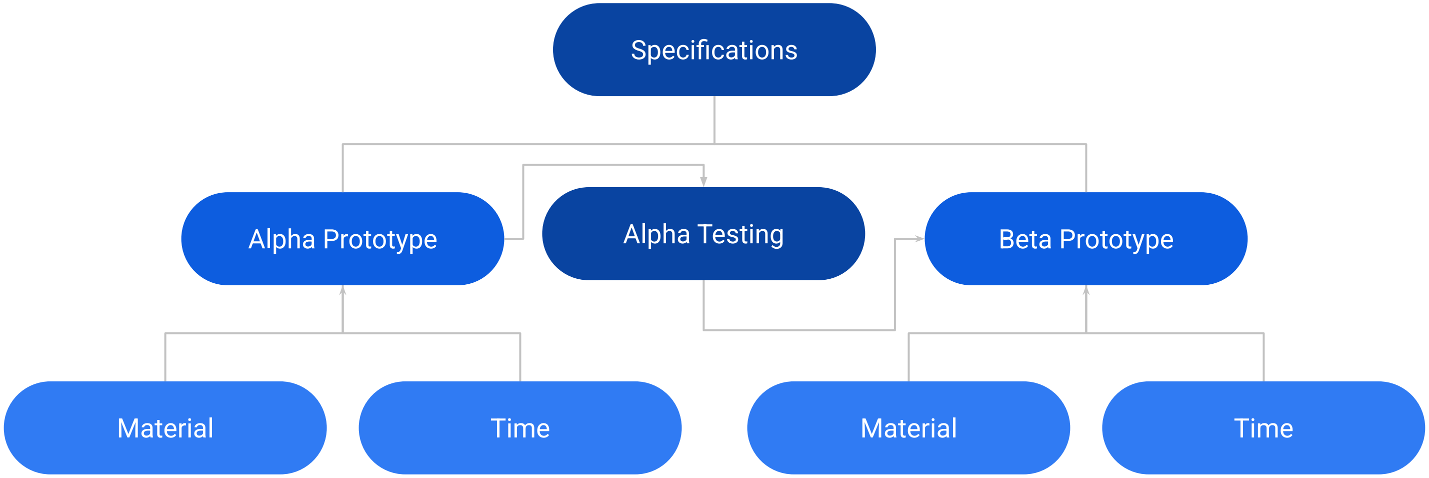
Impact of Product Development using Verilog

Auxiliary Topic as part of Student Outcome H
ABET Monitoring Program

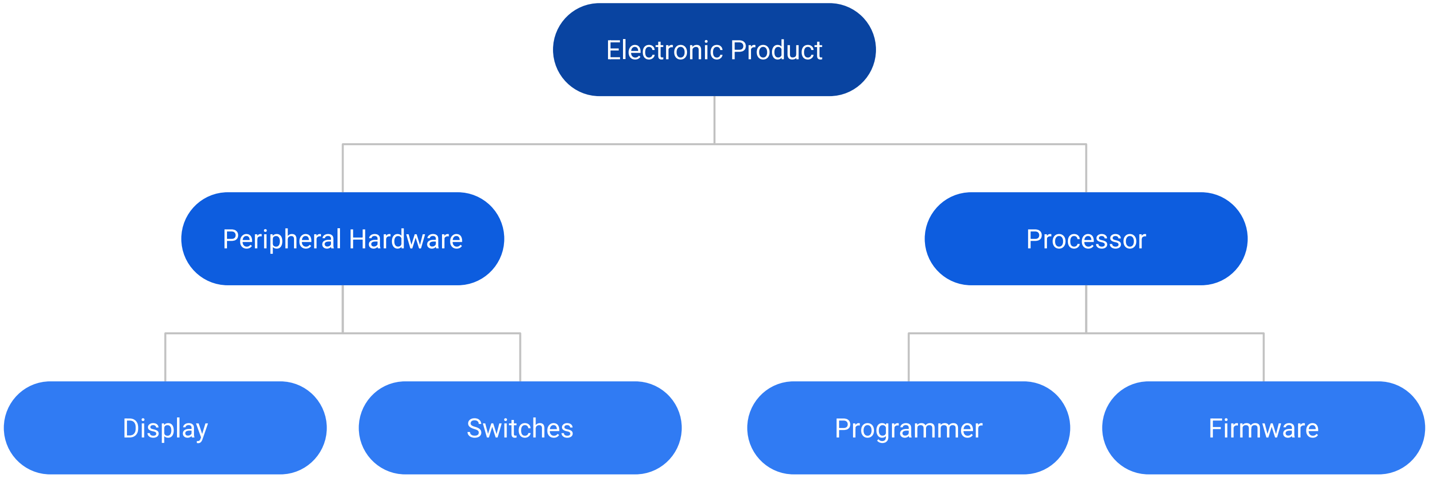
Product Development Cycle

Ideation	Validation	Prototyping
Finding out the specifics needed to be covered by the product. -Market Research	Confirming that the specifics isolated and identified are really what is needed - Market Confirmation Research	Creation of: 1. Plotting Signal Flow 2. Creating / Mapping Operational Blocks 3. Translating Operational Blocks to Circuits

Costs in the Product Cycle



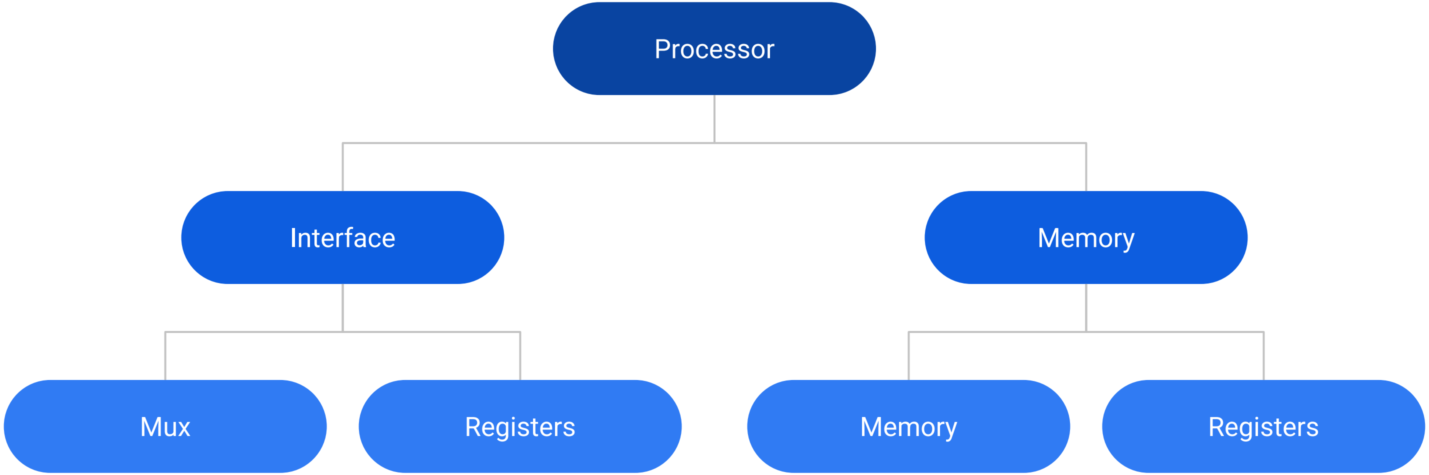
Basic Timer Traditional Development



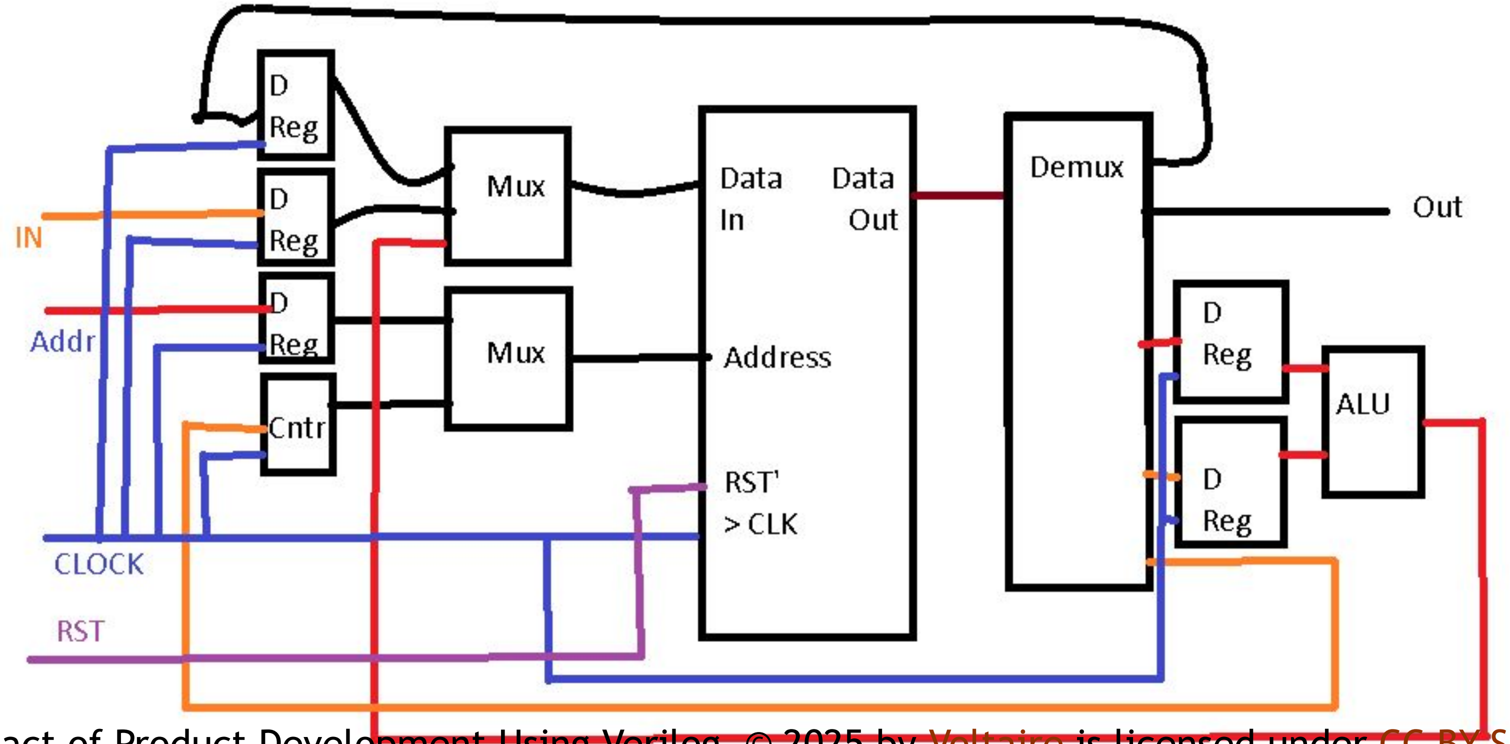
Timer Costs

Ref	Item		Material Cost	Man Hours	Labour Cost/Hour	Labour Cost
1	Display	LCD	500	0	0	0
2		Wires	150	0	0	0
3	Input	Switch Assembly	200	0	0	0
4	Controller	Processor	300	0	0	0
5		Programmer	1400	0	0	0
6		Firmware	0	40	128	5120
7		PCB	1000	4	128	512
Sub - Total			PHP 3,550.00	44	Hours	PHP 5,632.00
Total			PHP 9,182.00			

Processor Traditional Development



RISC Processor



Processor Costs

Name	Part Description	Quantity	Total	Subtotal
74LS04	Hex Inverter	28.75	1	28.75
74LS08	Quad 2-Input AND Gate	36.56	1	36.56
74LS151	1-of-8 Data Selector	75.00	4	300
74LS153	Dual 1-of-4 Data Selector	80.00	8	640
74LS32	Quad 2-Input OR Gate	36.56	1	36.56
74LS74	Dual D-Type Flip-Flop	35.64	10	356.4
74LS83	4-Bit Full Adder	105.56	1	105.56
74LS85	4-Bit Magnitude Comparator	105.56	1	105.56
74LS86	Quad XOR Gate	22.56	1	22.556
PCB		1000.00	4	4000
Man Hours		400.00	128	51200
Total				56831.946

Using Verilog

Man Hours

- Timer Circuit - 2 Hours - 256 PhP
- Processor - 44 Man Hours - 5,128.0 PhP

Power Consumption assume Laptop Uses 200W / Hr and PC 500W/ Hr

- Timer Circuit - 2 Hours = 400WHr => 4.636 PhP @ 11.59 PhP / kWH
- Processor - 44 Man Hours = 101.992 PhP

Environmental Impact

All parts use resources and generate pollution:

This is measured by the Life Cycle Assessment (LCA) Method where the emissions from mining, refining, manufacturing and distribution as well as operational life of the component is estimated based on models developed.

1. CO_2 Emission (Wafer Production, Transportation, Packaging, Operation, Disposal)
   a. Ozone Depletion
   b. Acid Rain
2. Water Consumption (Manufacturing and Disposal)

LCA and CPE and ECE Relationships

Life Cycle Assessment is not a item that is covered by ECE Curriculum nor CPE Curriculum the closest program here in DLSU concerned with it is Industrial Engineering and Systems Integration.

Consequently any new electronics equipment fielded for the market has to have one of these things done on it to evaluate its environmental impact. There is no escape from climate politics and government and NGO oversight.

Some useful references:

1. Boyd, S. B. (2012). *Life-Cycle Assessment of Semiconductors.* doi:10.1007/978-1-4419-9988-7
2. Andersen, Otto & Hille, John & Gilpin, Geoffrey & Andrae, Anders. (2014). Life Cycle Assessment of Electronics. 10.13140/2.1.4893.1840.

CMOS Logic Chip Data

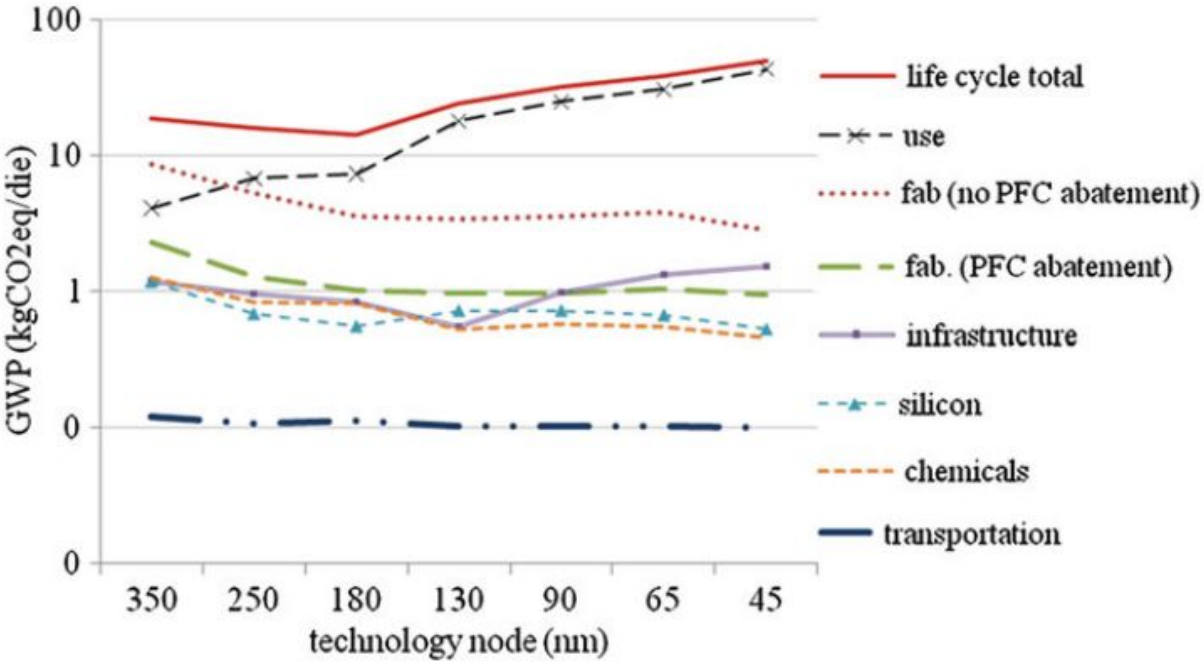


Fig. 5.2 Global warming potential per die by life-cycle stage, over 7 technology nodes

30kgCO2eq/die

CMOS Logic Chip Data

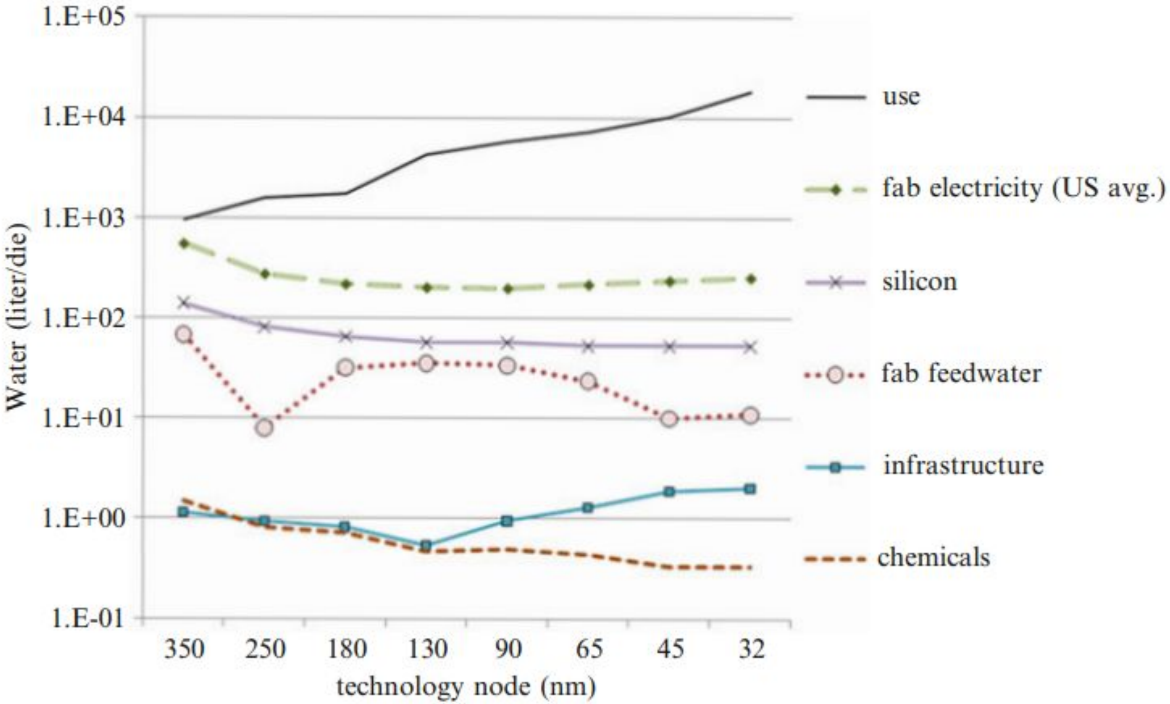


Fig. 5.3 Water use per die, by life-cycle stage, over 7 technology generations

30kgCO2eq/die
1E+04 liter/die

CMOS Logic Chip Data

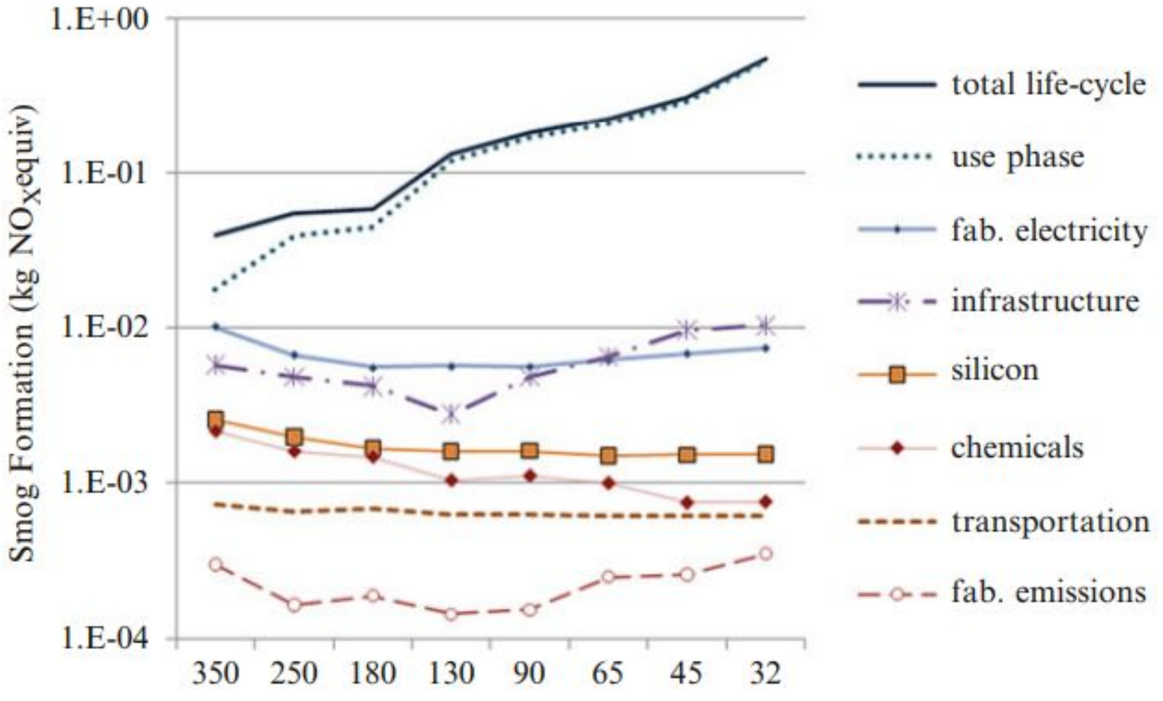


Fig. 5.4 Smog formation per die by technology node

30kgCO2eq/die
1E+04 liter/die
0.8 kgNOx/die

CMOS Logic Chip Data

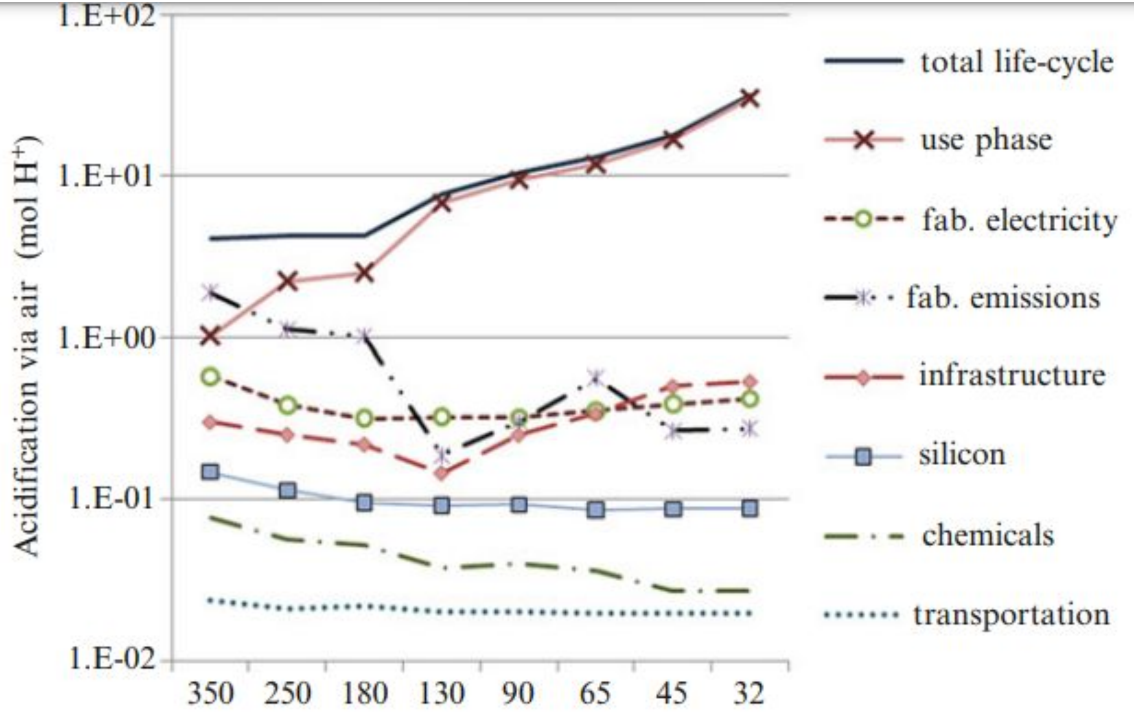
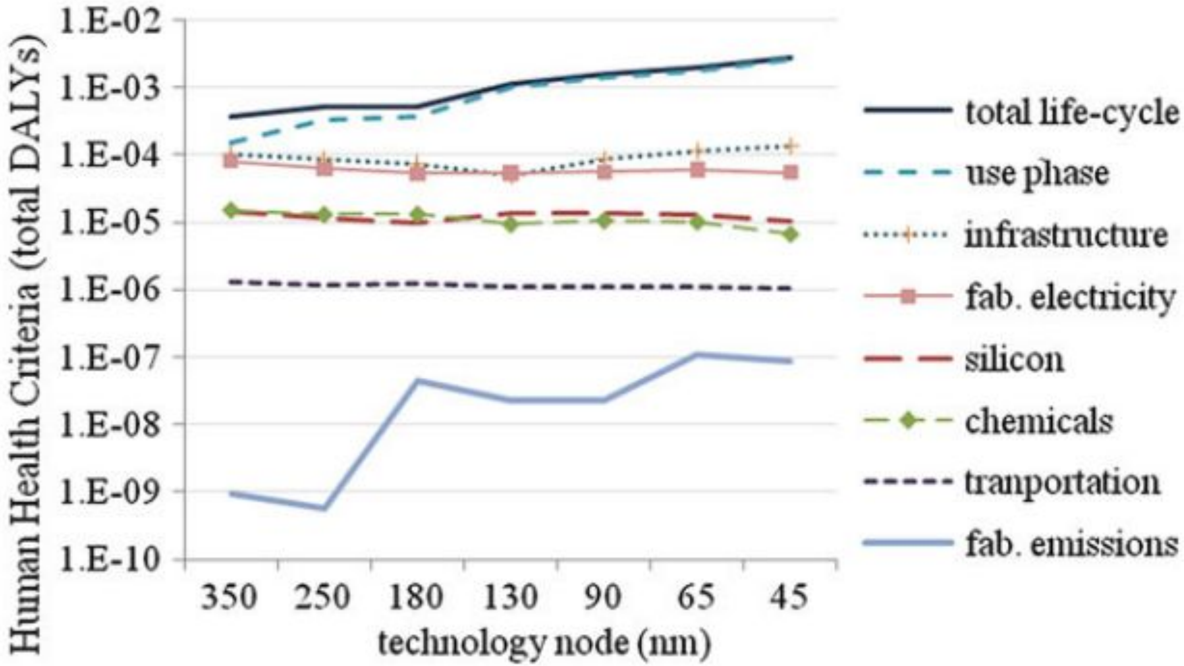


Fig. 5.5 Acidification per die by technology node

30kgCO2eq/die
1E+04 liter/die
0.8 kgNOx/die
50mol H+/die

CMOS Logic Chip Data



Global Warming
30kgCO2eq/die
Water Used
1E+04 liter/die
Smog Formation
0.8 kgNOx/die
Health Impact
50mol H+/die
Non Cancer Health Impact
1.3mDALY’s

Fig. 5.7 EPA criteria human health impacts per die by technology node

CMOS Logic Chip Data

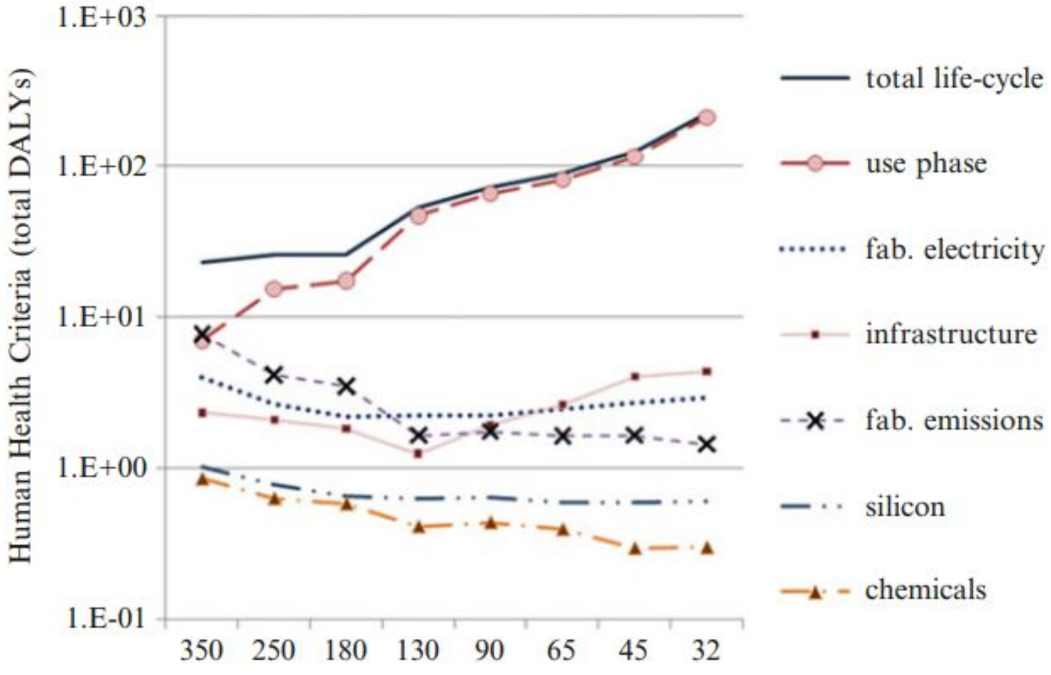


Fig. 5.8 Human non-cancer health impacts per die by technology node

30kgCO_2eq/die
1E+04 liter/die
0.8 kgNO_x/die
50mol H^+/die
1.3mDALY's

CMOS Logic Chip Data

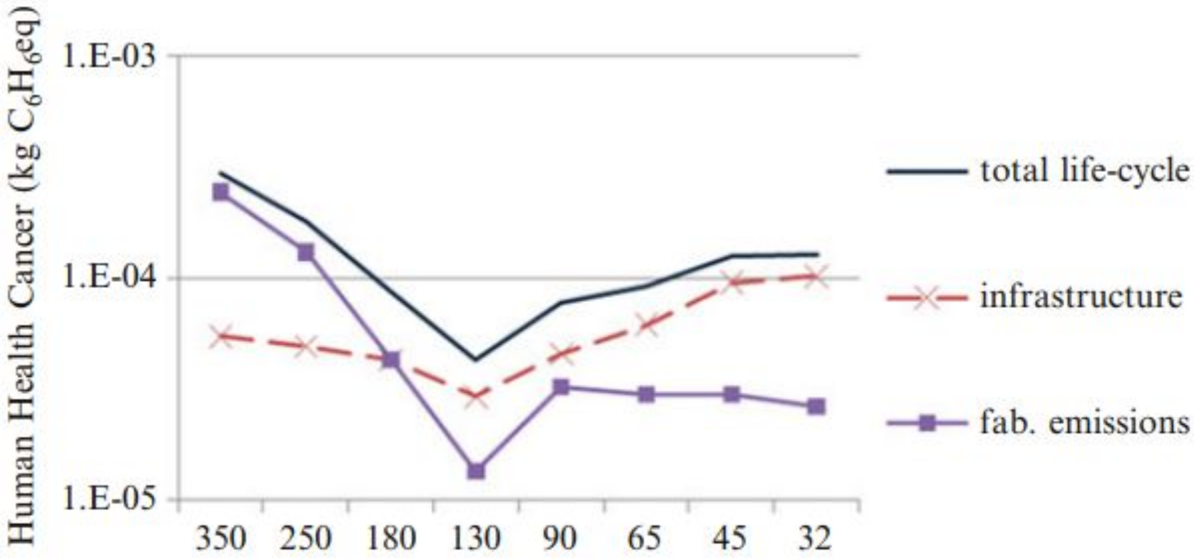


Fig. 5.9 Human carcinogenic impacts per die by technology node

Global Warming
30kgCO2eq/die
Water Used
1E+04 liter/die
Smog Formation
0.8 kgNOx/die
Health Impact
50mol H+/die
Non Cancer Health Impact
1.3mDALY’s
Carcinogenic Health Impact
0.12kg C6H6 eq /die

CMOS Logic Chip Data

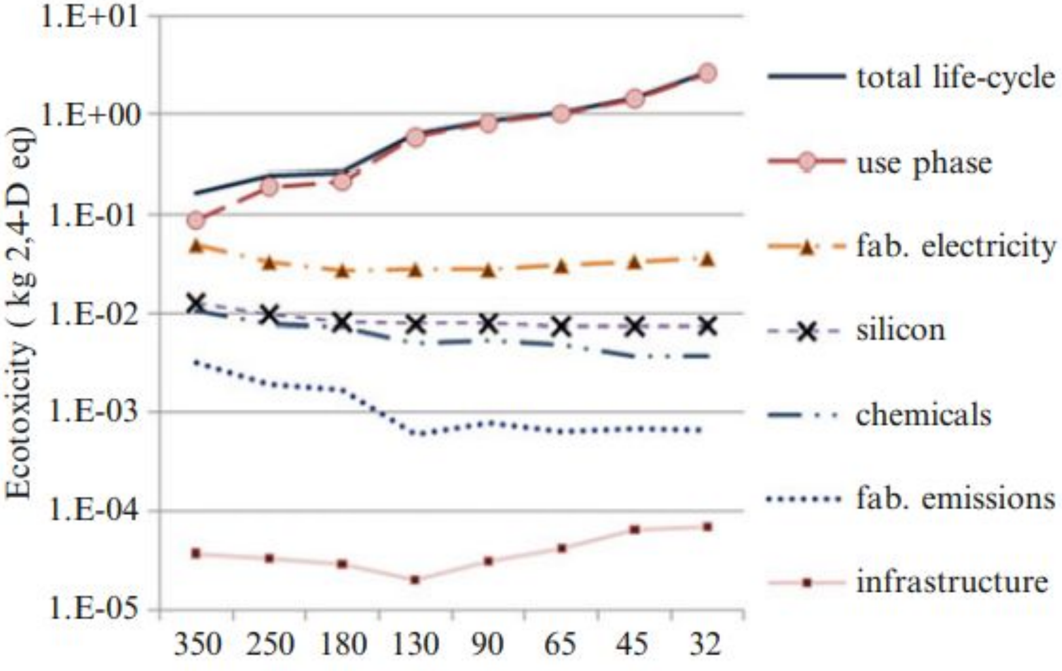


Fig. 5.10 Ecotoxicity per die by technology node

Global Warming
30kgCO2eq/die
Water Used
1E+04 liter/die
Smog Formation
0.8 kgNOx/die
Health Impact
50mol H+/die
Non Cancer Health Impac
1.3mDALY's
Carcinogenic Health
Impact
0.12kg C6H6 eq /die
Ecotoxicity
20 kg 2,5D eq/die

CMOS Logic Chip Data

Summary:

Global Warming 30kgCO2eq/die
Water Used 1E+04 liter/die
Smog Formation 0.8 kgNOx/die
Health Impact 50mol H+/die
Non Cancer Health Impact 1.3mDALY’s
Carcinogenic Health Impact 0.12kg C6H6 eq /die
Ecotoxicity 20 kg 2,5D eq/die

DRAM Data

Energy Consumption 30 MJ/OS

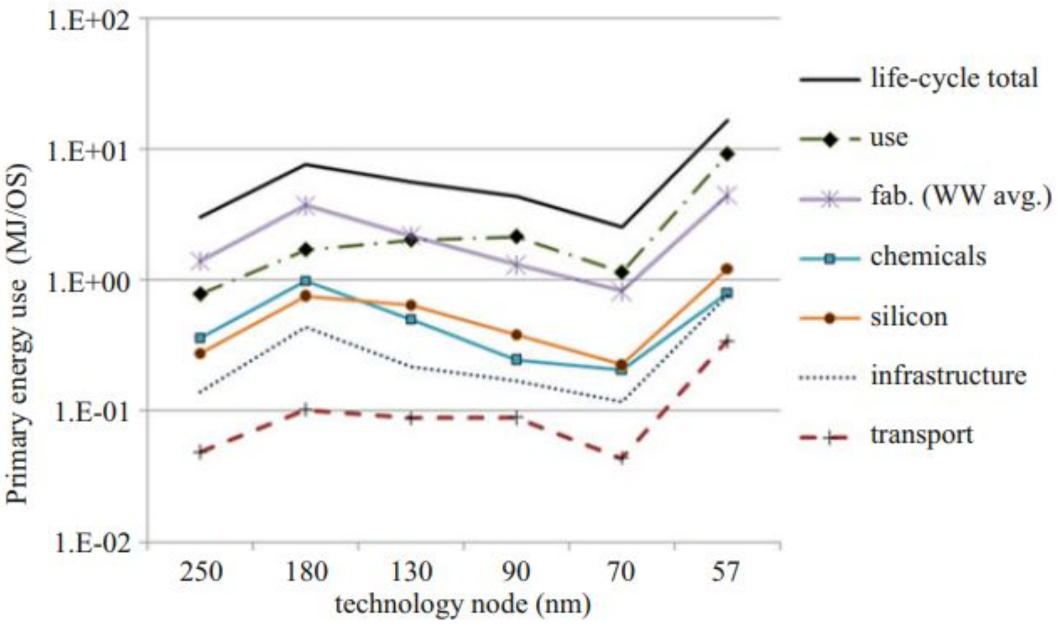


Fig. 7.1 Primary energy consumption per OS memory capacity (MJ/OS), over five technology nodes

DRAM Data

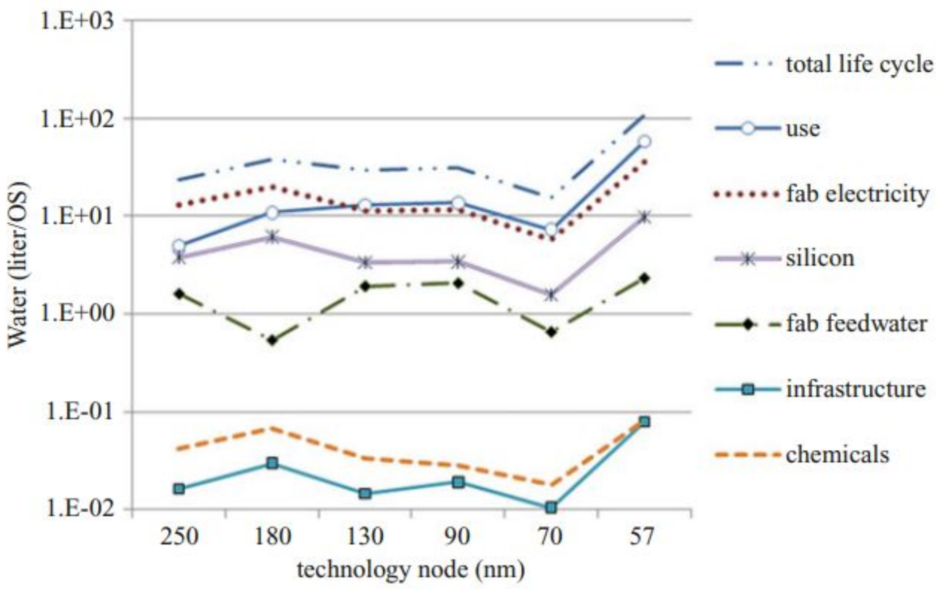


Fig. 7.2 Water consumption per OS memory capacity, by life-cycle stage, over five technology nodes

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS

DRAM Data

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS
Smog Formation 1g NOx

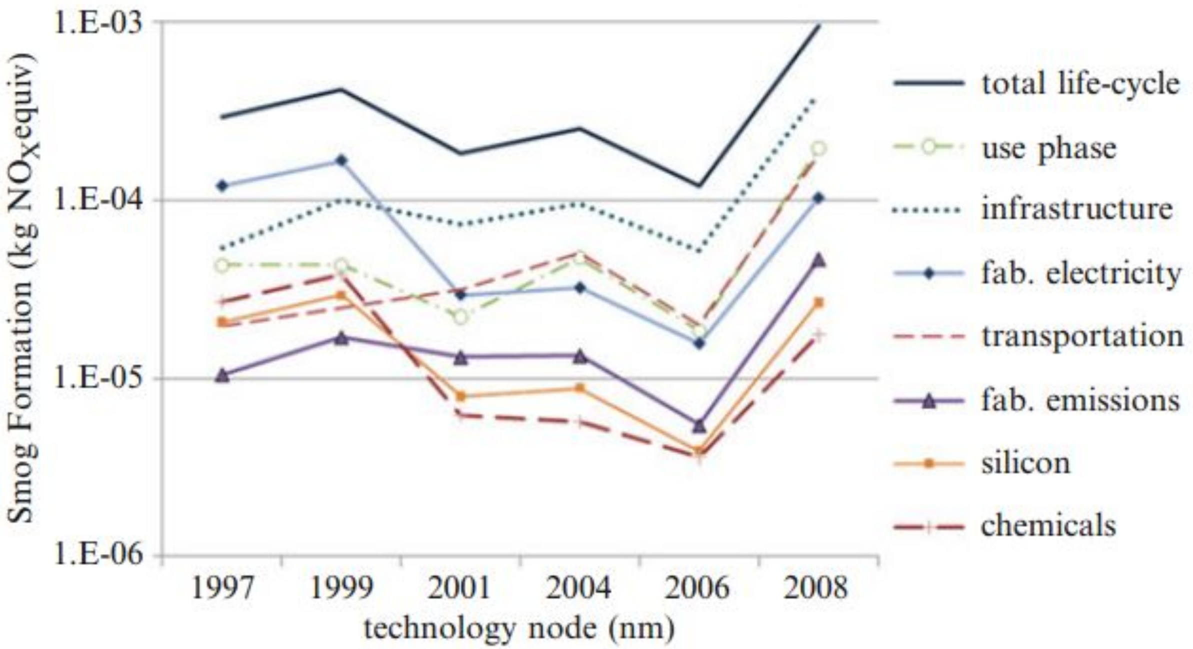


Fig. 7.4 Smog formation per OS by technology node

DRAM Data

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS
Smog Formation 1g NOx
Acidification 0.8E-1 molH+

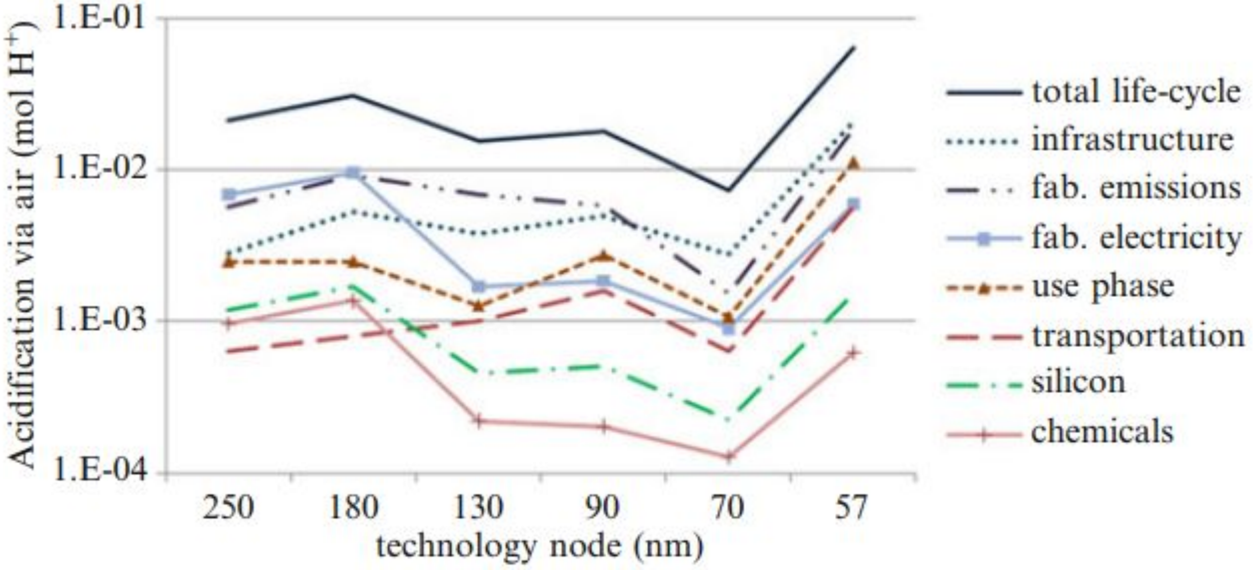


Fig. 7.5 Acidification per OS by technology node

DRAM Data

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS
Smog Formation 1g NOx
Acidification 0.8E-1 molH+
Ecotoxicity 1.3 g 2,4-D

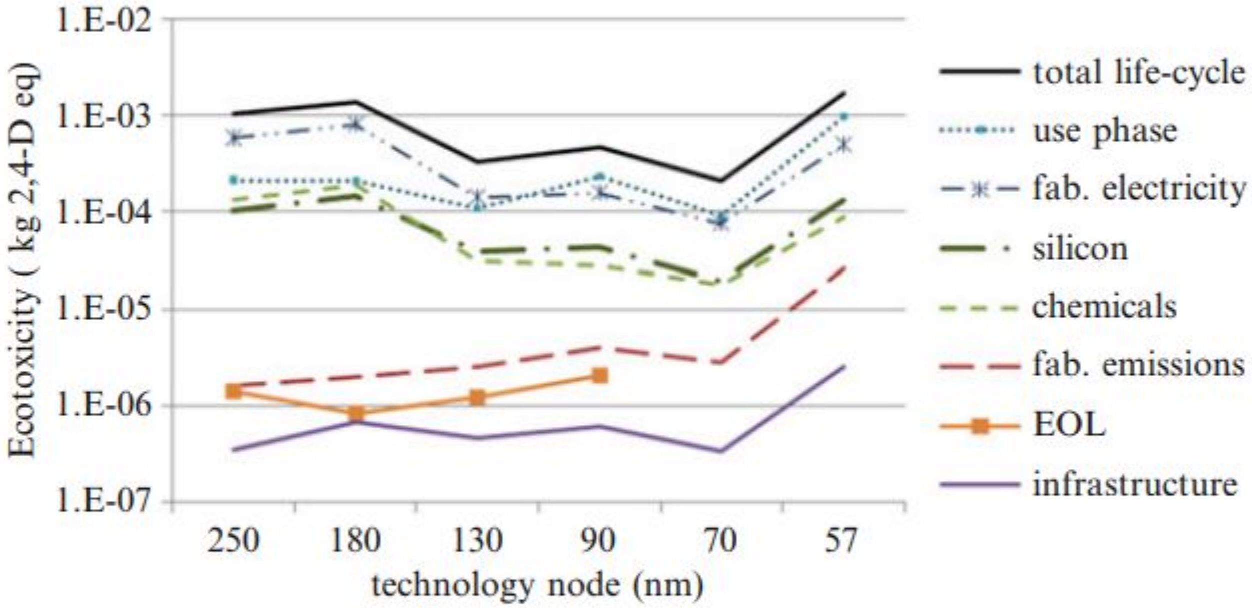


Fig. 7.7 Ecotoxicity per OS by technology node

DRAM Data

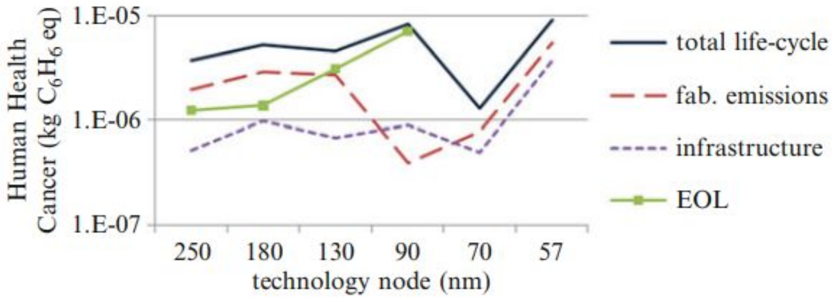


Fig. 7.9 Carcinogenicity per OS by technology node

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS
Smog Formation 1g NOx
Acidification 0.8E-1 molH+
Ecotoxicity 1.3 g 2,4-D
Carcinogenecity 0.1mg C6H6

DRAM Data

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS
Smog Formation 1g NOx
Acidification 0.8E-1 molH+
Ecotoxicity 1.3 g 2,4-D
Carcinogenecity 0.1mg C6H6
Non Cancer Health Impact 0.8kg C7H7

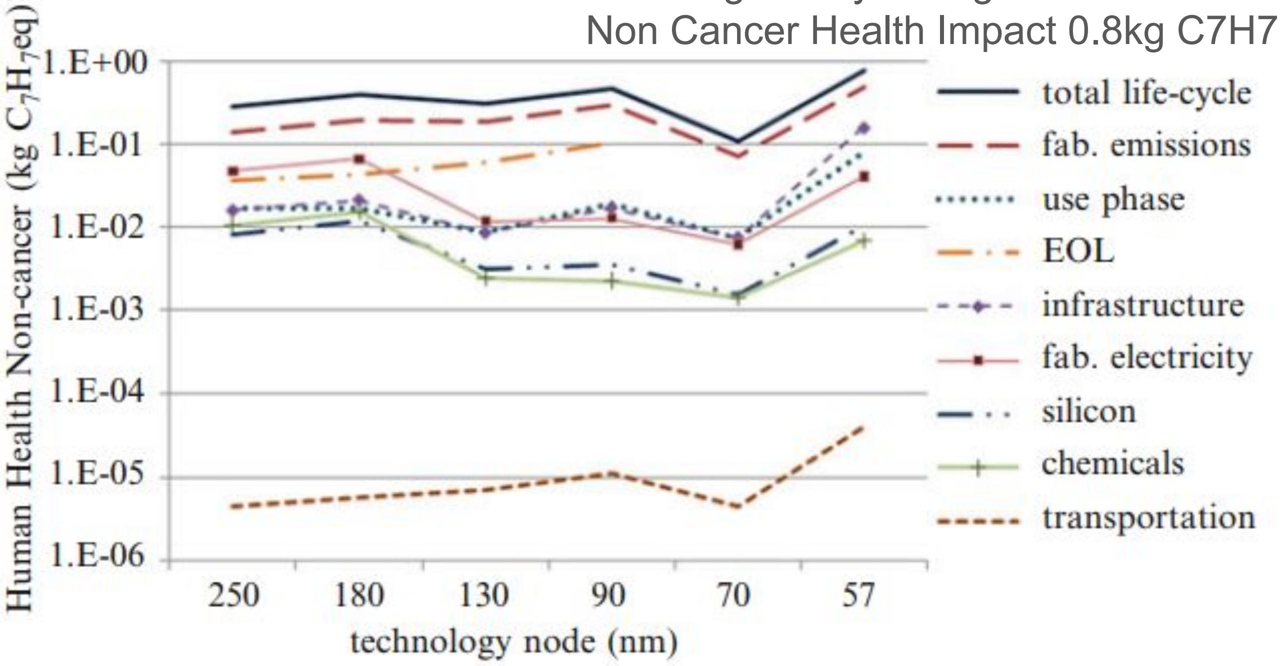


Fig. 7.10 Non-cancer human health impacts per OS by technology node

DRAM Data

Summary Data:

Energy Consumption 30 MJ/OS
Water Consumption 100 L/OS
Smog Formation 1g NOx
Acidification 0.8E-1 molH+
Ecotoxicity 1.3 g 2,4-D
Carcinogenecity 0.1mg C6H6
Non Cancer Health Impact 0.8kg C7H7