RETSCreen Expert
Introduction to Energy Performance Analysis

IEA Training

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1. INTRODUCTION:
1.1 RETSCREEN SOFTWARE

- **RETScreen Clean Energy Project Analysis Software** is a unique decision support tool
- Developed with the contribution of numerous experts from government, industry, and academia.
- The software can be used worldwide to evaluate the energy production and savings, costs, emission reductions, financial viability and risk for various types of Renewable-energy and Energy-efficient Technologies.
- The software (available in multiple languages) also includes product, project, hydrology and climate databases
- A detailed user manual, and a case study based college/university-level training course
- Recent Development: RETScreen Plus, RETScreen Clean Energy Policy Toolkit, RETScreen Expert tool RETScreen EnMS, based on ISO 50001

1.2 LATEST INFORMATION ON RETScreen

- Users in more than 220 countries
- More than1000 new users every week
- Over 300 universities and colleges active
- http://www.retscreen.net/ang/news.php
- Energy Efficiency projects evaluation for buildings, residential, commercial and industrial,
- **More than 4700 data recording stations in collaboration with NASA**

- Integrated energy efficiency and cogeneration energy systems

- **Project data base including templates, case studies and user defined projects**.

RETScreen Clean Energy Analysis

- The RETScreen International Clean Energy Project Analysis Software:
- Is a leading tool
- Aimed at facilitating pre-feasibility and feasibility analysis of clean energy technologies.
- The core of the tool consists of a standardized and integrated project analysis
- Software which can be used worldwide to evaluate the energy production, life-cycle costs
- Each model also includes integrated product, cost and weather
- databases and a detailed online user manual,
- Help to dramatically reduce the time and cost associated with preparing pre-feasibility studies.
- The RETScreen Software is perhaps the quickest and easiest tool for the estimation of the viability of a potential clean energy project.

2.1 DEFINITION

Clean Energy Technologies

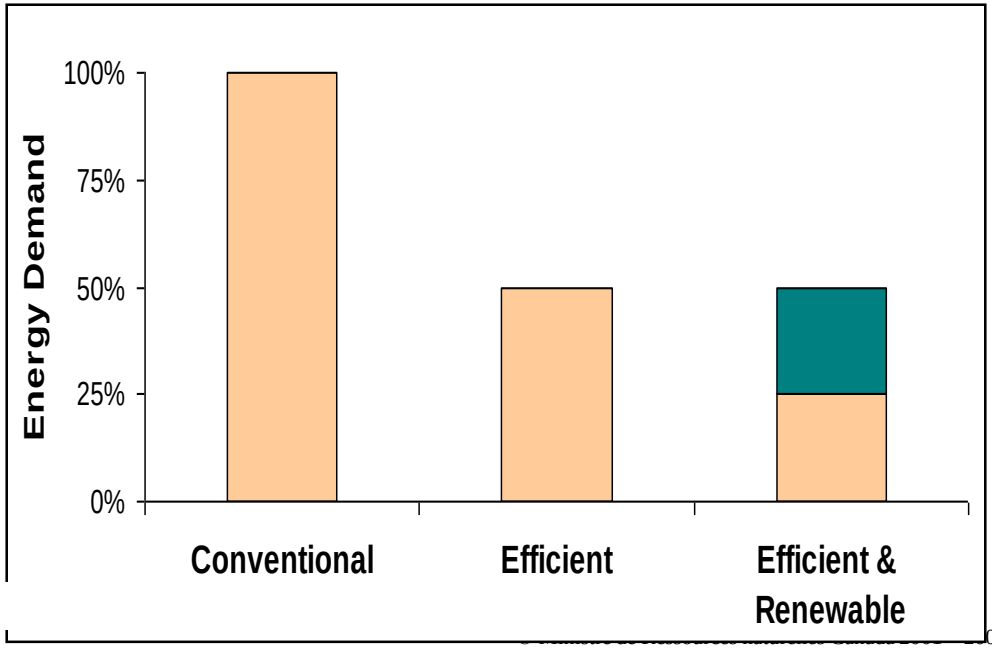
Energy Efficiency

- Using less energy resources to meet the same energy needs

Renewable Energy

- Using non-depleting natural resources to meet energy needs

Super Insulated Passive Solar Home



2.2 Renewable Technologies

Renewable Technologies

- Wind turbines
- Hydroelectric
- Geothermal power
- Solar photovoltaics
- Solar thermal power
- Ocean current power
- Tidal power
- Wave power

Photovoltaï c Central gridl, Bavière, Allemagne

2.4 The Type of fuels

Combustible Fuels

- Fossil fuels: coal, diesel, natural gas, propane, oil, etc.
- Biomass: bio-diesel, ethanol, bagasse, wood, bark, coconut fibre, straw, hemp, peat, willow, switch grass, etc.
- Waste: tires, landfill gas, food waste, forest residue, coffee refuse, Christmas trees, poultry litter, packaging waste, etc.
- Hydrogen

Renewable Energy "Fuels"

- Sunshine, wind, waves, tides, geothermal, water, etc.

FINANCIAL FEASIBILITY INDICATORS

- ***Debt payments***

Debt payments are a constant stream of regular payments that last for a fixed number ofyears (known as the debt term).

- ***Internal rate of return (IRR) and return on investment (ROI)***
- The internal rate of return *IRR is the discount rate that causes the Net Present* Value (NPV) of the project to be zero.

- ***Simple payback***

The simple payback *SP is the number of years it takes for the cash flow (excluding* debt payments) to equal the total investment (which is equal to the sum of the debt and equity

3.1 Energy Project Implementation Process

Pre-feasibility Analysis

Feasibility Analysis

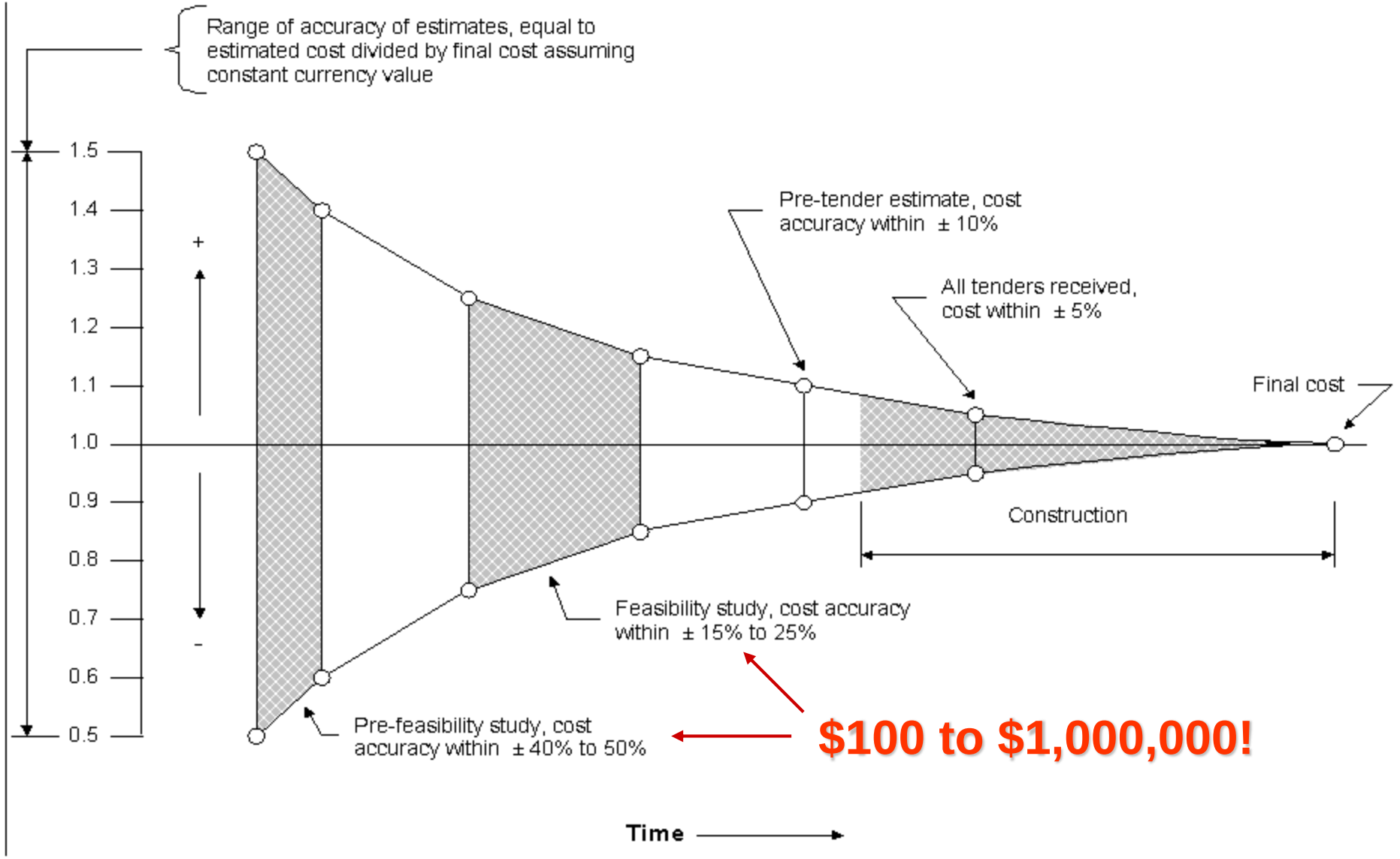
Developpement & ingénieriing

Construction & Commissioning

<u>Significant barrier</u>

Clean Energy projects not being considered up-front !

Accuracy vs. Investment Cost Dilemma



3.4 Project Viability (e.g. Wind energy project)

- **Ressource énergétique sur le site**

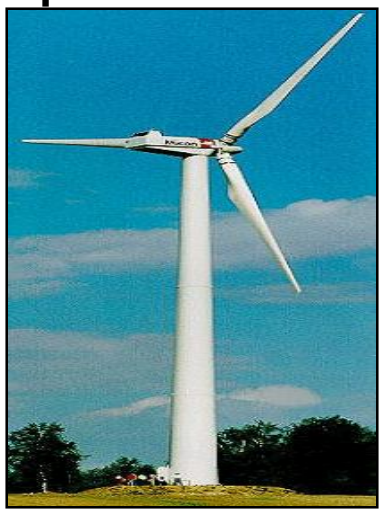
  (p. ex. : rayonnement solaire)
- **Rendement des équipements**

  (p. ex. : absorptivité solaire)
- **Coûts d'investissement du projet**

  (p. ex. : collecteurs solaires)
- **Crédits en fonction du cas de référence**

  (p. ex. : revêtement conventionnels)
- **Frais annuels et périodiques**

  (p. ex. : vandalisme)



- **Energy resource at project site**

  (e.g. solar radiation)
- **Equipment performance**

  (e.g. solar absorptivity)
- **Initial project costs**

  (e.g. solar collectors)
- **"Base case" credits**

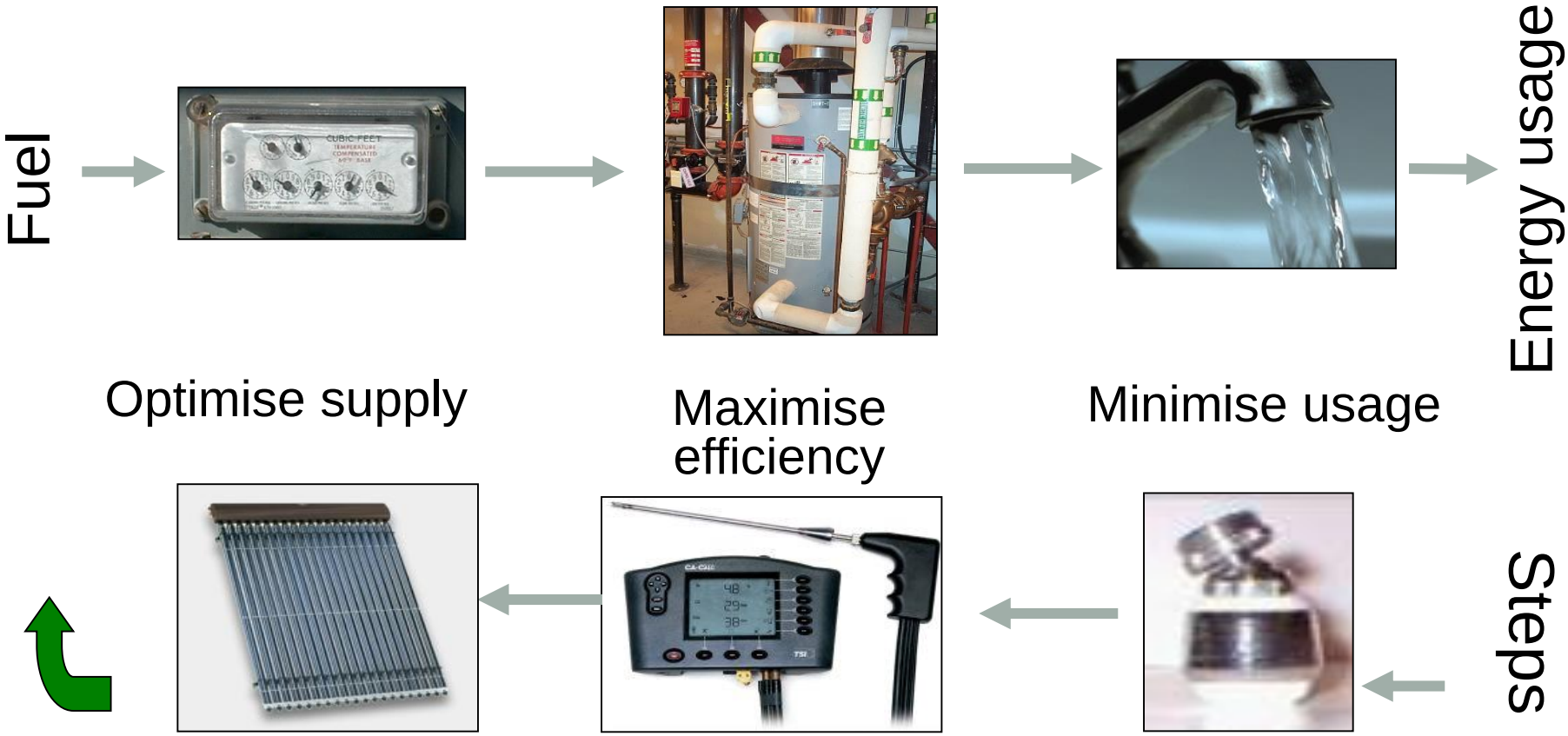
  (e.g. conventional cladding)
- **Annual & periodic costs**

  (e.g. vandalism)

3.5 Project Viability (Continued)

- **Avoided cost of energy**
  (e.g. wholesale electricity price)
- **Financing**
  (e.g. debt ratio & length, interest rate)
- **Taxes on equipment & income (or savings)**
- **Environmental characteristics of energy displaced**
  (e.g. coal, natural gas, oil, large hydro, nuclear)
- **Environmental credits and/or subsidies**
  (e.g. greenpower rates, GHG credits, grants)
- **Decision-maker's definition of cost-effective**
  (e.g. payback period, IRR, NPV, Energy production costs)

3.6 Energy Efficiency Analysis



3.7. Financial and Risk Analysis

- **Energy cost :Base case reference**

  (e.g. cost of diesel)

- **Financing**

  (e.g: debt ratio, duration, interest rate)
- **Taxes on equipment,**
- **Environemental characteristics:**

  (e.g.: diesel, natural, gaz, grid electricity)
- **Subsidies, GHG credits**
- **Sponsors decisions**

  (e.g.: simple pay back period, return on investment, net actual value, cost of energy production)

3.8 Total Cost of an Energy Generating or Consuming System

- Total cost ≠ purchase cost
- Total cost = purchase **cost**

+ *annual fuel and O&M costs*
+ *major overhaul costs*
+ *decommissioning costs*
+ *financing costs*
+ *etc.*

3.10 Key (Output) Indicators of Financial Viability

	Simple Payback	Net Present Value (NPV)	Internal Rate of Return (IRR & ROI)
Meaning	# of years to recoup additional costs from annual savings	Total value of project in today's dollars	Interest yield of project during its lifetime
Example	3 year simple payback	$1.5 million NPV	17 % IRR
Criteria	Payback < n years	Positive indicates profitable project	IRR > hurdle rate
Comment	• Misleading • Ignores financing & long-term cashflows • Use when cashflow is tight	• Good measure • User must specify discount rate	• Can be fooled when cashflow goes positive-negative-positive

3.11 Financial Analysis

- RETScreen® accounts for cashflows due to initial costs, energy savings, O&M, fuel costs, taxation, GHG and RE production credits

- RETScreen® automatically calculates important indicators of financial viability

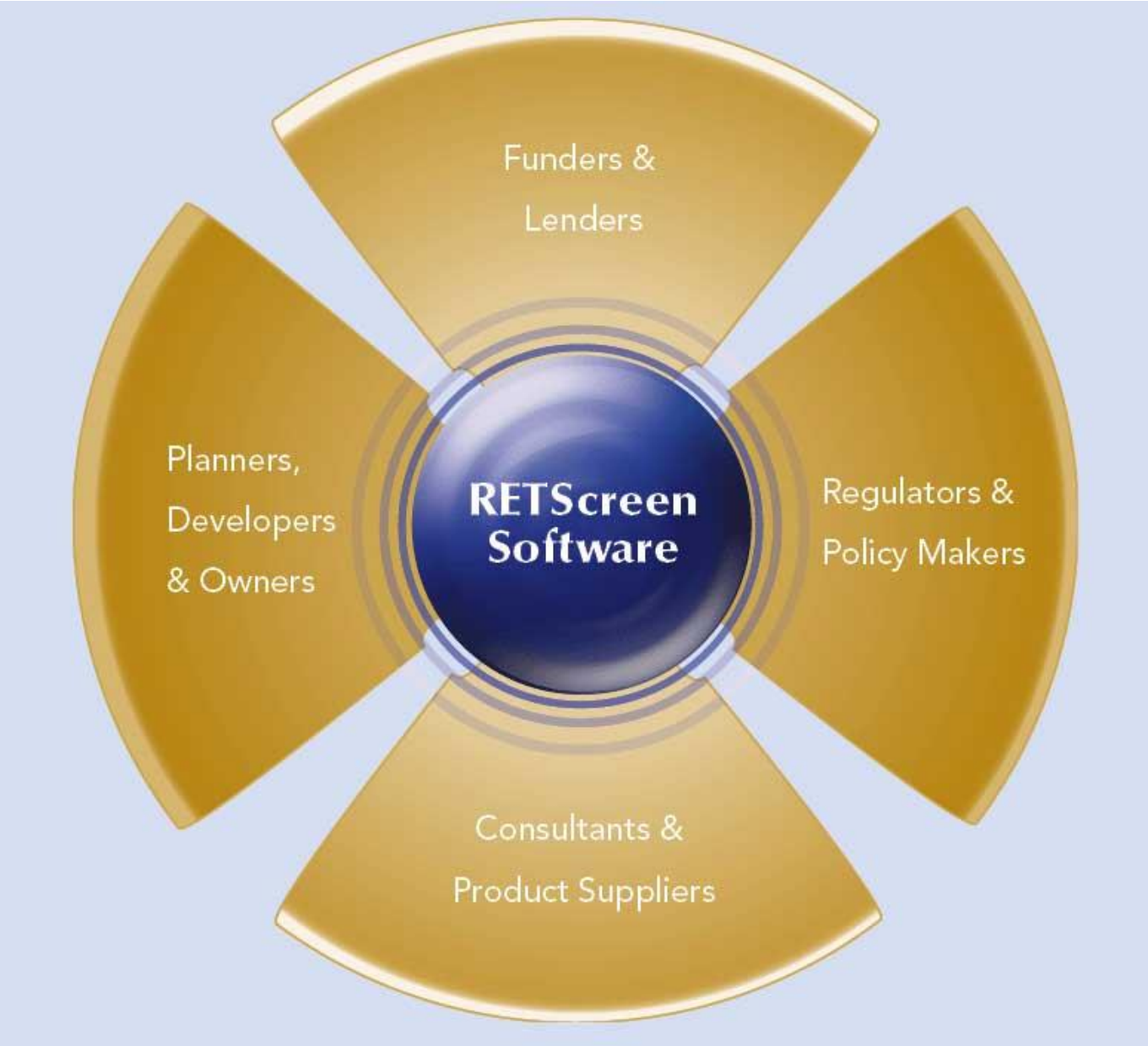
- The sensitivity of the key financial indicators to changes in the inputs can be investigated with RETScreen®

- Indicators that consider profitability over the life of the project, such as the IRR and NPV, are preferable to the simple payback method

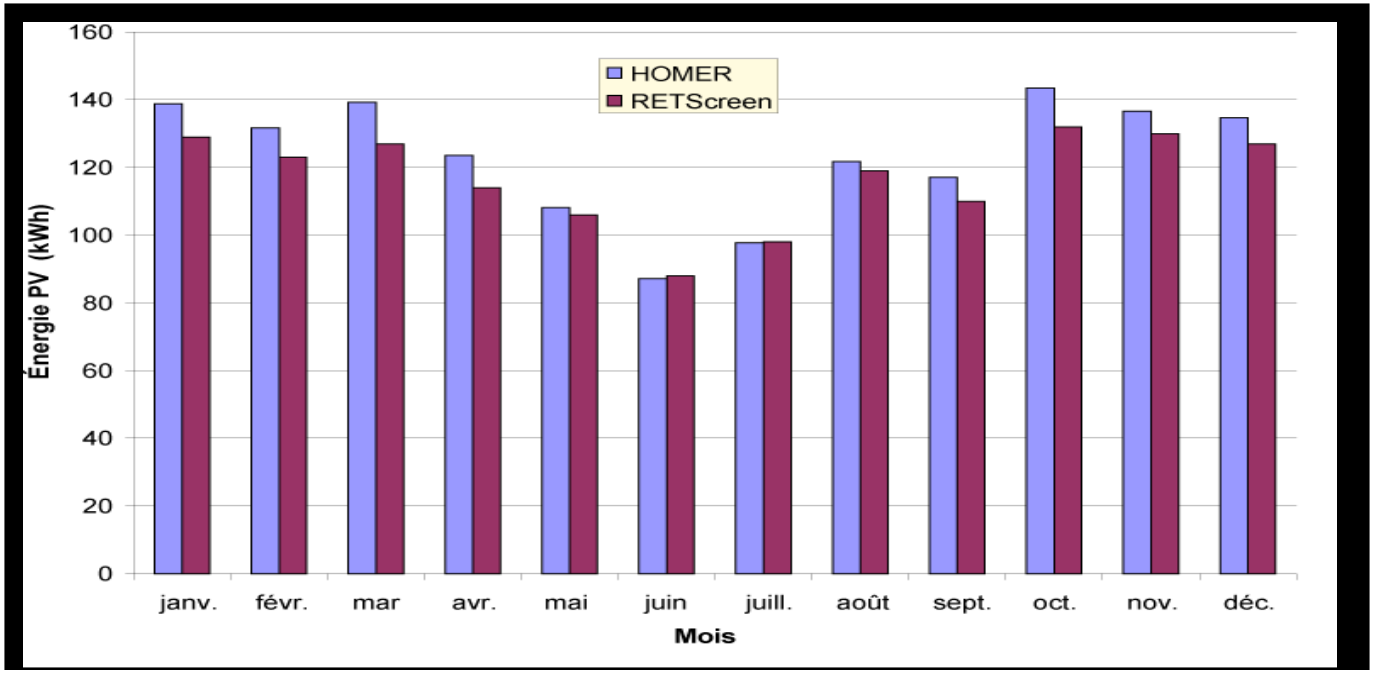
4. Why Use RETScreen®?

- Simplifies preliminary evaluations
  - Requires relatively little user input
  - Calculates key technical and financial viability indicators automatically
- Costs 1/10th the amount of other assessment methods
- Standardized procedures allow objective comparisons
- Increases potential for successful clean energy project implementation

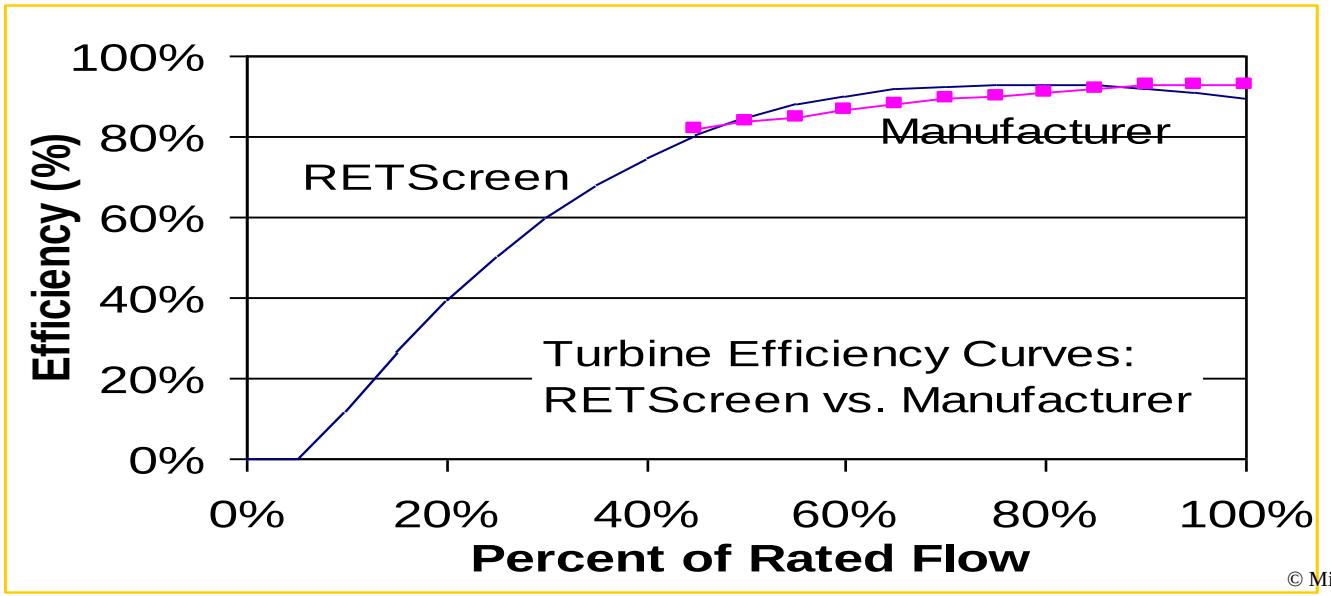
4.1 A plate-form of communication



4.2 Example Validation of the RETScreen®



Computed value of PV versus RETScreen



Modèle énergétique RETScreen - Projet de production d'électricité

ficher d'autres unités

Système de production d'électricité du cas proposé

Surcoûts à l'investissement

Technologie		Moteur à pistons		
Disponibilité	h	8,000	91.3%	
Méthode de choix du combustible		Un seul combustible		
Type de combustible		Gaz d'enfouissement		Compléter la feuille Outils
Prix du combustible	$/m³	0.000		
Moteur à pistons				
Capacité électrique	kW	1,300	$ 1,300,000	la Base de données de produits
Électricité exportée au réseau	MWh	10,400		
Fabricant				
Modèle				
Consommation spécifique	kJ/kWh	9,692		
Combustible nécessaire	GJ/h	12.6		
Prix de l'électricité exportée	$/MWh	30.00		

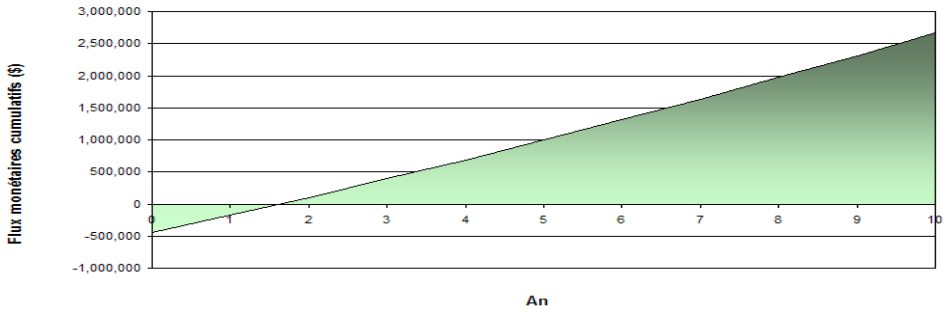
Analyse des émissions

Réseau électrique de référence (Niveau de référence)					
Pays - région	**Type de**	**Facteur d'émissions GES tCO2/MWh**	**Pertes de transport et de distribution %**	**Facteur d'émissions GES tCO2/MWh**	
Norvège	Tous les types	0.003	5.0%	0.003	
Électricité exportée au réseau	MWh	10,400	Pertes t-d	1.0%	
Émissions de GES					
Cas de référence	tCO2	41,014			
Cas proposé	tCO2	86			
Réduction annuelle brute d'émissions de GES	tCO2	40,928			
Frais de transaction pour les crédits de GES	%	0.0%			
Réduction annuelle nette d'émissions de GES	tCO2	40,928	est équivalente à	8,321	Automobiles et camions légers non utilisés
Revenu pour réduction de GES					
Crédit pour réduction de GES	$/tCO2	5.00			
Durée du crédit pour réduction de GES	an	10			
Taux d'indexation du crédit pour réduction de GES	%	2.0%			

Analyse financière

Paramètres financiers			
Taux d'inflation	%	2.0%	
Durée de vie du projet	an	10	
Ratio d'endettement	%	70%	
Taux d'intérêt sur la dette	%	7.00%	
Durée de l'emprunt	an	10	
Coûts d'investissement			
Système de production d'électricité	$	1,300,000	86.9%
Autre	$	196,500	13.1%
Total des coûts d'investissement	$	1,496,500	100.0%
Encouragements et subventions	$		0.0%
Frais annuels et paiements de la dette			
Coûts (économies) d'exploitation et entretien	$	104,000	
Coût en combustible - cas proposé	$	0	
Paiements de la dette - 10 ans	$	149,148	
	$		
Total des frais annuels et paiements de la dette	$	253,148	
Économies et revenus annuels			
Coût en combustible - cas de référence	$	0	
Revenu d'exportation d'électricité	$	312,000	
Revenu pour réduction de GES - 10 ans	$	204,637	
	$		
Total des économies et des revenus annuels	$	516,637	
Viabilité financière			
TRI avant impôt - capitaux propres	%	63.0%	
TRI avant impôt - actifs	%	15.3%	
Retour simple	an	3.6	
Retour sur les capitaux propres	an	1.6	

Graphique des flux monétaires cumulatifs



How is this calculated?

$$\text{Annual GHG emission reduction } (t\ CO_2) = \left[\text{Base case GHG emission factor } (t\ CO_2/MWh) - \text{Proposed case GHG emission factor } (t\ CO_2/MWh)\right] \times \text{End-use annual energy delivered } (MWh)$$

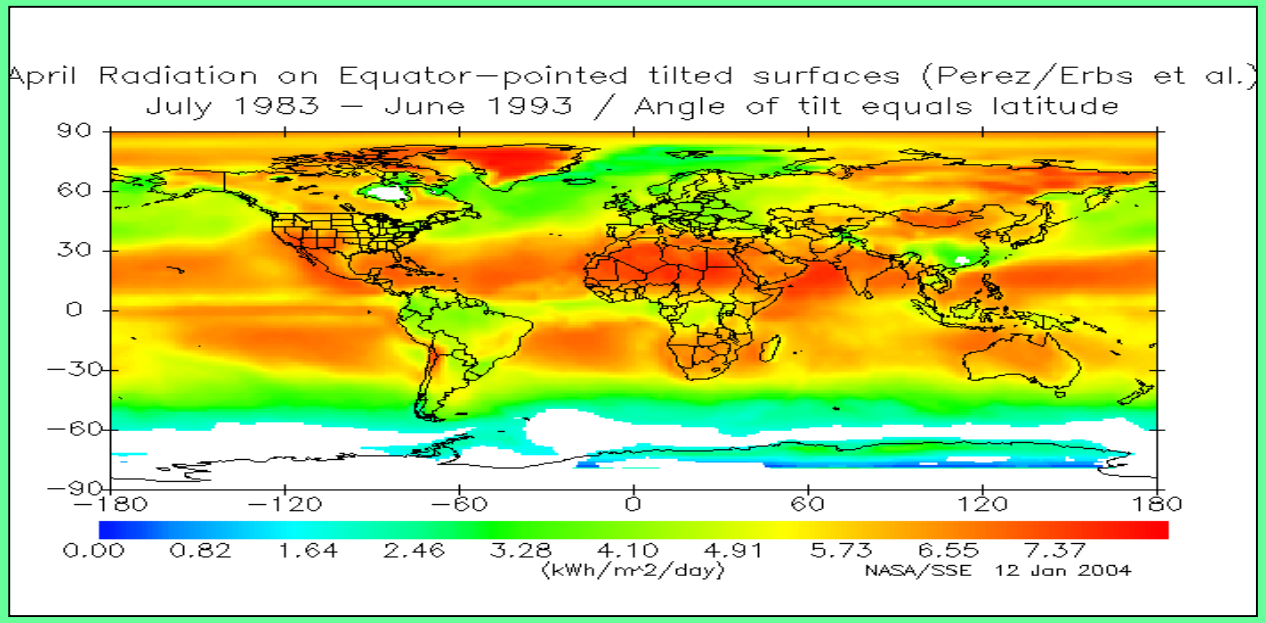
- RETScreen® adjusts the annual reduction to account for transmission & distribution losses and GHG credits transaction fees

DATA FROM NASA

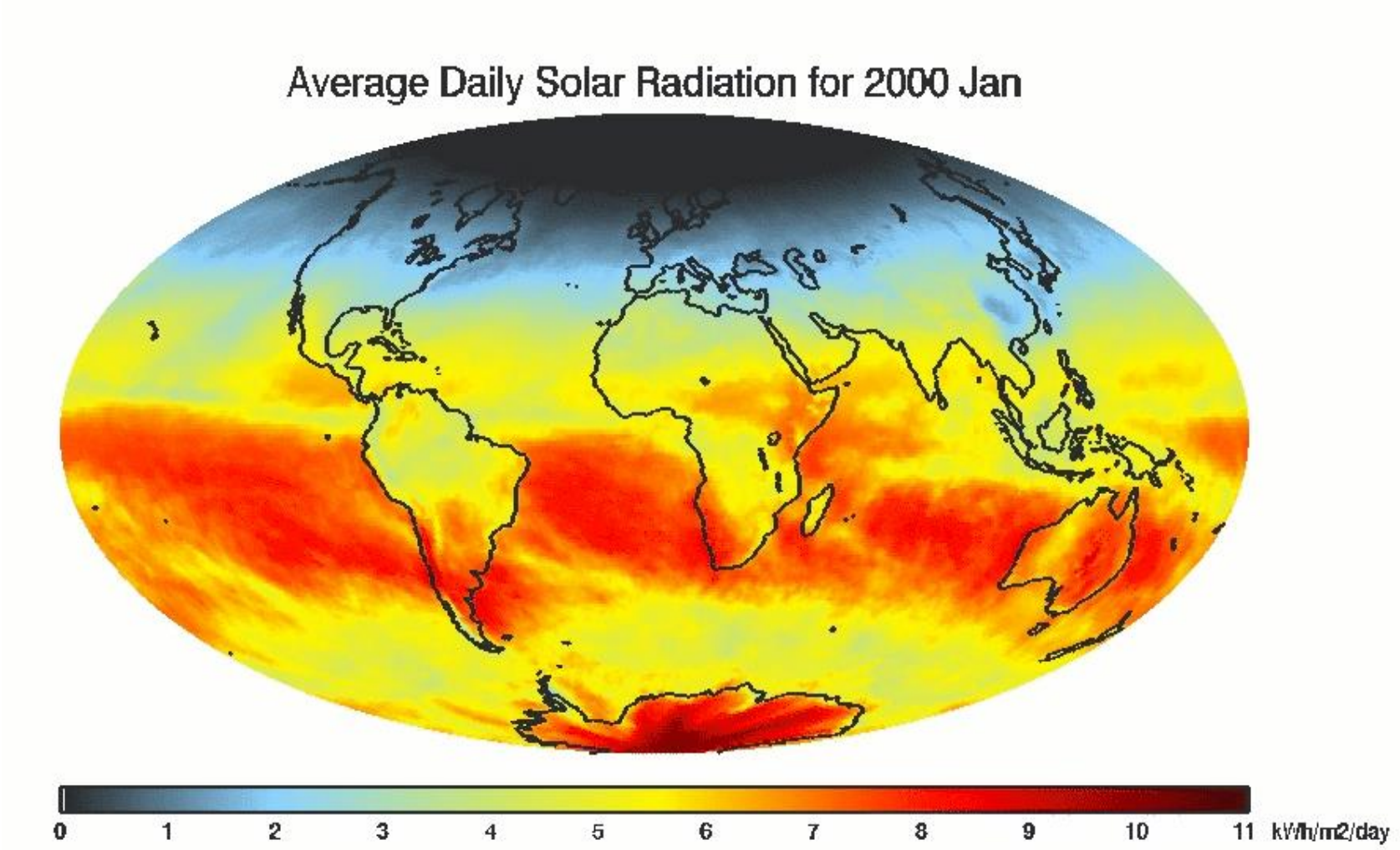
SSE Web Site

http://eosweb.larc.nasa.gov/sse/

> 200 solar and meteorology parameters; averaged from 23 years of data



NASA Observing Spacecraft for Earth System Research



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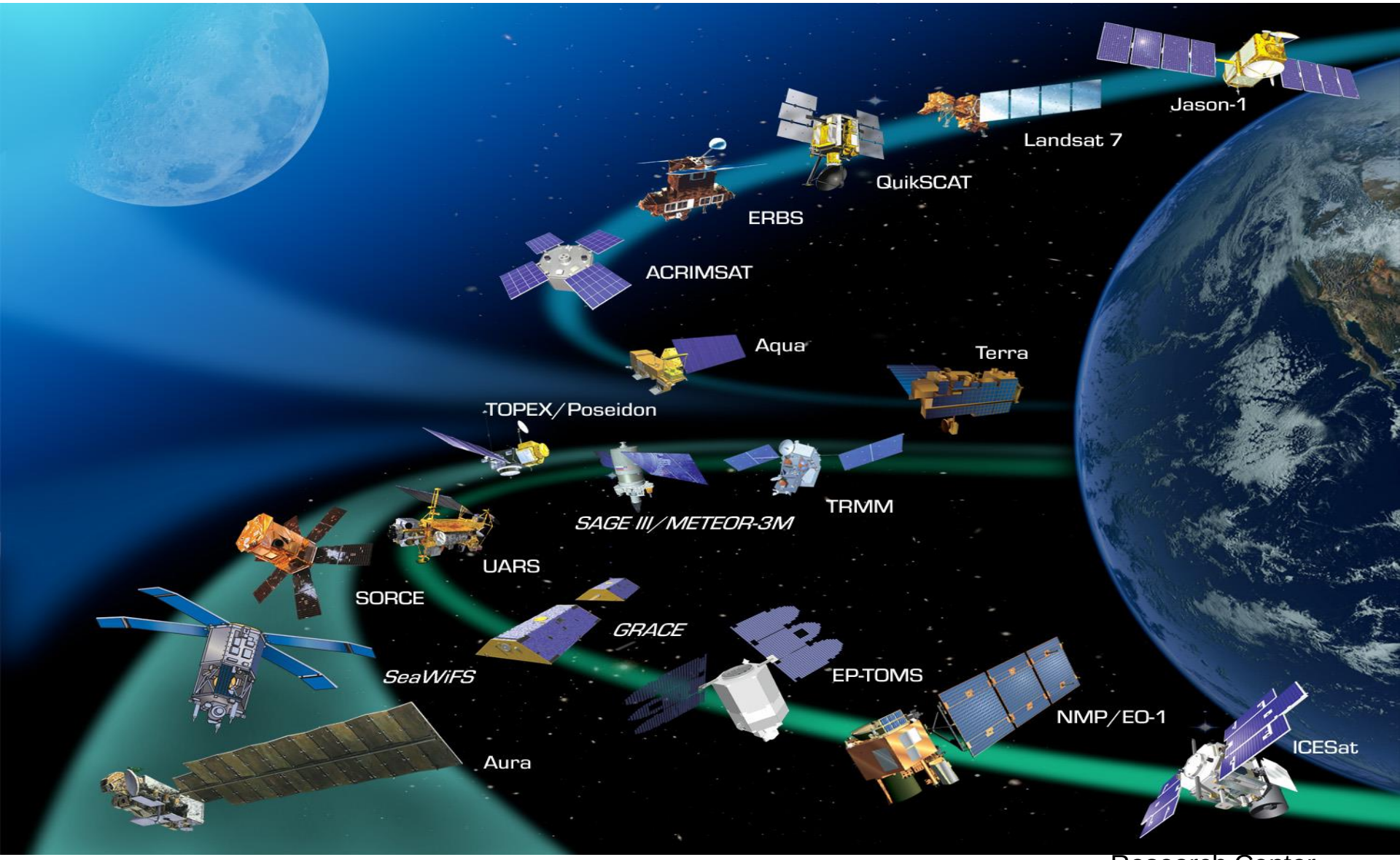

Merci