Munich RE

HYDRO POWER

Underwriting or Being Underwritten?

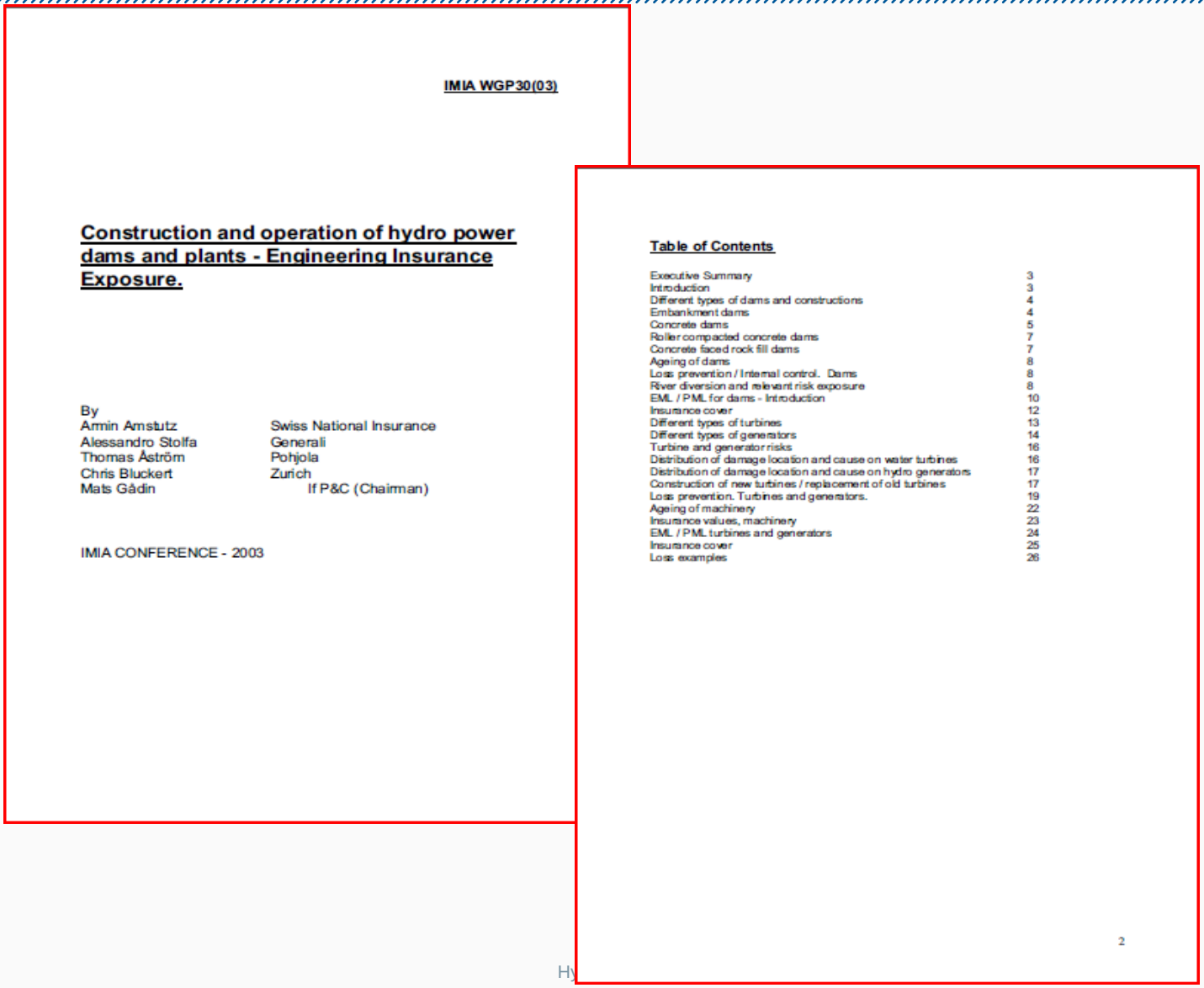
IMIA Conference

Rio, 16 September 2012

Rodrigo Belloube

Munich RE

IMIA has addressed the topic of hydro power plants in a systematic manner since 2003



IMIA WGP30(03)

Construction and operation of hydro power dams and plants - Engineering Insurance Exposure.

By

Armin Amstutz	Swiss National Insurance
Alessandro Stolfa	Generali
Thomas Åström	Pohjola
Chris Bluckert	Zurich
Mats Gådin	If P&C (Chairman)

IMIA CONFERENCE - 2003

Table of Contents

2

What we will cover today

Munich RE

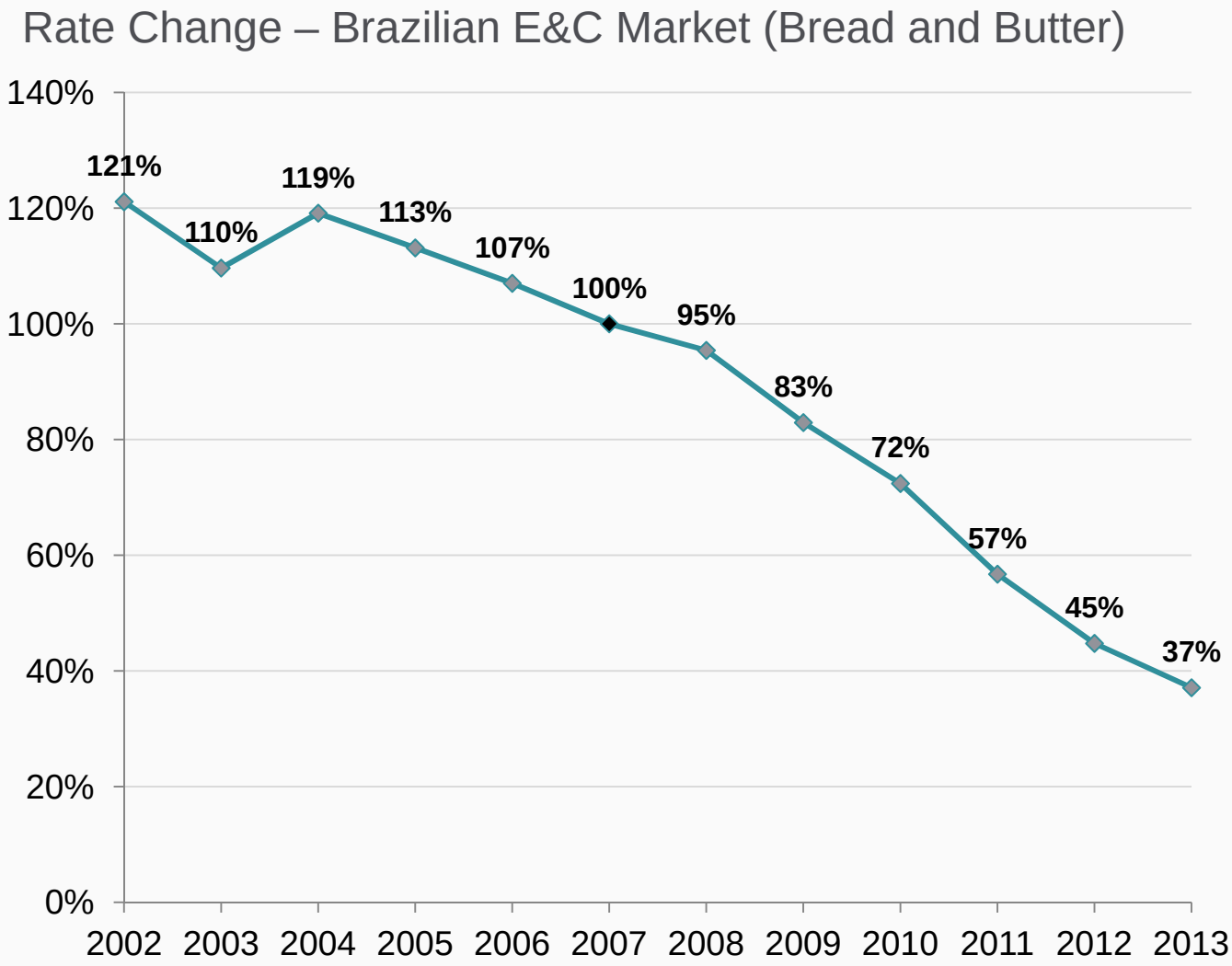
- The backdrop against which the hydro power risk has been addressed
  - Rate changes
  - How Engineering & Construction (E&C) portfolios have been managed at the primary end
  - Profitability(?) of the CAR/EAR/ALoP business
- What has caught our attention most recently when dealing with hydro power risks:
  - Quality of design, construction and supplies
  - Litigious, misinformed debate around environmental issues and its main consequences
  - Remoteness of endeavours and the resulting challenges in respect of logistics
  - Management of labour force and the relationship with unions
  - Increasingly ampler scope for ALoP
  - Inadequacy of wordings based on Common Law and other foreign legal frameworks
  - Debris removal as set out by Susep

Backdrop

Carriers focusing on plain-vanilla accounts

are now pricing their books at roughly 30% the level of 10 years ago

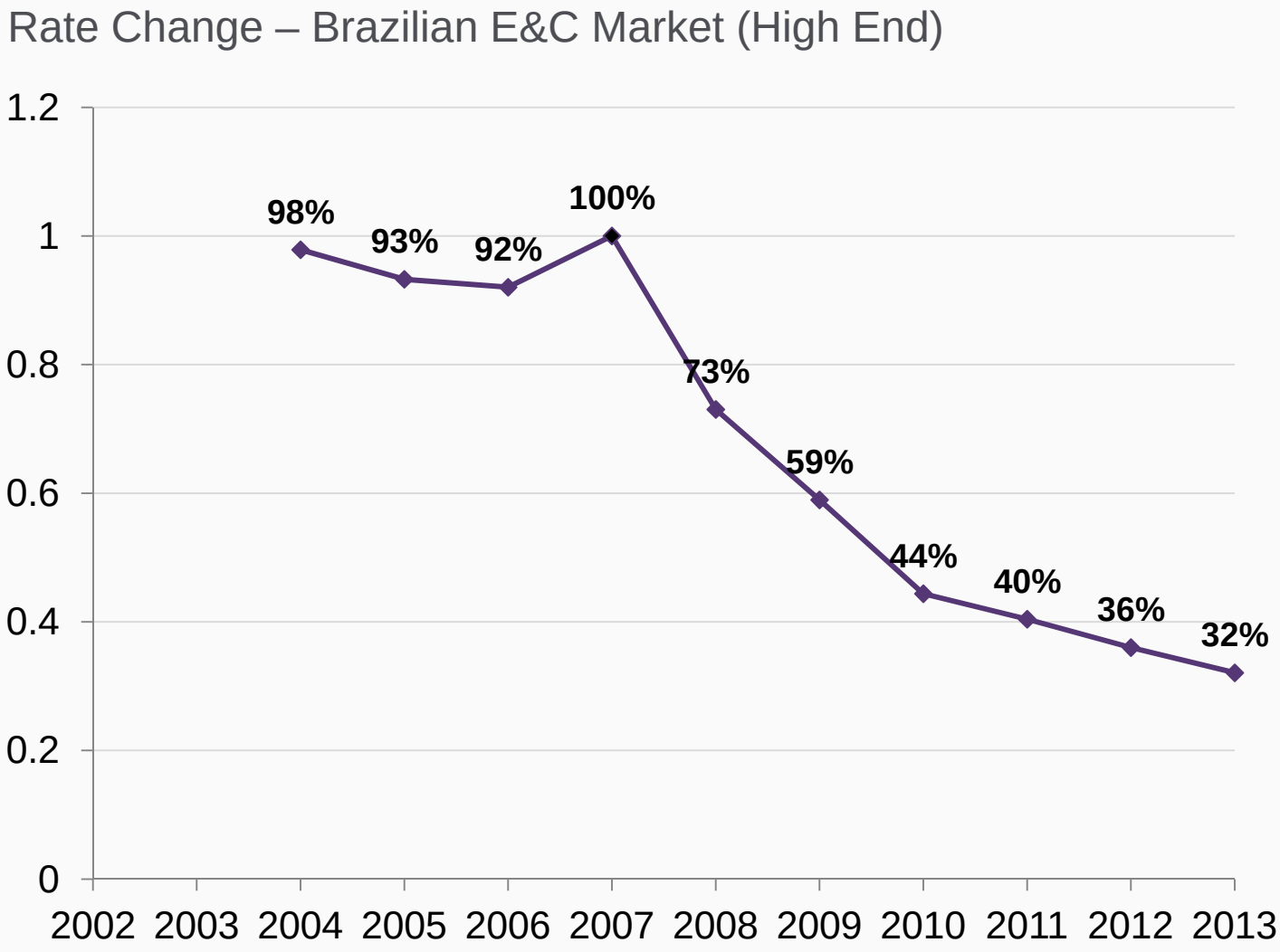
Munich RE



Source: risk profiles accounting for more than 90% of the market.

Carriers entertaining complex accounts
have followed suit

Munich RE



Source: risk profiles accounting for more than 90% of the market.

Is CAR/EAR in Brazil worthy an opportunity to tap into?

Munich RE

FACTS

- ✓ Insurers have predominantly measured their own portfolio performance on a FY basis;
- ✓ Few have control over premium and loss developments (triangulations) across UYs;
- ✓ Historical losses do not necessarily reflect forward-looking behaviour given strategic changes;
- ✓ Primary rates have fallen way short of most popular pricing tools;
- ✓ Skyrocketing treaty capacity;
- ✓ Coinsurance as a means for avoiding facultative markets;
- ✓ Significant number of players with rather ambitious business plans;
- ✓ Falling interest rates as opposed to claims inflation.

Is CAR/EAR in Brazil worthy an opportunity to tap into?

Munich RE

QUESTION MARKS

- ✓ Is rate-making carried out on minimally technical grounds?
- ✓ Are risk quality and term setting reflected in pricing?
- ✓ Is the market big enough?

Most importantly:

- ✓ Is CAR/EAR/ALoP a profitable and sustainable piece of business?

The impact of developing figures

A case study from real life

Munich RE

GWP (nominal figures):

	Y1	Y2	Y3	Y4	Y5	Y6	Y7
2005	4.587.507	4.890.839	4.981.913	5.014.158	5.014.158	5.014.158	5.014.158
2006	4.060.269	4.585.519	4.843.887	4.906.324	4.916.906	4.916.906	
2007	6.424.419	7.552.307	8.013.559	8.169.211	8.184.222		
2008	7.082.732	8.390.632	9.256.530	9.581.273			
2009	11.070.184	13.817.286	14.799.931				
2010	13.979.864	14.799.931					
2011	8.787.491						

Note: BRL figures modified for the sake of confidentiality.

GWP above, adjusted for rate change and inflation, then developed to ultimates:

	Y1	Y2	Y3	Y4	Y5	Y6	Y7
2005	3.646.909	3.885.193	3.952.739	3.975.503	3.975.503	3.975.503	3.975.503
2006	3.189.565	3.579.120	3.761.524	3.811.211	3.821.667	3.821.667	3.821.667
2007	4.764.725	5.560.994	5.928.056	6.081.860	6.097.655	6.097.655	6.097.655
2008	5.000.282	6.041.101	6.896.723	7.238.404	7.252.105	7.252.105	7.252.105
2009	8.809.589	11.524.085	12.557.985	12.905.234	12.929.661	12.929.661	12.929.661
2010	13.813.940	15.528.195	16.800.549	17.265.111	17.297.790	17.297.790	17.297.790
2011	9.245.846	10.870.776	11.761.508	12.086.733	12.109.610	12.109.610	12.109.610

The impact of developing figures

A case study from real life

Munich RE

Incurred loss (nominal figures):

	Y1	Y2	Y3	Y4	Y5	Y6	Y7
2005	630.204	740.319	773.947	793.502	793.502	793.502	793.502
2006	1.047.258	2.213.316	2.436.318	2.578.133	2.610.559	2.610.559	
2007	3.206.305	4.520.359	5.055.031	5.095.450	5.106.974		
2008	1.809.361	3.126.124	4.074.370	4.183.493			
2009	1.159.788	3.434.138	4.650.636				
2010	570.195	2.252.207					
2011	210.024						

Note: BRL figures modified for the sake of confidentiality.

Incurred loss above, adjusted for inflation, then developed to ultimates:

	Y1	Y2	Y3	Y4	Y5	Y6	Y7
2005	984.679	1.137.209	1.173.968	1.177.853	1.177.853	1.177.853	1.177.853
2006	1.559.036	3.212.447	3.486.016	3.647.901	3.675.942	3.675.942	3.675.941,75
2007	4.546.379	6.236.068	6.871.619	6.904.966	6.904.966	6.904.965,90	6.904.965,90
2008	2.332.629	3.879.771	4.911.015	4.911.015	4.920.310,49	4.920.310,49	4.920.310,49
2009	1.401.311	3.913.885	5.101.518	5.223.261,87	5.249.355,16	5.249.355,16	5.249.355,16
2010	646.408	2.398.215	4.004.693,36	4.167.566,28	4.202.474,87	4.202.474,87	4.202.474,87
2011	220.941	2.414.757,99	2.612.619,12	2.726.641,06	2.751.079,41	2.751.079,41	2.751.079,41

The impact of developing figures

L/R on an FY basis is a poor measure of profitability

Power supply matrix

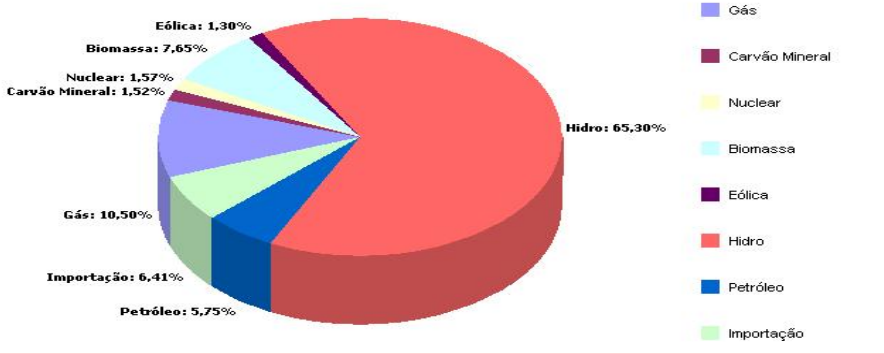
Hydro accounts for 65% of overall installed capacity

ANEEL

Atualizado em: 17/09/2012

Matriz de Energia Elétrica

Empreendimentos em Operação							
Tipo		Capacidade Instalada		%	Total		%
		N.° de Usinas	(kW)		N.° de Usinas	(kW)	
Hidro		1.010	83.252.496	65,30	1.010	83.252.496	65,29
Gás	Natural	105	11.550.013	9,06	145	13.381.696	10,50
	Processo	40	1.831.683	1,44			
Petróleo	Óleo Diesel	936	3.390.599	2,66	970	7.326.910	5,75
	Óleo Residual	34	3.936.311	3,09			
Biomassa	Bagaço de Cana	358	8.027.644	6,30	444	9.752.112	7,65
	Licor Negro	14	1.235.643	0,97			
	Madeira	44	378.035	0,30			
	Biogás	20	78.182	0,06			
	Casca de Arroz	8	32.608	0,03			
Nuclear		2	2.007.000	1,57	2	2.007.000	1,57
Carvão Mineral	Carvão Mineral	10	1.944.054	1,52	10	1.944.054	1,52
Eólica		80	1.662.532	1,30	80	1.662.532	1,30
Importação	Paraguai		5.650.000	5,46		8.170.000	6,41
	Argentina		2.250.000	2,17			
	Venezuela		200.000	0,19			
	Uruguai		70.000	0,07			
Total		2.671	127.502.645	100	2.671	127.502.645	100



62 more undergoing construction and to add 18,830,985 kW to the system

Hydro power supply

Just a handful of plants with capacity in excess of 1,000 MW

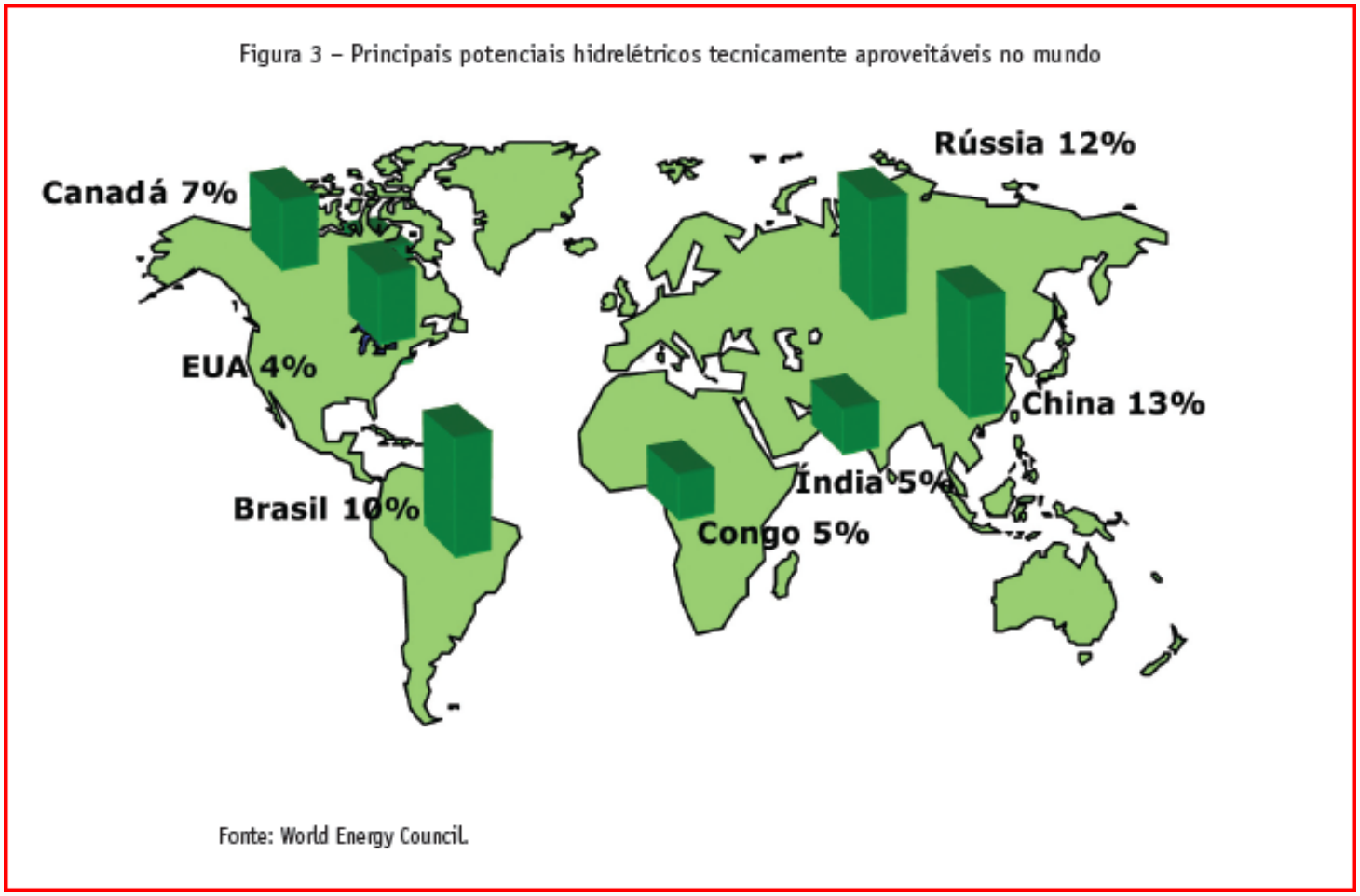
Tabela 3 – Centrais hidrelétricas em operação no Brasil - potência superior a 1.000 MW

	Usina	Município – UF	Rio	Potência (MW)
1	Itaipu[1]	Foz do Iguaçu – PR	Paraná	14.000
2	Tucuruí[2]	Tucuruí – PA	Tocantins	8.370
3	CHE Paulo Afonso[3]	Delmiro Gouveia – AL	São Francisco	4.280
4	Ilha Solteira	Ilha Solteira – SP	Paraná	3.444
5	Xingó	Canindé de S. Francisco – SE	São Francisco	3.162
6	Itumbiara	Itumbiara – GO	Paranaíba	2.124
7	Porto Primavera	Anaurilândia – MS	Paraná	1.980
8	São Simão	Santa Vitória – MG	Paranaíba	1.710
9	Foz do Areia	Pinhão – PR	Iguaçu	1.676
10	Jupiá	Castilho – SP	Paraná	1.551
11	Itaparica	Glória – BA	São Francisco	1.480
12	Itá	Itá – SC	Uruguai	1.450
13	Marimbondo	Fronteira – MG	Grande	1.440
14	Salto Santiago	Saudade do Iguaçu – PR	Iguaçu	1.420
15	Água Vermelha	Indiaporã – SP	Grande	1.396
16	Serra da Mesa	Cavalcante – GO	Tocantins	1.293
17	Furnas	Alpinópolis – MG	Grande	1.270
18	Segredo	Mangueirinha – PR	Iguaçu	1.260
19	Salto Caxias	Cap. Leon. Marques – PR	Iguaçu	1.240
20	Emborcação	Cascalho Rico – MG	Paranaíba	1.192
21	Machadinho	Piratuba – SC	Pelotas	1.140
22	Salto Osório	Quedas do Iguaçu – PR	Iguaçu	1.078
23	Sobradinho	Juazeiro – BA	São Francisco	1.050
24	Estreito	Rifaina – SP	Grande	1.050
Total (exclusive a parte paraguaia de Itaipu)				52.437

Nota: (1) Usina bi-nacional, 50% da potência pertence ao Brasil e 50% ao Paraguai. Entram em operação, em 2006, as duas últimas unidades geradoras de 700 MW, cada; (2) Considera a segunda casa de força, em fase de motorização, que abriga 11 unidades geradoras, de 375 MW, cada; e (3) Compreende as usinas de Paulo Afonso I a IV e Moxotó.
Fonte: ANEEL.

And there seems to exist a long way to go until this energy source is fully exploited

Unrealised Potential

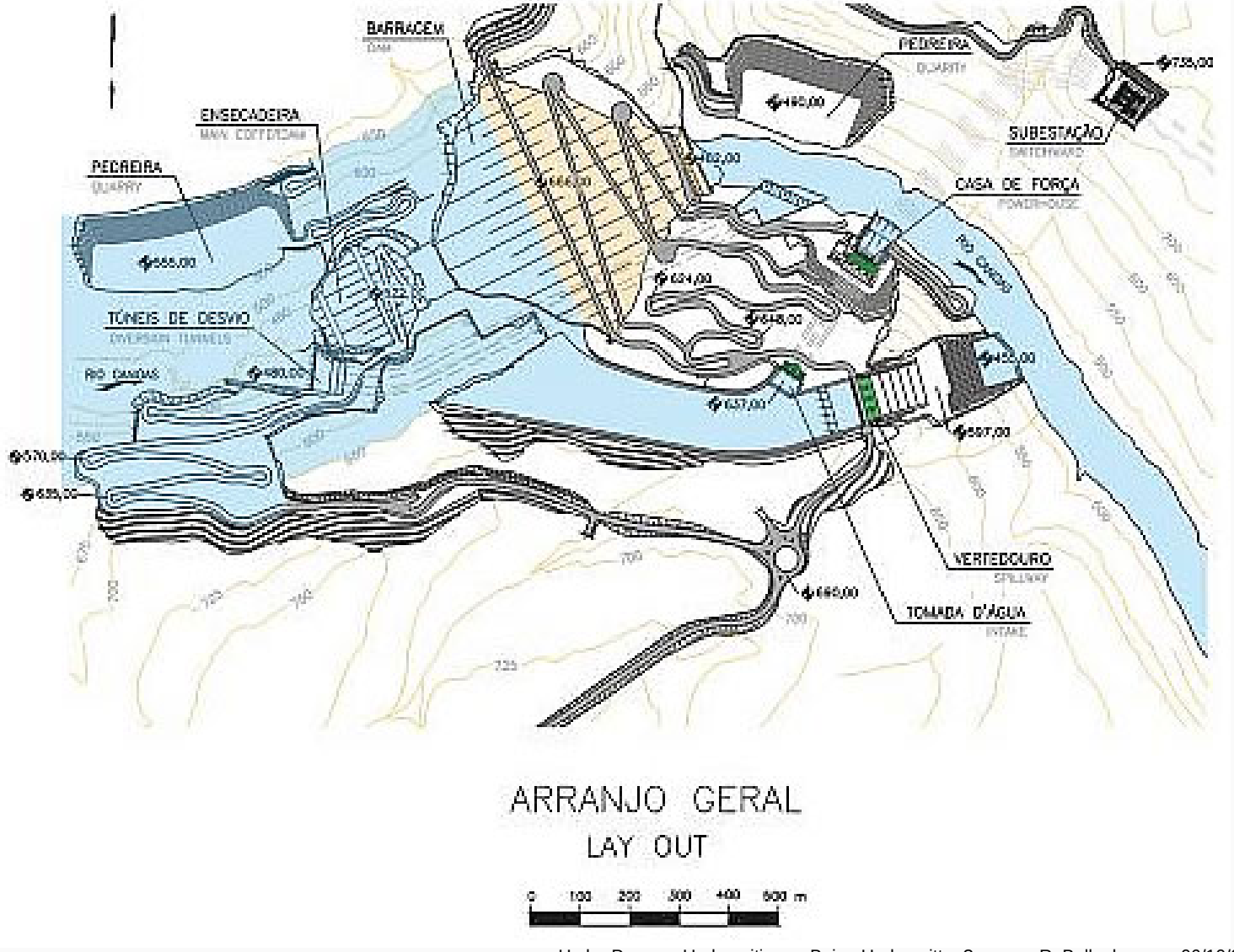


What has caught our attention most recently

Design, Construction and Supplies

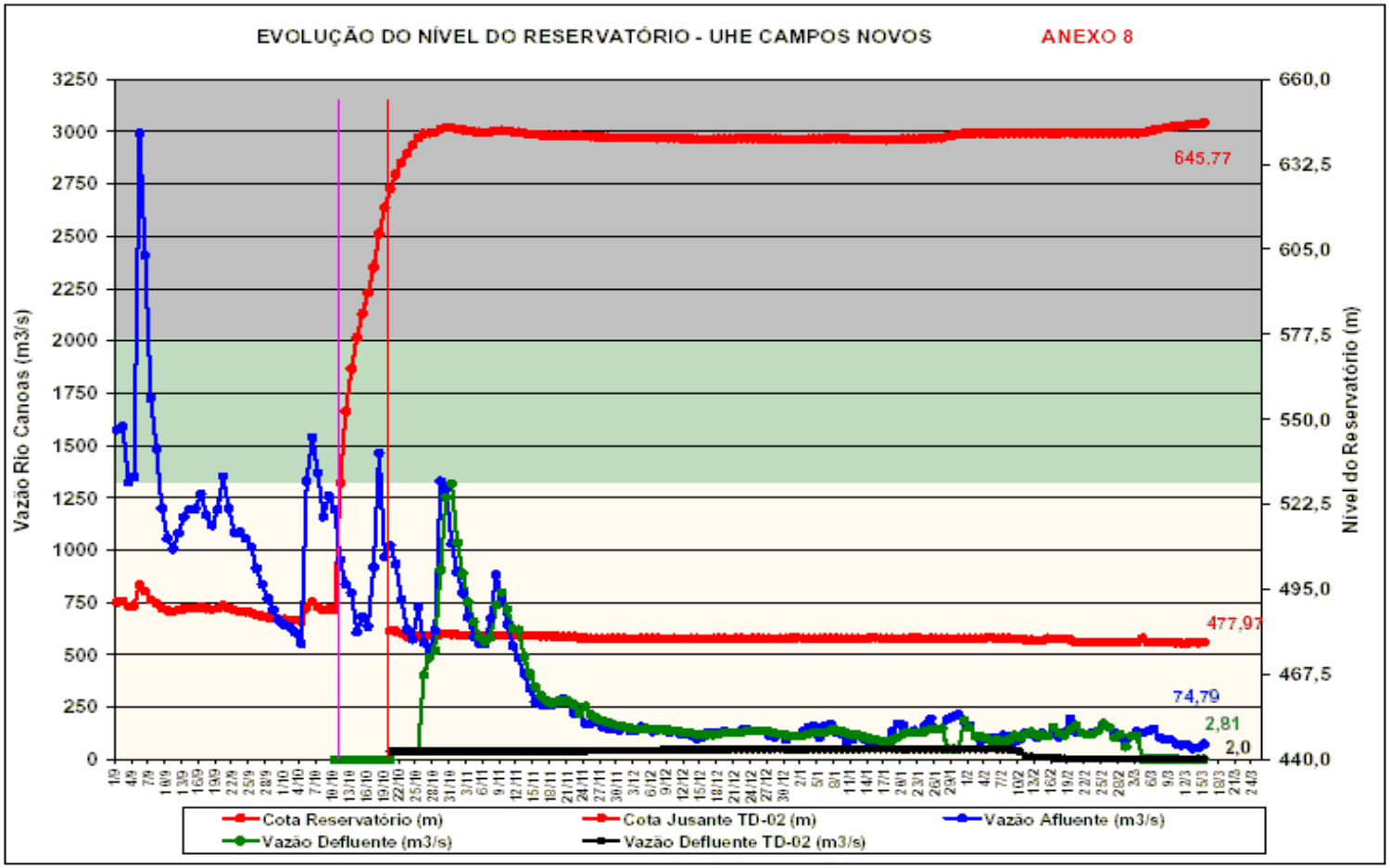
Quality of design, construction and supplies

Case Study


BARRAGEM
ENSECADEIRA
PEDREIRA
QUARRY
TÚNEIS DE DESVIO
RIO CANOAS
PEDREIRA
QUARRY
SUBESTAÇÃO
CASA DE FORÇA
VERTEDOURO
SPILLWAY
TOMADA D'ÁGUA
INTAKE
ARRANJO GERAL
LAY OUT
0 100 200 300 400 500 m

Case Study

Case Study


EVOLUÇÃO DO NÍVEL DO RESERVATÓRIO - UHE CAMPOS NOVOS
ANEXO 8
Vazão Rio Canoas (m3/s)
Nível do Reservatório (m)
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
660,0
632,5
605,0
577,5
550,0
522,5
495,0
467,5
440,0
645,77
477,97
74,79
2,81
2,0
Cota Reservatório (m)
Cota Jusante TD-02 (m)
Vazão Afluente (m3/s)
Vazão Defluente (m3/s)
Vazão Defluente TD-02 (m3/s)

Case Study

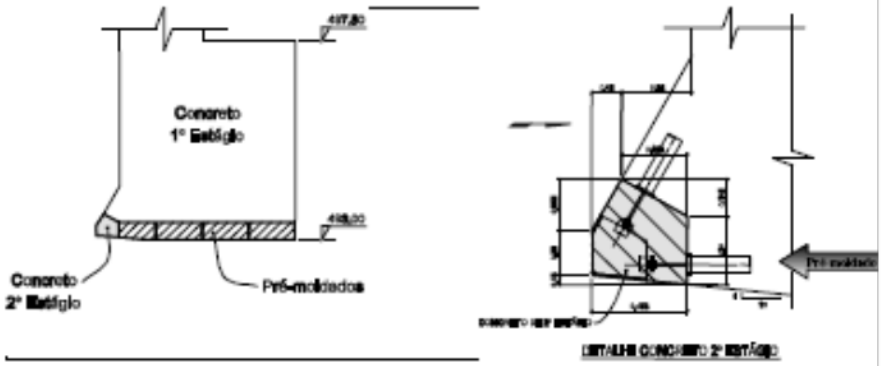
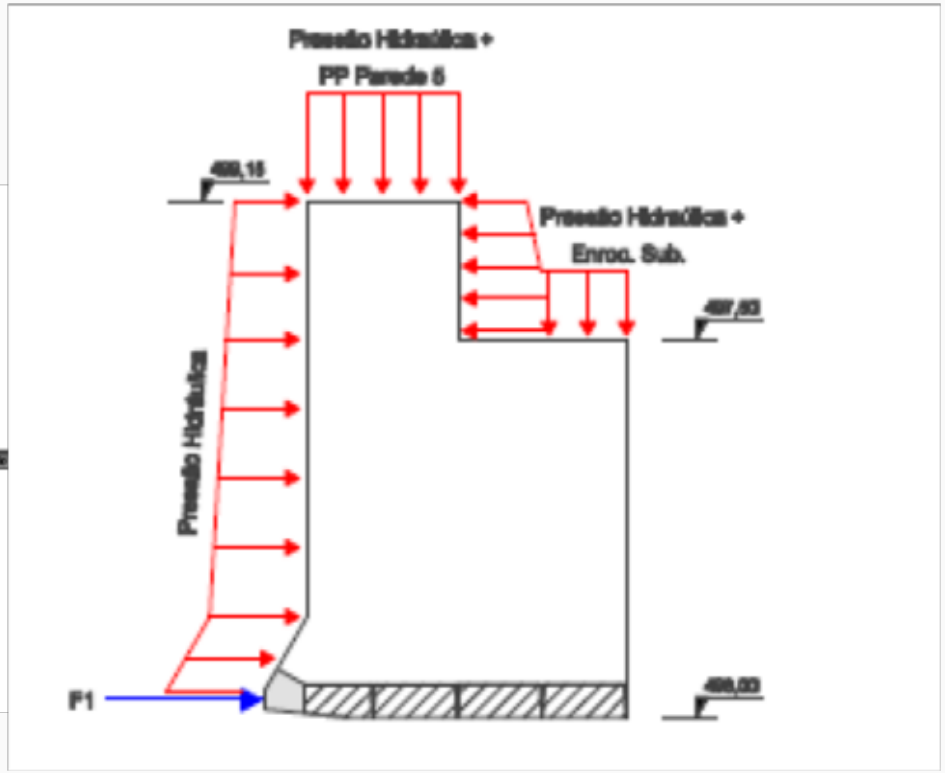
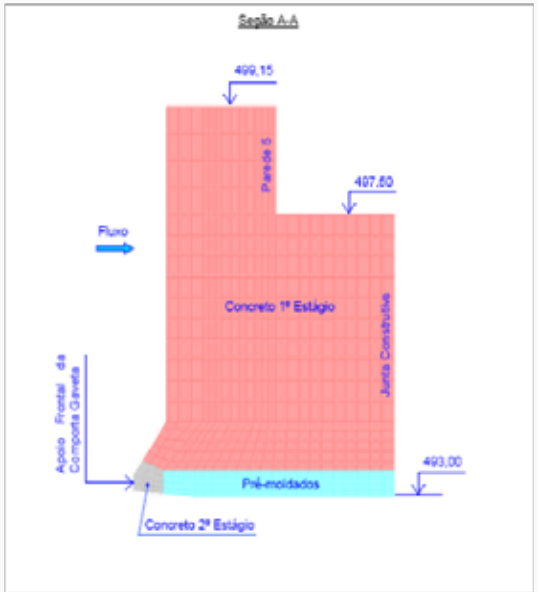
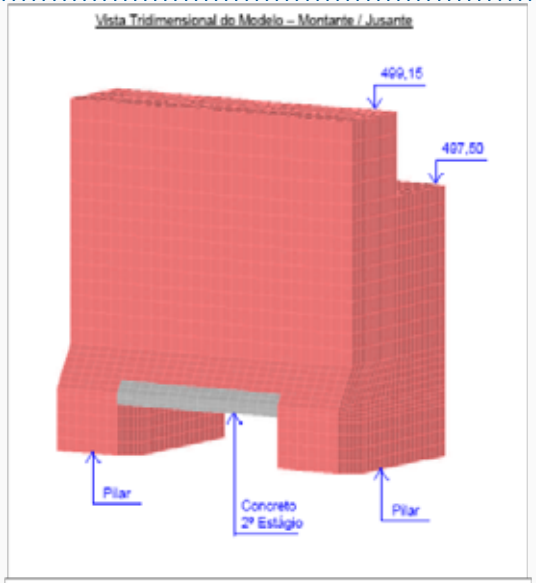


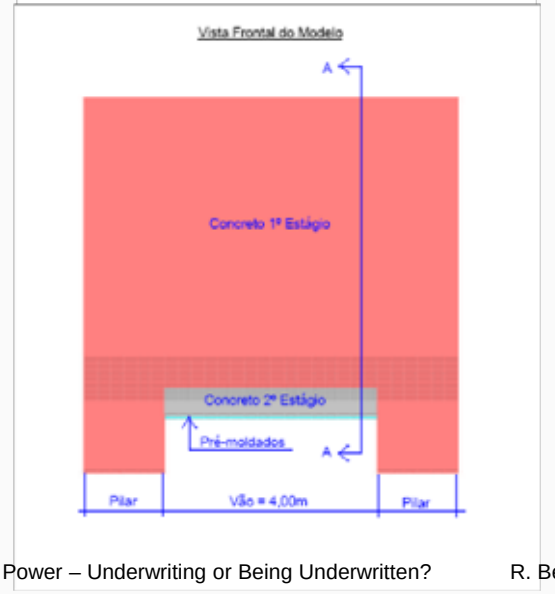
Figura 1 – DETALHE DO CONCRETO DE 2° ESTÁGIO



Case Study


Seção A-A
499,15
497,50
Parede 6
Fluxo
Concreto 1º Estágio
Junta Construtiva
Apoio Frontal da Comporta Gaveta
493,00
Pré-moldados
Concreto 2º Estágio

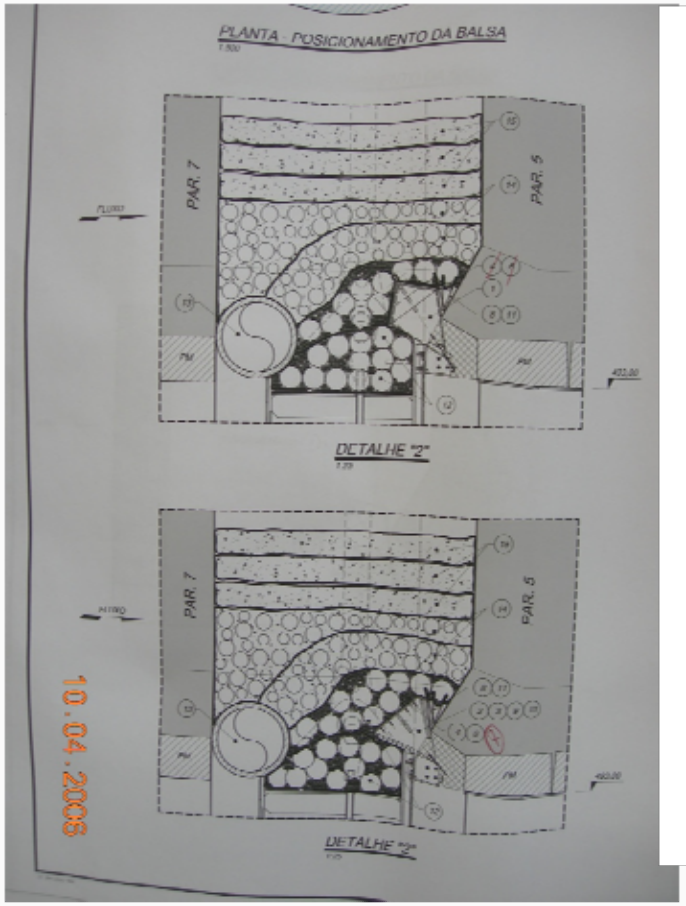

Vista Tridimensional do Modelo – Montante / Jusante
499,15
497,50
Pilar
Concreto 2º Estágio
Pilar


Vista Frontal do Modelo
A
Concreto 1º Estágio
Concreto 2º Estágio
Pré-moldados
A
Pilar
Vão = 4,00m
Pilar

Case Study

Comporta 02 do TD-02 (Vista a jusante – na parte superior da foto observa-se vazamento pela junta entre os pré-moldados)

Case Study



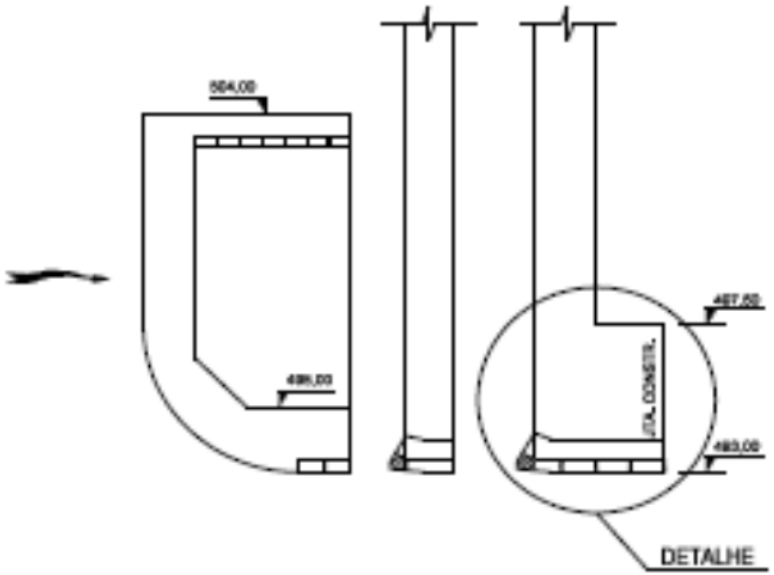
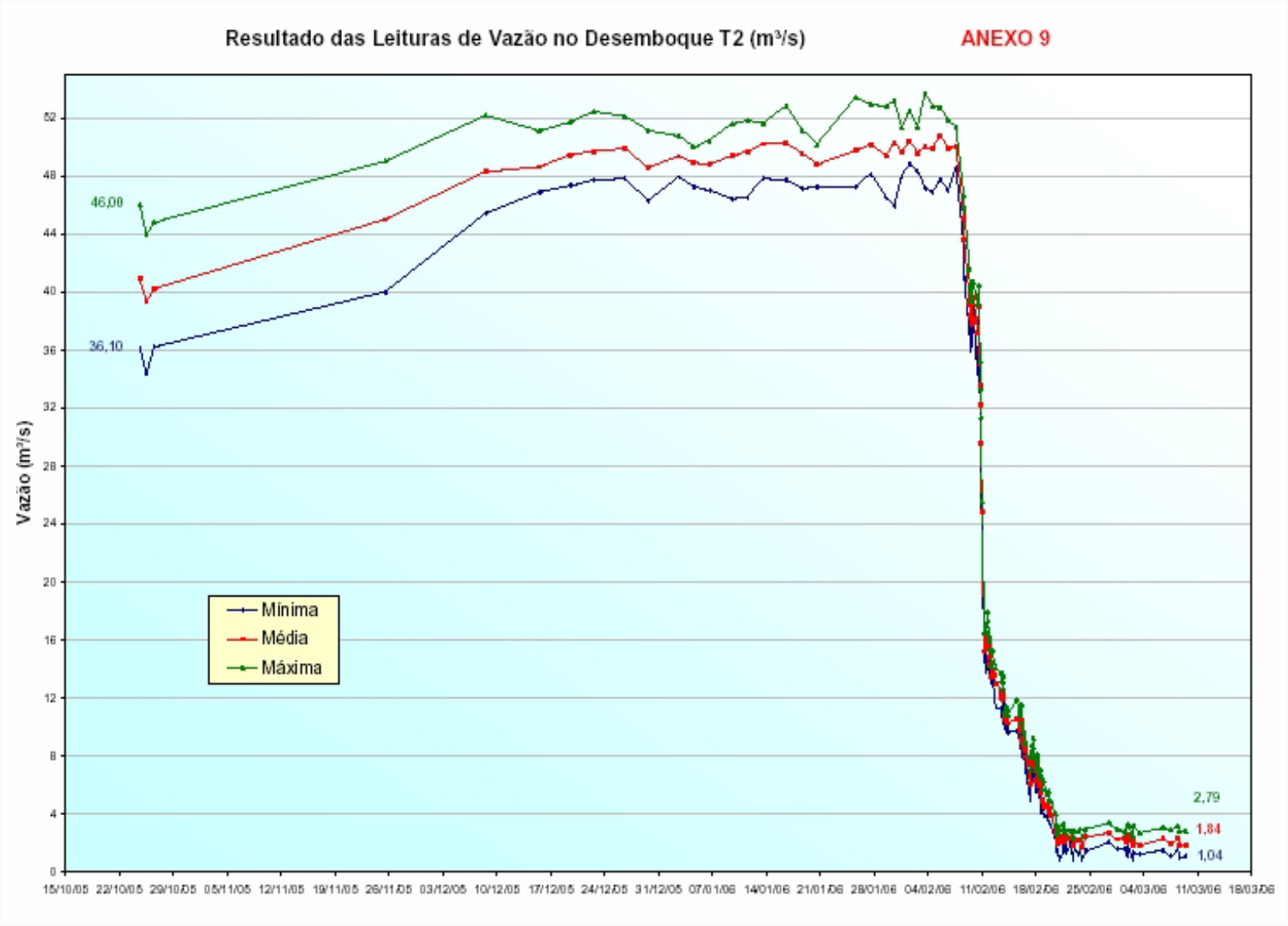


Figura 3 – CORTE NA ESTRUTURA DA TOMADA D'ÁGUA DOS TÚNEIS DE DESVIO.

Case Study


Resultado das Leituras de Vazão no Desemboque T2 (m³/s)
ANEXO 9
Vazão (m³/s)
46,00
36,10
2,79
1,84
1,04
Mínima
Média
Máxima

Case Study

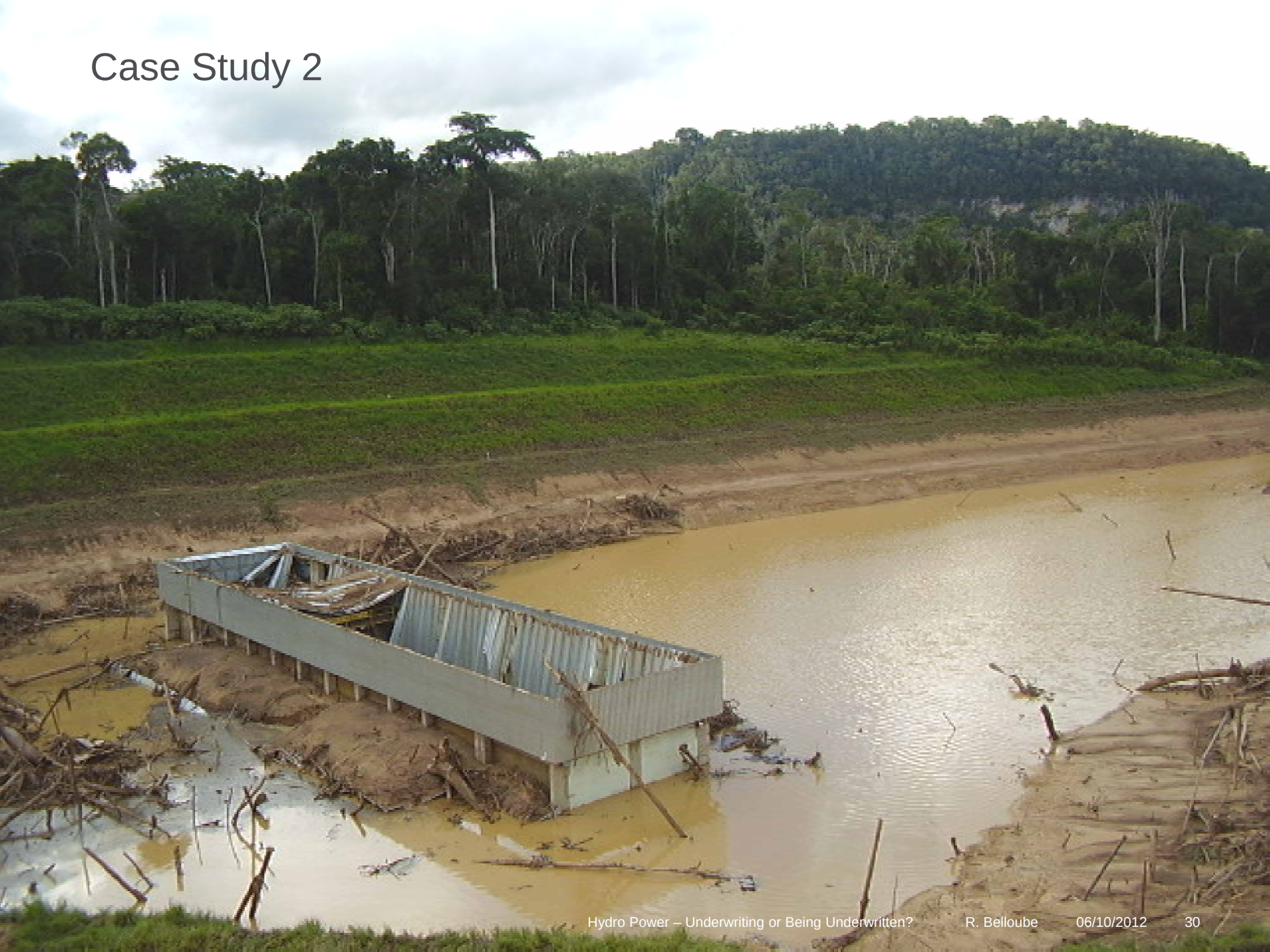
Case Study

Case Study 2

Case Study 2

Case Study 2

Case Study 2



Case Study 2

Case Study 2

Munich RE

- ✓ Impouding of water behind the dam lasted for 17 days since 13 Dec 2007;
- ✓ Leakage observed underneath the spillway on 05 Jan 2008;
- ✓ To control erosion, installation of an inverted filter was brought into consideration;
- ✓ Erosion aggravated and dam stretch around spilway collapsed on 09 Jan 2008;
- ✓ Powerhouse flooded and severely damaged;
- ✓ River banks partially destryoed along 15km downstream.

Root cause:

Erosion of sandstone (piping)
Treatment of spilway foundations with cement grout turned out to be ineffective

What has caught our attention most recently

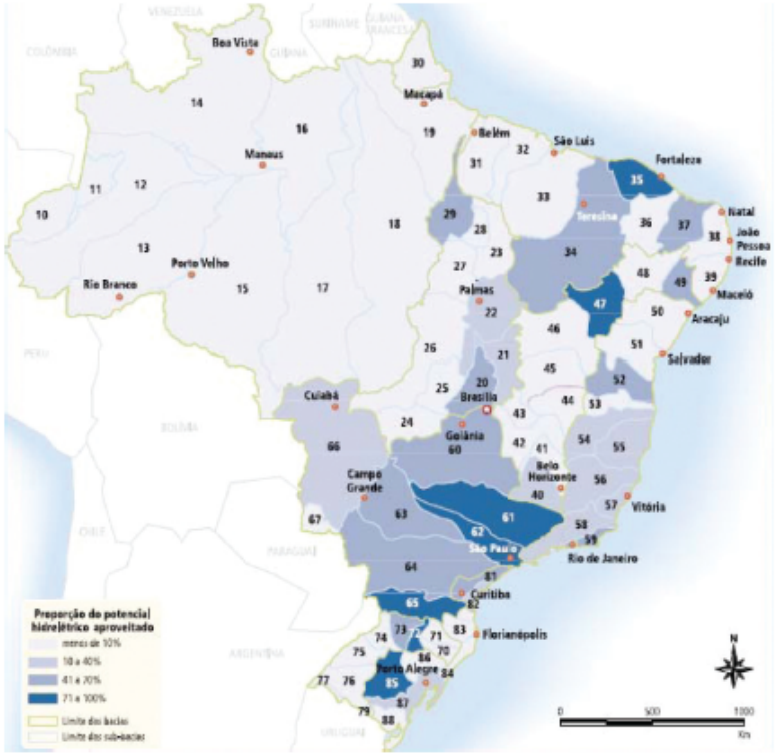
Environment

Why the environment will be increasingly in the spotlight

Munich RE

Realised Potential

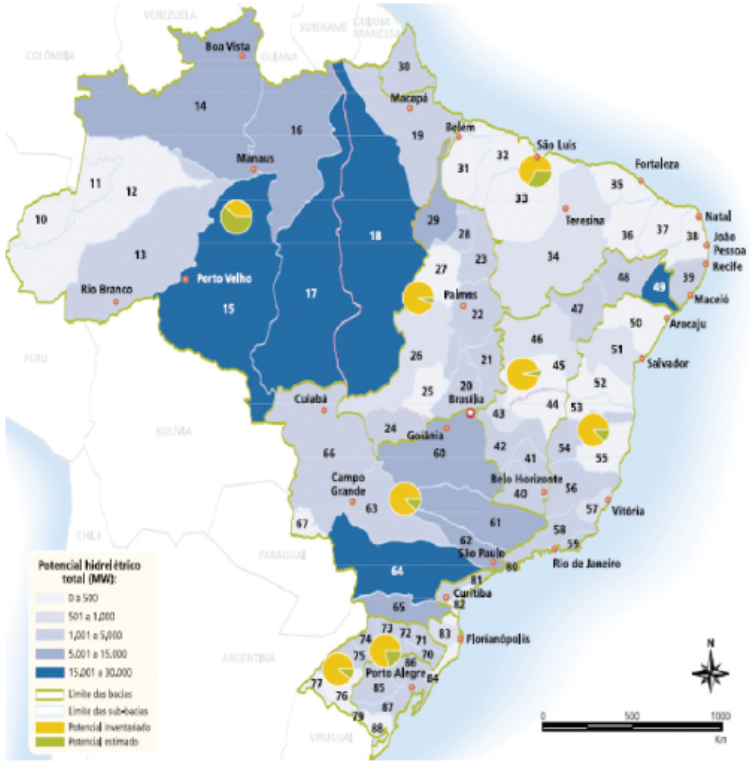
Figura 4 – Brasil.
Taxa de aproveitamento do potencial hidrelétrico por sub-bacia da ANEEL (situação em março de 2003)



Fonte: ANEEL, 2006.

Latent Potential

Figura 3 – Brasil.
Potencial hidrelétrico por sub-bacia hidrográfica da ANEEL



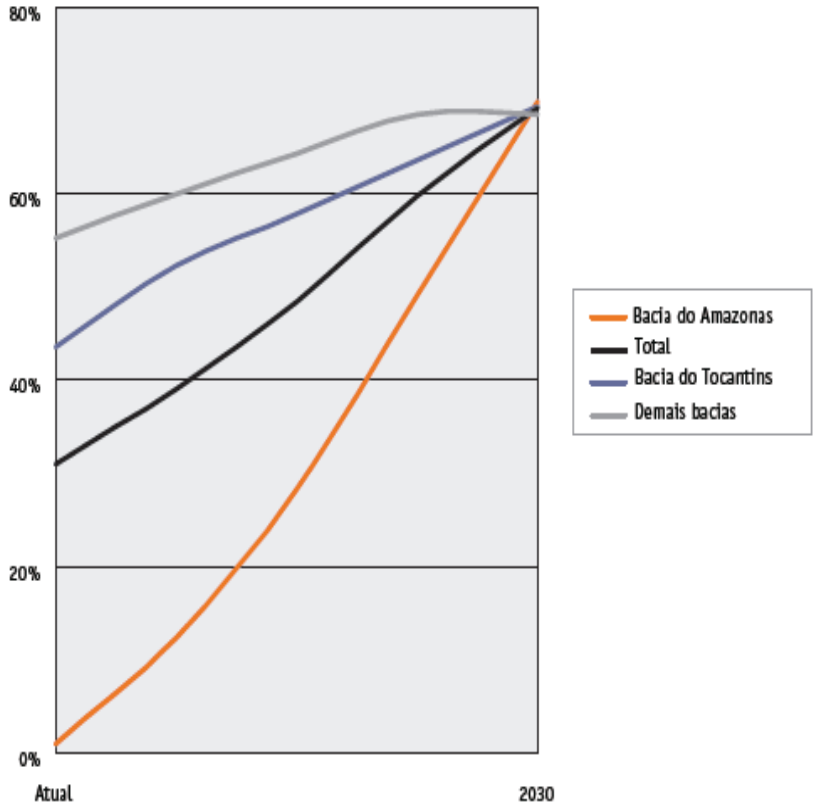
Fonte: ANEEL, 2006.

Expansion of hydro power plants
into rain forest brings about new risk dimension

Munich RE

Forecast on Evolution of Realised Hydro Potential

Figura 29 – Trajetória potencial do índice de aproveitamento dos recursos hidrelétricos nacionais

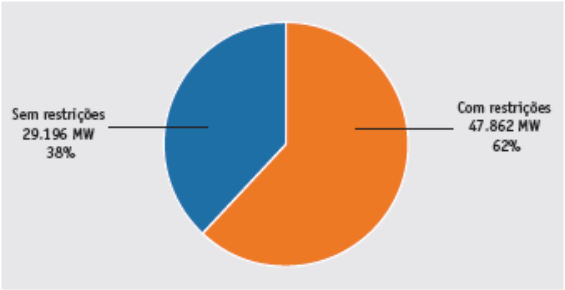


Whereabouts

Tabela 5 – Bacia do Amazonas
Localização do potencial hidrelétrico por sub-bacia (MW)

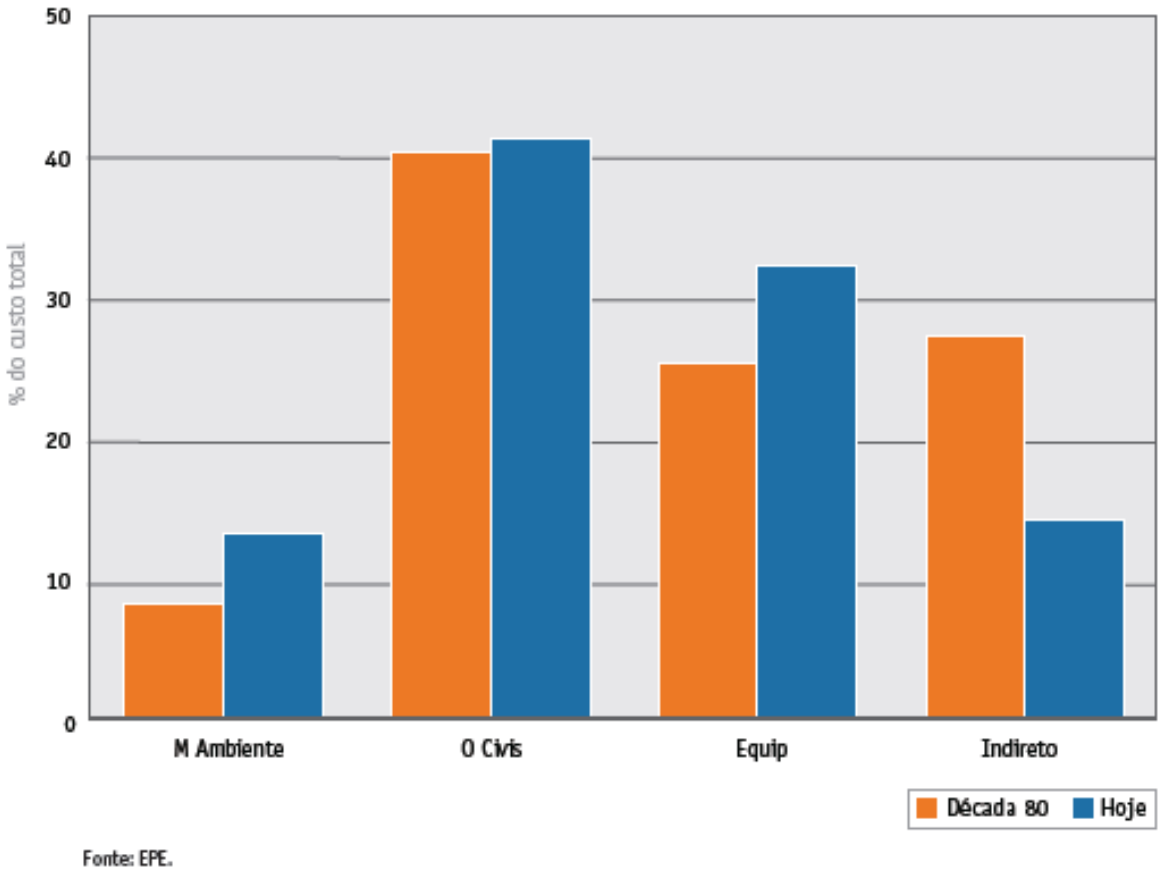
Sub-bacia	Potencial	%
Tapajós	24.626	32,0
Xingu	22.795	29,6
Madeira	14.700	19,1
Trombetas	6.236	8,1
Negro	4.184	5,4
Jari	1.691	2.2
Branco	1.079	1,4
Paru	938	1,2
Oiapoque	250	0,3
Purus	213	0,3
Maecuru	161	0,2
Nhamundá	110	0,1
Uatumã	75	0,1
Total	77.058	100,0

Figura 16 – Bacia do Amazonas.
Restrições ambientais ao potencial hidrelétrico a aproveitar



Environment tends to weigh more
on venture costs going forward

Figura 13 – Decomposição do custo de investimento em projetos hidrelétricos



Fonte: EPE.

Environment
Takeaways

- ✓ Underwriting trend towards incorporation of further environmental considerations into decision making;
- ✓ Hydrological windows may be narrowed by recurring interruption of works due to legal dispute;
- ✓ Monitoring of time schedule more relevant than ever (impact of deviation on flooding risk, ALoP);
- ✓ Possibility of misinformed and political exploration of subject;
- ✓ Wider movement by insurance industry in support of a more active role in defending the environment.

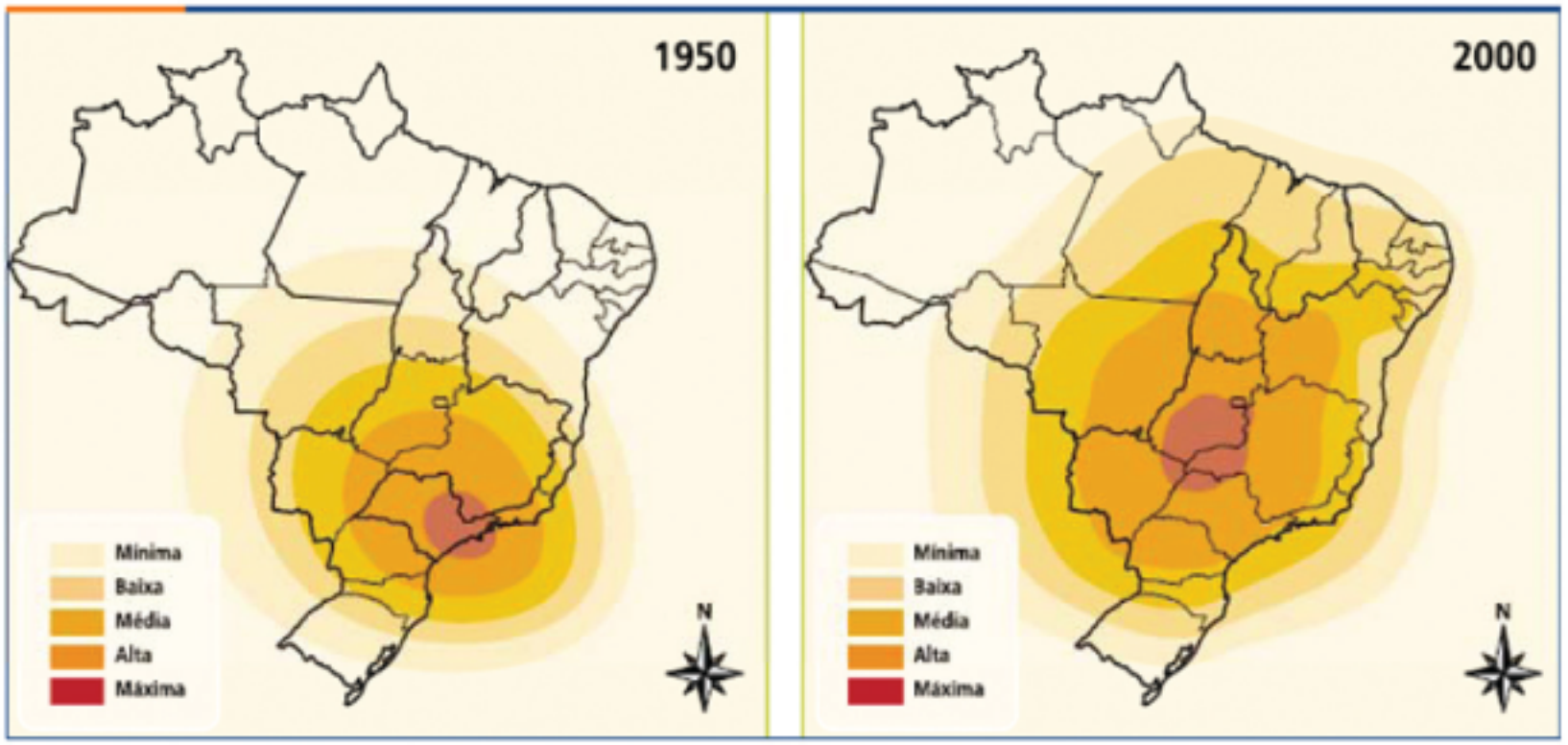
What has caught our attention most recently

Remoteness

Remoteness

Expansion into areas with decreasing infrastructure penetration

Figura 7 – Evolução territorial do aproveitamento do potencial hidrelétrico brasileiro

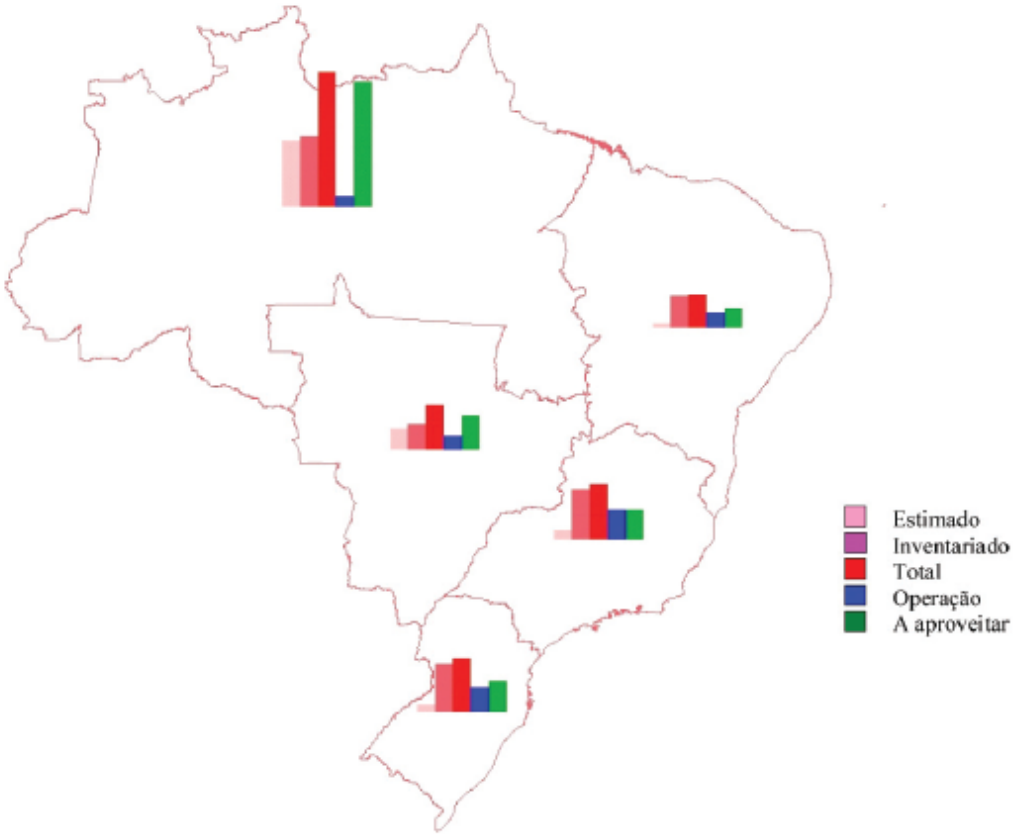


Fonte: Reprodução do Atlas de Energia Elétrica do Brasil, ANEEL, 2002.

Remoteness

Logistics and supply chain to become costlier and more complex

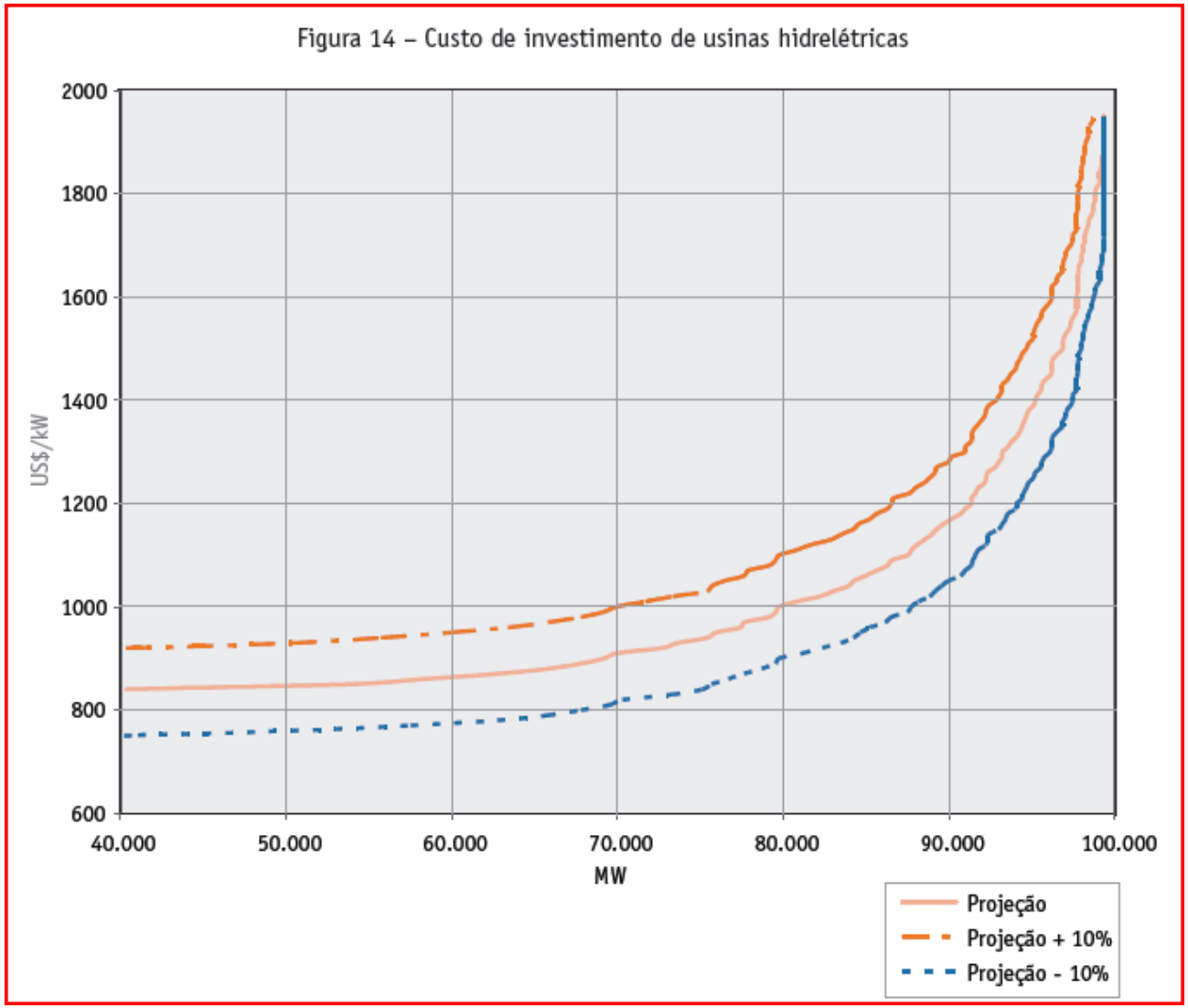
Figura 6 – Distribuição geográfica do potencial hidrelétrico brasileiro



Nota: 50% da Usina de Itaipu incluídos no Sul; Potencial em pequenas centrais hidrelétricas: 15 GW (5,7% do potencial total).
Fonte: Plano 2015, Eletrobrás, 1994.

Remoteness

Implementation costs to grow (rig approach?)



Remoteness

Complex logistics is intertwined with environmental issues

What has caught our attention most recently

Labour

Case Study 3

What has caught our attention most recently

ALoP

ALoP
Takeaways

- ✓ Valuation sometimes opaque and containing exotic interests;
- ✓ Widespread acceptance of civils for triggering cover unfolds into much ampler loss scenarios;
- ✓ New dimension of hydro-power risk calls for top-notch monitoring service by insurers;
- ✓ What if the first two case studies we analysed had ALoP in place?
- ✓ Contractual incentives to generate early x cross-shareholding x interests x entrepreneurial risk

Wording

and Debris Removal

Wording
MR (version 04; 2009)

- ✓ Underlying intention of “Common Law” wording translated into local legal framework;
- ✓ Cover amplitude and depth remain the same;
- ✓ Frictions noted during claim negotiations fed back into wording setup (e.g. adoption of LEG2);
- ✓ Improvements in relation to international standard (e.g. glossary; explicit exclusion of Manufacturer’s Risk for Extended Maintenance; etc);

Removal of debris

Susep Resolution 419

- ✓ Removal of debris covered up to the limit of the affected cover;
- ✓ Any limit for Debris Removal applied in addition to the above;
- ✓ Origin and reason for this resolution unknown and seemingly heterodox;
- ✓ Critical for risks such as hydropower and those involving tunnelling works;
- ✓ Recommended approach: Bilateral agreement with Insured for standard approach to be implemented in critical risks, otherwise exposure may be unbearable (how to meaningfully price it on a portfolio basis?).

HYDRO POWER

Underwriting or Being Underwritten?

Rio, 16 September 2012

Rodrigo Belloube

Munich RE