Process Development and Integration Lab

+ Measurements and Characterization

- PDIL Presentations
  - PDIL Introduction
  - Thin-Si Platform
  - Si Wafer Replacement Platform
  - CIGS Platform
  - CdTe Platform
  - Atmospheric Processing Platform
  - M&C Platform and Standalone Capabilities
  - Data Integration
- M&C Overview

DEPARTMENT OF ENERGY
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Austin Airport Marriott South

Austin, TX April 22-24, 2008

DEPARTMENT OF ENERGY
UNITED STATES OF AMERICA

2008 Solar Annual Review Meeting

PDIL Overview

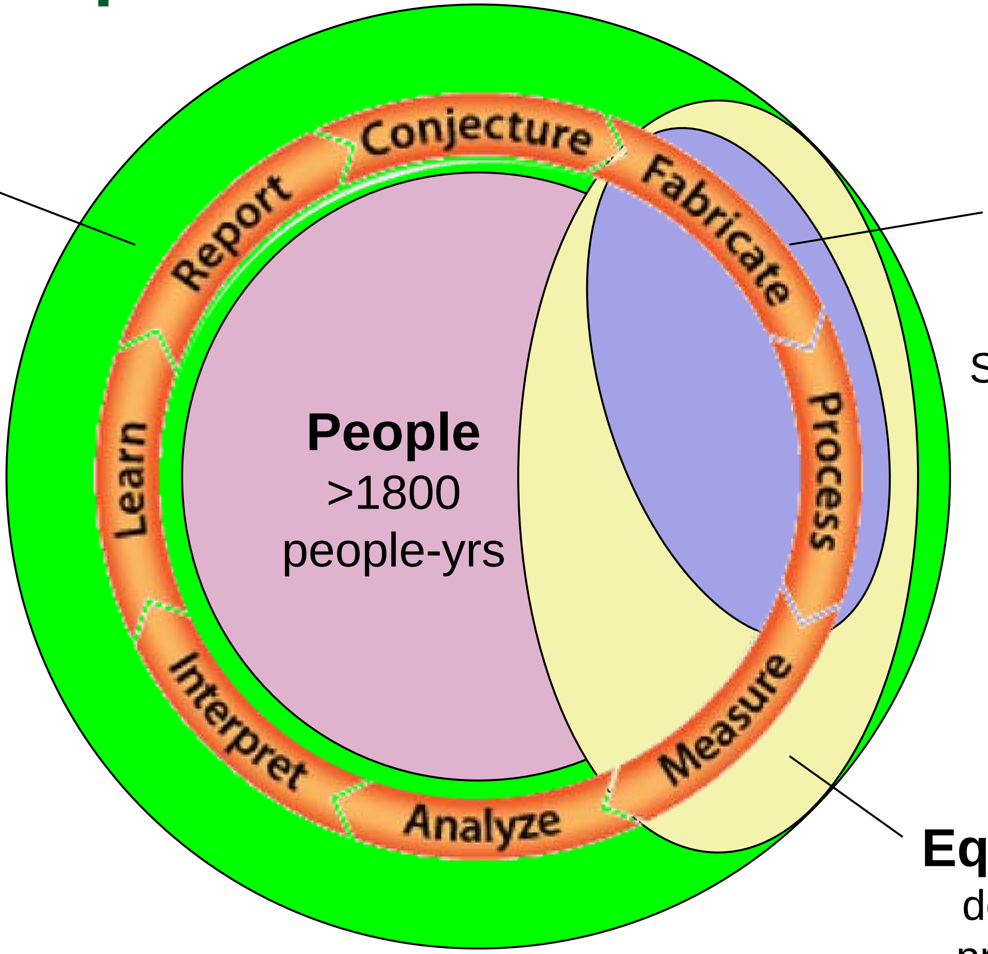
Brent P. Nelson

NREL

PDIL Vision

- Integrate deposition, characterization, and processing
  - Flexible and robust
  - Standardized transfer interface
  - Controlled sample ambient between tools
- Benefits
  - Answers to previously inaccessible research questions
  - Control and characterization of critical surfaces (interfaces) and how their impact on subsequent layers
  - Assess process-related source chemistry, surface chemistry and kinetics, and bulk reconstruction
  - Grow layers and alter interfaces using controlled processes and transfer ambients (without exposure to air)
  - Develop new techniques, methodologies, device structures, materials, and tools (growth, processing, and analytical)
  - Improved collaborations with university and industry researchers

PDIL Concept



Data
recipes
instrumentation
results
data mining
modeling
…

People
>1800
people-yrs

Materials
TCO's
Metals
Semiconductors
…

Equipment
deposition
processing
measurement
…

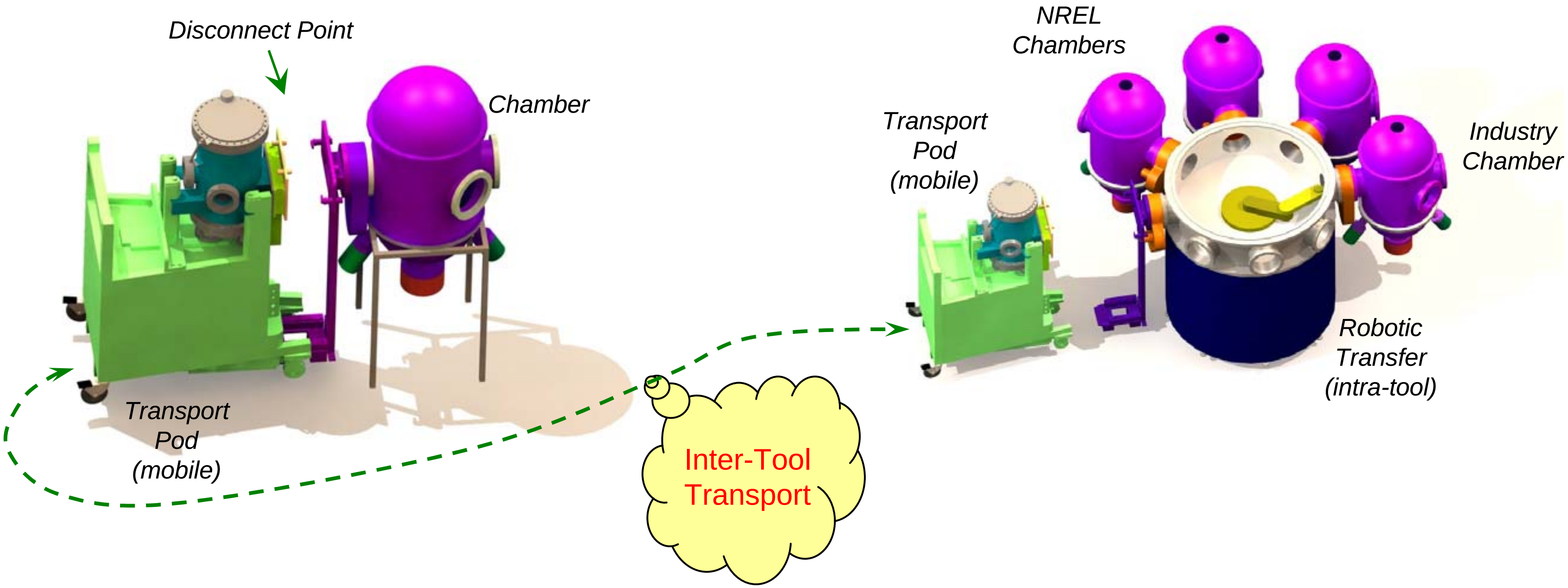
The PDIL = Collaborative Facility

- work closely with NREL scientists
- integrated equipment
- answer pressing PV related questions

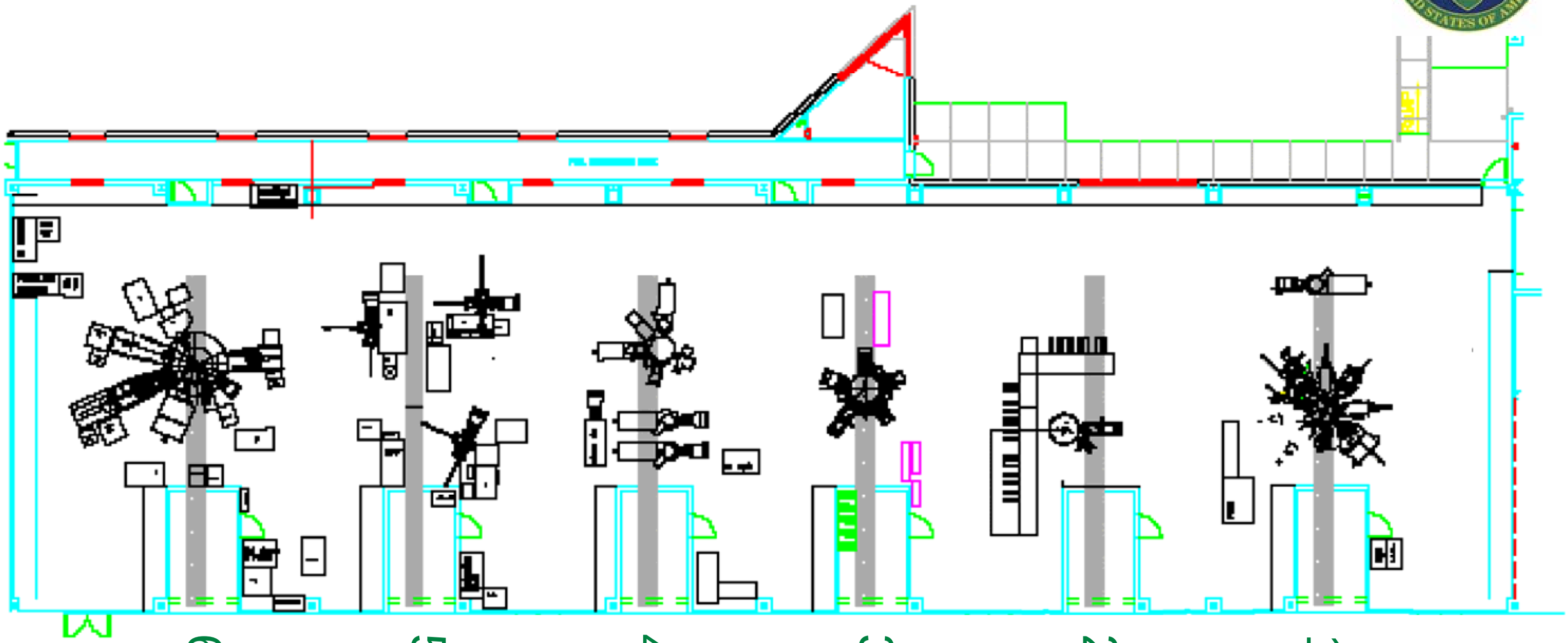
PDIL Implementation

Stand-Alone Tools

Platform: Robotic Transfer



PDIL Equipment Platforms



6) M&C Integrated

5) M&C Stand-Alone

4) Si / CdTe

3) Silicon Platform

2) Atm. Processing

1) CIGS Platform

PV Technology Road Map Support

	PV Technology Road Maps						
Platform	Wafer Si	Film Si	CPV	CdTe	CIGS	OPV	DSPV
Thin Si	🟩	🟩					
Wafer Rep.	🟩	🟩					
CIGS					🟩		
CdTe				🟩			
Atm. Proc.	🟩	🟩		🟩	🟩	🟩	🟩
M&C Ind.	🟩	🟩	🟩	🟩	🟩	🟩	🟩
M&C Cluster	🟩	🟩	🟩	🟩	🟩	🟩	🟩

Steps in Custom Equipment Acquisition

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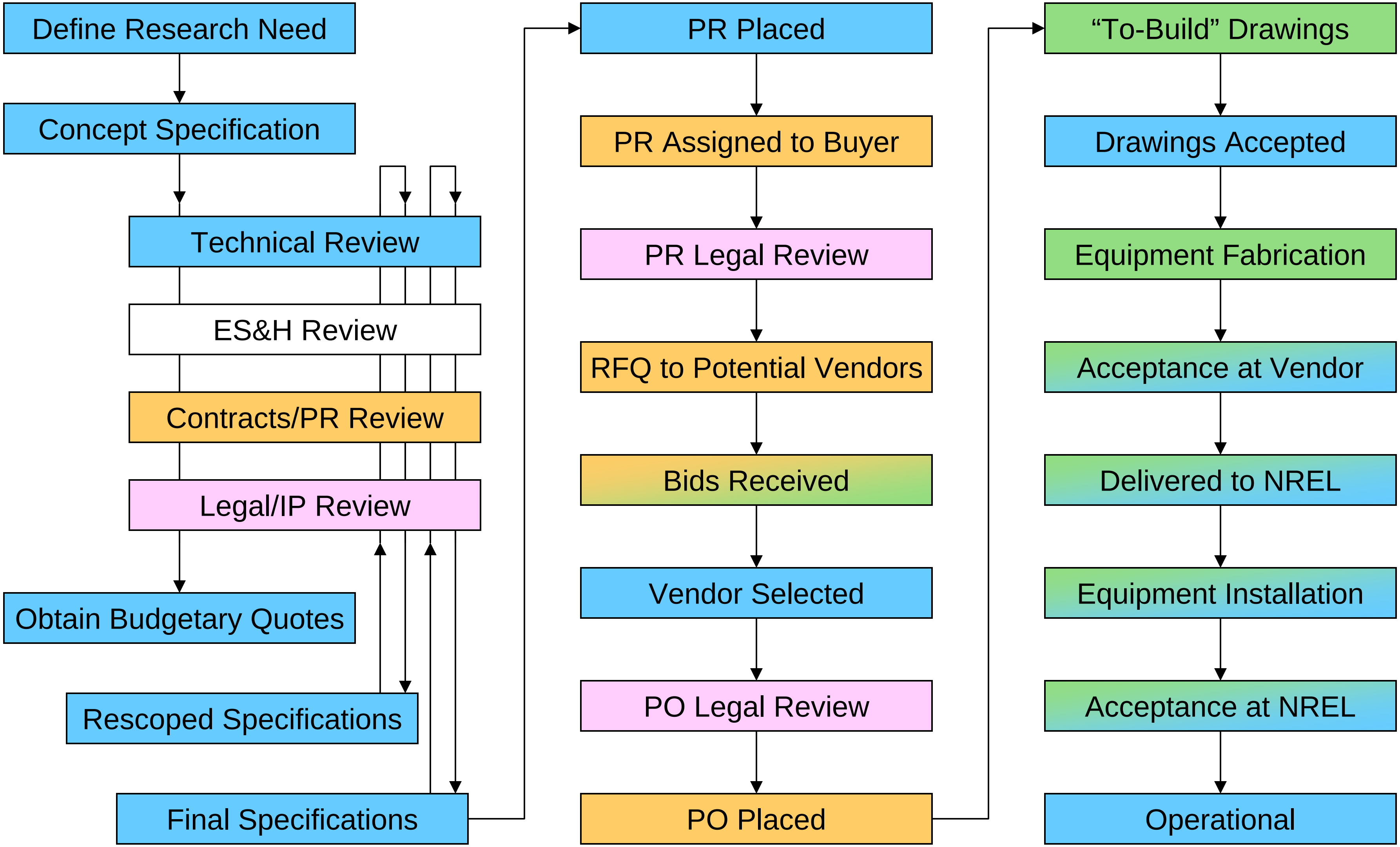


Define Research Need

Concept Specification

Technical Review

ES&H Review

Contracts/PR Review

Legal/IP Review

Obtain Budgetary Quotes

Rescoped Specifications

Final Specifications

PR Placed

PR Assigned to Buyer

PR Legal Review

RFQ to Potential Vendors

Bids Received

Vendor Selected

PO Legal Review

PO Placed

"To-Build" Drawings

Drawings Accepted

Equipment Fabrication

Acceptance at Vendor

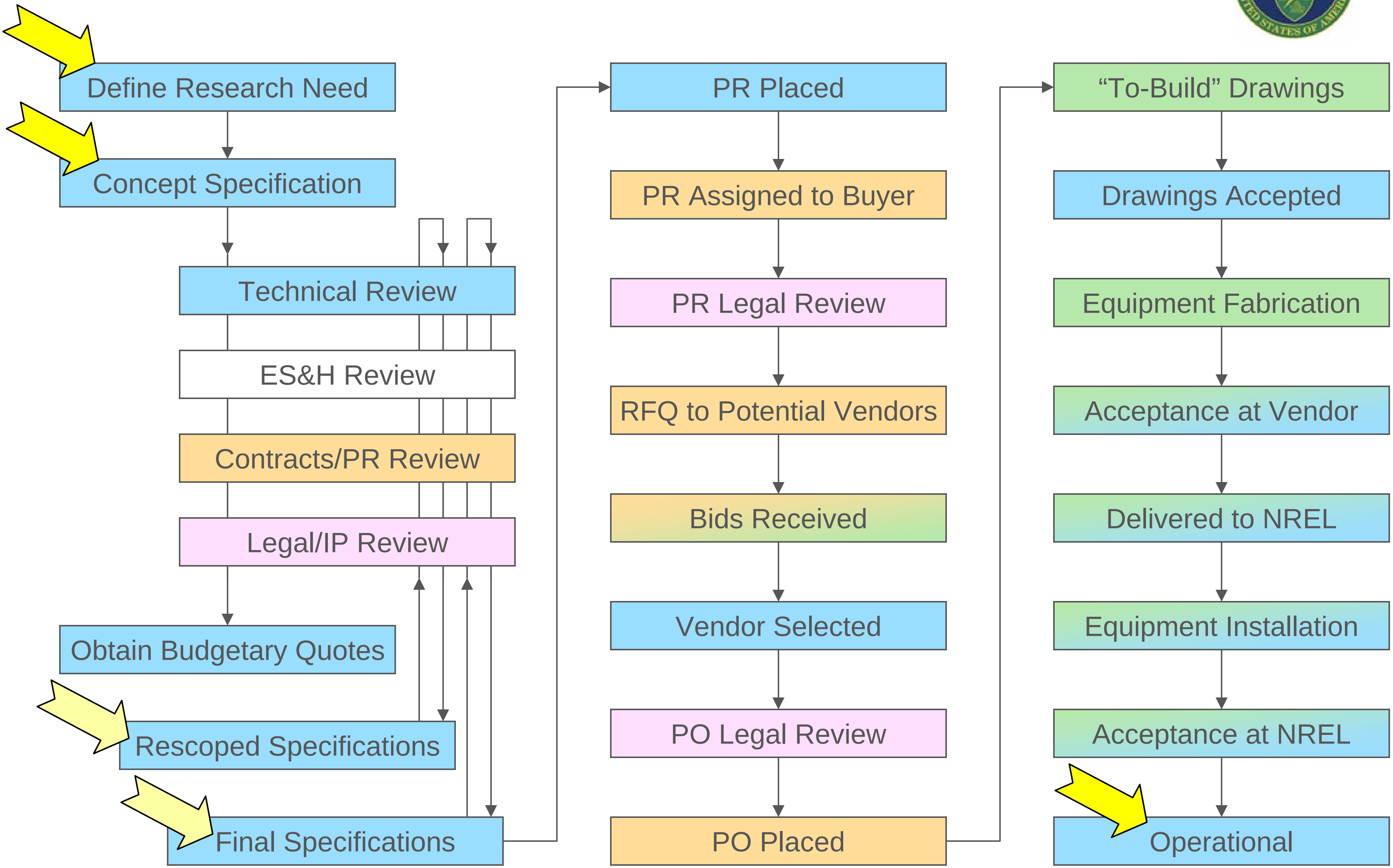
Delivered to NREL

Equipment Installation

Acceptance at NREL

Operational

Industrial Input



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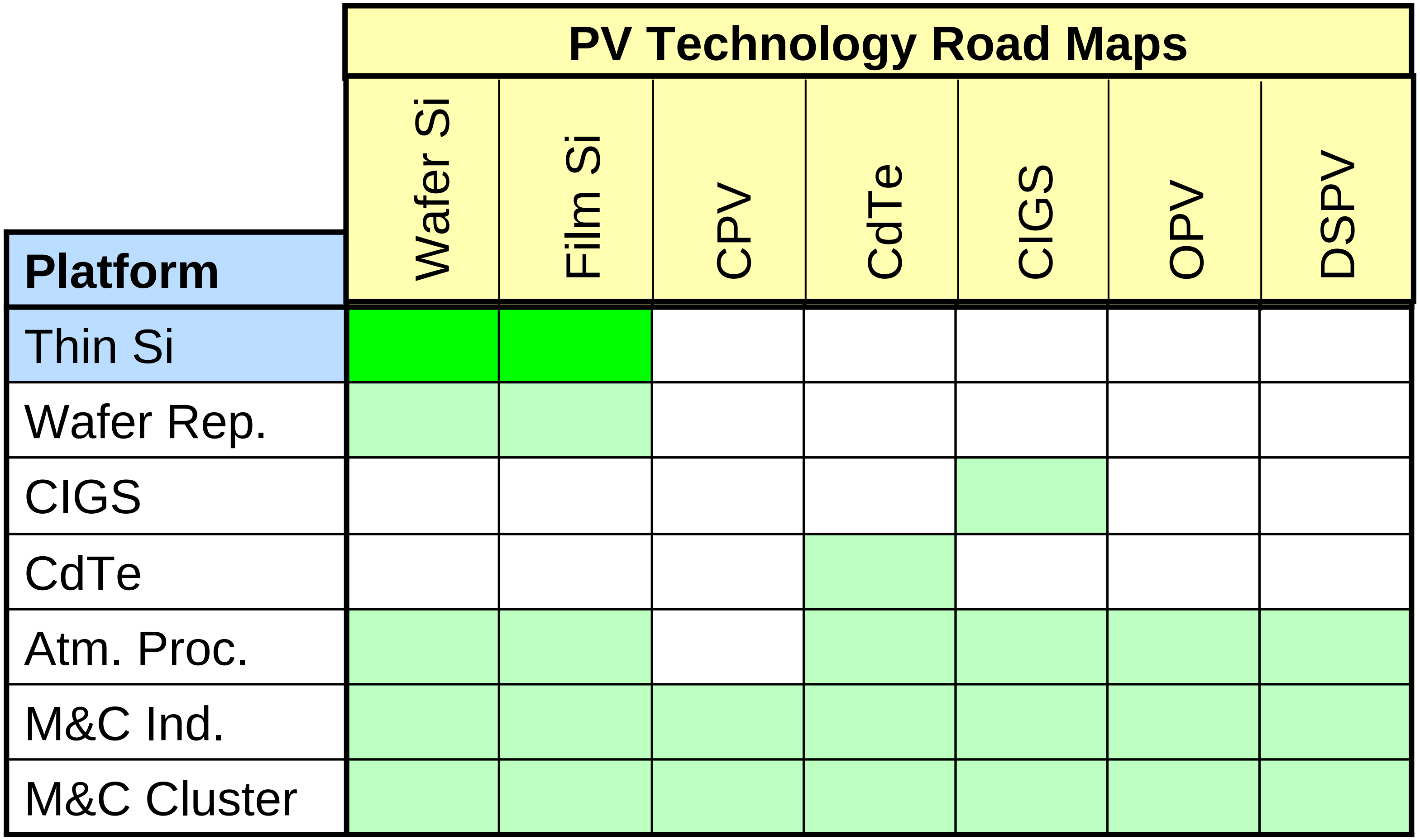
Thin-Silicon Platform

Qi Wang



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CdTe				🟩			
Atm. Proc.	🟩	🟩		🟩	🟩	🟩	🟩
M&C Ind.	🟩	🟩	🟩	🟩	🟩	🟩	🟩
M&C Cluster	🟩	🟩	🟩	🟩	🟩	🟩	🟩