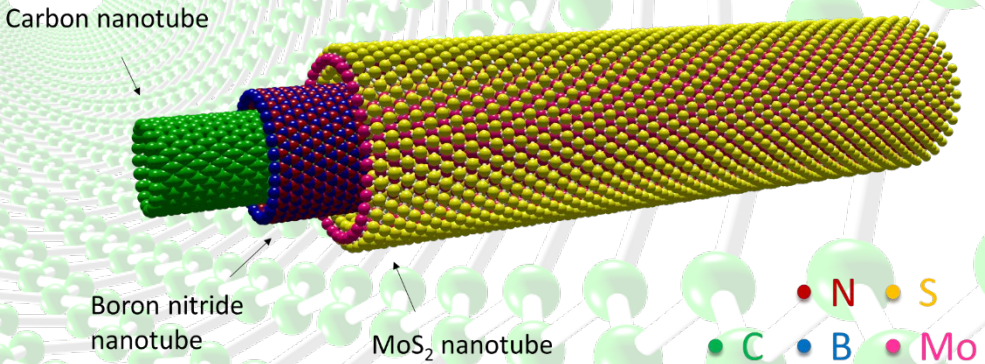
社会デザインと実践の方法 @ Online, September 24, 2020

第1部　各分野におけるデザインとそのプロセス
Materials and Energy
マテリアル・エネルギー



R. Xiang et al., *Science* **367** (2020) 537.

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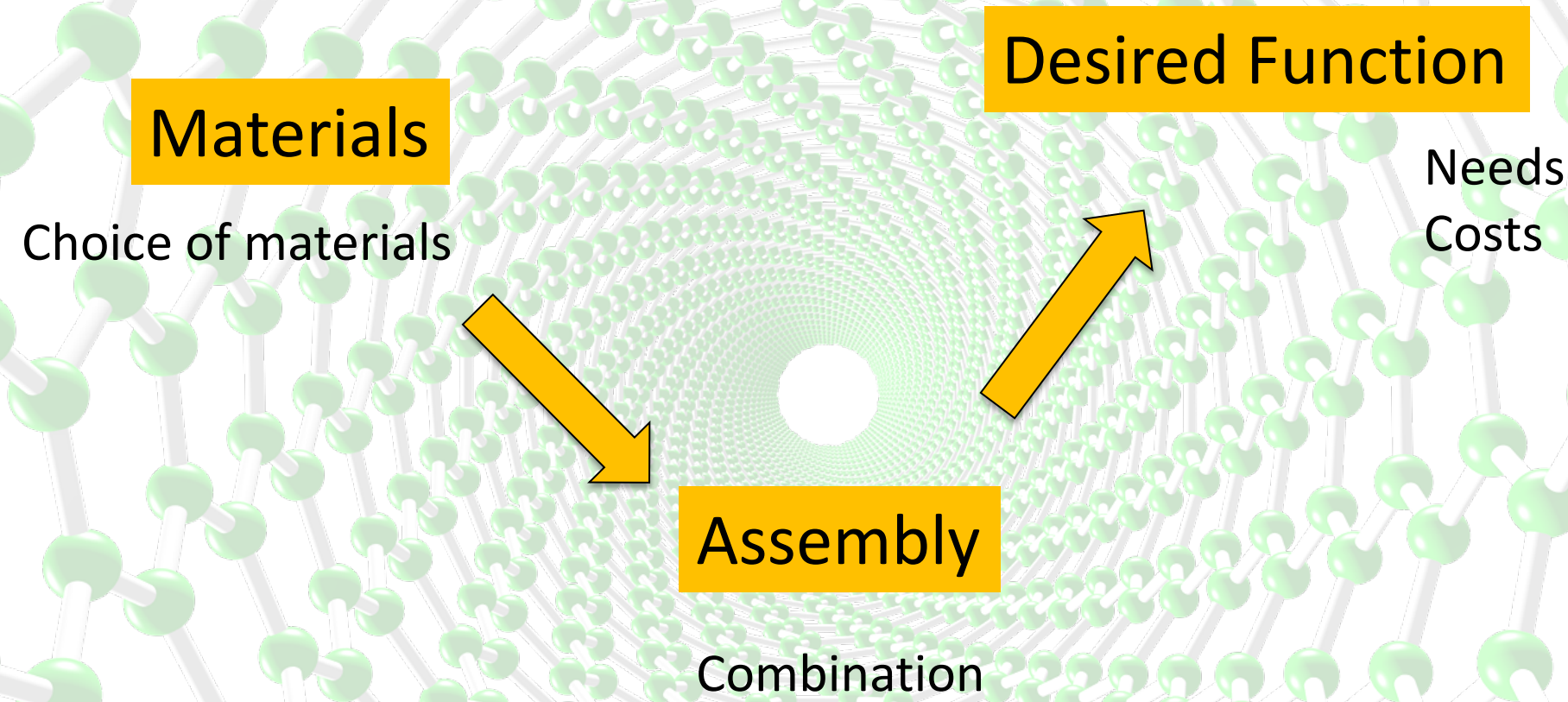
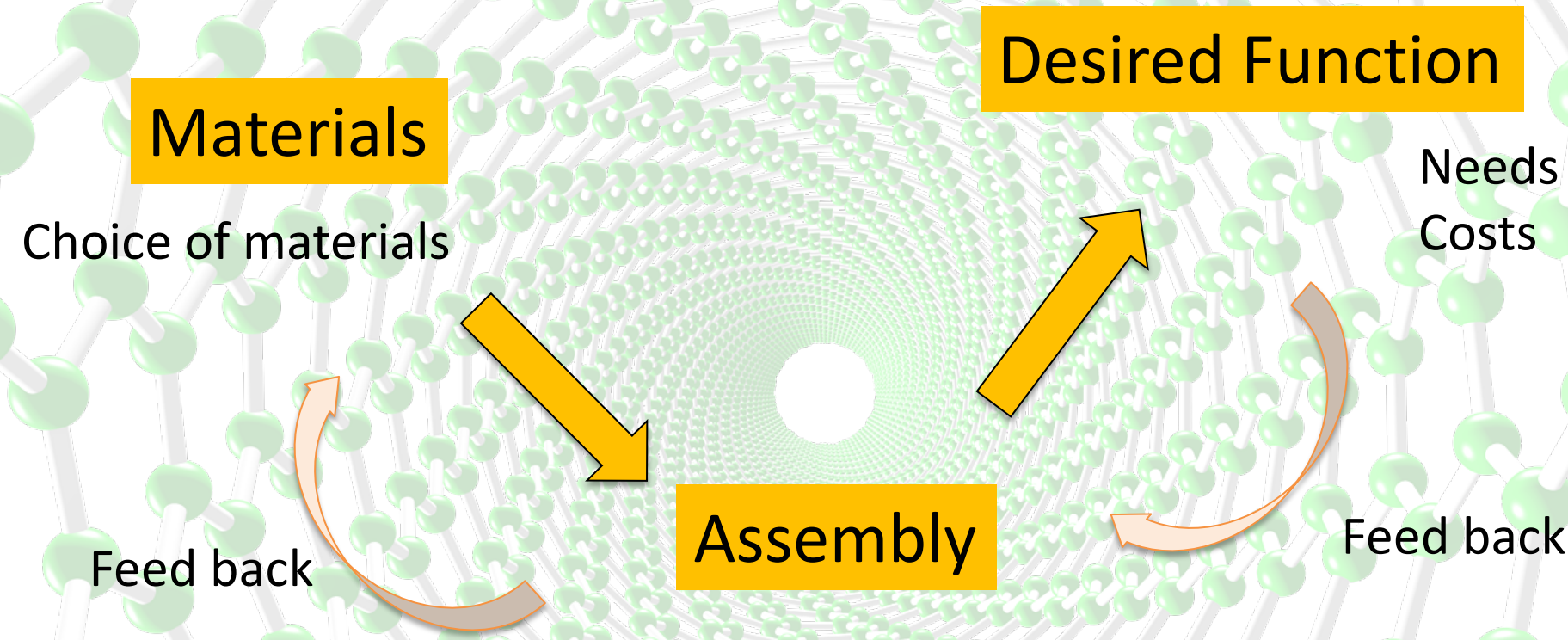
Design?


Materials
Choice of materials
Desired Function
Needs
Costs
Assembly
Combination

Design?



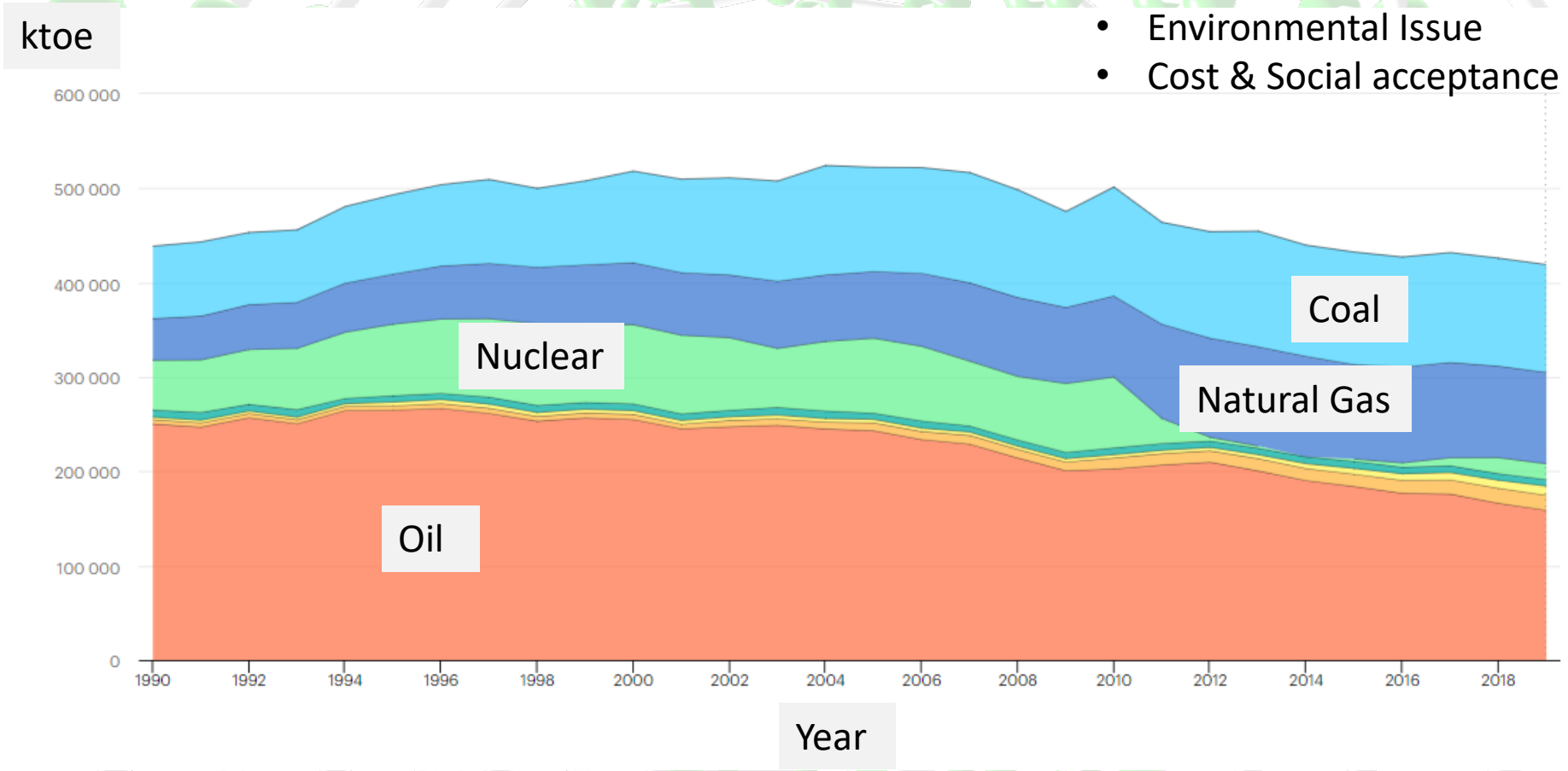
Experiments

Modeling & Simulation

Energy Sources in Japan

Full of topics of SDGs

- Sustainable Growth
- Global security
- Environmental Issue
- Cost & Social acceptance

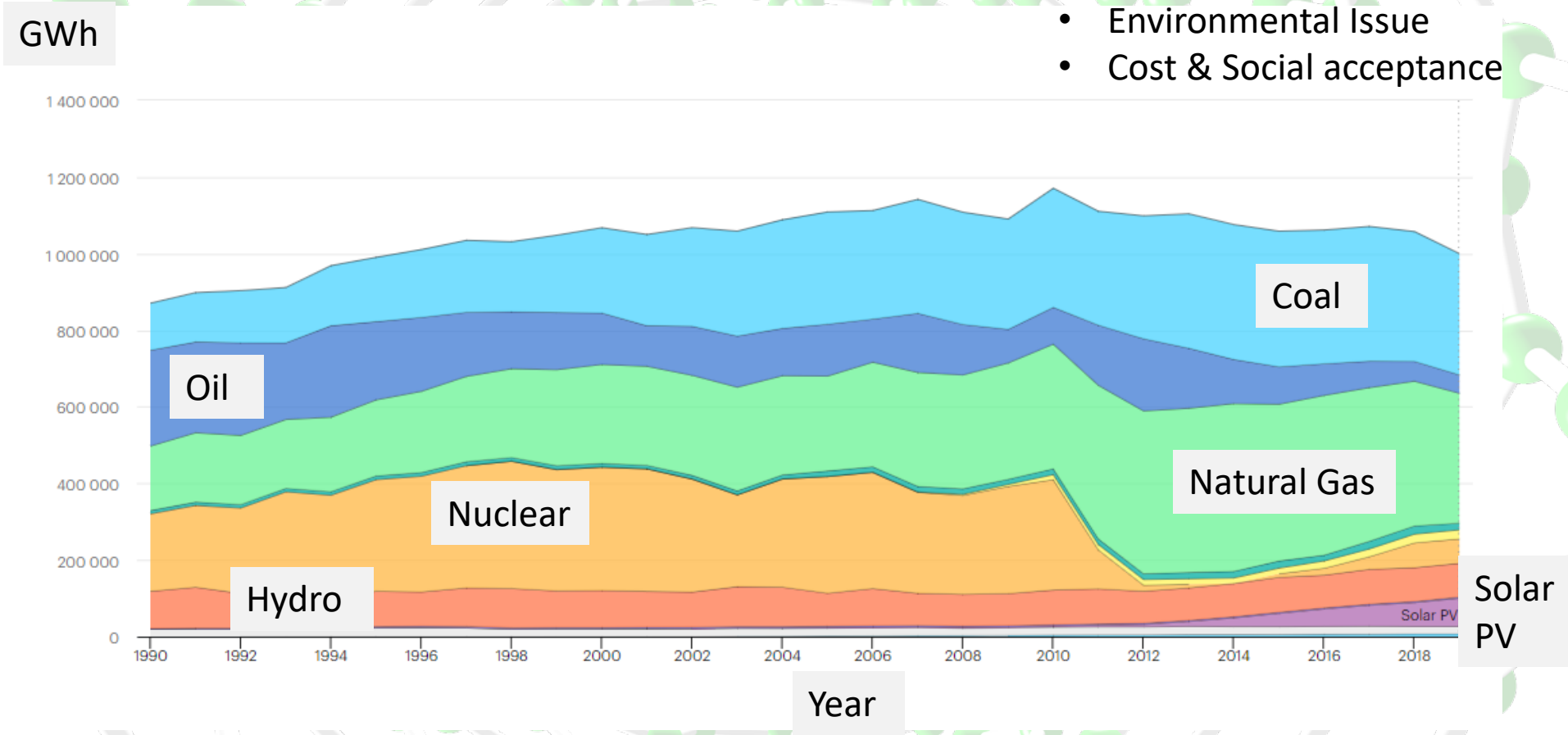


International Energy Agency(IEA): Data and Statistics, https://www.iea.org/

Electricity Generation in Japan

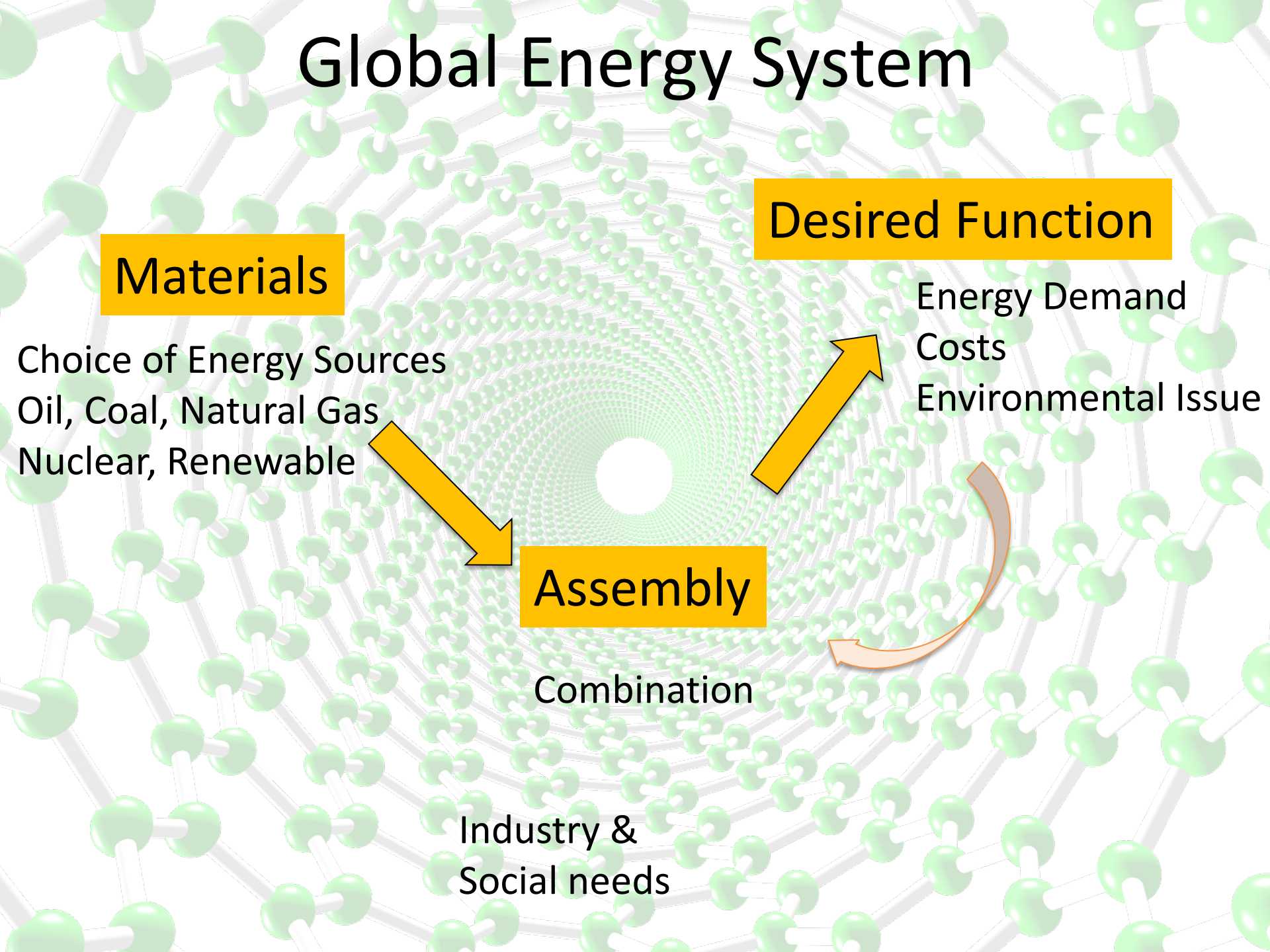
Full of topics of SDGs

- Sustainable Growth
- Global security
- Environmental Issue
- Cost & Social acceptance

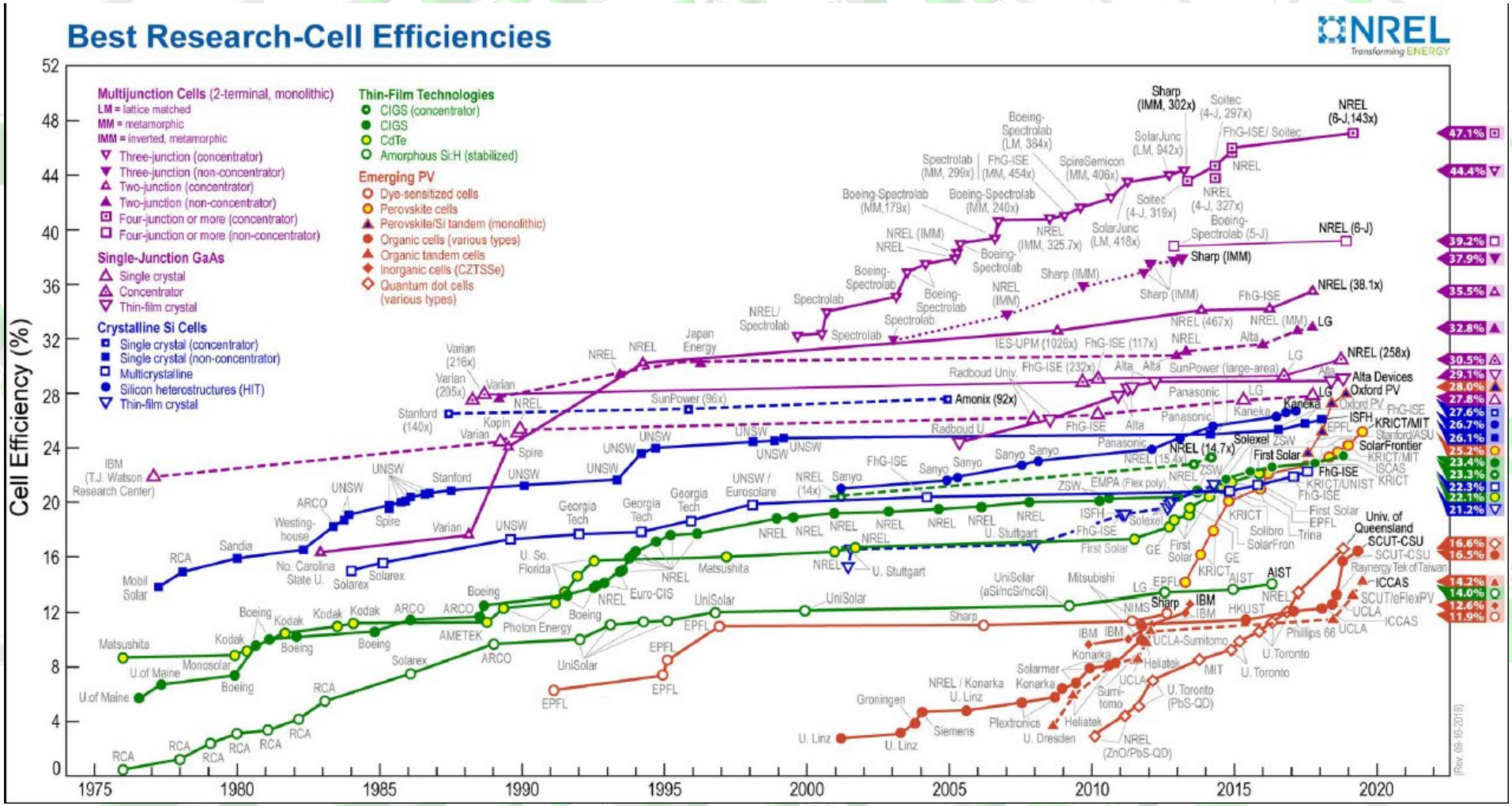


International Energy Agency(IEA): Data and Statistics, https://www.iea.org/

Global Energy System

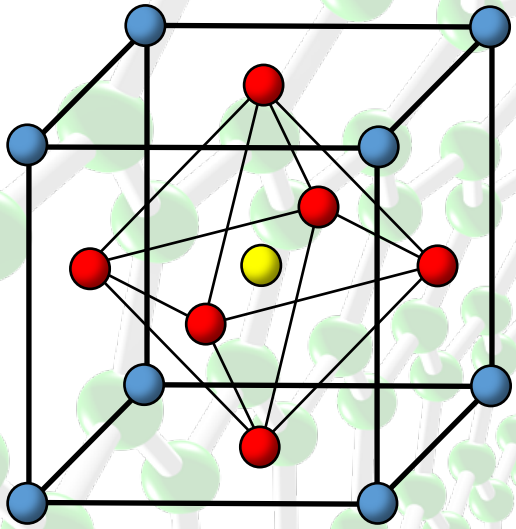


Solar PV



The National Renewable Energy Laboratory (NREL), Best Research-Cell Efficiency Chart, https://www.nrel.gov/pv/cell-efficiency.html

Perovskite Solar Cells

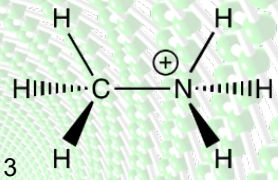


Perovskite: AMX_3

A = Methylammonium (MA), $CH_3NH_3^+$
Formamidinium (FA), $CH_3(NH_2)_2^+$
Guanidinium (Gua), $CH_6N_3^+$

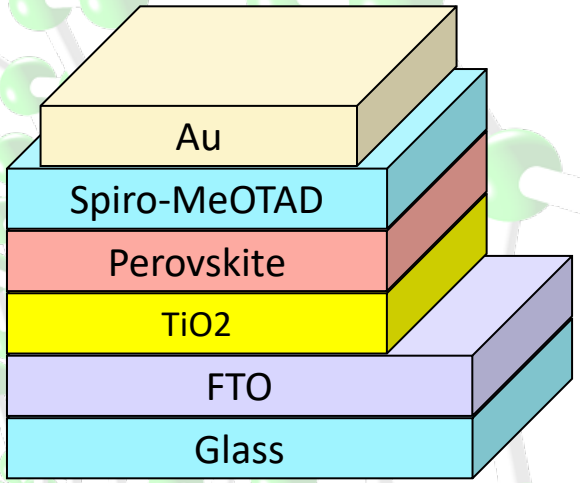
M = Pb^{2+}, Sn^{2+}, Cs^{2+}, Rb^{2+}

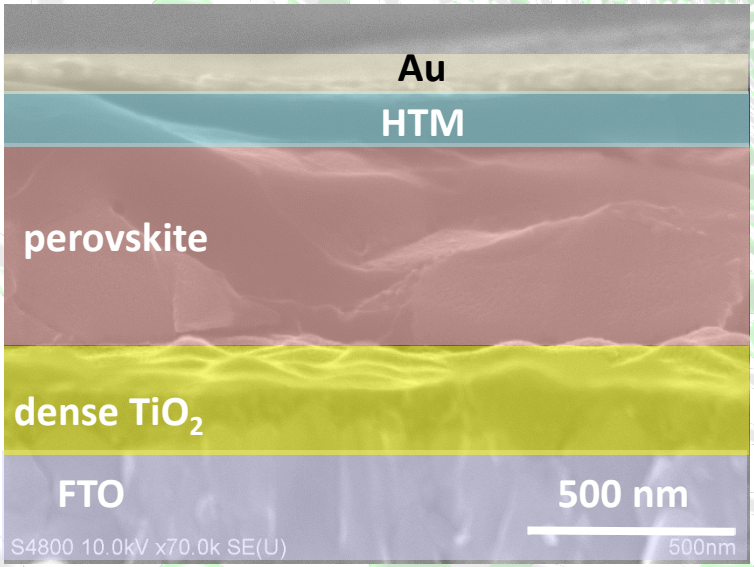
X = I^-, Cl^-, Br^-



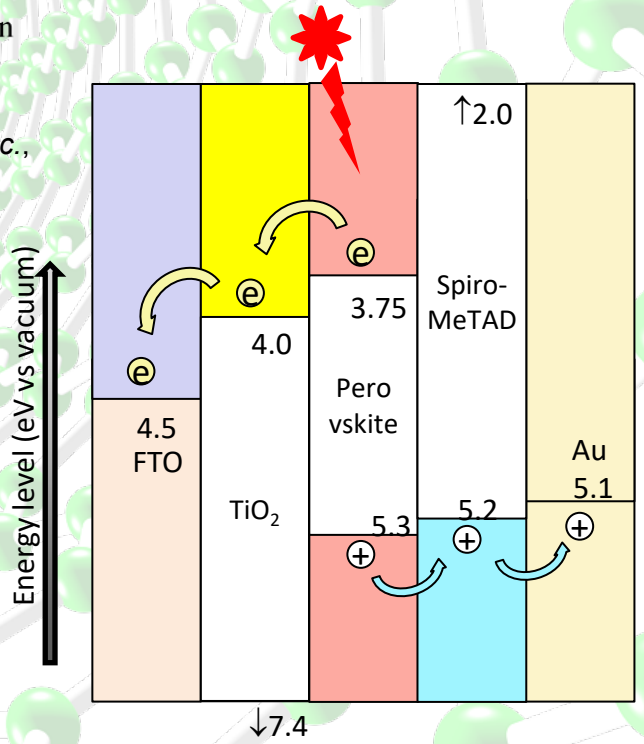
$MAPbI_3$: $CH_3NH_3PbI_3$

methylammonium ion

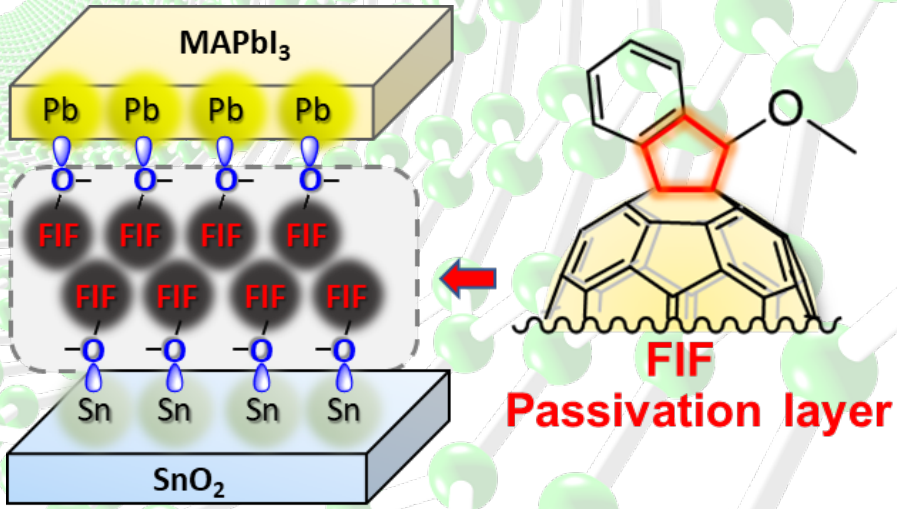




- Use of Perovskite **PCE 3.8 %**
  A. Kojima, *et al.*, *J. Am. Chem. Soc.*, **2009**
- Solid state solar cell **PCE 10.9 %**
  M. M. Lee, *et al.*, *Science*, **2012**
- High **PCE 20.1 %**
  N. J. Jeon, *et al.*, *Nature*, **2014**
- **PCE record 25.2% 2019**

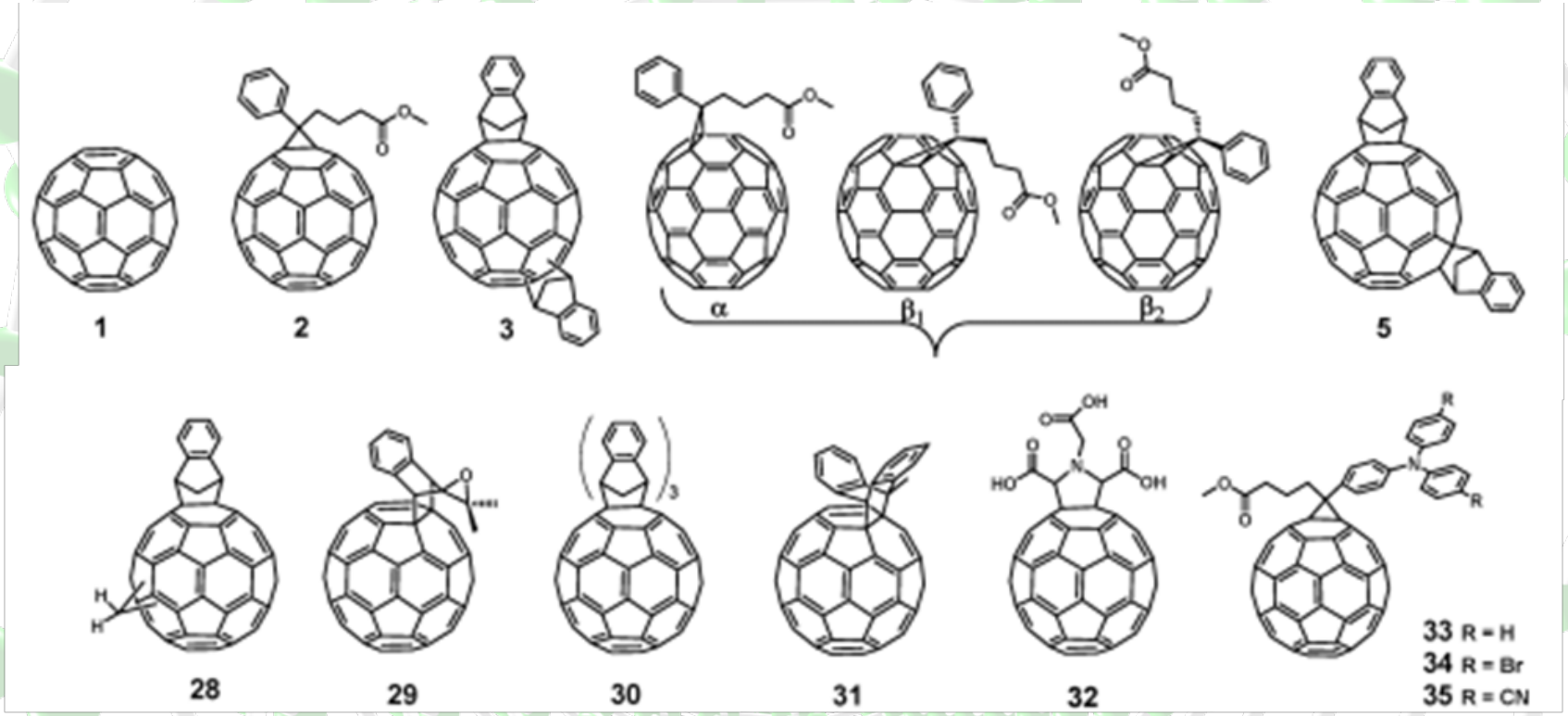


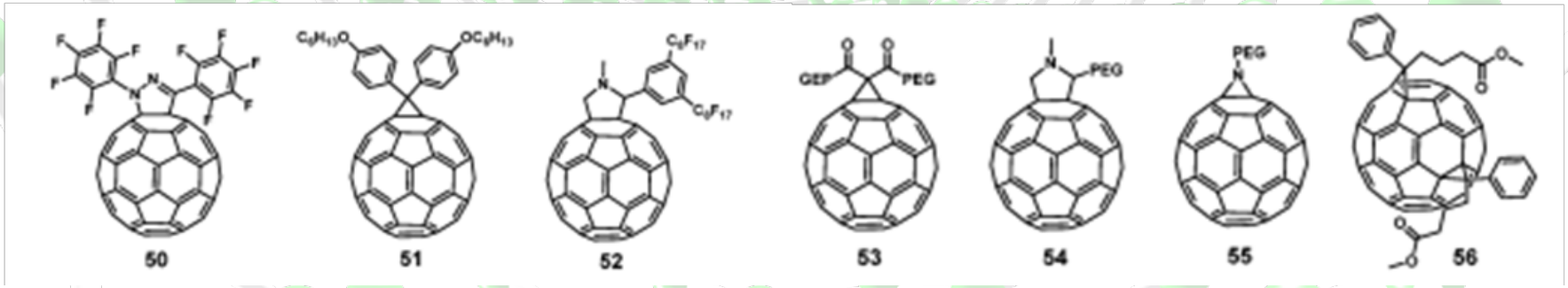
Passivation Layer



H.-S. Lin, I. Jeon, Y. Chen, X.-Y. Yang, T. Nakagawa, S. Maruyama, S. Manzhos, Y. Matsuo, *Chem. Mater.* **2019**, 31, 8432

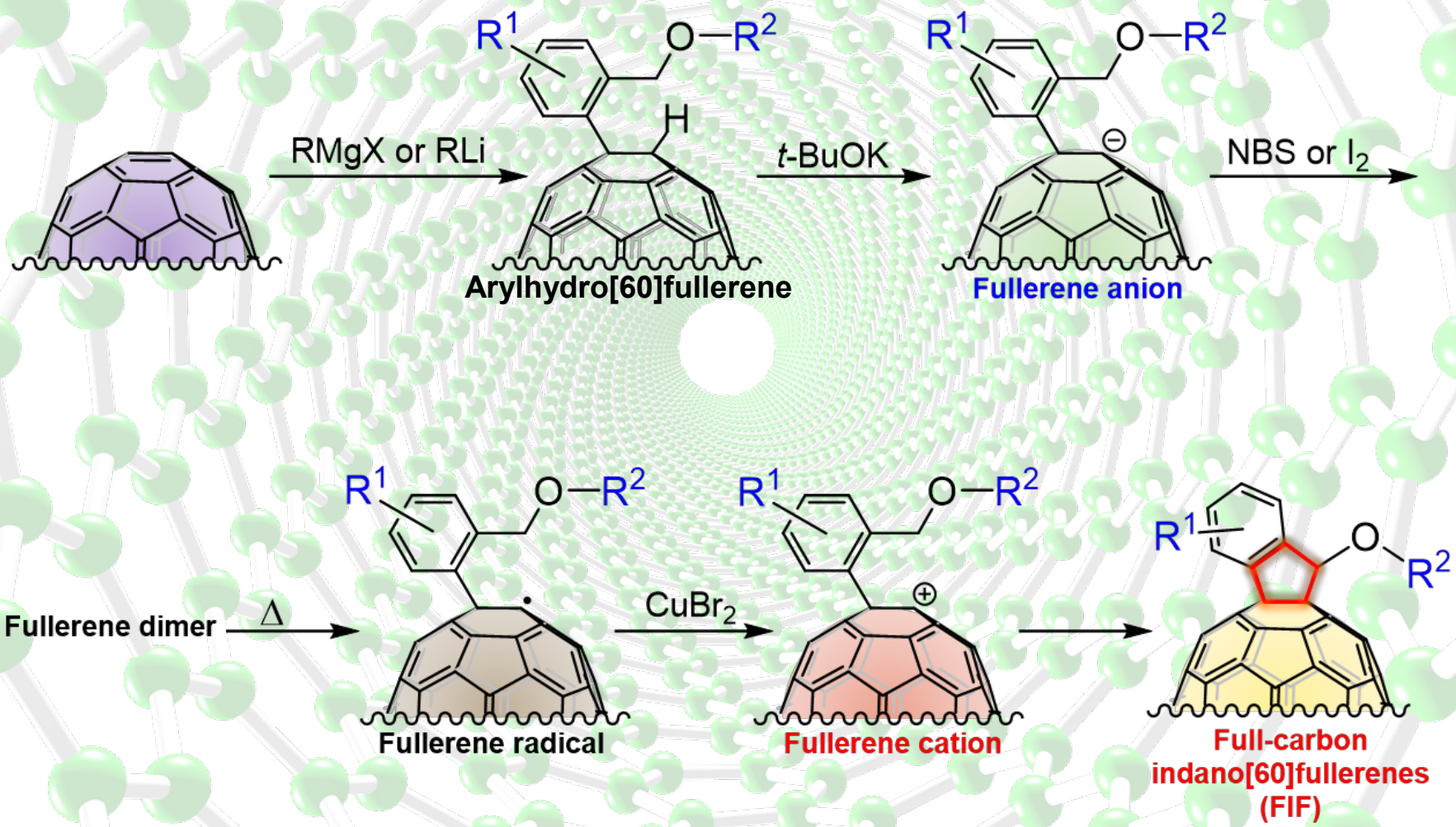
Choice of Molecules





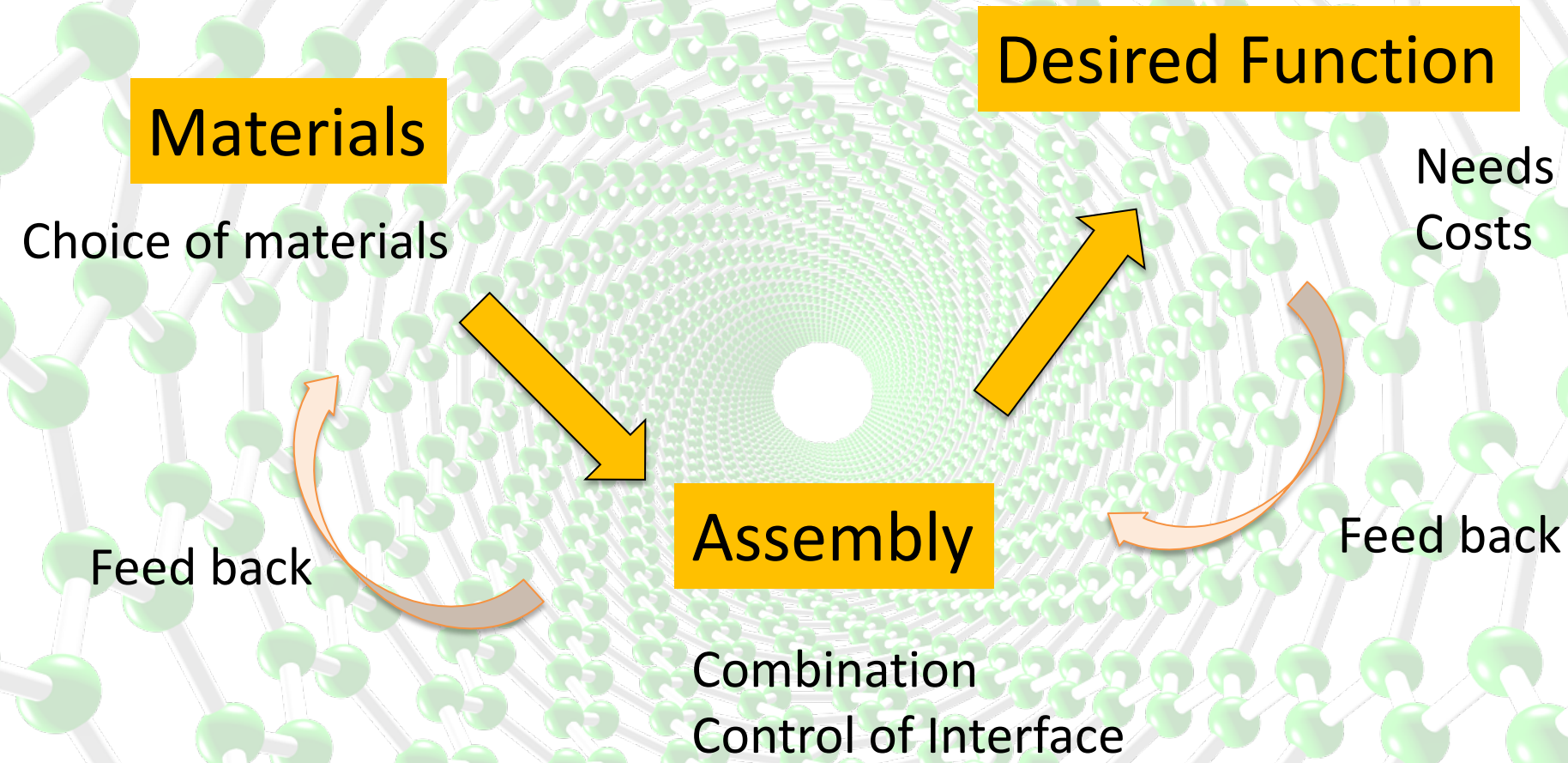
E. Castro, J. Murillo, O. Fernandez-Deglago, L. Echegoyen, *J. Mater. Chem. C* **2018**, 6, 2635

Molecular Design (=Chemistry)

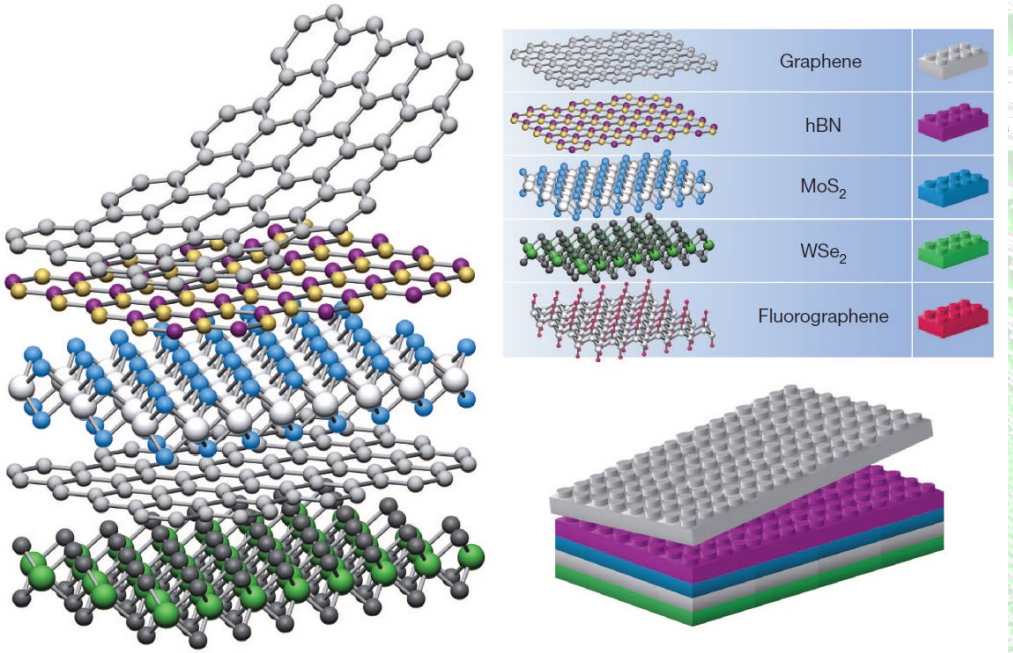


H.-S. Lin, *et al*, *Chem. Mater.* **2019**, 31, 8432.

Design in Engineering



Design in 1D and 2D materials

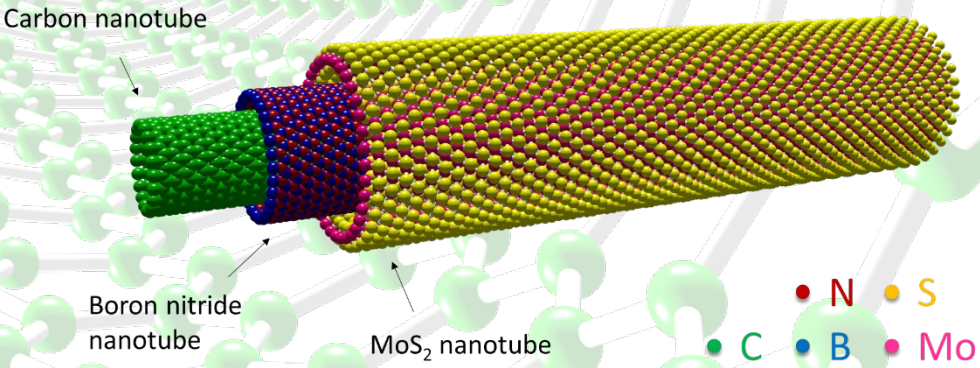


導電材 (conductor)

絶縁体 (insulator)

半導体 (semiconductor)

A. K. Geim & I. V. Grigorieva, *Nature* **499** (2013) 419.



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