



Mid-IR Investment Focus Group

Creating Infrastructure to Transition Early Stage Technologies to Commercial Use

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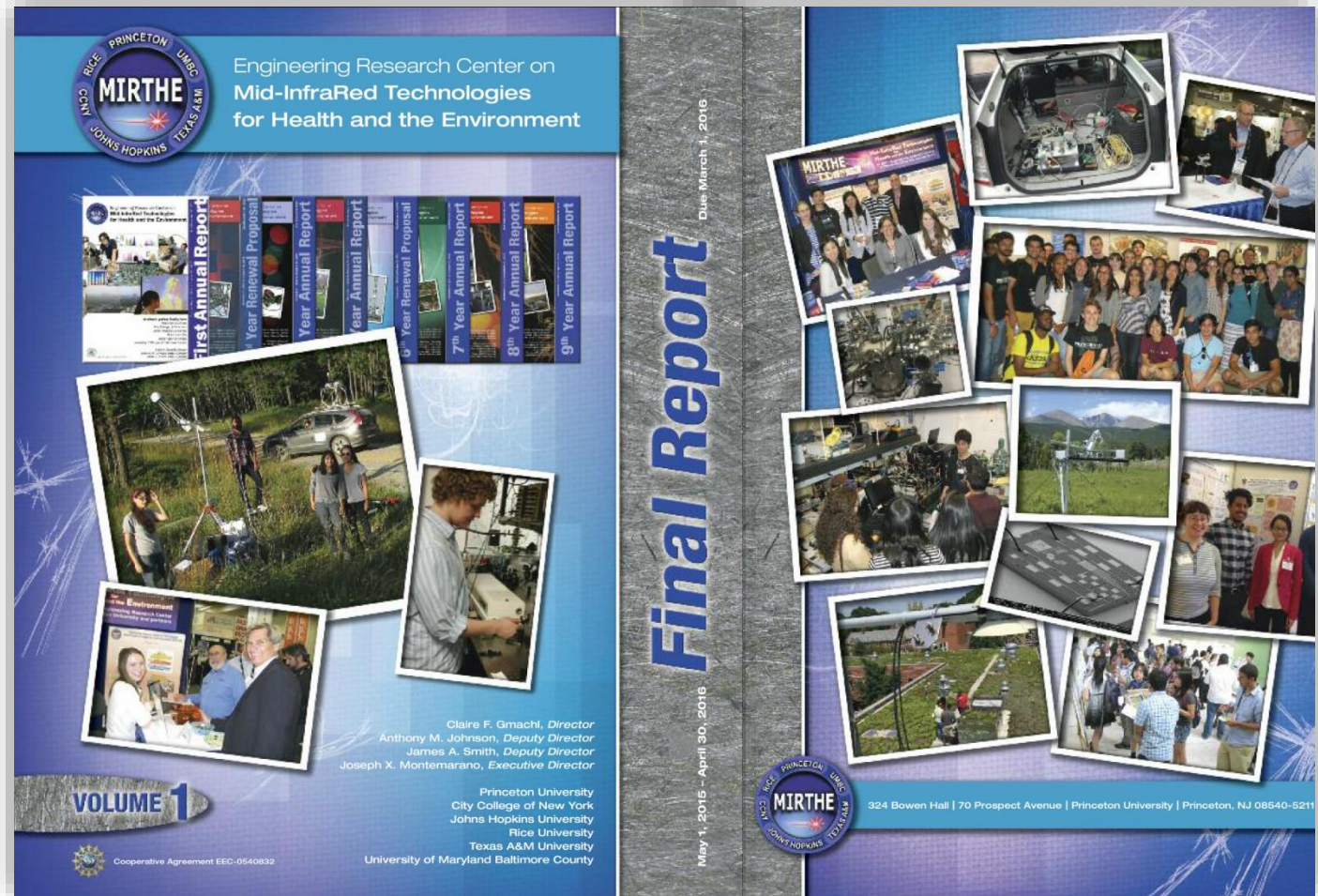


Today's Presentation Outline

- **Intro to NSF ERC Mid-InfraRed Technologies for Health and the Environments (MIRTHE)**
- **Tech transfer/commercialization environment at Princeton prior to MIRTHE's establishment**
- **MIRTHE as driver in the launch of the Investment Focus Group (IFG) and need for early-stage commercialization infrastructure**



Ubiquitous Mid-IR Sensing ...

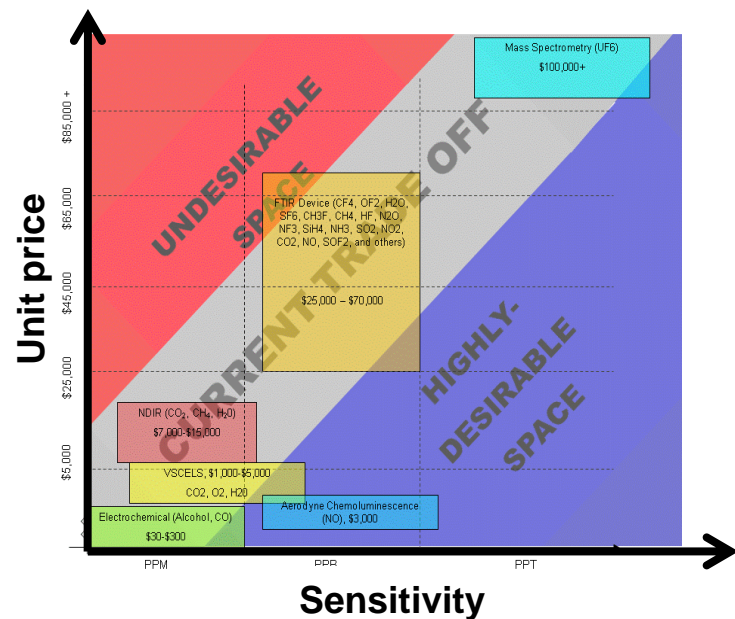
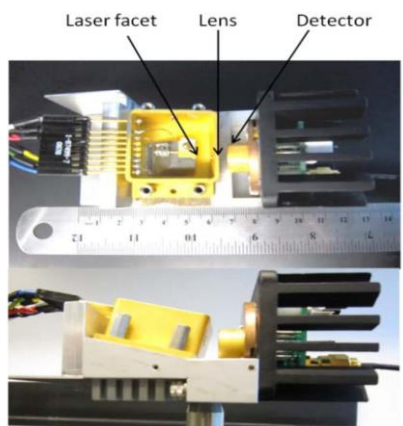


Accomplished with Stakeholders!



MIRTHE's Technology Vision

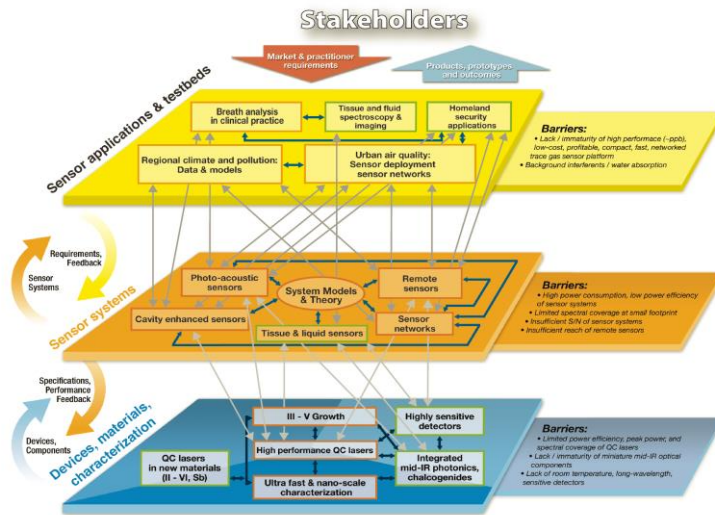
- **A new platform of mid-IR trace gas sensor systems**
 - Unprecedented high-performance sensitivity, real-time, compactness and cost-effective
- **Important commercial needs & societal challenges**
 - Securing a clean, safe, sustainable, and healthy environment on a National and Global scale





Consider Everyone a Stakeholder

Stakeholders make ERCs dynamic systems!



MIRTHE strategic 3-plane chart



MIRTHE & Members establish Mid-InfraRed Pavillon@CLEO

Communication is the key to mobilize advocates, mitigate critics, and bring others on-board



Investors don't buy technology

- **Big companies focus on big transactions**
 - Universities are scoured for “home-runs” with large companies posed to act
- **Less defined entrepreneurial opportunities not on large corporate radar**
- **Long gestation periods and intensive capital requirements in niche markets demand relationships must first be built just to get to the transaction stage**

What companies and venture investors buy are promising technology businesses opportunities



By 2010, MIRTHE had a formidable Mid-IR ecosystem and Stakeholders in place

Partners:

CORNING



General Members:



HAMAMATSU



PICARRO



Affiliates:



DURASENS



IRFlex



QTC Inc.



Media Affiliates:

LaserFocusWorld



Non-profit/Gov:



NIST



Rutherford Appleton Laboratory



Space Dynamics LABORATORY
Utah State University Research Foundation





Yet the ecosystem was not complete without input from the investment professionals

To be truly *transformative* MIRTHE needed the missing infrastructure to *understand the business opportunities!*

- While their money is important, VCs provide essential expertise and business smarts that most academics lack
 - But why would they be involved in a university research center?
 - How could they be attracted to provide the services our small company collaborators need?
- By giving investors the confidence that they will not miss the next Mid-IR big investment opportunity
 - Providing insights into technologies so they do not repeat the mis-steps that led to the 2001 telecom bubble and the inevitable a decade-long “nuclear winter fall-out” for investors and the global economy



Investment community engagement

Mid-IR Investment Focus Group (IFG)

Co-chaired by Dr. Mort Collins and Dr. Ralph Taylor-Smith, Battelle Ventures

- A network of professional and angel investors seeking opportunities emerging from mid-infrared technologies and related applications
 - Provides introductions to promising start-ups, established technology businesses, and large end-users
 - Serves as a window with input into development of MIRTHE's Mid-IR technologies and applications
 - **NOT** an Investment Fund
-
- VCs told “leave the checkbook at home...you know its too early to invest!”
 - Asked to help assess technology readiness & commercialization approaches
 - Opportunities to nurture MIRTHE student/faculty/entrepreneur-start-ups
 - Serve as a spring-board for firms interested in mid-infrared business formation and growth, as well as attractive new product commercialization opportunities



MIRTHE IFG Board Members

Mort Collins (Battelle Ventures); Co-Chair

Ralph Taylor-Smith (Battelle Ventures); Co-Chair

Maxine Ballen (New Jersey Technology Council)

Kathleen Coviello (NJEDA)

John Dexheimer (LightWave Advisors Inc.)

Karla Ewalt (Office of the Dean for Research, Princeton University)

Debbie Hart (BioNJ)

Randy Harmon (NJSBDC)

Cornelia Huellstrunk (Keller Center, Princeton University)

Eric Kutner (Princeton Entrepreneurs Network)

Michael Lucca (The Incubation Factory)

Mark V. Laurenzi (RedScript Ventures LLC)

Steven Lorenzet (Kean University)

Tom Melzer (RiverVest Venture Partners)

Joseph Michels (One Equity Partners)

Lawrence Newman (Rider University).

Gregory H. Olsen (GHO Ventures)

Katherine O'Neill (Jumpstart NJ Angel Network)

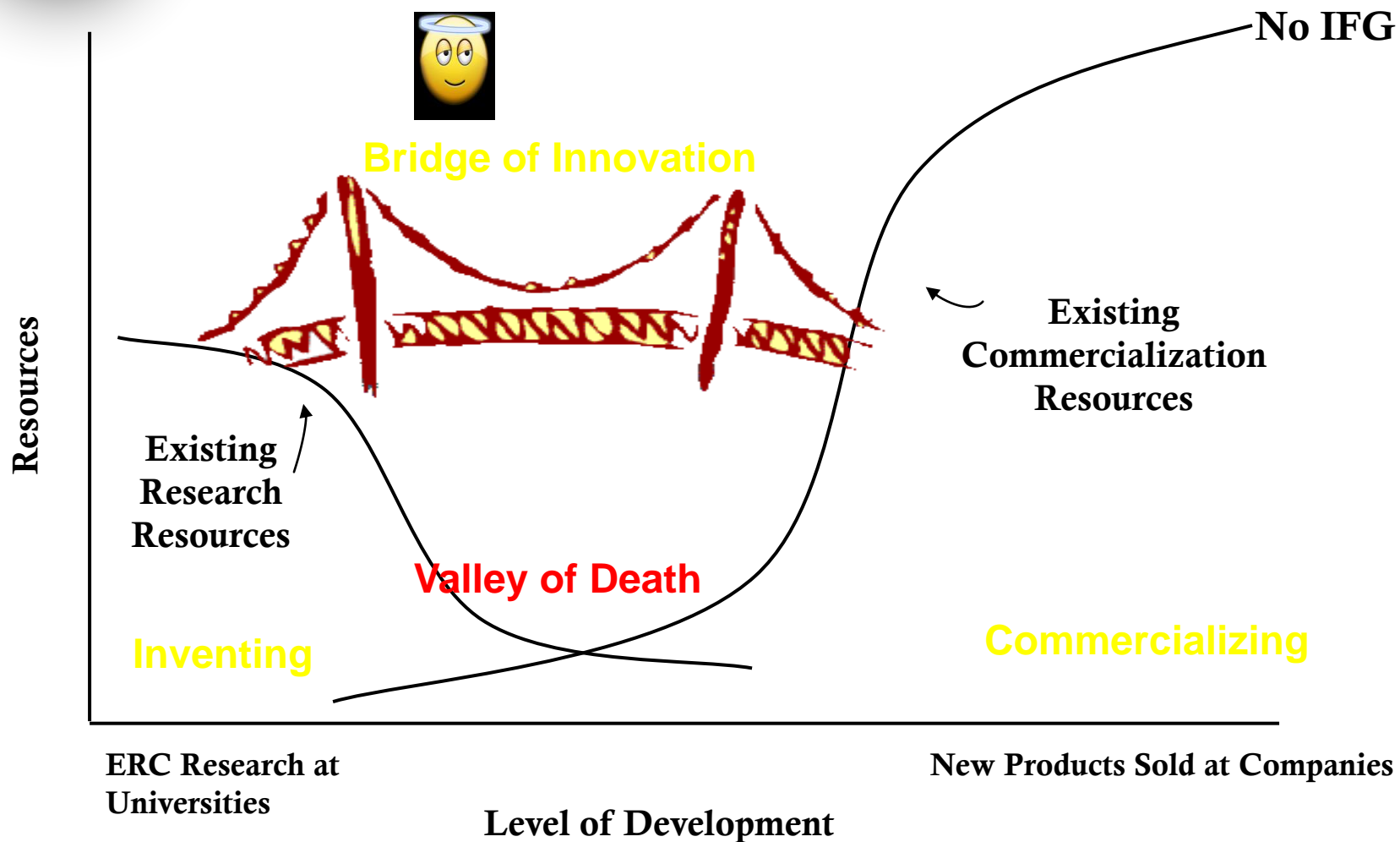
Cole Van Nice (Chart Venture Partners)

John Weaver (Princeton Entrepreneurs' Network)

Richard White (Silicon Valley Bank)

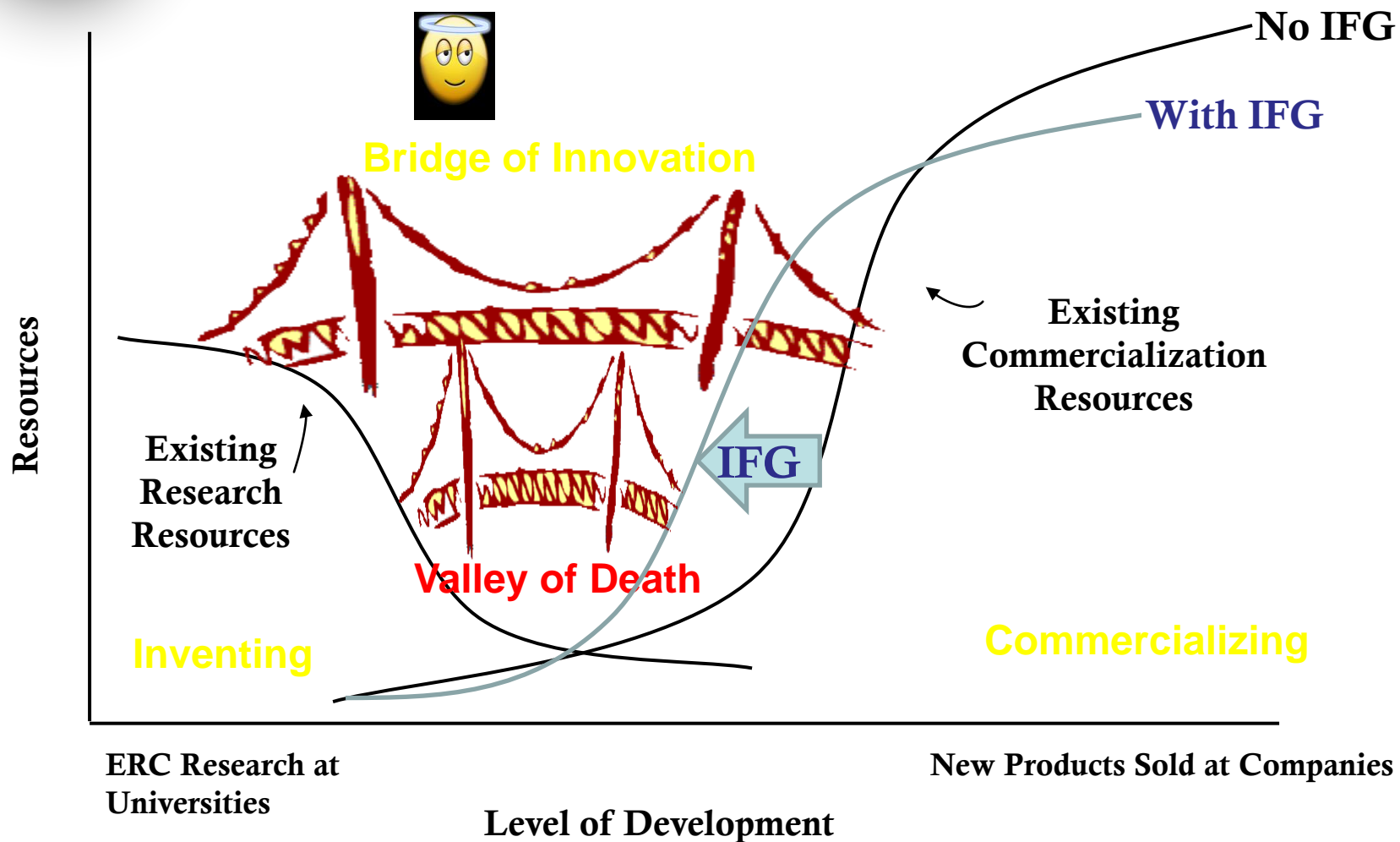


IFG Reduces Invention to Commercialization Gap





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MIRTHE IFG Real-World Impact

MIRTHE companies acquisitions:

Acquisition Year



2014 - Trace gas sensing technologies (multipass cell)



2012- IC/QC semiconductor laser technologies

2014 - quantum cascade laser (QCL) business and associated optical semiconductor technologies sold to THORLABS

2016 – Princeton student started company in 2011 at IFG acquired in 2016 by Mitutoyo Americas



Thorlabs Quantum Electronics (TQE), Jessup, MD, launched large optoelectronics design and manufacture facility making a **wide range of QCLs more affordable and available in its catalog**



TAG Optics Inc.





Mid-IR Early Stage Investment Forum became an SPIE-DSS/DCS “staple” in 2011



IFG Asset to Student Entrepreneurs



4th Annual Innovation Forum, Keller Center (2009)

Stephen So (post-doc) won 2nd place, and next year launched Sentinel Photonics



NSF-ERC Elevator Pitch Contest (2011)

Tracy Tsai (grad. student) won 2nd prize



7th Annual Innovation Forum, Keller Center (2012)

Michal Nikodem (post-doc) won 2nd place



Optoelectronics Start-up Challenge at Photonics West 2012

Yin Wang (grad. student) won 2nd prize



8th Annual Innovation Forum, Keller Center (2013)

Lei Tao (post-doc.) won a 1st prize

Arvind Ravikumar (grad. student) won a 3rd prize



10th Annual Innovation Forum, Keller Center (2015)

Loan Le (grad. student) one of the finalists



Conclusion: IFG was Worth the Risk

- **Large companies excel as solutions integrators for large markets**
- **Early-stage IP presents challenges to commercialization and requires special infrastructure**
 - Early technologies do not hit hurdle rates of large R&D companies and exceed corporate earnings timeframe
 - R&D screeners sometimes display “NIH” (not invented here) sentiments to externally generated technologies, especially from universities
- **While small companies are better acclimated for early development work they often lack the capacity**
- **The Mid-IR Investment Focus Group added the expertise and resources to identify and speed commercialization of promising technology business opportunities**

Mid-Infrared Technologies for Health and the Environment

