



Developing Semiconductor Manufacturing Capabilities in India



Strategic and Economic Rationale

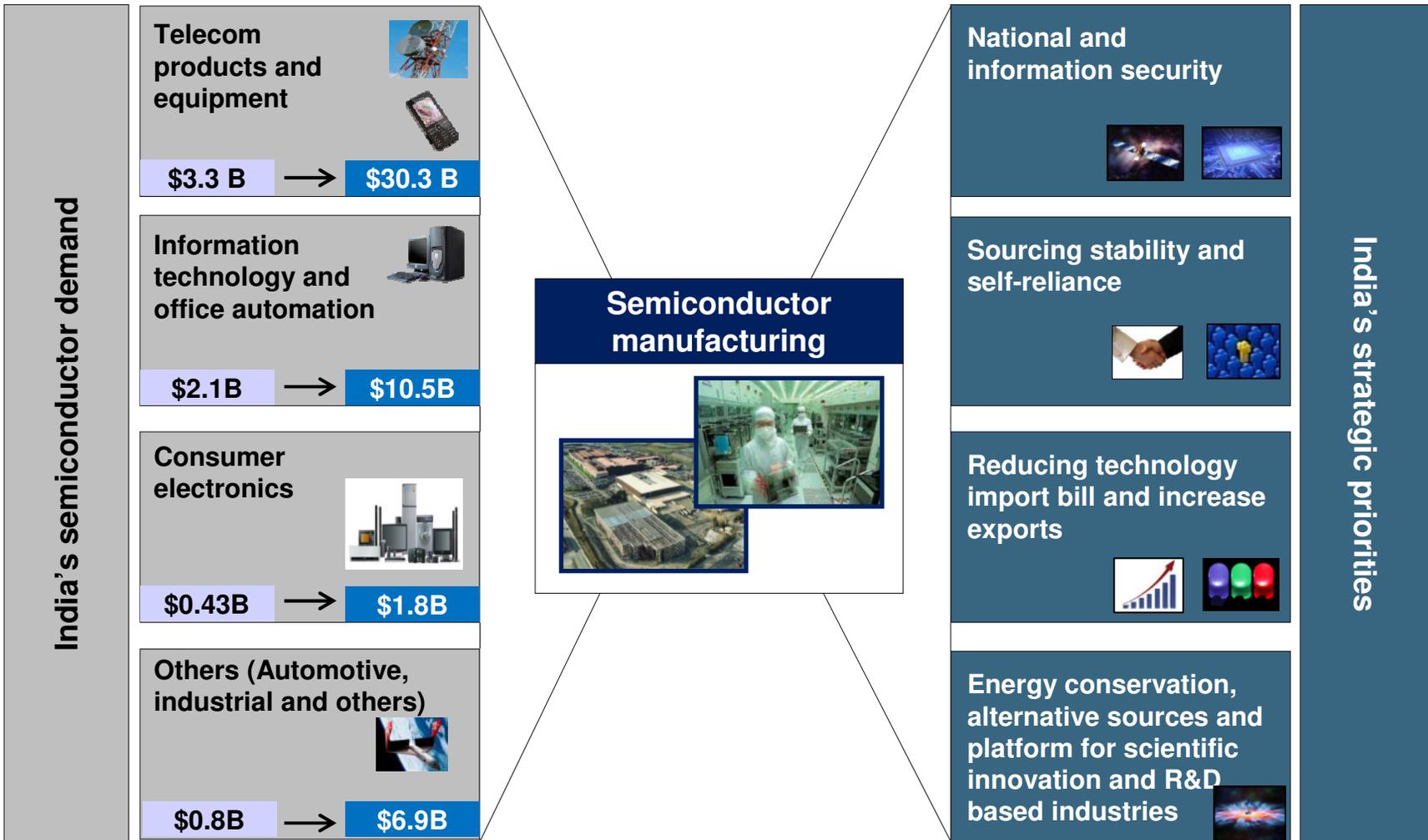


Both economic and strategic objectives provide a compelling rationale for developing semiconductor manufacturing capabilities in India

NOT EXHAUSTIVE

Economic opportunity

Strategic objectives



Source: ISA - FROST & SULLIVAN 2010 – 12 India Semiconductor Market Update

2010 semiconductor market
 2020 semiconductor market

The strategic rationale for semiconductor manufacturing rests on several key factors

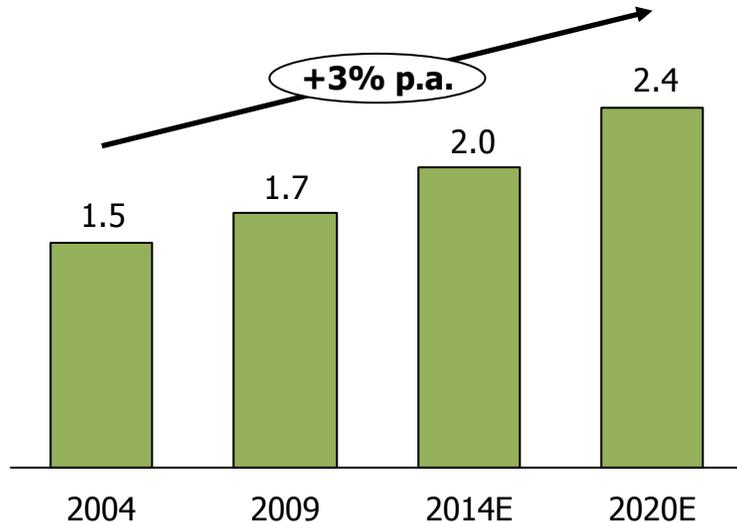
NOT EXHAUSTIVE

	Description
Reducing technology import bill and expanding exports	<ul style="list-style-type: none">• Import burden: Current import bill is around \$7 billion per year for semiconductors and increasing at 22% rate. By 2020, India's semiconductor import bill could reach \$45-70 billion
Sourcing stability and self-reliance	<ul style="list-style-type: none">• Sourcing security: Significant dependence upon imports from China, Taiwan, Japan, US and other countries leaves India exposed to disruptions in supply due to natural disasters, trade disputes, etc.• Self-reliance: India has around \$7 billion in annual semiconductor demand that can be met through local production
National and information security	<ul style="list-style-type: none">• National security and protection of critical information: Semiconductor design and chip specification play an influential role in security standards and policies, particularly for military and government applications
Energy conservation and alternative sources	<ul style="list-style-type: none">• Energy/electricity reduction: Semiconductor development curve, "Moore's law" effect increases compute power while reducing energy usage of semiconductor-powered devices• Alternative energy generation: solar, LED and logic can be applied to alternative energy industry (solar photovoltaic cells, solar LED lanterns, smart grid technology)
Platform for scientific innovation and R&D based industries	<ul style="list-style-type: none">• Fit with existing infrastructure : Complementary with the thriving semiconductor design industry• Innovation in new industries: Opportunity to build expertise in several technology end markets e.g. alternative energy industry (solar photovoltaic cells, smart grid technology)• Scientific innovation: Increases patent and publication per research \$ invested more commercialization opportunities• Infrastructure development: Opportunity to develop semiconductor ecosystem as well as infrastructure improvement for other businesses to thrive

India is playing a major and increasing role in the global electronics industry, which motivates the development of a local semiconductor manufacturing base

The global electronics industry is very large and growing. India's electronics industry is already important and growing at 7x the global rate

Global production of electronics, 2004-2020E
\$ Trillions



India market currently represents ~2% of the global production of electronics and is expected to grow at 22% per year

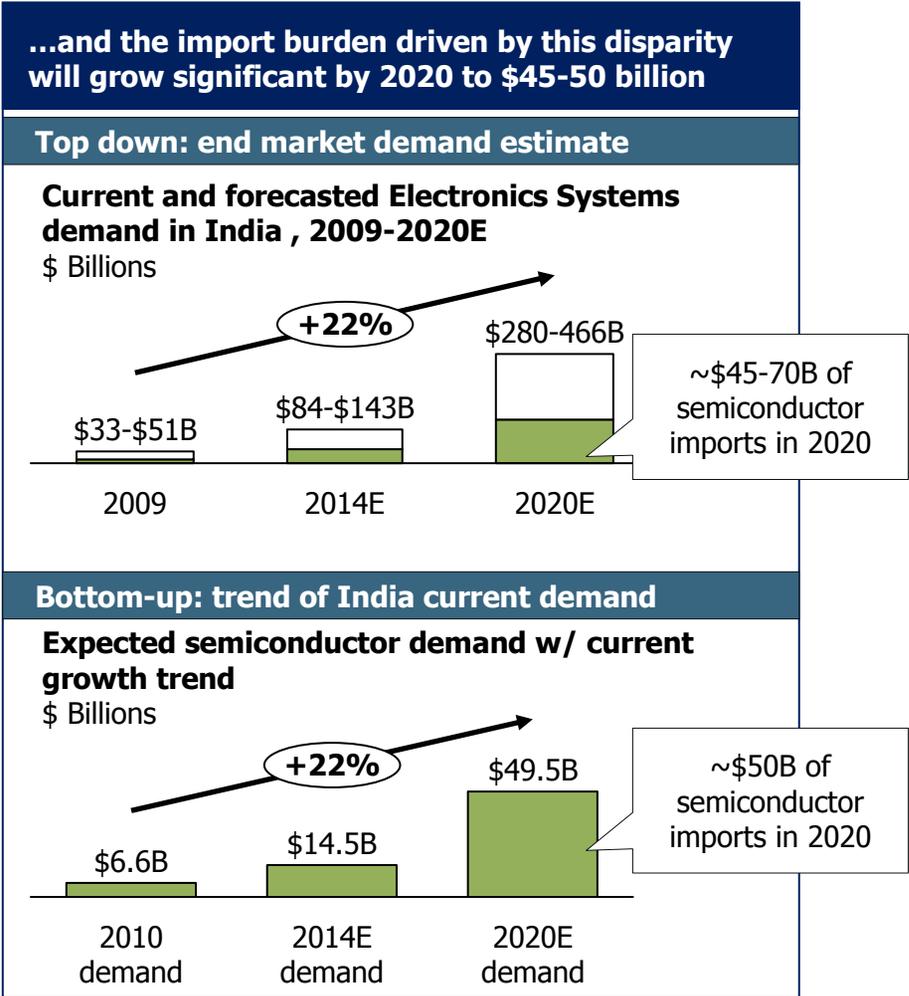
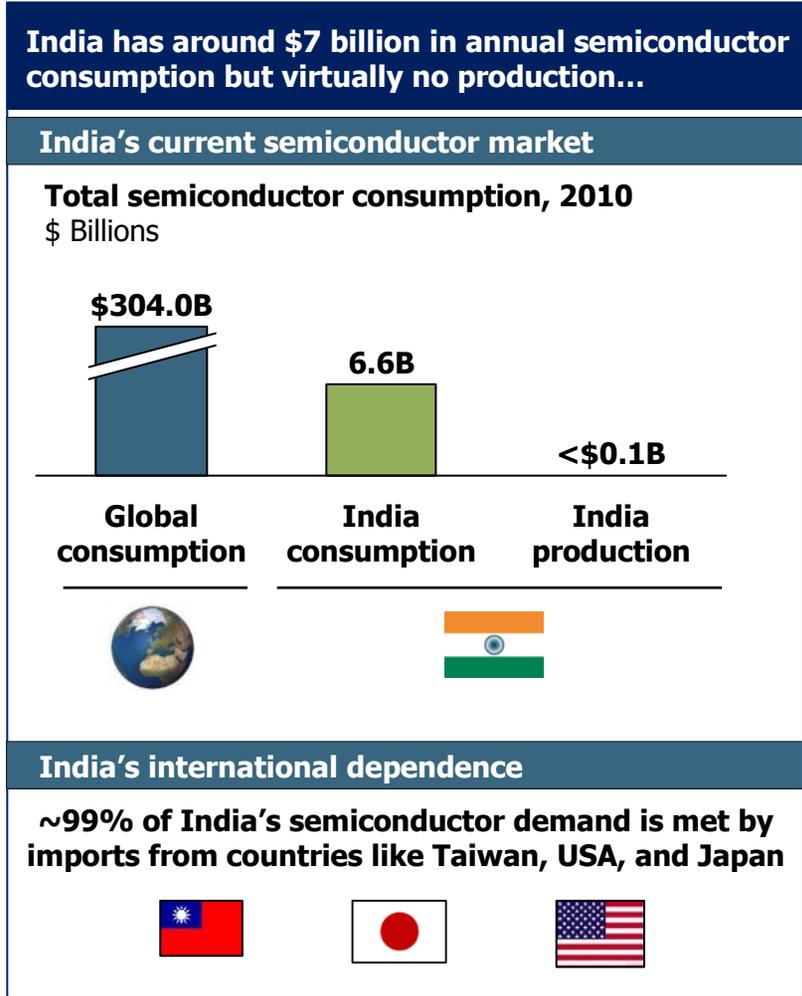
Semiconductor content in electronics products is very significant, which implies very strong demand for semiconductor manufacturing in India

Semiconductor content in some common electronic systems

Selected electronic systems	Semiconductor content (%)
Set Top Box	35%
Digital camera	34%
DVD Player	30%
Multimedia PC	28%
Telecom equipment	28%
Smartphone	26%
HDTV	25%
PC	23%
LAN	15%
CD Player	13%
Car radio	8%
Video camera	8%
Color TV	3%

Source: ESDM DOIT report; IC Economics report

The economic rationale for semiconductor manufacturing is driven by a significant and growing local demand, mostly satisfied by imports

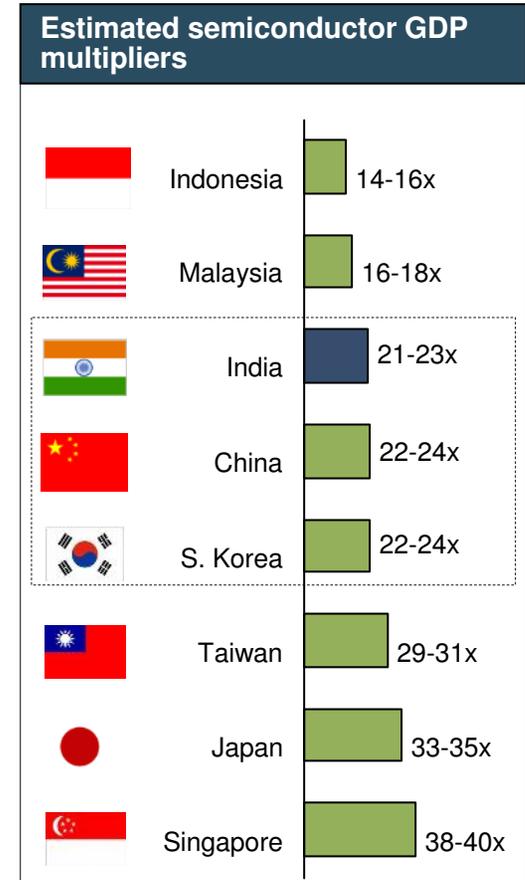
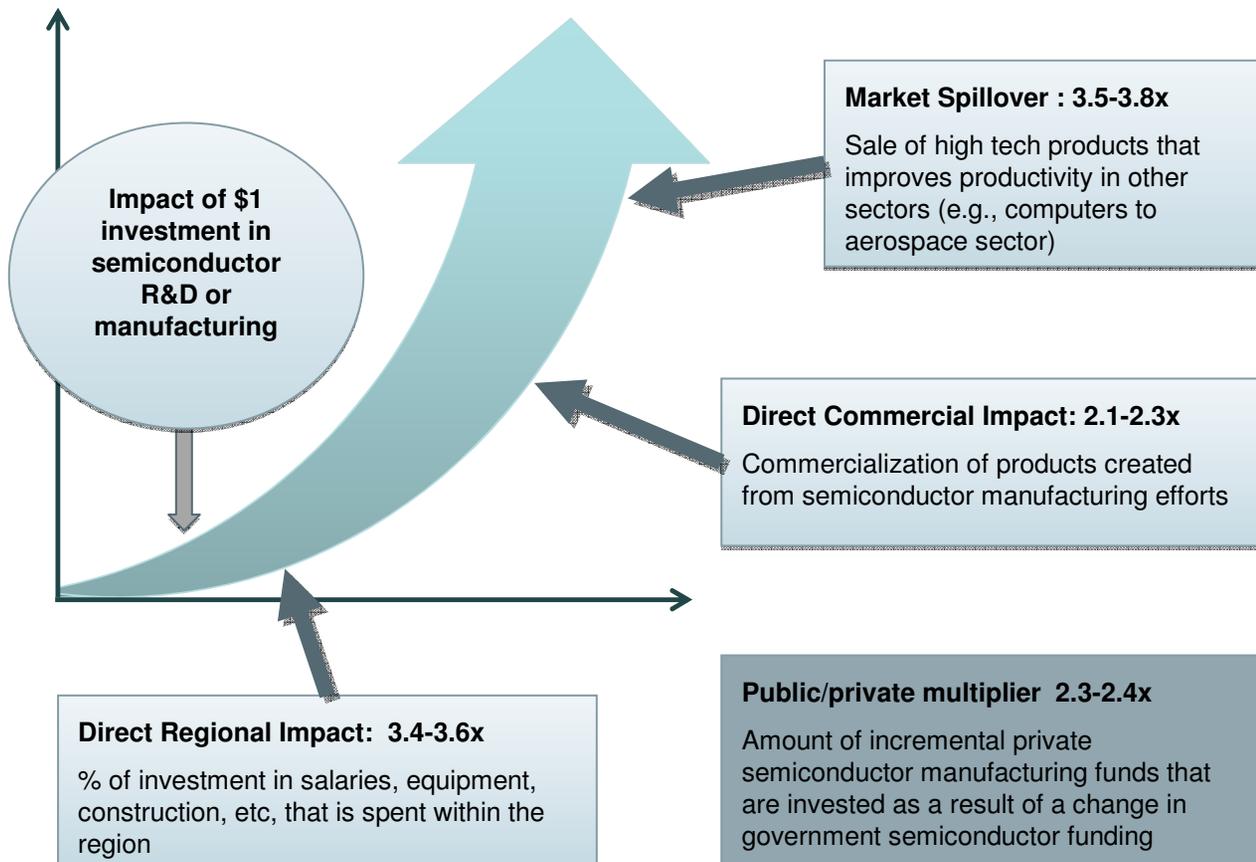


Source: ISA - FROST & SULLIVAN 2010 – 12 India Semiconductor Market Update; ESDM DOIT report

The rationale for semiconductor investment is strengthened by India's significant semiconductor GDP multiplier

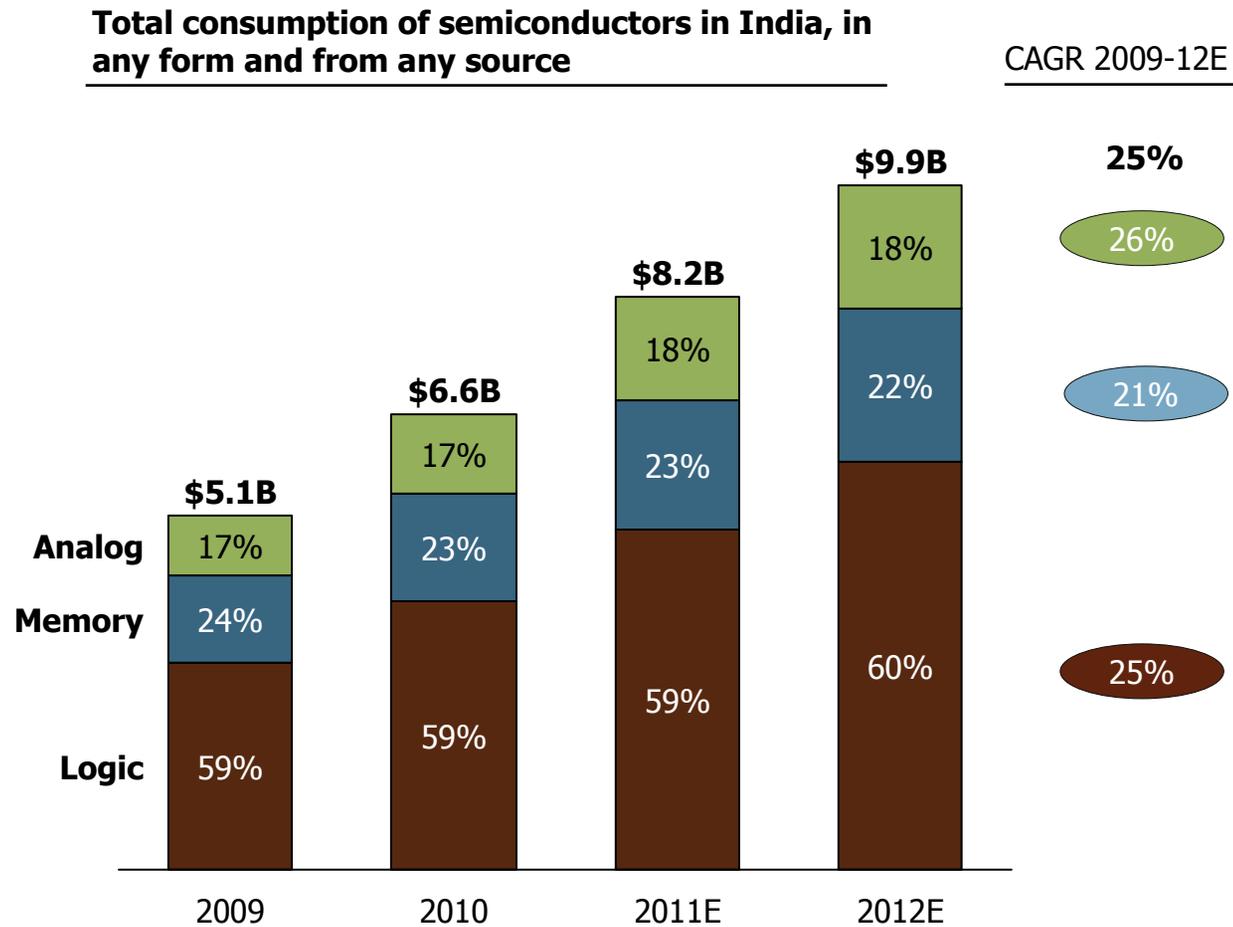
PRELIMINARY

GDP multiplier effect of technology investment



Total India GDP multiplier effect for technology investment is 21-23x

India's demand for semiconductors cuts across all industry focus areas but is greatest for logic



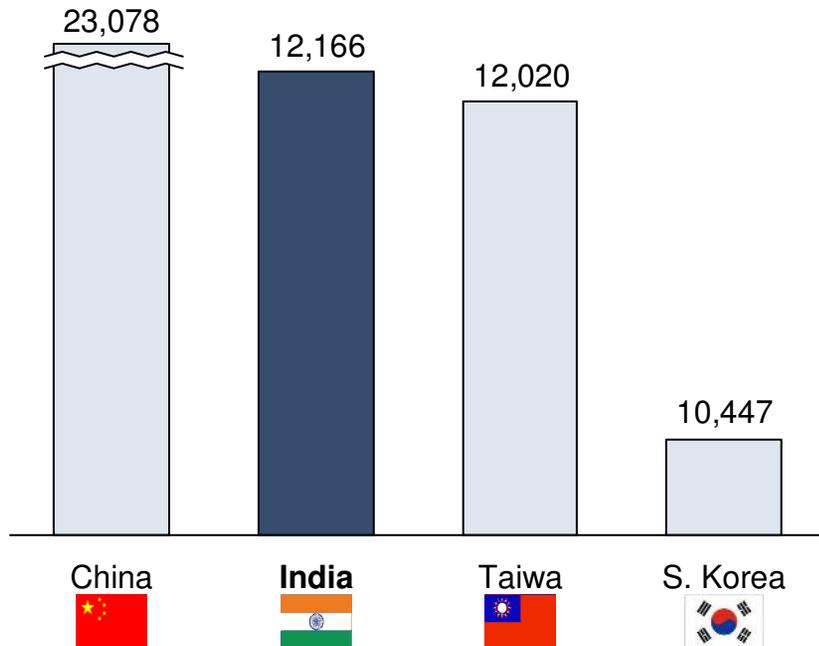
Sources: ISA – Frost & Sullivan 2010 – 12, India Semiconductor Market Update

India has a significant human capital presence already in semiconductors, but is currently focused on design

PRELIMINARY

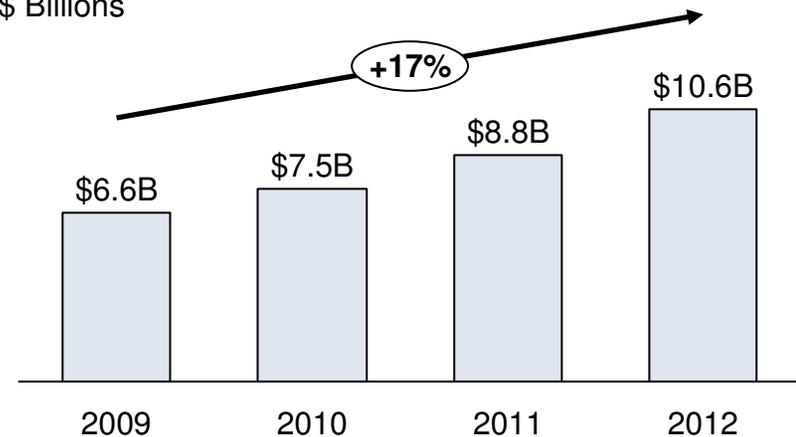
India has a potentially large highly skilled scientific and engineering expat population

Asian recipients of U.S. Science and Engineering doctorates, by field and country/economy of origin¹
Number of doctorates between 1985 and 2005



With a large talent pool of 200K+ design engineers, India semiconductor design market has grown at 28% over the last 7 years

India semiconductor design revenues
\$ Billions



“More generally, each year, around **three million science and engineering graduates** are added to the workforce, much higher than in China and other developed countries. The quality of Indian graduates is also ranked better than in China, Vietnam as well as Japan and the US on certain parameters”

– ESDM DoIT report, 2010

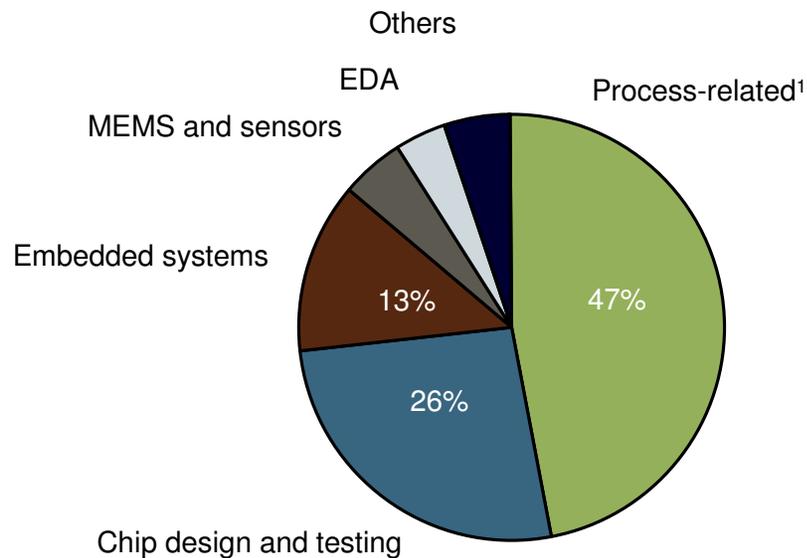
¹ Includes all engineering, computer science and physical sciences

Source: ESDM DoIT report 2010, NSF, Study on semiconductor design embedded software and services industry

Despite its design focus, India also has significant human capital competencies in semiconductor manufacturing

Majority (~50%) of India's semiconductor research publications are process-related

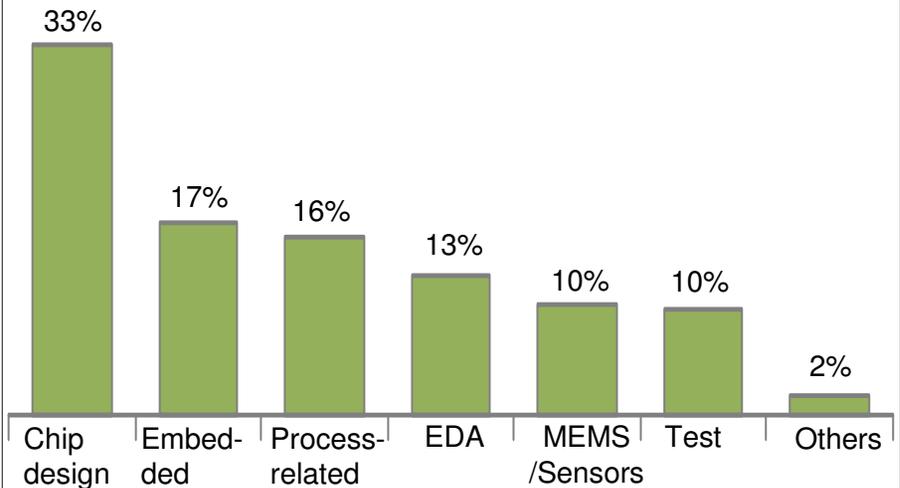
Research publications, by topic
Percent of total



¹ Research related to characterization, fabrication and modeling

Indian institutes/universities focus their research across the entire semiconductor value chain

Semiconductor research activities across Indian institutes by value chain
Percent of total research projects



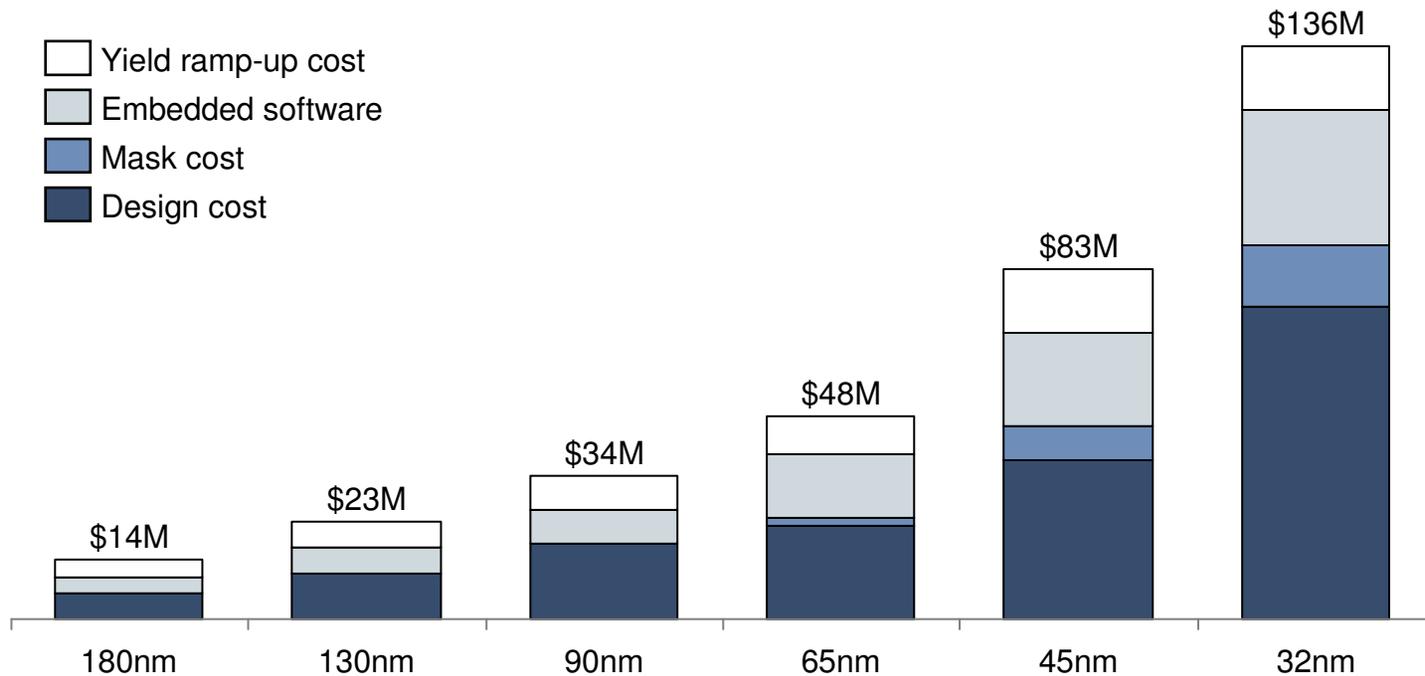
Source: IBM Global location trends, ISA-Evalueserve study 2008

The interaction between design and manufacturing is becoming increasingly complex, increasing costs and providing an escalating manufacturability pain point for potential technology partners

Design, mask, software and ramp-up costs are increasing due to a closer interaction between design and manufacturing

\$ Millions

- Yield ramp-up cost
- Embedded software
- Mask cost
- Design cost



Increasing design and IP qualification costs are reducing the demand for new semiconductor nodes and creating barriers to switching between foundries



Thank You





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