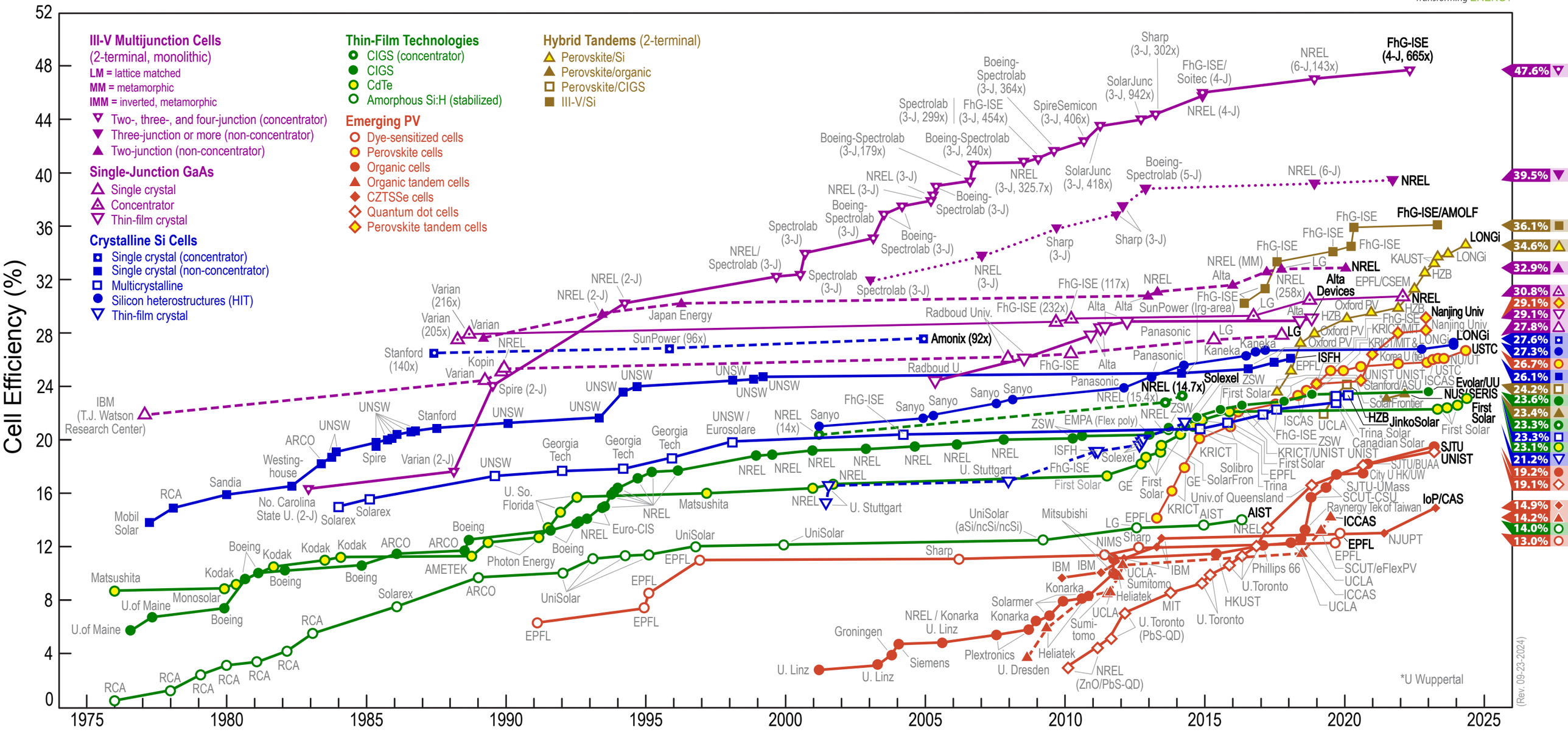
Best Research-Cell Efficiencies

NREL
Transforming ENERGY


III-V Multijunction Cells
(2-terminal, monolithic)
LM = lattice matched
MM = metamorphic
IMM = inverted, metamorphic
Two-, three-, and four-junction (concentrator)
Three-junction or more (non-concentrator)
Two-junction (non-concentrator)
Single-Junction GaAs
Single crystal
Concentrator
Thin-film crystal
Crystalline Si Cells
Single crystal (concentrator)
Single crystal (non-concentrator)
Multicrystalline
Silicon heterostructures (HIT)
Thin-film crystal
Thin-Film Technologies
CIGS (concentrator)
CIGS
CdTe
Amorphous Si:H (stabilized)
Emerging PV
Dye-sensitized cells
Perovskite cells
Organic cells
Organic tandem cells
CZTSSe cells
Quantum dot cells
Perovskite tandem cells
Hybrid Tandems (2-terminal)
Perovskite/Si
Perovskite/organic
Perovskite/CIGS
III-V/Si
Cell Efficiency (%)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
47.6%
39.5%
36.1%
34.6%
32.9%
30.8%
29.1%
29.1%
27.8%
27.6%
27.3%
26.7%
26.1%
24.2%
23.6%
23.4%
23.3%
23.3%
23.1%
21.2%
19.2%
19.1%
14.9%
14.2%
14.0%
13.0%
FhG-ISE (4-J, 665x)
NREL (6-J,143x)
Sharp (3-J, 302x)
FhG-ISE/ Soitec (4-J)
NREL (4-J)
SolarJunc (3-J, 942x)
SpireSemicon (3-J, 406x)
Boeing-Spectrolab (3-J, 364x)
Spectrolab (3-J, 299x)
FhG-ISE (3-J, 454x)
Boeing-Spectrolab (3-J,179x)
Boeing-Spectrolab (3-J, 240x)
NREL (3-J, 325.7x)
SolarJunc (3-J, 418x)
NREL (3-J)
Boeing-Spectrolab (3-J)
Boeing-Spectrolab (5-J)
NREL (6-J)
NREL
FhG-ISE/AMOLF
LONGi
KAUST
HZB
NREL
Alta Devices
EPFL/CSEM
Oxford PV
KRICT/MIT
Nanjing Univ
LONGi
USTC
NU/UT
ISFH
Korea U (Jeff)
UNIST
UNIST / USTC
ISCAS
Evolar/UU
NUS/SERIS
First Solar
SolarFrontier
HZB
JinkoSolar
First Solar
SJTU
UNIST
SJTU/BUAA
City U HK/UW
SJTU-UMass
SCUT-CSU
Raynergy Tek of Taiwan
IoP/CAS
ICCAS
NJUPT
EPFL
SCUT/eFlexPV
UCLA
ICCAS
UCLA
Phillips 66
U.Toronto
HKUST
U. Toronto
MIT
U. Toronto (PbS-QD)
NREL (ZnO/PbS-QD)
U. Dresden
Heliatek
Sumi-tomo
UCLA
Plextronics
Siemens
U. Linz
U. Linz
Groningen
NREL / Konarka
U. Linz
Solarmer
Konarka
Konarka
Heliatek
UCLA-Sumitomo
IBM
IBM
IBM
NIMS
Sharp
LG
EPFL
Mitsubishi
UniSolar (aSi/ncSi/ncSi)
AIST
AIST
KRICT
Univ.of Queensland
GE
First Solar
KRICT
Solibro
SolarFron
EPFL
Trina
KRICT/UNIST
UNIST
First Solar
ISCAS
UCLA
Trina Solar
Canadian Solar
FhG-ISE
ZSW
ISFH
Solexel
FhG-ISE
First Solar
U. Stuttgart
NREL
NREL
NREL