International Models

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and

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Panelists:

- Scott Bryant, Micro and Nano Commercialization Education Foundation
- Gary Albach, nanoAlberta
- John Cowie, American Forest and Paper Association, Agenda 2020 Technology Alliance
- Jaime Parada Avila, Monterrey International City of Knowledge

- International activities
  - ISO, OECD, bilateral, agency-to-agency, researcher-to-researcher
  - Collaborative approaches in precompetitive and noncompetitive areas
    - EHS
    - Contributions to solving global problems (water, energy…)
  - Trade, Intellectual Property Rights, Regulatory issues in competitive areas

- International Comparisons
  - Different innovation systems, levels of support at various points throughout the innovation process
  - Benchmarking activities
  - Educational systems and opportunities

Dynamic International Landscape in Nanotechnology: Challenges and Opportunities for U.S. Nanotechnology

Richard A. Johnson
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National Nanotechnology Initiative Workshop
Oklahoma City: April 2-3, 2009
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Mapping the Global Nanotechnology (NT) Landscape

- **Understanding the Rapidly Evolving Global Context of Nanotechnology Is Critical – 35+ Countries Have National Nanotechnology Strategies and Policies**

- **View NT Capacity, Competition, and Collaboration on a Global Scale: U.S. = 28% of global NT activity**
  - **OECD – Emerging Hub for Global Nanotechnology Policy**
  - **European Union Develops Robust, Integrated Approach to Nanotechnology**
  - **Asia Sees NT as a Core 21st Century Driver for Innovation, Competitiveness and Security**
  - **Russia Elevates NT to Top Priority -- $8 billion investment**
  - **Growing opportunities for smaller countries and SMEs with world-class "niche" strategies (e.g., Israel, Finland, Taiwan)**

Nanotechnology in a Global Context Creates Challenges and Opportunities for U.S. Regional, State and Local Initiatives - "Act Locally, Think Globally"

- Key Drivers
  - Large Markets: $2 trillion NT global market by 2012 [CMP Cientifica]; $3.1 trillion global market by 2015 [LuxResearch]
  - Globalization: $15 billion+ in NT investments in 2008
  - Increasing Global Capacity: Convergence, interdisciplinary, cross-sectoral; multiple applications/multiple players
  - Global Triple Helix: dramatic increase in NT university-industry-govt. initiatives and new ideas for NT outside the United States
  - Open Innovation, Global Value Chains, Networks, Business Models
- U.S. initiatives must be much more attuned to global trends, policies and competitive landscape
- Numerous new opportunities for U.S. regional-state-local programs -- collaborative initiatives, shared best practices, investments, networking and matchmaking

Asia as One Example – Nanotechnology is Key Priority and Strategic Driver for 21st Century Economic Growth and Competitiveness

- National Nanotechnology Strategies as Key Elements for Asian Innovation, Economic Growth, Global S&T Base and Competitiveness
- Japan
- China
- Korea
- Australia
- New Zealand
- India
- Taiwan
- Singapore

China – NT: Core Element of "Indigenous Innovation"

- "Indigenous Innovation" Strategy = Economic Priority #1
  - 20% annual increases in R&D for last 10 years
  - NT: a top targeted area for R&D and economic competitiveness
- Large NT investor today; Equivalence with U.S./Japan/EU by 2015?
- A global leader in new NT companies (800+), NT publications (11% of global) and NT patents (fastest growing patenting rate)
- NT markets in China will increase to $145 billion by 2015 (Physorg 2006); 16% global market share
- Large China economic stimulus plan supports nanotechnology
  - $18B for R&D; large share to NT
- Large defense nanotech program with civilian spillovers
- National Steering Committee for Nanoscience and Nanotechnology (MOST, CAS, NRDC/State Council, SDPC, MOE, NSFC)
- New measures related to research, innovation, standards, IPR, regional and university-industry links (20 university/regional NT centers of excellence)
- Nanomaterials #1; Nano-bio and other life sciences #2

Japan – 2nd Largest Global Player in NT

- Japanese Strategic Technology Roadmap (2005) and Third Science and Technology Basic Plan (2006-2011) – NT is one of 4 top priorities in Japan's National Growth Strategy
- National Nanotechnology Research Network Centre (since 2002)
- Major new initiatives with universities, national labs, and regions
- Eco-Innovation, Sustainable Manufacturing, and Next-generation Semiconductors, Electronics and Materials
- Major new focus on NT for energy, environment, water and climate
- NT R&D = $2.8 billion in 2004 ($900 million public) (FT, 2006)
- Japan expects $238 billion domestic NT market by 2020
- Developing NT Roadmap of Risk Assessment
- Key Agencies for Nanotechnology: AIST, METI, MEXT and MHLW, plus Prime Minister's S&T Council
- Beginning to consider range of policy issues re NT applications
- NT patents = 14% of global NT patents

Korea – Leading NT Player "Under the Radar"

- Nanotechnology as linchpin of its new S&T national strategy and technology-led growth plans
- Goal – become one of top 3 countries in NT by 2020
- Korean "Nanotechnology Roadmap" (2008)
- 5th largest investor in Nanotech R&D ($3 billion)
- Estimates $260 billion in global revenue from NT and NT-enabled manufacturing by 2015-2018
- Highly targeted approach with numerous national, university, corporate and regional joint initiatives
- Using NT as a growth and investment engine for SMEs

Top 12 International Legal, Policy and Regulatory Areas to Watch for Nanotechnology – Rapid Change

- Definitions, nomenclature and testing methods
- The science-innovation interface, including R&D, entrepreneurship and commercialization
- EHS Regulations and Regulatory (In)Compatibility
- Intellectual property rights
- Risk Governance -- including international regulatory frameworks
- Capital formation, investment and tax policy
- Human Capital policies – including universities, skill sets, training
- Liability and stewardship issues
- NT Innovation for Grand Challenges – environment, health, water, energy, climate change, security
- Public engagement, including ethics and outreach
- Security balance – narrow definition (military) v. broader one (economic and military)
- Standards – e.g., ISO TC 229 and de facto standards

International Models

Scott Bryant, Executive Director
Micro and Nanotechnology Commercialization Education Foundation
www.mancef.org

Goal: Emphasize comparative models that provoke thoughtful discussion

- **All Small Tech - Statement: Most other national models leverage both micro and nanotechnologies to cross-fertilize product development, not exclusive. Is there an artificial silo around nano in the US that inhibits communication, cooperation, and commercialization? Isn't more "Small" in the national strategy better for 3 C's?**
- **Framework - Statement: Other countries' and regions' models find that convergence works well as a more open framework for development of consortiums/networks, specialized centers, and industrial/commercialization goals. Is a national technology framework focused on convergence a better strategy for organizing a national inventory of assets toward commercialization?**
- **Convergence - Statement: The EU, Australia, and Japan, and Canada are much more focused on convergence (IT, bio, and nano) in their priorities planning because they are seen as pan-industrial enablers . Should recognition of the power of convergence lead the US S&T economic development model?**

International Models

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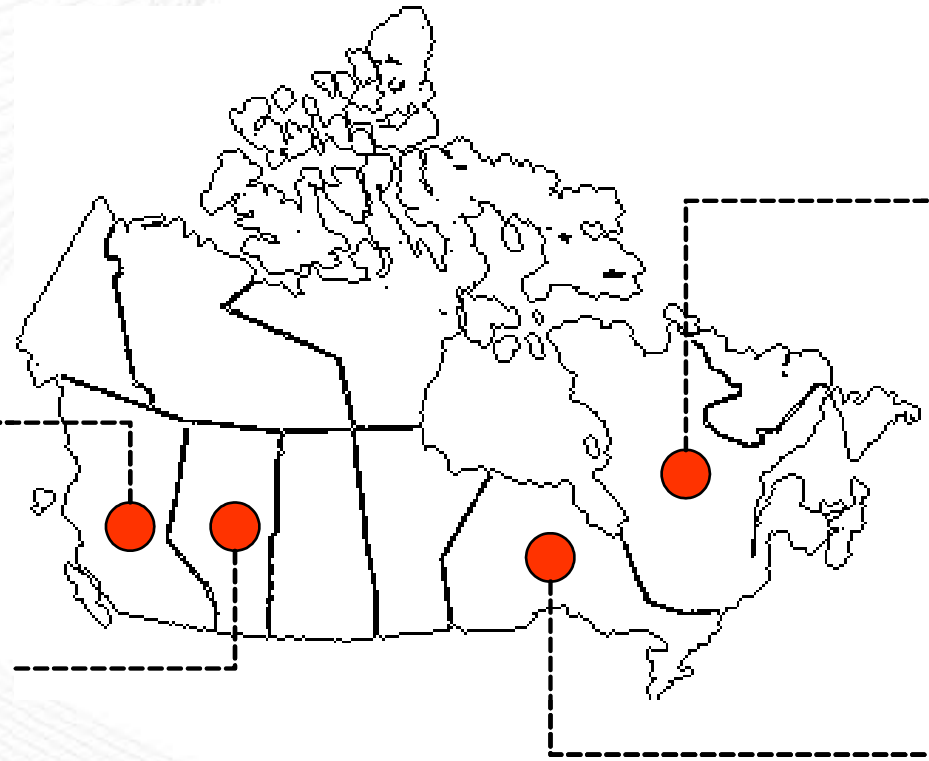
- **Survival Capacity - Statement: The EU model is successfully building a framework for eliminating the Valley of Death and building the capacities to apply their assets to clearly communicated EU priorities. Should this be a key national priority of a strategy for a tech-based economic development framework?**
- **Intra-Regional Collaboration - Statement: the UK, French, Dutch models and the EU model are successfully supporting regional and intra-regional collaborations. Is the US regionally fractured or silo'd? What could be done to facilitate more regional collaborations and industrial priorities?**
- **NAFTA NEMS - Statement: NAFTA could be applied to technology and used more to integrate the advantages of the free trade area model. State to state activity already in play (Texas-Nuevo Leon, New Mexico-Chihuahua) Mexican technicians and engineers? Can NAFTA be a vehicle to bridge the gap for more trade block collaboration & commercialization?**
- **Global Reach – Statement: MANCEF connects to a global MNT community who commercialize. See www.mancef-coms2009.org**

Canadian Landscape



British Columbia
Alternative Energy
IT Chips & Devices
Wireless Devices
Drug Delivery

Alberta
Energy & Environment
Health & Medical
Agriculture & Forestry

Quebec
BioPharma
Aerospace
Forest Products
Drug Delivery

Ontario
Medical Devices
IT & Telecom
Manufacturing
Automotive

About Alberta

- One 10 Canadian Provinces
  Population: 3.5 million (10% of country)
- Traditional Industries: Oil and gas, Agriculture, Forest products, Manufacturing
- Nanotechnology:
  ~50 companies employ ~600
  ~$500 million/5yr public investment
  ~1000 researchers

Infrastructure

NINT (National Institute for Nanotechnology)

ACAMP (Alberta Centre for Micro/Nano Products)

MSTRI (Microsystems Technology Research Initiative)

NanoFab (Open Access Fabrication Facility)

INRF (Integrated Nanosystems Research Facility)

ACSES (Alberta Center for Surface Engineering & Science)

AMIF (Advanced Microsystems Integration Facility)

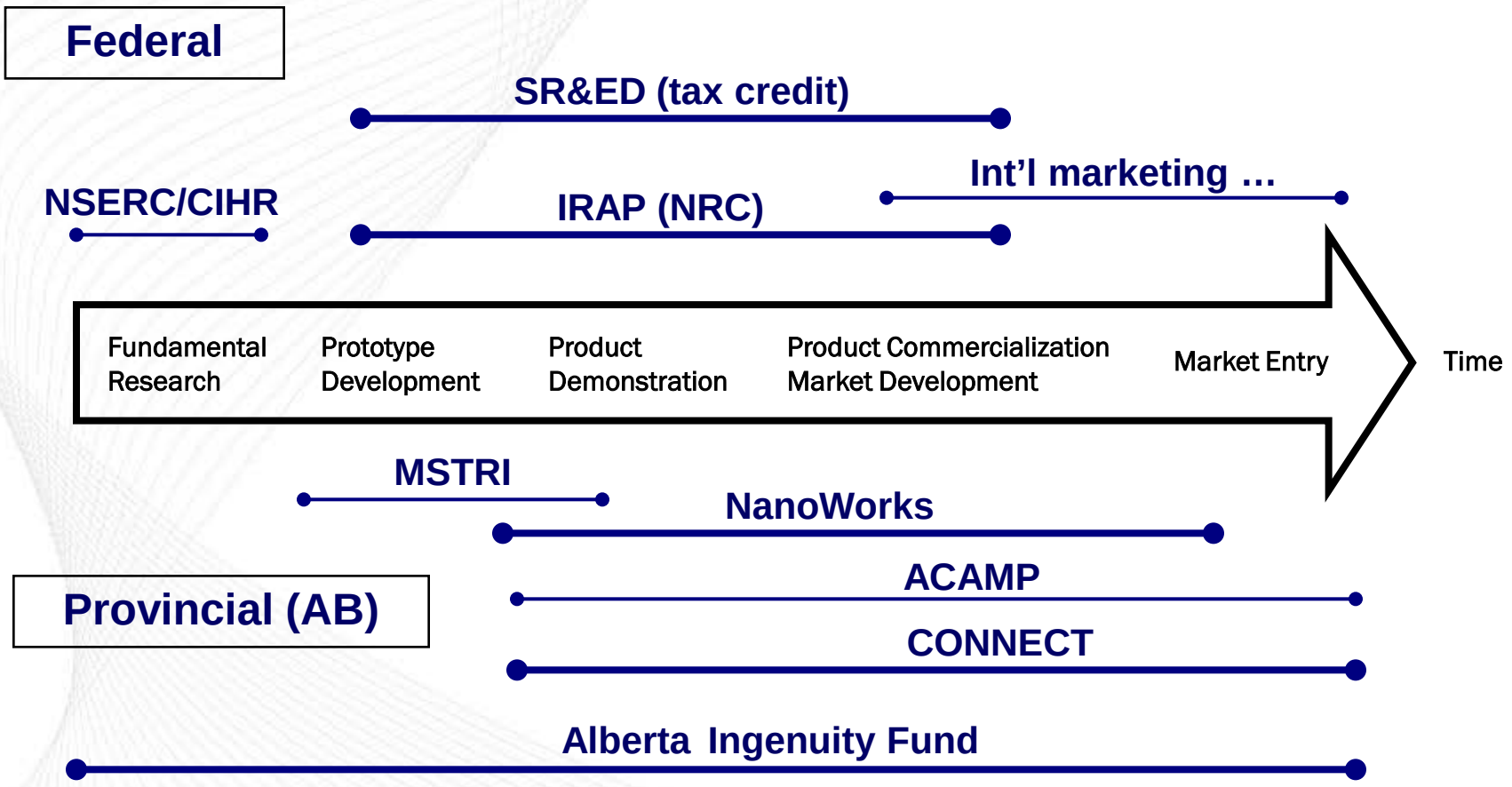
CIHM (Center for Intelligent Health Monitoring)

CEIN (Center of Excellence for Integrated NanoTools)

Institute for Biomolecular Design

Protein Gene Discovery Centre

Some Canadian Programs …



Agenda 2020 Technology Alliance

- Member alliance promoting transformational R&D for forest products industry
- Special Project of the American Forest & Paper Association (AF&PA), the national trade association of the forest products industry
- An industry-led partnership with government (e.g. USDA Forest Service, DOE, NIST, EPA, etc.) and academia
- Active programs include
  - Sustainable forest productivity
  - Pulp & paper breakthrough manufacturing
  - Nanotechnology for forest products industry
  - Forest biorefineries

Agenda 2020 Model for Innovation in the Forest Products Industry

- The Forest Products Industry has developed:
  - a strong public-private partnership and
  - a common and agreed upon agenda for advancing nanotechnology
- Agenda 2020 signed a Consultative Board for Advancing Nanotechnology (CBAN) with the NSET subcommittee through the National Nanotechnology Coordination Office (NNCO)
- New ideas and R&D projects are run through the Stage Gate process to increase the likelihood of success

Unique International Issues for Nanotechnology in Forest Products Industry

- Other countries are more focused than the US in R&D
  - Their governments and industrial partners work together, e.g., the Finnish government is part owner of UPM Kymmene
  - Cooperatively research and develop new products and processes for commercial applications
  - Not concerned with Anti-trust laws
- The US model is to publish in the open literature and hope the information is found by industrial users
  - Focus on precompetitive R&D
  - All that is allowed by law
  - Governed by Sherman Anti-trust laws

Forest Products Industry Experience with Technology Transfer and Commercialization

- Agenda 2020 employs the Stage Gate process for terminating failed projects before large capital investment
- In the US:
  - The government labs produce basic science and technology
  - Industry incorporates this technology into it's own product development laboratories for commercialization
- There is a very definite lack of technology transfer from the public sector to private enterprise
- Government labs develop the technology but have no involvement in the business aspects of commercialization:
  - Supply Chain development
  - Market force issues

Monterrey: International City of Knowledge

Monterrey
Ciudad Internacional del Conocimiento

Jaime Parada Ávila

CEO
Instituto de Innovación y Transferencia de Tecnología de Nuevo León

STATE OF PROGRESS

INSTITUTO DE INNOVACIÓN Y TRANSFERENCIA DE TECNOLOGÍA

Monterrey: International City of Knowledge

Vision 2030:

Competiveness: One of the top ranked cities in the world.
Knowledge: Diversified economy based in advanced manufacturing goods, and high added value products and services based in Innovation.
Income: From 18,000 usd to 35,000 usd.
Quality of life: Average of UNO human development indicators.
Education and R&D: Top class education; from 30% to 50% coverage in higher education and from 0.6% to 2% in R&D; social awareness about knowledge.

Strategy: Triple Helix Model (Government, academia, private sector)

Focused Areas:

5 Areas of Excellence: Biotechnology, Life Science, **Nanotechnology**, Mechatronics and IT & Software.
7 Strategic Clusters: Medical Services, Autoparts, Aeronautics, Household appliances, Software, Biotechnology and **Nanotechnology**

Strategic Programs & Projects:

Science &Technology in Education
Graduate programs & scholarships
Research funds & Tax incentives
Financial Instruments (seed & venture capital)
Incubators
Research & Innovation Parks
International Cooperation

Institutional Framework

Science coordination unit
Innovation & Technology Transfer Institute
New Law to support Knowledge Based Economy

Foundations:

Good Education & University System
Good Urban Infrastructure
Solid Economy (1st in competitiveness in Mexico)
Geographical position
Entrepreneurship Culture

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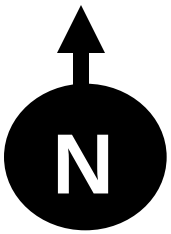
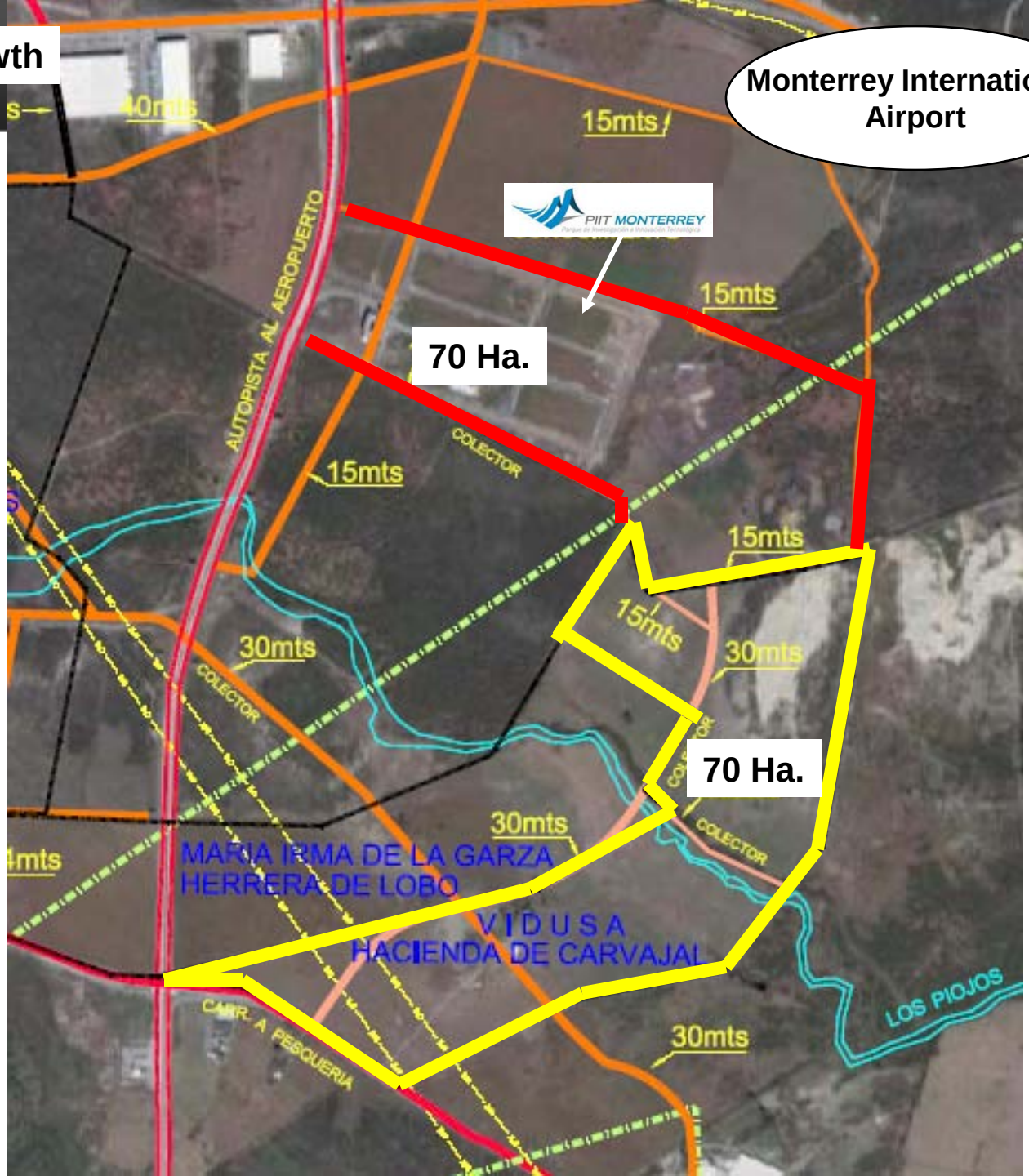
Projected Growth





Research and Innovation Park

Areas of R& D: Life Science, Biotechnology, Nanotechnology, Mechatronics, Energy, Food industry, Software, Electronics, Product Design & Manufacturing systems, applied mathematics, environment & optics.

Area: 140 Ha (70 developed + 70 2nd. phase)

Investment: $100 Musd public (N.L. government), $200 Musd - $250 Musd other sources (Federal government & private companies)

Expected employment (5 years) : +- 3,500 researchers, engineers, technicians & support personal.

8 Universities: UNAM, UANL, ITESM, UDEM, U of Texas, Texas A&M, Arizona State University and University of Arizona.

10 Public Research Centers: CINVESTAV, 7 CONACYT'S research centers, IIE and Water Technology Institute.

9 Private Technology Centers: Motorola, Pepsico, Metalsa, Sigma, Viakable, Qualtia, & Prolec – GE.

IT Cluster: 42 SME's software companies.

2 Business Incubators: Nanotechnology & Biotechnology.

Hotel, conference rooms & commercial services

Top class infrastructure & services (Internet 2, supercomputers, voice, data)

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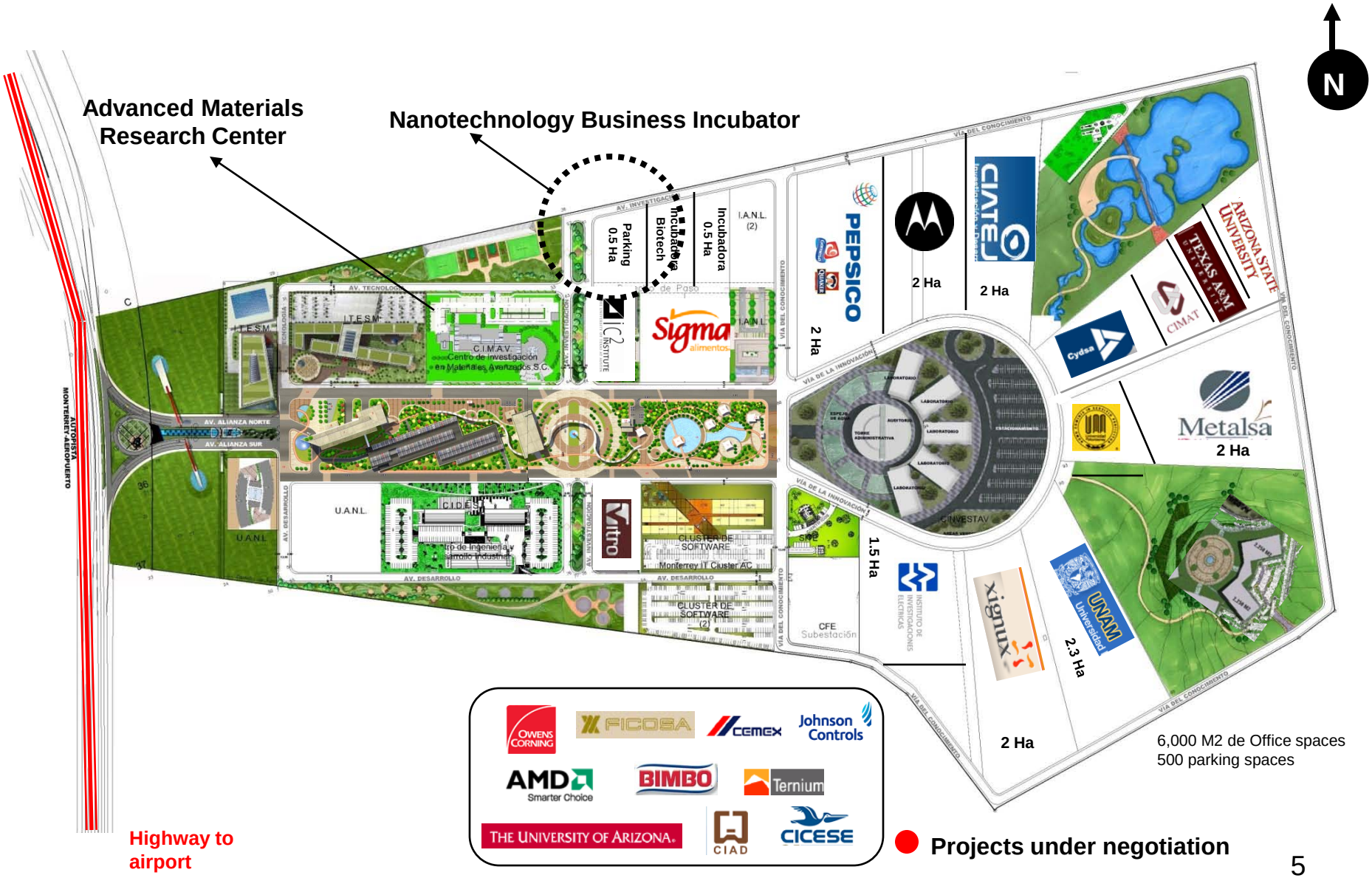
PIIT Monterrey - Master Plan



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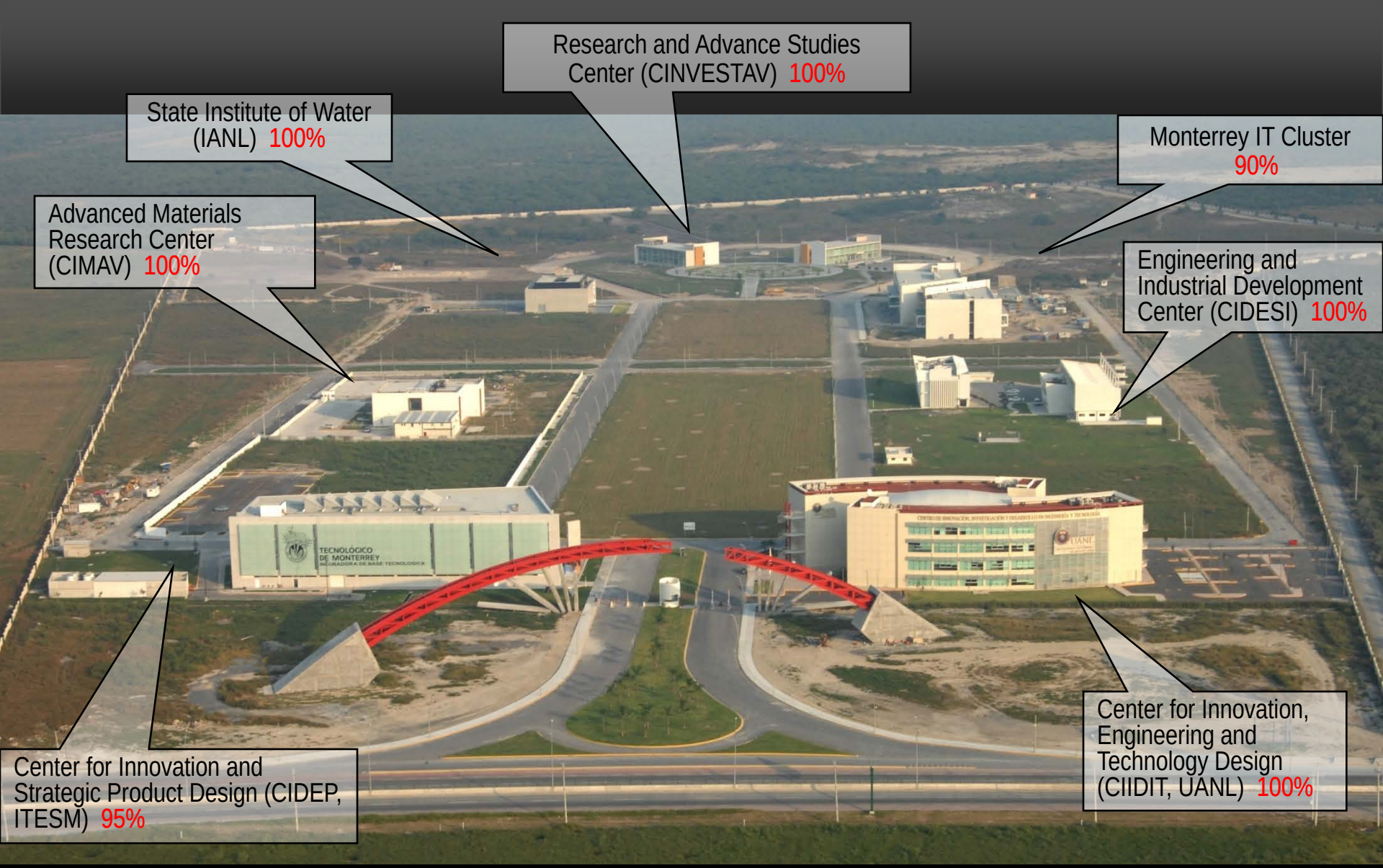

Progress

(October 2008)

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Nanotechnology program

- Based on a market study (Companies needs) made by Minister of Economy the Institute of Innovation and Technology Transfer of Nuevo Leon decided the creation of:

  1. A cluster of Nanotechnology (20 Monterrey based Companies, 5 R&D Centers)

  2. An incubator in Nanotechnology at Research and Innovation Park (PIIT)

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Main information and opportunities in Nuevo Leon and Mexico

1. The industries with higher interest in Nanotechnology:
   Plastics and polymers
   Coatings and paints
   Glass, Cement, ceramics, textiles
   Metal industry (wire, cables and alloys, Cu and Al)
   Chemical industry (catalyst, organic synthesis, oil industry)
   Electronic industry

2. What they need?:
   - Nanoparticles, (metal oxides, metal chlorides, metal hydroxides, metals, nanoclays)
   - Inorganic nanostructure materials (metal oxides, ceramic compounds)
   - Nanocomposites (nanoclays, Nanoparticles specially in PP,PE, PET, Nylon)
   - Metals (Ag, Au, Pt, Pd, Al, Cu)
   - Carbon nanotubes

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Cluster of nanotechnology of Nuevo Leon

- The cluster was officially launched by the Governor of Nuevo León in June of 2008.

- The funds for the operation of the cluster come from:
  - Companies
  - The Government of Nuevo Leon I2T2.
  - Centers and Universities of the cluster.

- The cluster is a Civil Association (non-profit) to promote the use of nanotechnolgy and facilitate the interacction among the government-academia-companies.

- The President of the cluster is Dr. Jesus Gonzalez Director of Center of Advanced Materials (CIMAV) highly recognized as an expert and experienced researcher in nanotechnology and advanced materials.

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Cluster of Nanotechnology

Cluster companies
Cemex Central, S.A. DE C.V.
Cydsa
Lamosa, S.A. de C.V.
MABE, S.A. DE C.V.
Magnekon, S.A. de C.V.
METALSA, S. de R.L.
Nemak
Owens Corning
Palmex Alimentos S.A. de C.V.
Plasticos Rex, S.A. de C.V.
Policyd, SA de CV
Prolec G.E.
Sigma Alimentos
Simplex, S.A. de C.V.
Univex, S.A.
Ternium
Viakable
Vitro Corporativo, S.A. de C.V.
Whirlpool

12 of this companies have a research group

The cluster companies identified 24 projects in progress or in develop

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Centers and Universities of the cluster of nanotechnology

Domestic

- **CIDESI:** Centro de Ingeniería y Desarrollo Industrial
- **UANL-CIIDIT:** Centro de Innovación, Investigación y Desarrollo en Ingeniería y Tecnología
- **CIMAV:** Centro de Investigación en Materiales Avanzados
- **CIDEP-ITESM:** Centro de Investigación y Diseño Estratégico de Productos
- **CIQA:** Centro de Investigación en Química Aplicada

Foreing participants

- **University of Texas en Austin:** IC^2, Business incubator
- **Arizona State University :** Nanotechnology

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Incubator of nanotechnology

The Institute with some experts decided the technological platforms to install in a facility inside the research and Innovation Park (PIIT)
The incubator work together with the cluster to offer service to the industry and R&D centers in Nuevo Leon and Mexico.

Technological platforms:

1. Nanoparticles top-down, bottom-up
    1. Wet Chemistry.
    2. Physical methods.
2. Inorganic nanostructure materials
    1. Carbon nanotubes
    2. Chemical Vapor Deposition
3. Nanocomposites
    1. Plastics, PP, PE, PET, Nylon, PVC.
4. Nanobiotechnology.

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Incubator of Nanotechnology

The technological platforms and the pilot plant selected have the follow characteristics:

1. Process patented or filed.
2. Minimum can synthesized kg/h from 0.5-1 kg/h
3. Must be proved the feasibility of the technology.
4. Pilot plants must produced a wide range of products and be flexible for trials.

- We have the participation of experts in Nanotechnology from UASLP, CIMAV, CIDESI, and companies like XETACOMP and an Spanish Company.

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Incubator of Nanotechnology Operation

- Plan to start up the next August 2009.

- Hire very qualified and train people operated for experts of Center of Advanced Materials (CIMAV)

1. One General Manager
2. Doctorate and Master people for the projects at least 4.
3. Technical people for the operation of the pilot plants at least 5.

- Hands-on operation concept.

- Cost per hour of use of each pilot plant.

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Incubator of Nanotechnology Summary

- Investment of 7 Million USD (first stage)
- 6 pilot plants with the technological platforms defined.
- First stage 700 m2 for the installation of the pilot plants and labs and 300 m2 for offices.
- Expected 80% of use of the pilot plants in two years.
- Expected five new companies created for the incubator in the first 2 years.

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STATE OF INNOVATION

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