Ice Protection Systems

A Parametric Analysis for Return on Investment

Presented by: **Matthew Wadham-Gagnon, eng.**

At WinterWind 2014

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Cold Climate Global Market

Globally 11,5 GW currently installed in moderate to severe icing
19,5 GW expected by 2017 (BTM World Market Update)

Assuming: 5% AEP loss due to icing without IPS, 30% utilisation factor, 100$/MWh:

$150M/yr lossed due to icing in 2012
$255M/yr lossed due to icing by 2017

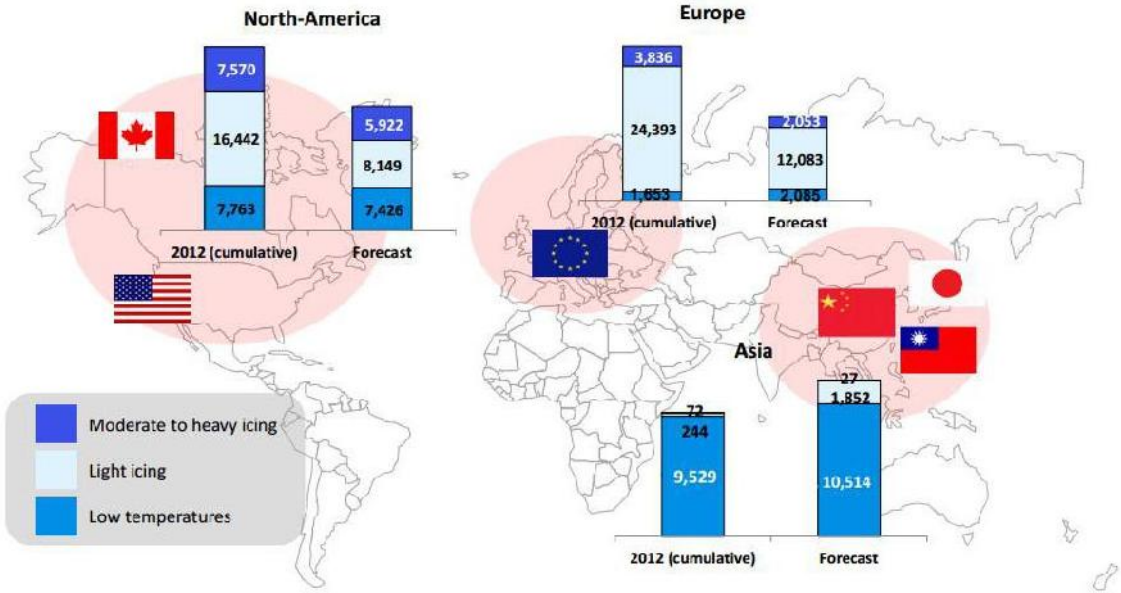
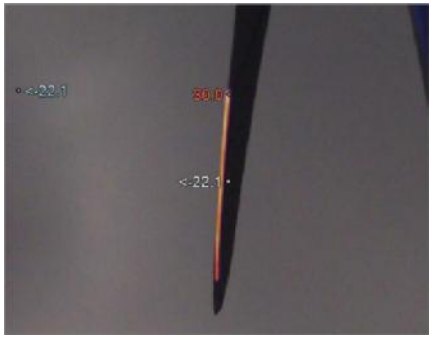


Image source: BTM World Market Update 2012, Navigant Research, 2013

Ice protection systems (IPS)

- Active systems
  - Examples: hot air, microwave pulse, integrated or retro-fit électrical resistance heaters



Repower, Winterwind 2013

- Passive systems
  - Examples: icephobic materials, nanotechnologies, black blades

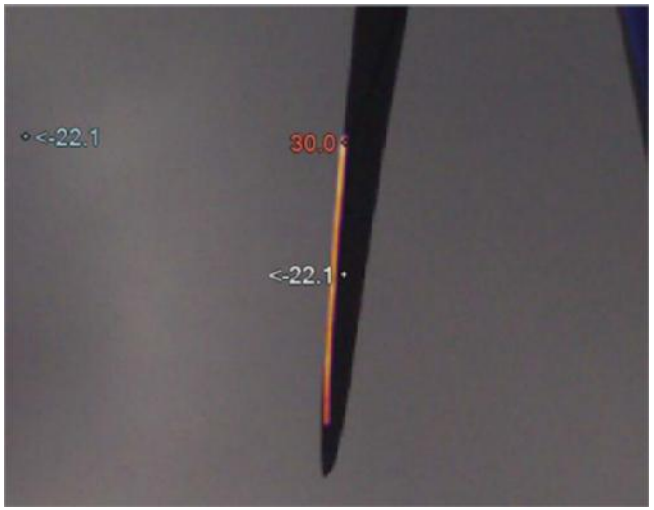
www.balconnette.co.uk

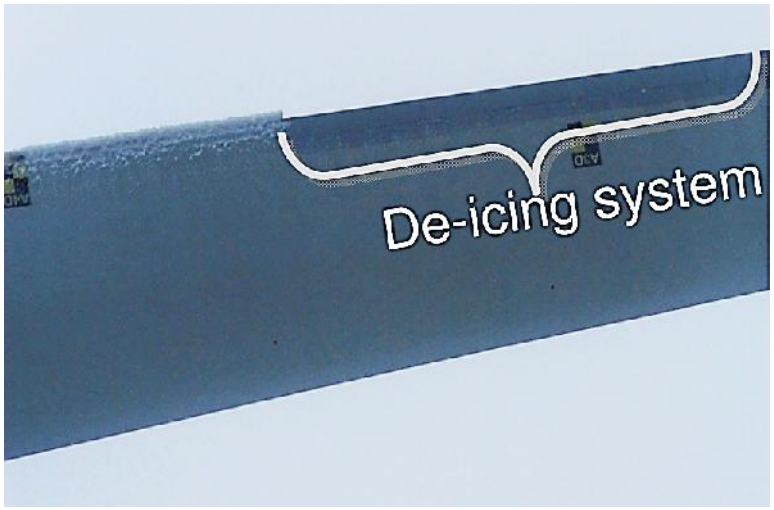
- Other solutions
  - Examples: Helicopters, rope access

www.alpug.ch

IPS related activities at the TechnoCentre

- Assessment of a thermoelectrically heated foil prototype
  - In collaboration with REpower Systems
  - Performance validation



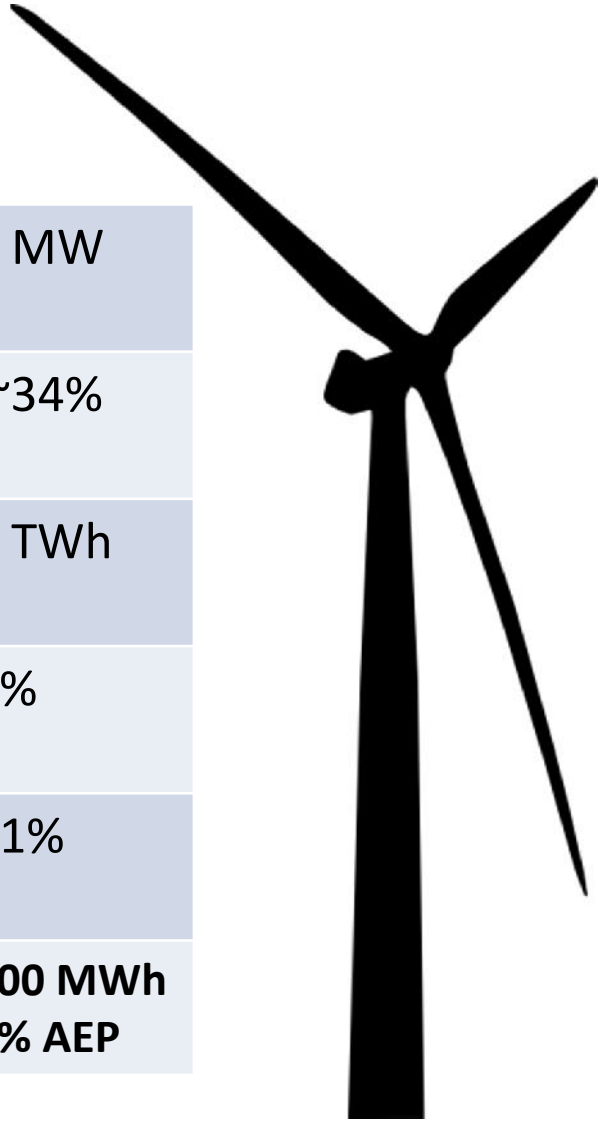


- Performance validation of passive systems

Expected Energy Lost due to icing

Generic (Realistic) Example

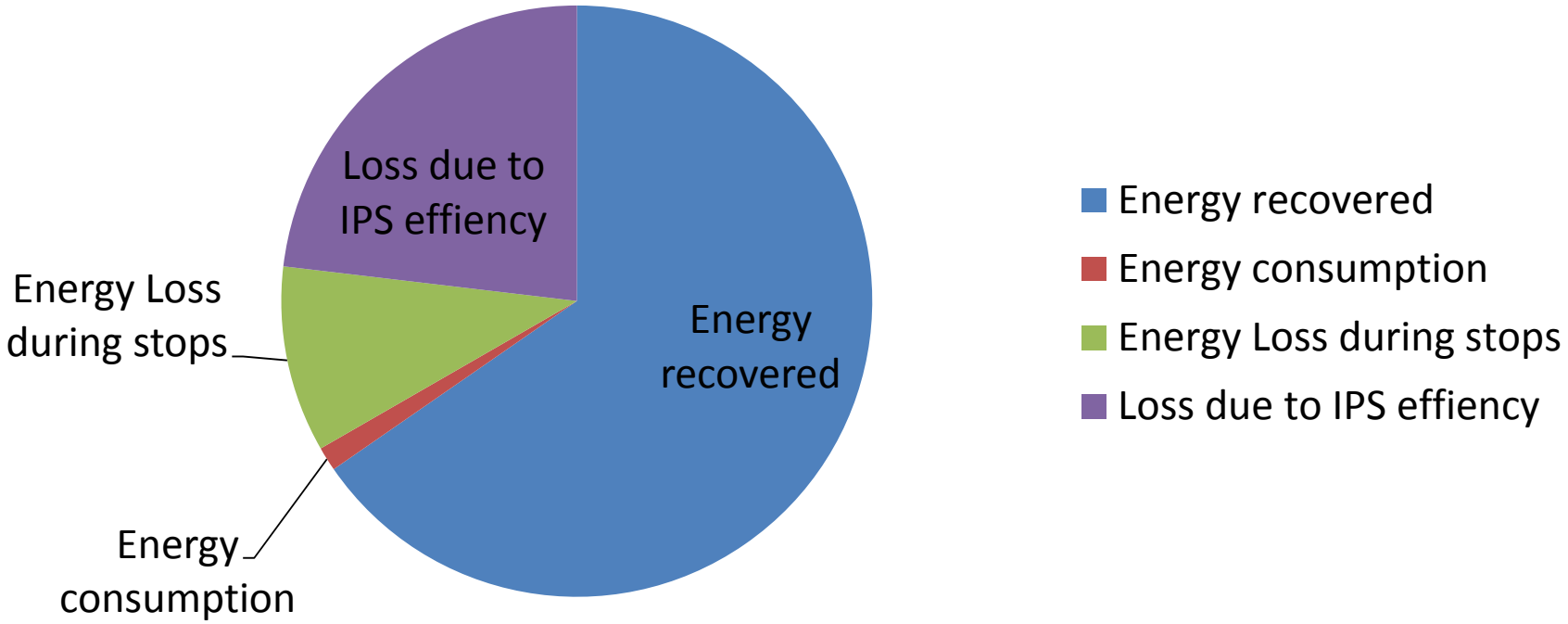
Turbine Rated Power	2 MW
Estimated Utilisation Factor (UF)	~34%
Annual Energy Production (AEP):	6 TWh
Meteorological Icing (% of year)	6%
Instrumental Icing (% of year)	11%
Expected loss due to icing with no IPS	**300 MWh 5% AEP**



Energy Recovered with IPS

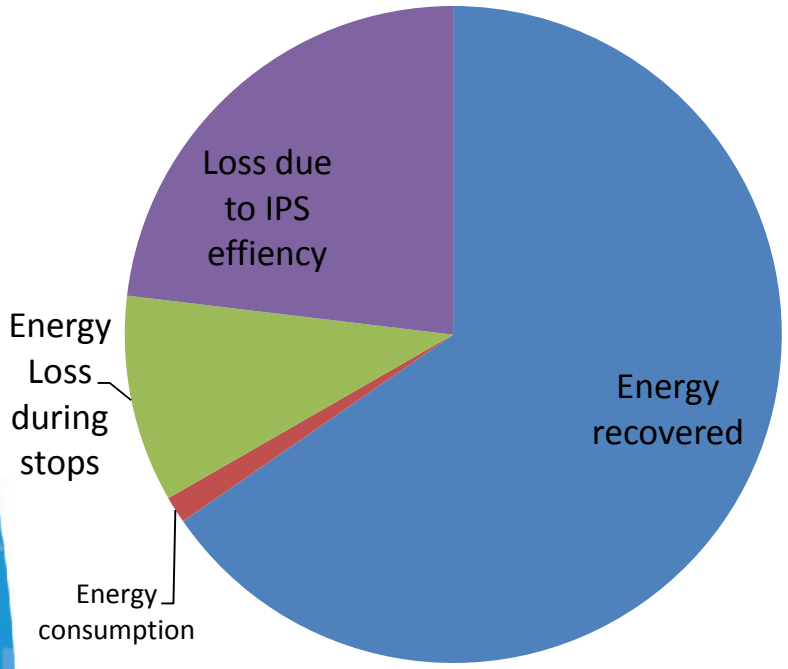
Generic (Realistic) Example continued:

Of the 300 MWh of energy available to recover

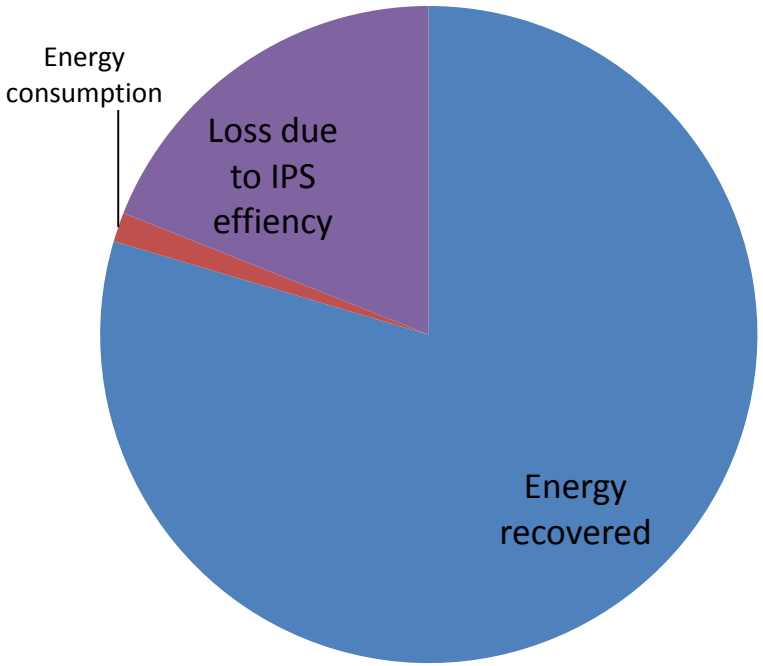


Energy Recovered with IPS

IPS "A"

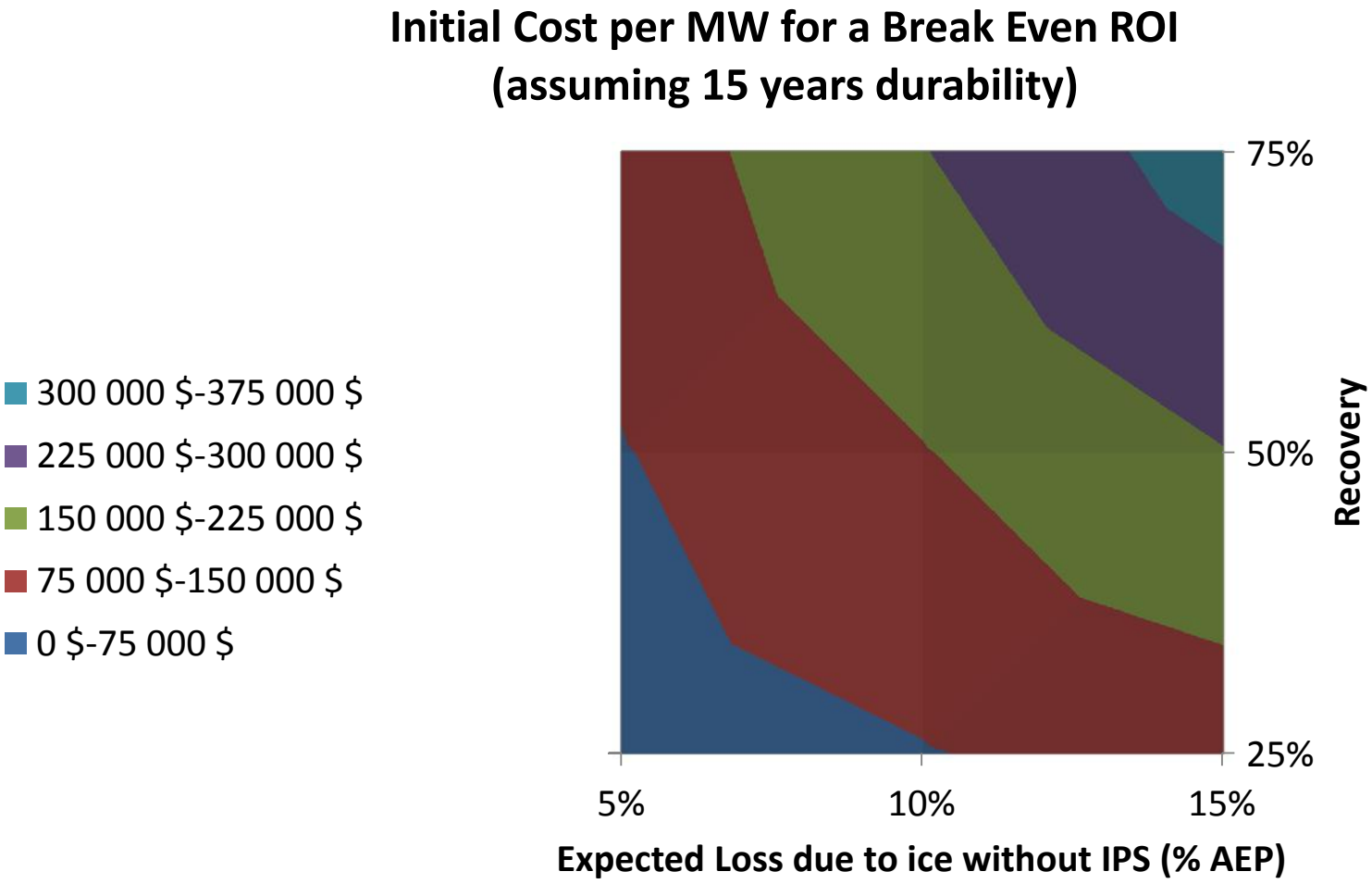


IPS "B"

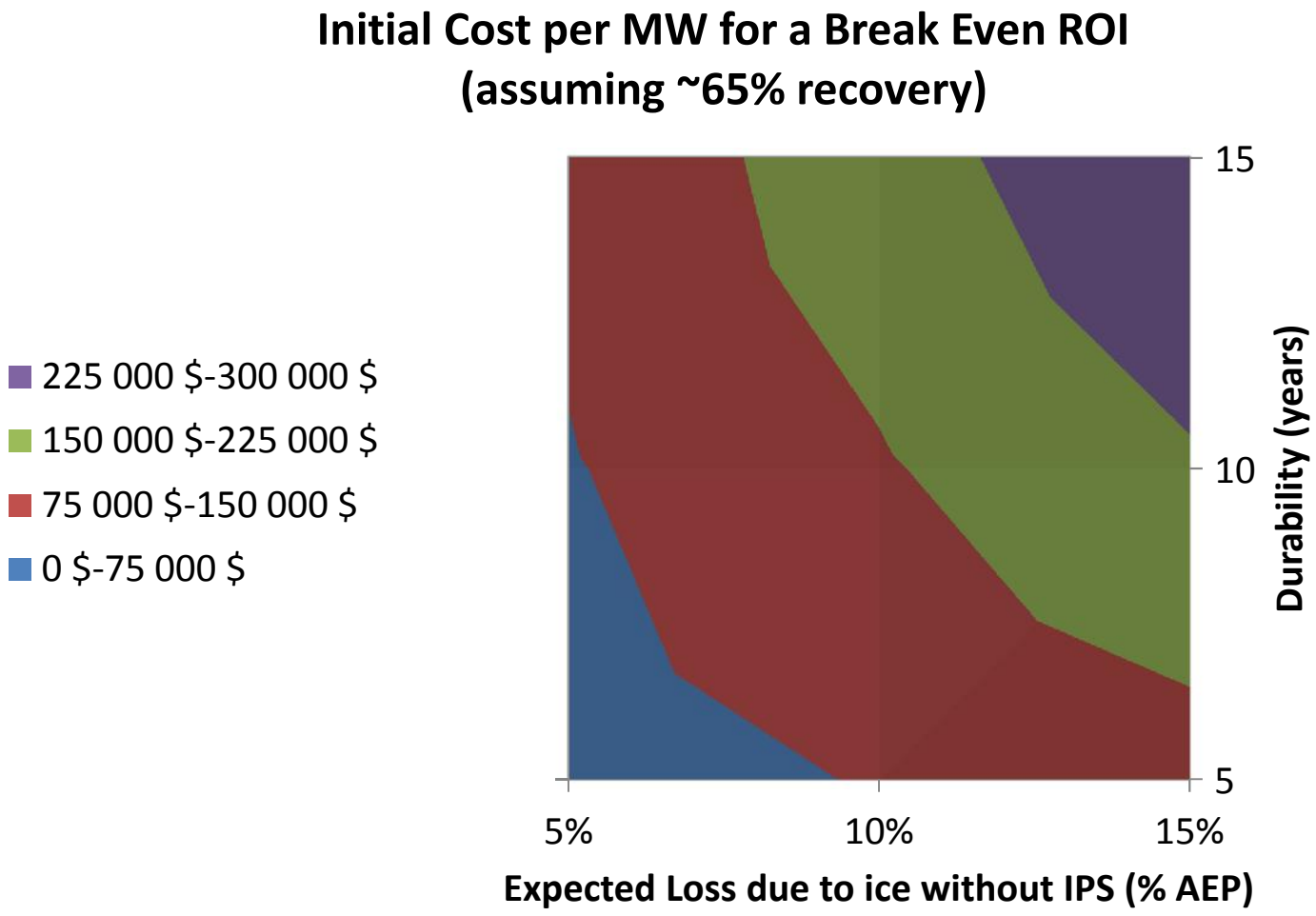


IPS “A”	IPS “B”
If LOWER initial cost	If HIGHER initial cost
Which IPS provides highest RETURN ON INVESTMENT???	

Recovery & site severity



Durability & site severity



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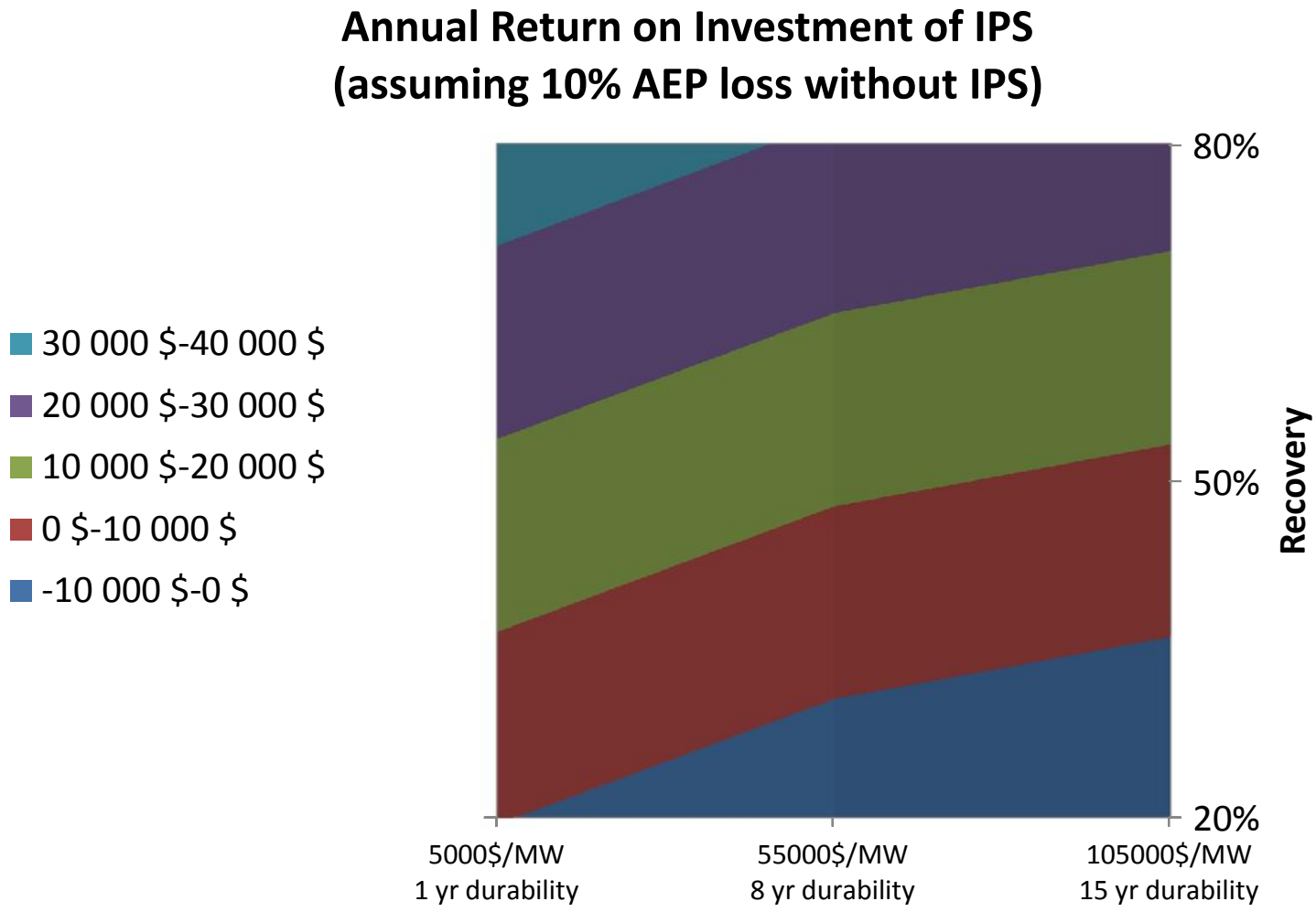
Return on Investment



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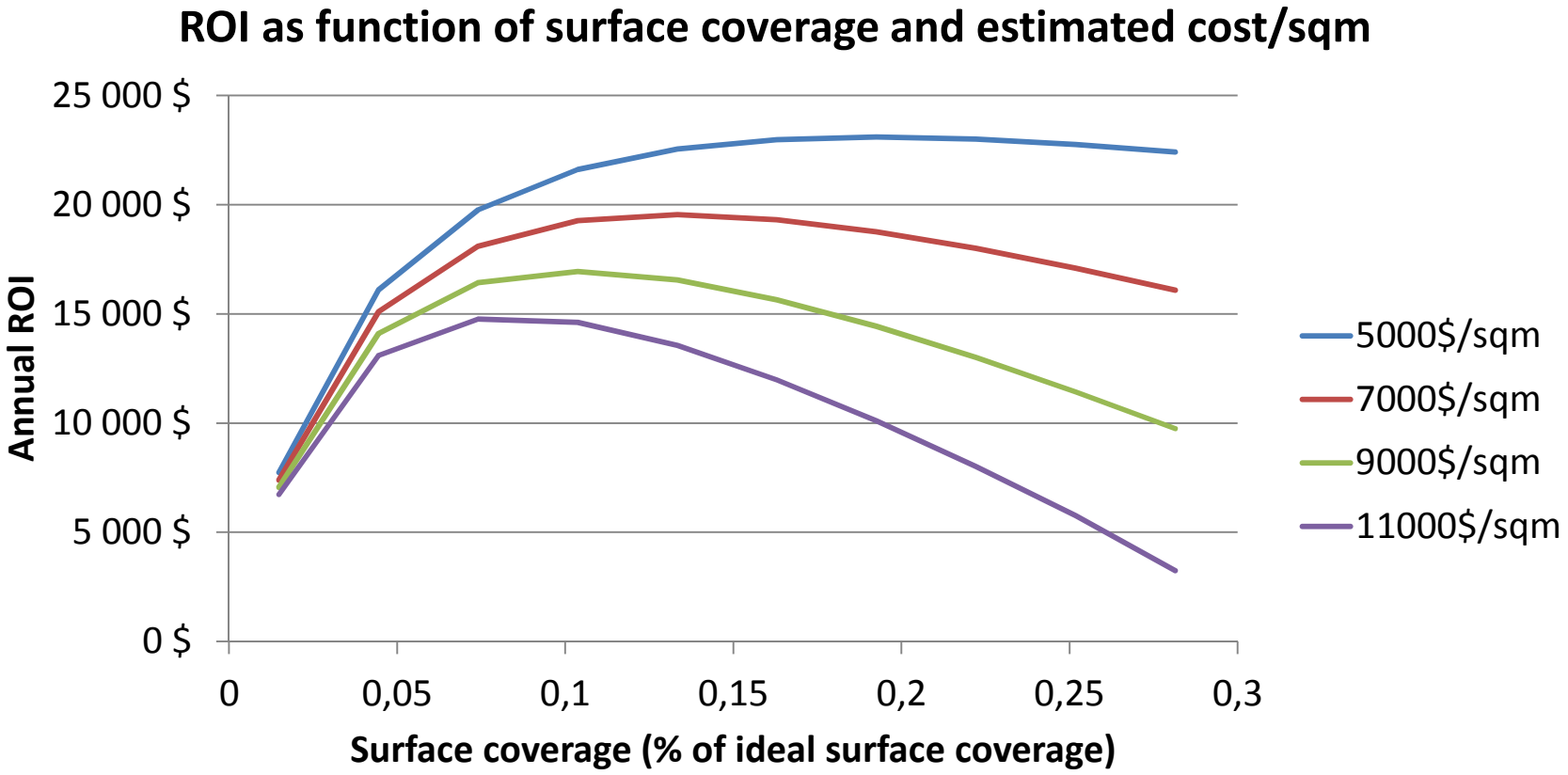
Surface Coverage of an active IPS



Assumptions:

10% AEP estimated loss due to ice without IPS

Fixed installation costs

Recovery varies as a function of coverage

Conclusions

- Return on investment depends on recovery, cost and durability of IPS
- A low cost and low recovery IPS can provide equivalent of higher ROI to a high cost high recovery IPS
- More surface coverage ≠ more ROI

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Thank you

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