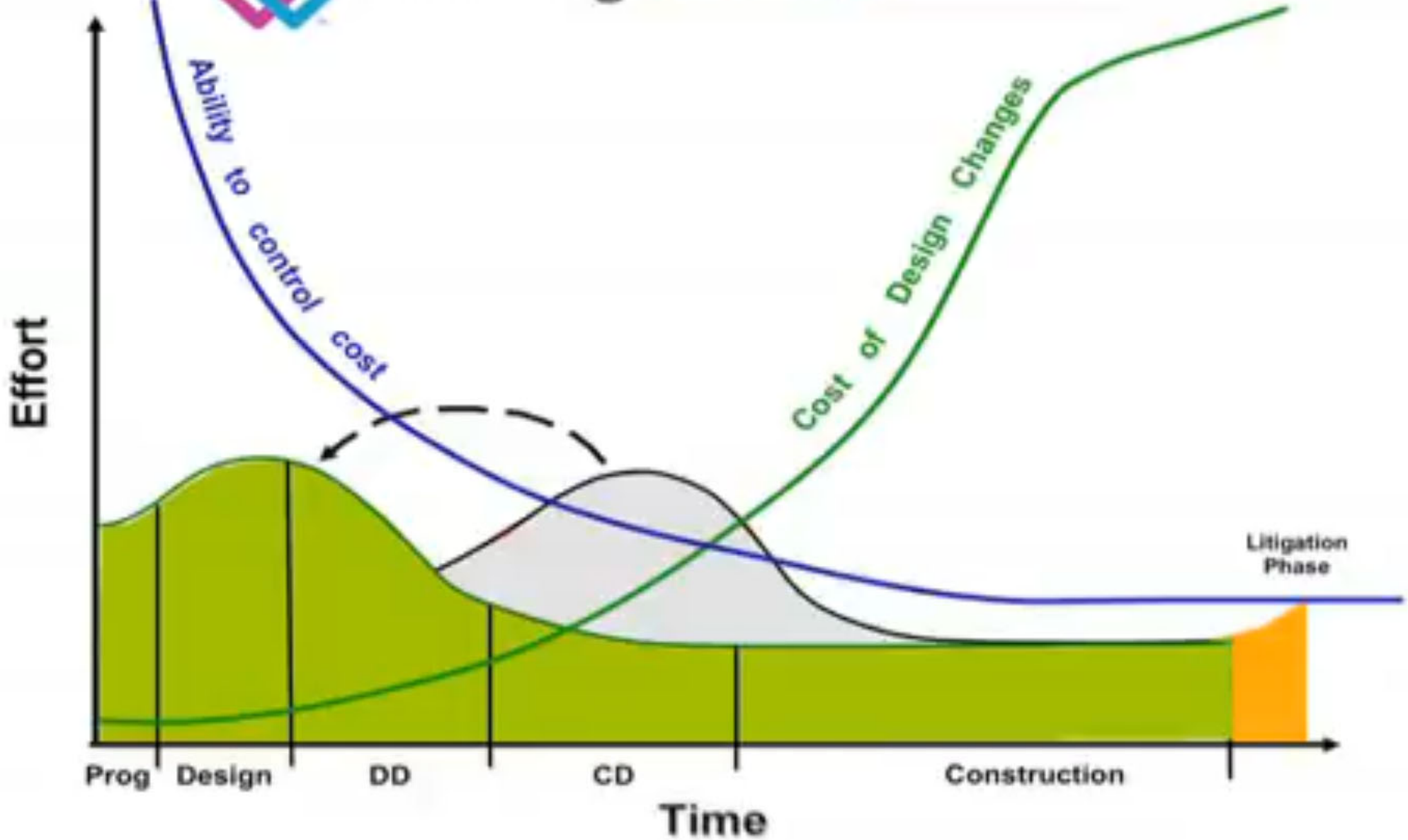
2D Drawn details cannot be tested!!!





building **SMART** Design

Effort v Time





Patrick MacLeamy CEO HoK

Benefit

BIM

BAM

BOOM!

Building
Design

Building
Assembly

Building
Operation

\$1

\$20

\$60

Time



Laing O'Rourke





BIM Is For Design and Construction

- BIM is tuned for collaboration and visualization during design and construction, not operations and maintenance.
- The intent of BIM is not to create a living breathing model of an operational building but to help architect and construct the building.
- The focus for BIM software has been to create a collaborative design and build process that visualises the physical and functional aspects of a building.
- Visualization in the design and prototyping phase of a new build has been essential for AECs to understand spatial relationships.
- Unlike a Digital Twin, this physical information model is tuned for buildings in flight, not ones occupied and utilized daily.





Digital Twins

- Digital Twins are a method for creating robust data models about all aspects of a building at various stages of its life cycle.





Coen van Oostrom





BIM Isn't Designed for Real-Time Operational Response

- Digital Twins are quickly being recognized as the most valuable part of a building's tech stack – it's a comprehensive picture of your built environment in real-time.
- A Digital Twin can give you information about the current state of build subsystems, how they're being impacted by occupant behaviour when assets like HVAC or lighting might fail and much more.
- It's a model that evolves over time to deliver more value with each new stage of the asset's lifecycle.
- BIM is a key data input for any Digital Twin, but BIM alone cannot answer the operational questions facility managers may have about optimizing operations.





BIM Focuses on Buildings Rather Than People

- The next evolution of the Digital Twin will see use cases moving beyond just assets to include entire organizations or the Digital Twin of an Organization (DTO).
- This means people, processes and behaviours will also be important data sources that give Digital Twins even more context about the built environment.
- If trends in Commercial Real Estate continue to gravitate towards understanding occupants and competing on workspace experience, the Digital Twin will certainly supersede BIM software even at the design and build phase of an asset's lifecycle.





Quantified Sustainability Take-Offs:

- “Copenhagen wants to be the world’s first carbon neutral capital in 2025.
- This is an ambitious plan requiring long-term action, but it is realistic.
- We are already well underway.
- In 2011, Copenhagen had reduced CO2 emissions by 21% compared to 2005”.
 - Frank Jensen, Lord Mayor of Copenhagen
- This means finding and applying methods of measuring carbon
- ...rewarding such practices
- ...and encouraging best practices





Reputations



Over Budget, Under Budget

Walt Disney Concert Hall



Figure 4 Walt Disney Concert Hall, Los Angeles (2003)
Photo credit: Michael L. Magat from "DIGITAL PROJECT - Frank Gehry's vision"
March 9th - May 20th 2007.

Guggenheim Museum in Bilbao



Figure 5 Guggenheim Museum in Bilbao, Guggenheim.
Photo credit: Thomas Mayer from "DIGITAL PROJECT - Frank Gehry's vision"
March 9th - May 20th 2007



Above BIM Level II?



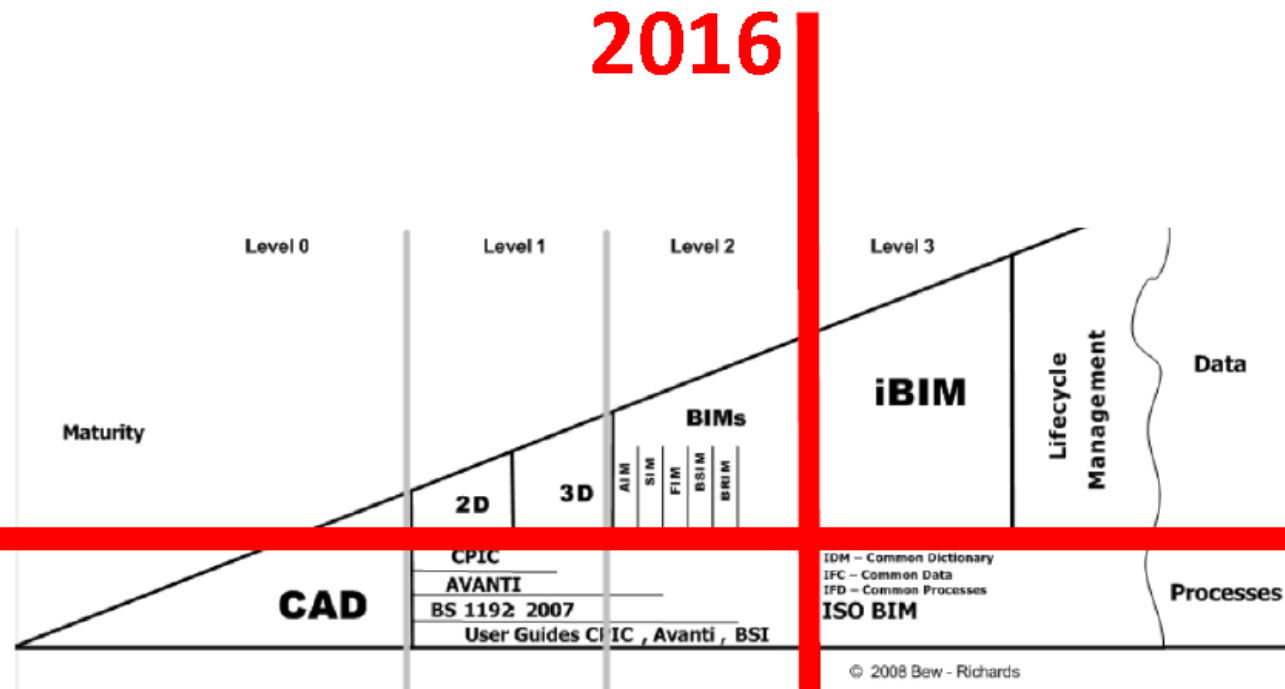
BIM Overlay

doing the right things
leadership
(shared)

(structured)

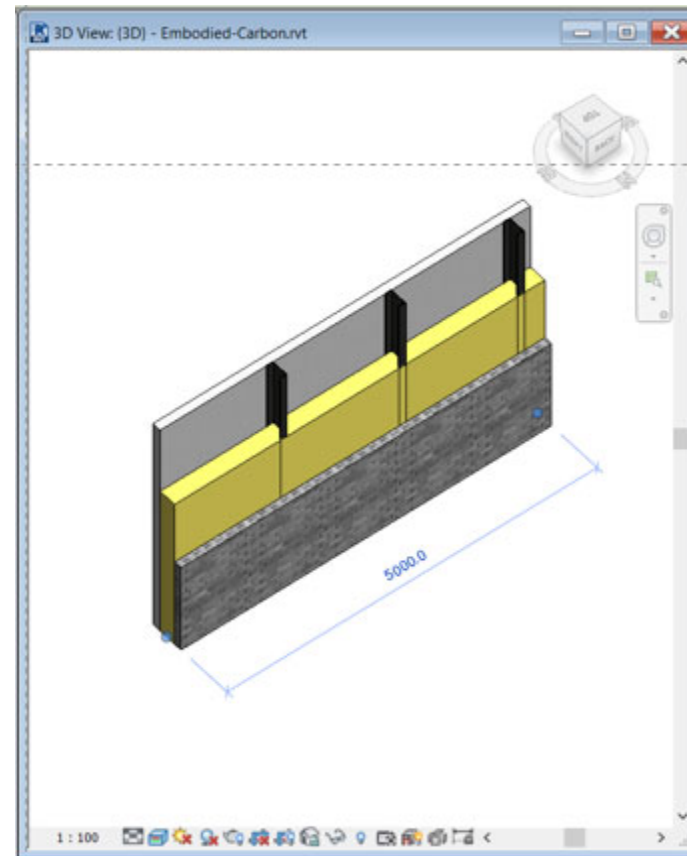
management

doing things right



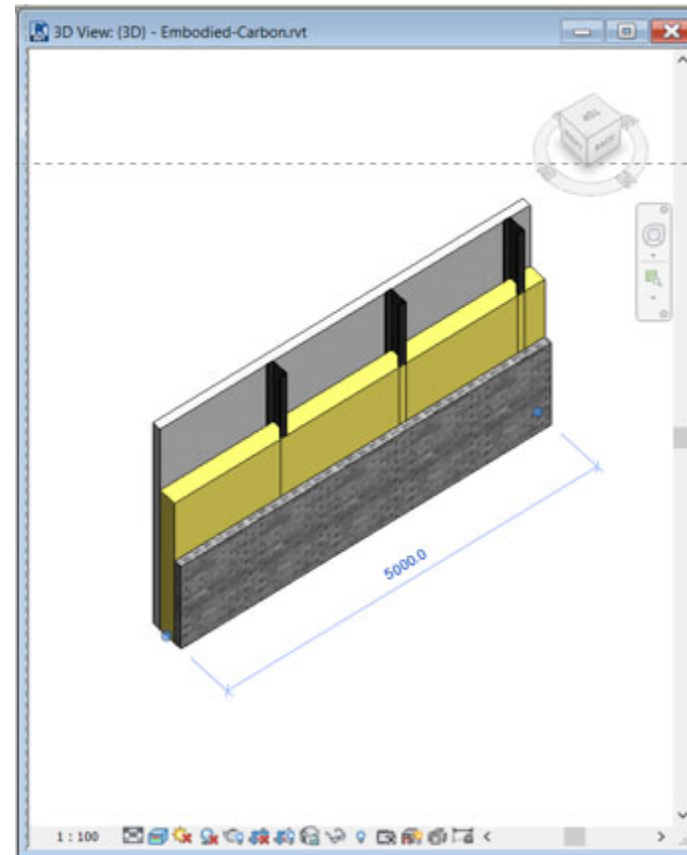
Soft Landings

- If, as a stakeholder, my involvement in the project is lengthened, and my desire to perform better is rewarded, then is it a win-win situation for both provider and user?



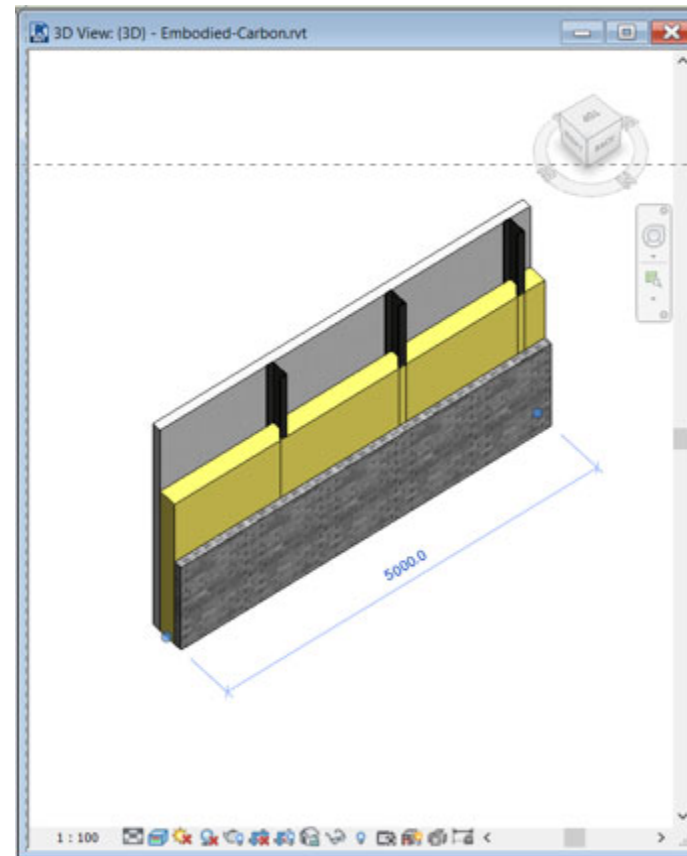
Performance/Reward

- If this wall will perform over its life-cycle, then as creator, can I solicit future payments or rewards?
- Is the wall sensed, so that data can be monitored, collected, valued and rewarded?



Incentive

- If this wall saves 20% energy over 20 years, can I get 5% of the saving paid out as an incentive to produce a better designed wall.





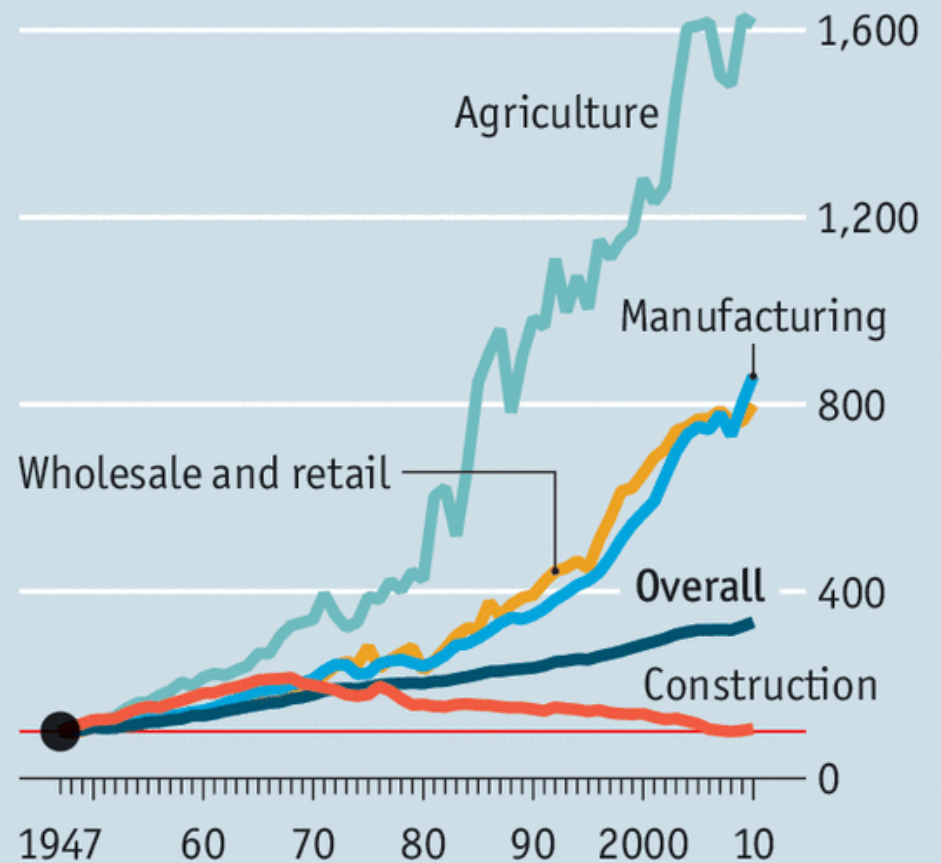
Reward

- BIM is more than 3D geometry, meaning that many properties or features can be added to the object to assess performance, monitor expectations and document best practices.
- This means that it rewards better performance throughout the facilities life-cycle, brings transparency to contractual dealings, it becomes the gift that keeps on giving.



Unlearning by doing

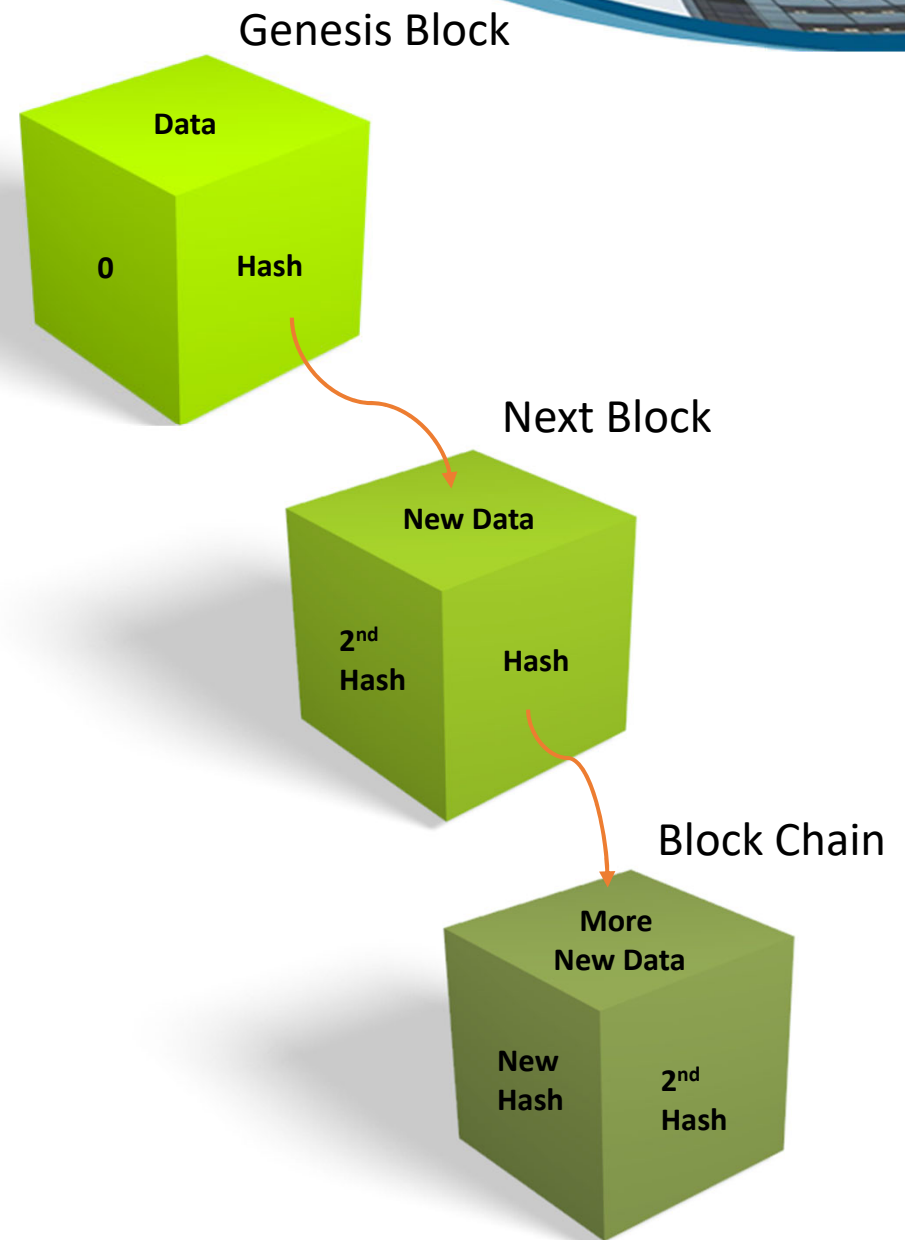
United States, gross value-added*
Per hour worked, 1947=100



Source: McKinsey Global Institute *At constant prices

Blockchain

- Blockchain is a series of blocks
- Each block consists of a piece of data, a hash number (#), and the preceding hash number
- When the Genesis block starts a chain, the successive blocks form a distributed ledger
- This gives consensus and brings transparency to the chain





Thank you

Questions?

Dr James Harty

BArch MArchSc PPCert RIBA MAA PGCert PhD

Making Sustainability Digital

22nd January 2020

kea